WORK PROGRAMME 2011

COOPERATION

THEME 3

ICT – INFORMATION AND COMMUNICATIONS TECHNOLOGIES

(European Commission C(2010)4900 of 19 July 2010)

6.2 Challenge 2: Cognitive Systems and Robotics

Challenge 2 focuses on artificial cognitive systems and robots that operate in dynamic, non-deterministic, real-life environments. Such systems must be capable of responding in a timely and sensible manner and with a suitable degree of autonomy to gaps in their knowledge, and to situations not anticipated at design time. Actions under this Challenge support research on engineering robotic systems and on endowing artificial systems with cognitive capabilities. Both research strands are intricately intertwined: many functionalities and desirable properties of robotic systems rely on cognitive capabilities. Conversely, robotic systems are suitable platforms for motivating, guiding and validating more basic cognitive systems work.

Hard scientific and technological research issues still need to be tackled in order to make robots fit for rendering high-quality services, or for flexible manufacturing scenarios. Sound theories are requisite to underpinning the development of robotic systems and providing pertinent design paradigms, also informed by studies of natural cognitive systems (as in the neuro- and behavioural sciences).

Research under Challenge 2 will fuel progress for instance from robots that are largely pre-programmed, to robots that are programmable through teaching and learning; from robots that are largely tele-operated, to robots that autonomously plan complex tasks; from robots with rigid components and structures, to those with dexterity and manipulation skills going beyond human level; from robots that operate in tightly controlled environments, to robots that can properly interact and cooperate with people in real-world environments. Future robots will also come in various shapes and sizes (including miniature) and will increasingly incorporate intelligent materials, as well as advanced sensor, actuator and effector, (distributed, brain-inspired) memory and control technologies, and where needed, they will exhibit physical compliance.

Cognitive systems research extends beyond robotics. Hence, this Challenge will also address issues related to monitoring, assessing, and controlling heterogeneous multi-component and multi-degree-of-freedom systems, where this hinges on implementing cognitive capabilities. At an elementary level, such capabilities include establishing and recognising patterns in sensor-generated data. This is a prerequisite to higher-level operations such as scene interpretation, reasoning, planning, intelligent control, and complex goal-oriented behaviour. Learning, in appropriate modes, is essential at all levels.

It is equally important to be able to measure and compare progress towards the ambitious goals set under this Challenge. Developing suitable benchmarks, conducting benchmarking exercises and supporting scenario-based competitions are therefore firmly placed on the agenda.

Although Challenge 2 does not target any specific application area, research will be motivated, guided and validated by realistic, demanding and scalable real-world scenarios, where appropriate backed by industrial stakeholders. Gearing up cross-fertilisation between relevant industry and research communities is a key issue in this respect and industrial participation is therefore greatly encouraged.

Work under Challenge 2 will improve competitiveness in existing and future markets (e.g., manufacturing, professional and domestic services), and provide innovative solutions in areas that include (but are not limited to) assistance and co-working, production, logistics and transport, construction, maintenance and repair, search and rescue, exploration and inspection, systems monitoring and control, consumer robotics, education and entertainment.

Participation in the Open Access Pilot in FP7

Open Access, defined as free access over the internet, aims to improve and promote the dissemination of knowledge, thereby improving the efficiency of scientific discovery and maximising return on investment in R&D by public research funding bodies. Since August 2008, the European Commission has been conducting a pilot initiative on Open Access to peer reviewed research articles in its Seventh Framework Programme (FP7). This pilot covers seven FP7 areas. Beneficiaries funded partially or entirely through this Challenge will be required to deposit peer-reviewed articles resulting from projects into an institutional or subject-based repository, and to make their best efforts to ensure open access to these articles within six months[12].

Objective 2.1: Cognitive Systems and Robotics

Target outcomes

a) **Robotic systems operating in real-world environments**: Expanding and improving the functionalities of robotic systems and further developing relevant features, such as autonomy, safety, robustness, efficiency, and ease of use. As appropriate, work will include exploring ways of integrating, in robotic systems, new materials and advanced sensor, actuator, effector and leading edge memory and control technologies.

b) **Cognition and control in complex systems**: Enabling technologies based on the acquisition and application of cognitive capabilities (e.g., establishing patterns in sensor data, classification, conceptualisation, reasoning, planning) for enhancing the performance and manageability of complex multi-component and multi-degree-of-freedom artificial systems, also building on synergies between cognitive systems and systems control engineering. This outcome complements Objective 3.3 / target outcome (d).

Realistic, highly demanding, scalable real-world scenarios will motivate and guide research related to targets a) & b), and serve to validate its results. *Specific Targeted Research Projects* (STREP) are particularly suited to *high-risk endeavours*, breaking new grounds, with high potential rewards. They are also appropriate for component-level research for particular domains. *Integrated Projects* (IP) are preferred for *system-oriented efforts*; they are expected to encompass all stages of the research and development lifecycle and, where appropriate, cutting across research topics.

c) **Gearing up and accelerating cross-fertilisation between academic and industrial robotics research** to strengthen synergies between their respective research agendas through joint industrially-relevant scenarios, shared research infrastructures; joint small- to medium-scale experimentation with industrial platforms and implementation of comparative performance evaluation methodologies and tools.

d) **Fostering communication and co-operation between robotics and cognitive systems research communities** through: identification of common interests and areas of co-operation; knowledge sharing between EU, national, and international initiatives; supporting open-source hardware and software developments; updating R&D roadmaps taking account of work under relevant past and ongoing European programmes; addressing issues such as market potential, user acceptance, standardisation, continuing education, ethics, and socio-economic impacts; outreach to relevant professional and general audiences.

[12] Further information: http://cordis.europa.eu/fp7/find-doc_en.html; http://ec.europa.eu/research/science-society/open_access; http://ec.europa.eu/research/science-society/scientific_information/

e) **Speeding up progress towards smarter robots through targeted competitions** based on suitably evolving reference scenarios focused on capabilities at issue under this Objective, and involving relevant stakeholders. This includes soliciting private sponsorships, organising and managing pertinent events as well as accompanying dissemination measures and public relations activities.

Expected impact

For a), b) and c):

- Integrated and consolidated scientific foundations for engineering cognitive systems under a variety of physical instantiations.
- Significant increase in the quality of service of such systems and of their sustainability in terms of, for instance, energy consumption, usability and serviceability, through the integration of cognitive capabilities.
- Innovation capacity in a wide range of application domains through the integration of cognitive capabilities.
- Improved competitive position of the robotics industry in existing and emerging markets for instance in the following sectors: manufacturing; professional and domestic services; assistance and co-working, production, logistics and transport, construction, maintenance and repair, search and rescue, exploration and inspection, systems monitoring and control, consumer robotics, education and entertainment.
- Consensus by industry on the need (or not) for particular standards. More widely accepted benchmarks. Strengthened links between industry and academia.

For d):

- Stronger cohesion between relevant industrial and academic R&D communities; and a higher level of awareness among wider (including non-professional) audiences of the potential of the technologies at issue.

For e):

- Greater innovation through competitions which allow to measure and compare progress towards the ambitious goals set under this Challenge.

Funding schemes:

a)-b): STREP, IP; c) IP; d-e) CSA (CA only)

Indicative budget distribution[10]: EUR 155 million

Calls:

FP7-ICT-2011-7: target outcomes (a), (d)

- IP/STREP: EUR 70 million of which a minimum of 50% to IPs and a minimum of 30% to STREPs
- CA: EUR 3 million

FP7-ICT-2011-9: target outcomes (b), (c), (e)

- See footnote[10]

6.3 Challenge 3: Alternative Paths to Components and Systems

Challenge 3 covers electronic and photonic components, integrated micro/nanosystems, multicore computing systems, embedded systems and their monitoring & control and cooperating complex systems. It complements the developments undertaken in the ENIAC and ARTEMIS JTIs.

More specifically, Challenge 3 focuses on:

- The deep miniaturisation, energy-efficiency, performance increase and manufacturability of nano-electronic devices using alternative solutions to the traditional miniaturisation path, for information and communication systems and other applications in 2020 and beyond.
- The integration of new functionalities for the next generation of application-specific components and smart systems through the convergence of microelectronics, nano-materials, biochemistry, measurement technology and ICT.
- The design, modelling and operation of systems composed of a large number of independent, heterogeneous and interacting embedded systems as well as their monitoring and control; and the management of interconnected large, yet autonomous systems ("Systems of Systems").
- The parallelisation and programmability methods to allow the adaptation of existing software to multicore computing architectures and systems, from embedded devices to general-purpose and to high performance computing.
- The further development of core and disruptive photonic technologies (lasers, waveguides, photodetectors, amplifiers, LEDs, optical fibres, etc), fundamental in strategic applications such as medicine, biology, communications, lighting, sensing and measurement, and manufacturing.
- The development of advanced, low temperature processing, and potentially printable devices and systems on large area and/or flexible substrates, such as light emitting and sensing devices, photovoltaics, displays, printed electronics for smart tags, or wearable smart textiles.

Research addressing this Challenge in particular will encourage international cooperation under the Intelligent Manufacturing Systems (IMS) scheme[13].

Objective ICT-2011.3.1 Very advanced nanoelectronic components: design, engineering, technology and manufacturability

This objective covers the combination and convergence of advanced More-than-Moore elements with Beyond-CMOS devices and their integration and interfacing with existing technology. It addresses research from a "System Perspective", i.e. linking new advanced component technologies with advanced system design to support miniaturised electronic systems for 2020 and beyond. Developed components and technologies need to fulfil the criteria of "systemability", "integratability" and "manufacturability" where appropriate.

The interaction of circuit, device and technology research communities will be stimulated. Research for disruptive approaches and holistic research solutions to address new levels of miniaturisation at component and system level are targeted as well as related novel

[13] IMS member countries include South Korea, Mexico and the USA, see Agreement under: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2008:053:SOM:EN:HTML

manufacturing solutions and access to manufacturing and integration platforms for European equipment and material suppliers.

The activities under this objective are complementary to the activities in the ENIAC JTI[14].

Target outcomes

a) Beyond CMOS technology:

- New switches and interconnects which offer scalability, performance and energy efficiency gains, operational reliability and room temperature operation with preferably CMOS process and architectural compatibility .
- Advanced system integration technology and new methods for computation.
- Emerging memories targeting the concept of non-volatile universal memory.
- Nano-photonic devices & interconnects integrated with nano- and Beyond–CMOS.
- Carbon based electronic devices.
- Novel materials for interconnects, nano-packaging, Beyond-CMOS (logic and memory).
- Understanding fundamental artefacts and limits: nano-scale thermal processes; computational material and device science.

b) Circuit-technology solutions, addressing in a *combined manner*:

- Architectures including energy efficiency, spin devices; silicon with molecular switches; ferromagnetic logic; heterogeneous and morphic system architectures.
- Circuit design, methodology and tools addressing e.g. power dissipation constraints; SRAM stability; digital-analogue convergence; device variability, model accuracy; reliability and novel functionality.
- Technology addressing e.g. device leakage current, power dissipation, process variability; monolithic as well as 3D integration of Beyond-CMOS and advanced More-than-Moore; co-integration of photon and electron based devices.
- Modelling and simulation: e.g. quantum and atomic scale effects; electro-thermo--mechanical effects; band-to-band tunnelling; drift diffusion effects; variability; modelling for new materials, processes and devices, and higher abstraction level models for cross technology cross IP level simulation.
- Design-technology solutions for energy efficiency, high reliability and robustness including ultra low power techniques and zero-power concepts; thermal aware design, solutions for complex single or multi-technology systems; reuse and standardisation with respect to IPs , design for self-testing, self-healing and self-configuring.

c) Nano-manufacturing and Joint Equipment Assessment, comprising the complete manufacturing supply chain for flexible and customised manufacturing of integrated nano- and Beyond-CMOS components:

- Manufacturing approaches to Beyond-CMOS and advanced More-than-Moore', and to their integration with nanoCMOS including 3D integration.

[14] The JTI addresses application-guided industrial cooperative research in the 'More Moore' and 'More than Moore' domains for the next generation components and systems and targets large strategic initiatives. In manufacturing, the JTI targets larger volume fabrication with emphasis on generic manufacturing and equipment development. See http://www.eniac.eu

- Enhanced variability control; integrated metrology/inspection/analysis concepts and tools to support 3D approaches; functionalised assembly and packaging (also at wafer level).
- Joint Assessments of (combined) equipment/metrology/process solutions ranging from proof of concept for 'disruptive' approaches and for 450 mm to prototype testing with suppliers and users;
- 200/300 mm wafer integration platforms and short user-supplier feedback loops.

d) **Coordination and Support Actions**

- Broker services to offer European researchers and SMEs access to training, to CAD tools and to advanced technologies, design kits and IP blocks for education, prototyping and small volume production.
- Roadmaps; benchmarks; strategy papers; studies of limits of Beyond-CMOS and advanced More-than-Moore processes, devices and architectures w.r.t systemability, integratability, energy efficiency, scalability and manufacturability.
- Stimulation of young people towards electronics careers; training and education for high school students; access for students and PhDs to production lines and research labs.
- International cooperation, in particular with the USA, Taiwan, Korea and Japan.
- Support, coordination and standardisation actions including preparatory work for 450 mm wafer processing targeting material and equipment companies.

Expected impact

- Increased European knowledge, resources and skills at the frontier of nanoelectronics technology and miniaturised electronic systems, enabling further European partnerships in world-wide collaborations. European research organisations in leading positions.
- A more integrated nano-electronics technology, device and design research community, better targeted to the business strategy of the European industry.
- Increased attractiveness for investments in components miniaturisation, functionalisation and manufacturing in Europe; increased business opportunities and market share.
- New electronic applications of high economic and socio-economic relevance.
- Strengthened competitiveness of the European foodchain for the nanoelectronics industry (materials, equipment and component suppliers, academia and institutes).

Funding schemes

a): STREP; b): IP, STREP; c): IP, STREP; d): CSA

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

Objective ICT-2011.3.2 Smart components and smart systems integration

Smart (miniaturized) systems have the ability to sense, describe, and qualify a given situation, as well as to mutually address and identify each other. They are able to predict, decide or help to decide, and to interact with their environment by using highly sophisticated interfaces between systems and users. They can be standalone, networked, or embedded into larger systems, they comprise heterogeneous devices providing different functionality (e.g., sensing,

actuating, information processing, energy scavenging, communication, etc.) and excel in self-reliance and adaptability. Their development thus requires the integration of inter-disciplinary knowledge.

Smart components demonstrate enhanced performance and functionality enabled by the re-use of nano-electronics processes and building blocks in combination with longer term research to address very advanced performance, high voltage and high power operation or operating under special conditions. Research is needed on specific devices, processes, technologies and design platforms to support applications in 2017 and beyond. The activities in this area are expected to be complementary to the activities in the ENIAC JTI[15] and to the activities of the 'Green Car' initiative[16] (cf. Objective 6.8).

Micro-Nano Bio Systems (MNBS) are smart systems combining microsensing and microactuation, microelectronics, nano-materials, molecular biology, biochemistry, measurement technology and ICT.

Within this objective, a high level of industry participation is expected and demonstration aspects are encouraged.

Target outcomes

a) **Future smart components and smart systems**

Materials, technologies, processes, manufacturing techniques and design methods for:

- Innovative smart components (Systems on Chip or Systems in a Package) demonstrating very advanced performance (very high performance analogue, very high frequency, integrated passives); high voltage and high power operation or operating under special conditions (e.g. high temperature, high reliability, long lifetime).
- Miniaturized and integrated smart systems with advanced functionality and performance including nanoscale sensing systems.
- Autonomously operating, power efficient and networked smart systems.
- Robust systems, compatible and adaptive to environment and lifetime requirements.

Projects should address one or more of the points above. Research should be driven by advanced system requirements and address innovation at the various levels: advanced functionalities, key enabling technologies, basic methodologies.

Advanced Functionalities include: Nanoscale, multidimensional sensing; Communication and data processing through micro/nanoscale and RF devices; Scavenging, storage and management of energy and power; in-systems energy sourcing. Interfacing and interaction requiring very high analogue or frequency performances, operation under harsh environments, voltage or power conditions; Human-Machine Interfacing using gesture, tactile and motion detection; Comfort and ergonomy, e.g. by wearable solutions.

Key Enabling Technologies include: Material combination of e.g. semiconductors, ceramics, polymers, glass, textiles, cellular tissue, rigid and flexible substrates; Advanced materials and technologies for smart components (on silicon or other materials e.g. SiC, III-V, …); New devices, processes, packaging and integration technologies that can meet

[15] The JTI research agenda targets large initiatives to develop the next generation of processes, technologies, devices and components which are demonstrated in close-to-market applications. See http://www.eniac.eu

[16] The 'Green Car' initiative targets to further improve, integrate and transfer innovative smart components for their use in the next generation electric car.

advanced, high performance requirements; New sensors, actuators and components (RF, etc.) exploring the nano dimension.

Basic Methodologies include: New architectures for devices and smart components that can fulfil the complexity and the very advanced, very high performance requirements; Tools for modelling and design of smart components and smart systems with optimum embedded software; Fabless industry concepts taking advantage of the European research infrastructure; Manufacturing approaches, which are flexible and modular where additional functionalities can be cost efficiently integrated; Techniques, processes and equipments for optimized yield, reliability, reproducibility, testing and validation; Standardization of interfaces and levels of quality, reliability and robustness.

b) **Micro-Nano Bio Systems (MNBS)**

- Increased intelligence of devices (computation/decision power, sensing capabilities)
- Enhanced miniaturisation and integration of devices and systems
- Increased integration of bioactive components (molecular and cellular components, bio/nanochemistry) as well as processes.

The novel generation of MNBS shall be smaller, perform better, and be faster and cheaper, while still delivering highly reproducible results, exhibiting increased sensitivity and being extremely, and proven, reliable.

Research actions should be driven by application requirements from application sectors such as health, medical and pharmaceuticals, transport and mobility, security and safety, environment and food quality assurance, etc.. and address whenever relevant, bio-chemical calibration and bio-molecule stability aspects.

For those actions addressing in particular the health area, emphasis is on:

- highly integrated, safe, active and autonomous "smart" implants which provide real-time performance feedback and are able to tolerate interfering body signals;
- integrated systems for rapid, sensitive, specific and multi-parametric in vitro molecular analysis/detection and cellular manipulation based on biodegradable materials. Cost, manufacturing and real scenarios validation should be considered;
- autonomous body sensor and actuator based systems for non- or minimally-invasive targeted early detection, diagnosis and therapy.

The focus of projects targeting environment protection and food/beverage safety and quality control should be on:

- integrated multisensing micro-nano systems able to analyse environment, food and beverage samples for the simultaneous and rapid identification of potentially dangerous species e.g. pathogens, allergens, chemicals, etc. Of paramount importance are selectivity, sensitivity, modularity and detection that is capable to identify several species;
- integrated sensor and actuator systems for safety and security that are able to support the individuals operating in harsh environments through contextual monitoring, feedback and networking capabilities.

c) **Coordination and Support Actions**

- Coordination and interaction of national and EU R&D programmes in the area of smart systems

- Actions aiming at strengthen the cooperation between the various actors along the value chain of smart systems integration, from scientific research to industrialisation.
- Actions aiming at stimulate the take-up of smart systems approaches by relevant industrial sectors
- Roadmaps to link very advanced application requirements with smart components and smart system needs; benchmarks with the aim to identify new research needs.
- Linking of R&D strategies and stimulation of international cooperation

These coordination and support actions should involve relevant smart components and systems stakeholders.

Expected impact

- Closer business relationships between materials, equipment and component suppliers, integrators, manufacturing plants and institutes. Strong involvement of industry participants interacting closely with R&D organisations and users.
- Increased European knowledge and skills at the frontier of smart component and smart systems integration, increased efficiency and effectiveness of smart components and smart systems engineering contributing to the competitiveness of the European industry involved, increased attractiveness to investments and putting European research organisations in leading positions.
- Substantial market shares gained in high end markets requiring very high performance smart products and new electronic applications.
- Contributing to environment protection through smart solutions for energy management and distribution, smart control of electrical drives, smart logistics or energy-efficient facility management.

Funding schemes

a-b) IP/STREP c) CSA

Indicative budget distribution[10]

a): EUR 38 million of which a minimum of 50% to IPs and a minimum of 30% to STREPs

b): See footnote[10]

c): EUR 3 million

Calls:

- FP7-ICT-2011-7 for a) and c)
- FP7-ICT-2011-8 for b)

Objective ICT-2011.3.3 New paradigms for embedded systems, monitoring and control towards complex systems engineering

The objective is to push forward the limits of embedded systems, monitoring, control and optimisation technologies and "System-of-Systems" engineering. The aim is to develop novel methodologies and advanced engineering approaches for designing, developing and executing/running complex/large scale, distributed, and cooperating systems. These systems need to satisfy high performance, reliability, survivability and power-awareness requirements and cope with internal and/or external uncertainties/disturbances. Linking and connecting together large yet autonomous adaptive systems, call for new paradigms of systems design,

towards "System of Systems" engineering, e.g. complementing the "correct by construction" by a "correct by evolution" design approach. Multi-disciplinary cooperation and multi-aspect concurrent design (where appropriate) from the computing, control, communications, energy consumption and information theory & engineering points of view is highly encouraged, including, where relevant, support or enhancements of new educational curricula and training.

Target outcomes

To facilitate the design and development of advanced Embedded Systems composed of any number of independent, mainly heterogeneous and interacting intelligent embedded components and sub-systems, emphasis is on:

a) Novel dependable and scalable architectures and tools mainly for energy efficient and energy-aware, heterogeneous embedded systems; projects may include, whereas relevant, enhancements of educational curricula.

b) Secure composition concepts, methods and novel validation / verification / testing techniques and tools, including meta-modelling.

To achieve stable and robust behaviour of (in particular closed loop) real life systems, actions should address the systematic engineering, through (embedded) intelligence, diagnostics, advanced control and optimisation techniques and the development of systems capable of dealing with complex, distributed and/or uncertain dynamics and/or very large amounts of sensory data and standardisation of configuration interfaces and exchange platforms. Emphasis is on:

c) Robust distributed estimation/prediction, cooperative networked control, synchronisation, and optimisation methods in industrial environments.

d) Energy-aware, self-organising, monitoring and control systems including fault-adaptive methods for adjusting to/recovering from failures. Projects may include usage of wireless sensor/actuator networks in closing reliably the control loops. Research actions should demonstrate proof of concept. This outcome complements Objective 2.1 / target outcome b).

At a much higher and at global system level, actions should analyse and advance the management of behaviour of very large scale, or complex man-made systems towards the design, development and engineering of System-of–Systems (SoS). Emphasis will be on concepts, methods, architectures and tools towards building SoS addressing societal needs e.g. in distributed energy systems and grids, multi-site industrial production, emergency coordination and global traffic control. The work should demonstrate its potential use across more than one application sectors. Focus is on:

e) Basic underpinning technologies such as large scale modelling and simulation to understand the operation and behaviour of the constituent systems of SoS and of their interdependencies and to allow them to work together for a common goal and/or a global end-to-end optimisation of behaviour. Concepts, methods, architectures or tools addressing the autonomy versus cooperation challenges in SoS engineering as well as the management of dynamic properties as constituent systems of SoS change, are added or removed as the SoS structure and goals evolve.

f) Coordination and support actions for elaborating strategic research and engineering roadmaps by bringing together the relevant stakeholders and elaborating representative case studies.

To facilitate and promote international cooperation, focus is on:

g) Analysis of international research agendas and preparation of concrete joint R&D initiatives for international collaboration, in particular with the USA mainly in the area of SoS and Western Balkan Countries (WBC), mainly in the monitoring and control area. Separate proposals per geographic area are expected.

Expected Impacts

- Improved industrial competitiveness through strengthened capabilities in advanced embedded systems, in monitoring, control and optimisation of large-scale complex systems, in areas like energy, transport, and production, and in engineering of SoS.
- New business eco-systems providing innovative products and services based on SoS.
- Reinforced European scientific excellence and technological leadership in the design and operation of large-scale complex systems.
- Wider educational and training activities in systems and control engineering in Europe at all levels.
- International cooperation with targeted geographical areas creating mutual benefits which will further European interests on focused technical topics.

Funding schemes

a), b), c), d): IP, STREP

e): IP: It is expected that a minimum of one IP is supported.

f), g): CSA. Funding per CSA under g) should not exceed EUR 0.5 million

Indicative Budget distribution[10]

- IP/STREP: EUR 46 million of which a minimum of 50% to IPs and a minimum of 30% to STREPs

- CSA: EUR 4 million

Call

FP7-ICT-2011-7

Objective ICT-2011.3.4 Computing Systems

The objective is to achieve breakthroughs in the transition to multi-core architectures across the whole computing spectrum: embedded computing, general-purpose computing (PC/servers) and high-performance computing (HPC). This transition affects the underlying hardware, the system software (compilers, tools, OS, etc) and the programming paradigms.

Target outcomes

a) **Parallel and Concurrent Computing**

Automatic parallelisation, new high-level parallel & concurrent programming languages and/or extensions to existing languages (including their runtime implementation) that provide portable performance taking into consideration that user uptake is a crucial issue. Projects should go beyond on-chip, off-chip boundaries addressing the challenges of programming, testing, verification and debugging, performance monitoring and analysis, low-power and power management especially for large scale parallel systems and data centres, and

heterogeneous and accelerator-based multi-core systems. Research priorities include domain-specific languages; concurrent algorithms and transformation of concurrency to parallelism through adaptive compilers and runtime systems; new verification and optimisation environments for parallel software; efficient execution exploiting heterogeneous cores; new approaches to scalability of high-performance computing application codes.

b) **Virtualisation**

Virtualisation technologies that are ensuring task isolation and optimised resource allocation as well as guaranteeing performance, timing and reliability constraints. The focus is on full virtualisation solutions for heterogeneous multicore platforms including the design of virtualisation-ready heterogeneous multicore hardware platforms and support for accelerator virtualisation.

c) **Customisation**

Unifying hardware design and software development with emphasis on rapid discovery and production of optimal customisations of heterogeneous single-chip multicore systems and associated tool-chains for particular applications. Research priorities include: reconfigurable, flexible, soft or hybrid architectures and instruction sets; automatic tool-chain generation; system modelling and simulation, including performance predictability; efficient exploration of the customisation space; low-power and customisation for power efficiency; parallel programming for single-chip multicore architectures; architectural and system-level reliability techniques to counter increasingly probabilistic behaviour of transistors in lower geometries.

d) **Architecture and Technology**

The focus is on the impact of next-generation chip fabrication technology on system architectures, tools and compilers. Research areas include: implications of 3D stacking; alternative (non von Neumann) models of computation. The key challenge is to bridge parallel computing architectures and chip fabrication technology.

e) **International Collaboration**

The purpose is to analyse international research agendas and to prepare concrete initiatives for international collaboration, in particular with the USA, India, China and Latin America, for all topics of this objective. Separate proposals per geographic area are expected.

Expected Impact

- Drastically improved programmability of future parallel multicore/multichip computing systems, providing efficient execution and portable performance of codes on a large variety of computing platforms
- Efficient and ubiquitous use of virtualisation for heterogeneous multi-cores.
- Accelerated system development and production, enabling new products to be realised with a considerably shorter time-to-market.
- Reinforced European excellence in multi-core computing architectures, system software and tools.
- Strengthened European leadership in cross-cutting technologies that are applicable to different market segments of computing systems and, in particular, European leadership in parallel computing systems for large data centres.

Funding schemes

(a)-(d): STREP, NoE

(e): CSA

Indicative budget distribution[10]

- STREP: EUR 40 million
- NoE: EUR 4 million
- CSA: EUR 1 million

Call

FP7-ICT-2011-7

Objective ICT-2011.3.5 Core and disruptive photonic technologies

Target Outcomes

a) **Core photonic technologies**

Extending the state-of-the art for application fields where Europe is strong, including notably *application-specific photonic components and sub-systems* (such as laser and other light sources, modulators, transmitters and receivers, multiplexers, cross-connects, detectors and sensors, fibre components) for a given set of application fields. The aim is to provide new opportunities for advanced products, with a view to industrialisation. Priority is given to innovative or 'breakthrough' approaches rather than incremental developments. The interrelated materials, processing and device integration issues including electronics/photonics integration may also be dealt with. *Cross-cutting technology* actions further address device integration in a more systematic way.

Research actions should be driven by user requirements, should include validation of results for the targeted applications, and should cover the supply chain as appropriate (in particular in Integrated Projects).

Application-specific photonic components and subsystems should cover one of the following application fields:

1. ***Optical data communications*:**

   (i): *Communication networks* that are more transparent, dynamic, energy efficient and faster[17]. For *core networks*, the goal is scalable technology for truly cost-effective transport at 100 Gb/s single-channel rate and beyond, scalable towards 100 Tb/s systems (node-throughput). For *access networks*, the goal is affordable technology enabling 1-10 Gb/s data-rate per client over more than 100 km.

   (ii): *Optical interconnects* aiming at cost- and energy-effective technology for Tb/s optical data links in short range communication. Applications range from on-board and board-to-board links at the smaller scale, to links in data centres and local area networks at the larger scale.

   Further to "digital" optical transmission, "radio-over-fibre" techniques may also be addressed, in particular for local area networks and access networks. Research actions should bring together researchers, component manufacturers and suppliers of communication equipment.

[17] Photonic components and subsystems for communication networks support the overall vision and requirements of Objective 1.1 "Future networks".

2. ***Biophotonics for early, fast and reliable medical diagnosis*** of diseases, such as cancer, infectious and eye-related diseases. The applications vary from point-of-care diagnosis to functional imaging. Typical issues are high sensitivity, selectivity, resolution, and depth of penetration, according to the targeted technique and disease. Particular emphasis is on a strongly multidisciplinary approach involving also medical/biomedical end-users. Technical results should undergo preclinical validation, with clinical trials being excluded.

3. ***Imaging and sensing for safety and security*****:**

   (i) CMOS integrated, compact, affordable, high-performance mega-pixel image sensors (with CMOS-compatible detection layer) operating at ambient temperature and low power. Focus is on single-photon detection at video-rate read-out speed and very high dynamic range, and/or functional integration based on smart pixels with sub-picosecond temporal resolution, pixel-level hyperspectral or multispectral resolution, and polarisation sensitivity.

   (ii) Compact, cost effective, widely tuneable, high-performance photonic sources enabling a highly sensitive, selective and reliable detection of hazardous organic and inorganic substances. Emphasis is on advanced technology such as novel quantum cascade lasers and terahertz sources.

   Technical results should be validated for safety and security applications. Research actions should bring together researchers, component manufacturers and suppliers of safety & security imaging/sensing equipment.

4. ***Lighting and displays*****:**

   High brightness LEDs and 'light engines' (i.e. LED with driver electronics, optics and thermal management for lighting applications; or LED backlighting modules for displays). Focus is on:

   – Improved efficacy at high brightness at LED and light engine level (in particular light engines for warm white light with efficacy above 130 lm/W, CRI at least 90, and consistent colour over 25000 hours);
   – High brightness, high efficiency green components with intensity peak around 540 nm;
   – Novel approaches to white components (e.g. new phosphors, monolithic sources, hybrid approaches).

   The relevant system integration issues may also be addressed to some extent. Research actions should demonstrate a potential for significant system and operating cost reduction.

   LED suppliers and/or manufacturers should be involved.

Cross-cutting technology covers:

5. ***Photonics integration platforms*** that enable the cost-effective, automated volume manufacturing of a large variety of complex, compact, high-performance photonic integrated circuits ("PICs") combining active and passive components. Platforms should address a range of different application fields. The technology must be scalable for new technology generations, in particular for higher integration complexities at reduced cost per function. The platforms should address also the relevant design, modelling and simulation tools and generic manufacturing and packaging technology. Research actions should present a credible route to industrial manufacturing in Europe.

b) **Disruptive photonic technologies**

Technologies at the proof-of-principle stage that offer a potential for breakthrough advances in functionality, performance, component size or cost reduction. They often exploit effects at the limits of light-matter interaction (e.g. plasmonics, controlling the quantum degrees of freedom, sub-wavelength structures and near-field effects, photonic crystals, nano-photonics) or exploit the use of new materials (including meta-materials). The objective here is to bring such technologies from the research lab closer to applications, by demonstrating their industrial potential through a functional component with involvement of industrial players.

Such disruptive technologies could address for instance: New components for high performance (including extreme high power) laser systems, in particular compact, cost-effective high-performance laser sources; Exploiting nano-photonic structures, near-field effects and new materials for enabling PICs of higher performance, functionality or complexity; New photonic functions realised in optical fibres by integrating non-conventional materials; Components for quantum communication; Electro-optic modulation, signal processing and beam steering exploiting alternative materials, novel wave-guide structures or slow-wave effects; New photonic approaches for life sciences, such as biophotonics based tools for investigating bio-chemical and metabolic processes and/or the origins of disease at the cellular level; New photonic approaches for imaging systems, information displays, lighting, memory and storage.

c) **ERANET-Plus action**

A joint call for proposals on a photonics topic of strategic interest, to be funded through an ERANET-Plus action between national and regional grant programmes.

d) **Development of innovative solutions through Pre-Commercial Procurement (PCP) action**

To achieve a significant quality and/or efficiency improvements to public sector challenges through innovative photonics-based solutions. These solutions should be defined and developed by public sector organisations using a PCP approach. PCP shall be implemented according to the conditions outlined in Objective 11.1 and Appendix 6.

e) **Coordination and support actions**

- An ERA-NET action for the coordination of related national, regional and EU-wide R&D programmes/activities and cooperation between the relevant authorities. This action may also cover the field of organic electronics.
- Technology road-maps for high power / high energy laser components and systems and identification of new joint research and industrial opportunities in the field of high power lasers, across different application fields and related high power laser research infrastructures;
- Cooperation and coordination between regional clusters and/or national technology platforms with focus on best practice exchange and promotion of research and innovation;
- Targeted international cooperation activities driven by stakeholders representing the photonics community, aiming at the identification and development of "win-win" cooperative activities, including for example pre-standardisation, with selected industrialised countries;
- Supporting the coordination of the European photonics research constituency in the Photonics21 ETP; this may include specific coordination activities aiming at further

defining and promoting joint community structuring efforts towards significantly larger scale future activities.

- Access of SMEs and researchers to advanced technologies, design expertise and/or manufacturing facilities.
- Education and training actions with strong support from industry: Education actions to foster entrepreneurial and interdisciplinary skills at graduate and post graduate level; Training actions for industry (in particular SMEs) that provide state-of-the-art skills and hands-on experience in addressing industrial R&D challenges.

These coordination and support actions should involve the key stakeholders in photonics.

Expected Impact

- Actions under *Application-specific photonic components and subsystems* should reinforce European industrial leadership, competitiveness and market share in the concerned technologies and application fields; and/or provide significant societal impact with regard to health, safety, or security.
- Actions under *Cross-cutting technology* should secure a European manufacturing basis for components in the concerned application fields, contributing thus also to secure European industrial leadership and market share in those application fields.
- Actions under *Disruptive photonic technologies* should provide clear evidence for a longer-term potential of European industrial leadership or relevant societal benefits in the concerned application fields, or provide significant opportunities for new applications.
- The *ERANET and ERANET-Plus actions* should foster closer cooperation and greater alignment between the participating national/regional/EU-wide research programmes in topics of strategic interest.
- The *PCP action* should accelerate the introduction of advanced photonic technologies and applications on the European market.
- *Coordination and support actions* in high power / high energy lasers should lead to increased knowledge exchange and cooperation and help opening new market opportunities; Cooperation and coordination between regional clusters and national technology platforms should increase their overall effectiveness in promoting research and innovation; Targeted international cooperation activities should lead to greater cooperation between European players and their counterparts elsewhere on common goals for mutual benefit which will further European interests; Supporting the coordination of the European photonics research constituency should facilitate the European consensus building on research priorities and strategies; Access of SMEs and researchers to advanced technologies should foster the broader uptake of advanced photonics technologies; And, education and training actions should foster stronger and more durable collaboration between industry and academia leading to a competitive advantage of European photonics industry at large.

Funding Schemes

a): 1-4: IP, STREP; 5: IP;

b): STREP;

c): ERANET-Plus;

d): CP-CSA;

e): CSA

Indicative budget distribution[10]

a): See footnote[10]

b): EUR 20 million;

c): See footnote[10]

d): See footnote[10]

e): EUR 5 million

Calls

b), e): FP7-ICT-2011-7

a), c), d): FP7-ICT-2011-8

Objective ICT-2011.3.6 Flexible, Organic and Large Area Electronics and Photonics

Target outcomes

a) **OLAE[18] technology and components**

Development of advanced OLAE technology, device concepts, processes and materials, considering the full value chain. Addressing technology barriers whilst considering the manufacturing implications[19], component performance, improving materials parameters, and flexible/conformable devices. Improved encapsulation and/or alternative conductors, especially in the areas of OPV (Organic Photovoltaics) and OLED (Organic Light Emitting Diodes). Organic/printed logic and memory components; transparent electronic components; power supplies; polymer-based sensors and actuators; adaptable optical elements for electronics and lighting applications; large area energy scavengers & sensors. Modelling and circuit design, including the combination of OLEDs with CMOS technology, may also be addressed.

- Technology for low-cost production processes for OLEDs, improving external quantum efficiency, reliability and lifetime with targets > 100 lm/W at brightness levels in the order of 5.000 cd/m^2, stable over 10.000 hours lifetime.
- Technology for mass production processes for low-cost OPVs aiming at costs of ~0.7€/Wp, increased device efficiency of 8-10% on module level, improved in-coupling efficiency and a significant lifetime increase of up to 20 years.
- Technology for flexible, tileable and sizeable low-cost colour emissive and reflective displays with good image quality displays even in direct sunlight: for *emissive displays*, focus is on materials and process development; for *reflective displays*, focus is on video-rate performance front- and backplanes, and solid state device integration enabling homogeneous system integration.
- Circuitry with increased functionality and performance, i.e.: complexity up to 10,000 transistors; mobility in organic semiconductors beyond 1 cm^2/Vs; drive voltages down to 3V; circuit frequency up to 25 KHz; integration of analogue building blocks such as A/D converters and rectifiers; and addressing organic and inorganic integration, process

[18] The abbreviation OLAE as used in this description should be understood to also cover organic photonics technologies such as OLEDs (Organic Light-Emitting Diode) or OPVs (Organic Photovoltaics). It also includes smart textiles based on conformable and stretchable electronics.

[19] The focus here is on the technology development, whilst Objective "PPP manufacturing solutions for new ICT products" under Challenge 7 (the Factories of the Future PPP) will concentrate on demonstrating the feasibility of industrial manufacturing processes.

variations and process tolerant design, stability, interconnects, multilayers, packaging and encapsulation, modelling, simulation, and novel device and circuit design for OLAE.

– For smart textiles, interdisciplinary work addressing fibre components, heterogeneous integration of multiple functions (such as sensing, actuation, energy scavenging, power management, data processing and communication) and interconnection, device and materials reliability, packaging and encapsulation, washability and durability.

b) **OLAE systems and applications**

Advanced technology development and integration of components through new or improved systems and devices targeting wider applications to facilitate rapid and extensive exploitation, particularly:

– Lighting systems with high quality white CRI (Colour Rendering Index) > 90, stable over a 10 year lifetime with reasonable costs;

– OPV modules with costs of ~0.7€/Wp, external efficiency of 8-10% and a lifetime of up to 20 years for mobile and fixed applications;

– High quality emissive and reflective colour displays and signage;

– Flex/foil-based organic and printed electronics for mass market/low cost applications;

– Integrated Smart Systems for a range of applications including health monitoring and diagnostics, large area sensing, smart labels and packaging. Smart textiles in higher added value products and applications, particularly for health.

Actions under a) and b), IPs but also STREPs as far as possible, should address the full value chain, from material to devices and from researchers to component manufacturers. End-of-life/disposal/recyclability issues should also be addressed.

c) **ERA-NET Plus action** A joint call for proposals on an OLAE topic of strategic interest, to be funded through an ERA-NET Plus action between national and regional programmes.

d) **Coordination and Support Actions**

– Cooperation and coordination between the OLAE competence centres. This may include their research and innovation-related activities, training, manufacturing, (pre)standardisation, etc.

– Access to OLAE technology and facilities for industry, especially SMEs, and researchers.

– Targeted international cooperation activities particularly with Japan, South Korea, Taiwan and the USA, aiming at the identification and development of "win-win" cooperation.

– Focused education and training actions aiming at keeping industry (in particular SMEs) abreast of OLAE state-of-the-art knowledge and tools, and promoting entrepreneurship.

– An ERA-NET action for the coordination of related regional, national and EU-wide R&D programmes/activities and cooperation between the relevant authorities[20].

These coordination and support actions should involve the key stakeholders in OLAE.

Expected impact

- Actions under *OLAE technology and components* should yield increased European competitiveness through having OLAE and smart textiles expertise and manufacturing capability in Europe, covering the full technology value chain as far as possible.

[20] If an ERA-NET action is intended to address both Objectives 3.5 and 3.6, it should be submitted to Objective 3.5.

- Actions under *OLAE systems and applications* should yield greater expertise and capability over the full value chain and the accelerated emergence of new devices, products and applications, leading to increased market share of European players in each of the key applications and/or the creation of new markets. Innovative systems and products for high value-added applications should establish or reinforce EU lead markets.
- The ERA-NET and/or ERA-NET Plus Actions should foster cooperation and alignment between participating states'/regions' research activities in topics of joint interest.
- Improved coordination of the OLAE competence centres, creating synergies, common strategies, and pooling of resources. Access actions should foster broader take-up of OLAE technology, and transfer OLAE expertise across Europe. International cooperation activities in OLAE should lead to greater cooperation between European players and their counterparts elsewhere on common goals for mutual benefit which will further European interests whilst safeguarding European Intellectual Property. Education and training actions should increase knowledge and expertise across Europe in OLAE.

Funding schemes

a), b): STREP, IP; c): ERA-NET Plus; d): CSA

Indicative budget distribution[10]

- IP/STREP: EUR 40 million of which a minimum of 50% to IPs and a minimum of 30% to STREPs

- ERA-NET Plus: EUR 6 million (Any remaining funds following the selection of an ERA-NET Plus action will be transferred to target outcomes a) or b))

- CSA: EUR 4 million

Call:

FP7-ICT-2011-7

6.4 Challenge 4: Technologies for Digital Content and Languages

Digital content is the foundation of a knowledge based society; it is in digital content that knowledge is stored and from digital content that knowledge is extracted and exploited by individuals and organisations across modalities and languages. This makes it crucial for this resource to be readily and reliably accessible over time to European citizens and enterprises and for every step in its lifecycle to be adequately supported and enhanced in response to changes in the technology landscape.

Challenge 4 focuses on:

- easing and speeding up the creation of added value, in particular by SMEs, using resources that are today too burdensome to acquire or complex to use; putting the ability to create quality content and innovative services within the reach of individuals and small organisations by lowering skill and cost barriers,
- allowing people to access and use online content and services across language barriers, in their preferred language,
- ensuring complete reliability of retrieval and use of digital resources across applications and platforms over time, and design digital content natively engineered for obsolescence avoidance,
- scaling up data analysis to keep pace with the rate of growth of data streams and collections and enable novel forms of real time intelligence that only become possible on extremely large data volumes.

Participation in the Open Access Pilot in FP7

Open Access, defined as free access over the internet, aims to improve and promote the dissemination of knowledge, thereby improving the efficiency of scientific discovery and maximising return on investment in R&D by public research funding bodies. Since August 2008, the European Commission has been conducting a pilot initiative on Open Access to peer reviewed research articles in its Seventh Framework Programme (FP7). This pilot covers seven FP7 areas. Beneficiaries funded partially or entirely through this Challenge will be required to deposit peer-reviewed articles resulting from projects into an institutional or subject-based repository, and to make their best efforts to ensure open access to these articles within six months[11]

Objective ICT-2011.4.1 - SME initiative on Digital Content and Languages

SMEs have ideas that sometimes cannot be implemented because they depend on the availability of data resources or specialised tools that are too expensive to obtain and maintain. In some areas, data pooling, sharing and reuse are further complicated by Europe's many languages. Actions under this objective aim to make it easier for innovative players, especially SMEs, to exploit and contribute to large digital resource pools. User-centred experimentation will be supported as well, with the aim of demonstrating the integration of data-intensive technologies within innovative solutions and processes.

Target outcomes

a) **Bootstrapping a data economy:** the target is to lower the barrier to entry in providing advanced services over linked digital resources, including both data analytics and reuse of creative content. Projects shall develop (or reuse and recombine where appropriate) practical

and automated tools for the finding, matching, screening, validation, conversion, pooling, editing of data and content. The main objectives are:

- To maximise reuse of digital content resources by making them easy to find, evaluate and integrate.
- To foster reuse of digital content resources by providing guarantees and fair incentives for their creators and maintainers. This includes the creation of data exchanges or commons whose quality (breadth, timeliness, temporal qualification, ..) and value increases with the number of users and the feedback and validation they contribute. It also includes mechanisms for aggregating demand, thus stimulating the creation of additional resources and services.
- To develop robust and highly usable new services demanded by citizens and businesses (especially SMEs) and create value by correlating independently produced datasets or extracting valuable information not foreseen by the original data producer. Usability is of paramount importance, particularly when the science underlying such services (statistics, machine learning, data mining, ..) is non-trivial.

Consortia shall consist of a limited number of innovative, fast-moving actors, in particular SMEs, able to identify and address real market needs or opportunities and with a clear stake in the exploitation of results.

b) **Community building and best practices:** Produce rigorous studies on the actual or projected economic impact of digital resources pooling as a function of well defined parameters such as the size of resources, user populations, socio-economic sectors, and software stacks adopted. Use the results of such studies to set up data exchange facilities, disseminate best practices and increase awareness of short term existing opportunities. Develop educational curricula designed to train data analysis professionals, expert in the maintenance and exploitation of data commons.

c) **Sharing language resources:** Projects are expected to make a fresh use of digital pools of language data, metadata and tools to develop advanced technologies and services. They shall address multiple EU languages[21] and where relevant the languages of major EU trade partners. The main objectives and outcomes are:

- To make more effective the acquisition of language resources exploiting automated and/or collaborative means; in many cases existing resources will need to be cleaned and documented, upgraded to widely-accepted technical or linguistic standards, linked across sources or aligned across languages, etc., before they can be used and shared.
- To contribute to an open exchange place based upon the concerted pooling of resources having a significant potential for reuse. This electronic trading place must offer clear incentives and simple and yet robust mechanisms for both providers and users to contribute, maintain, share and exploit resources while ensuring that intellectual property rights and agreed access/reuse conditions are respected.
- To show the concrete impact of using, combining or repurposing the above resources in a given use context, in terms of improved functionality, maintainability, scalability and portability of new systems and technologies.

Consortia shall include players from the demand and supply sides, in particular SMEs, who have a clear stake in the exploitation of results. All projects shall encompass the "sharing" element.

[21] Emphasis is placed on the EU official working languages and on the official languages of the other countries participating in the Framework Programme.

d) **Building consensus and common services:** Commercial and research organisations must be brought together to define how the intended exchange place can be populated and operated, and evolve over time. Actions under this heading must help establish mechanisms, forums and support services to (i) coordinate efforts, reach consensus, mobilise the community at large, and (ii) set up and manage the planned electronic trading facilities.

Expected impact

- Improved European competitive position in a multilingual digital market through the provision of better services to citizens and businesses.
- Novel forms of partnership between new programme entrants and established players, reduced development costs and shorter time-to-market, thus stimulating innovation and expanding markets.
- Result-driven knowledge transfer between research centres (and their spin-offs) and progressive technology providers (especially SMEs), data brokers/aggregators and content providers.

Funding scheme

a), c): STREP

b), d): CSA

Indicative budget distribution[10]

- STREP: EUR 26 million
- CSA: EUR 5 Million for outcome b) and EUR 4 Million for outcome d)

Calls

Call FP7-ICT-2011-SME-DCL

Two step evaluation process with specific eligibility and evaluation criteria.

Objective ICT-2011.4.2 – Language Technologies

There is a growing need for effective multilingual solutions that support business and inter-personal communication and enable people to make sense of online content and services in Europe's many languages. Projects shall address multiple languages[22] and cater for written and/or spoken language as appropriate. Technologies must be adaptive, they must handle language in its various uses, cope efficiently with massive volumes, and be embedded within information flows. Contextualisation is a common requirement and so is personalisation.

Target outcomes

a) **Multilingual content processing:** Projects will address the digital content lifecycle in online environments, exploiting language-encoded knowledge embedded in documents, social media, web and audiovisual objects. They are expected to (i) advance the current state of the art in the machine translation field, and (ii) improve the usability, performance and cost effectiveness of emerging technologies by means of field testing and embedding within complex processes.

- *Advancing machine translation* is geared towards automation and calls for approaches that can significantly improve the quality and suitability of the translation output, drawing

[22] Emphasis is placed on the EU official working languages and on the official languages of the other countries participating in the Framework Programme.

where necessary from other disciplines. Expected innovations include the ability to cope with everyday language as found in e.g. social networks; to autonomously learn from use and adapt to new situations with high scalability and portability across languages and domains; to compile translation resources from the web, open sources or enterprise repositories, efficiently and accurately.

- Projects under *integration of language-enabled content technologies* shall address a meaningful combination of content authoring, management, translation and publishing tasks and tools within typical production processes and translation/localisation workflows, in real-life multilingual settings. Projects will optimise and integrate promising but untried technologies within demanding application environments, assess their suitability and increase their potential. Field trials will be an integral element of the projects together with user-related and economic (e.g. cost-benefit) analyses.

b) **Information access and mining:** The main thrust under this heading is to couple language processing and extra-linguistic semantic analysis to capture knowledge encoded in human language. Projects shall aim to achieve accurate and efficient deep analysis with broad coverage in any suitable mix of the following domains: (i) cross-lingual information search and retrieval; (ii) audio and video mining by means of linguistic cues; (iii) text mining and information extraction from multilingual collections. The key innovation is the ability to capture and represent concepts and facts, find connections and similarities, extract relations between entities, reason over facts while interpreting time and space, etc., well beyond what is possible with existing techniques. Emphasis is on cross-disciplinary approaches and generic technologies that will be evaluated in selected domains and tasks.

c) **Natural spoken interaction:** Spontaneous human-machine interaction is a major challenge for the next generation of voice-based interactive services. Projects shall develop either complete proof-of-concept systems or component technologies that support a much richer and robust interaction between humans and computer systems. The outcome is conversational social agents that can recognize and synthesize conversational speech; adapt to new conditions without manual intervention and react proactively to new communicative situations; learn from interaction and exhibit graceful degradation; recognize, interpret and generate social cues. Technologies should be portable across domains, tasks and acoustic environments. They should enable non-intrusive interaction, exhibit real-time performance and feature multi- and where relevant cross-lingual capabilities. Focus is on speech interaction, although other modalities may be justified in specific cases.

d) **Developing joint plans, methods and services:** The target community consists of two main constituencies (speech technology and natural language processing) and a wide range of research and commercial organisations which must be brought together along the following lines:

- Establish and pursue widely supported technology roadmaps; stimulate academia/industry partnerships and co-operation with national actors; ease technology transfer by means of demand-oriented analyses, themed workshops and portal services.
- Measure progress and performance of different approaches by means of community-driven evaluation methods, metrics and challenges for technology-, system- and application-oriented tasks.
- Develop methods, guidelines and standards to enhance the quality, (re)usability and inter-operability of language datasets and processing tools; promote and support open repositories of research results and development/training resources of general interest.

Expected impact

- Improved European competitive position in a multilingual digital market through the provision of better products and services to citizens and businesses.
- Scientific and technological leadership as a result of a widely accepted vision and roadmap encompassing presently fragmented communities.
- Cooperation and exchanges between European and national efforts, closer dialogue and partnership between research and industry, better understanding of user requirements, thus stimulating innovation and technology uptake.

Funding scheme

a), c): IP, STREP

b): STREP

d): CSA

Indicative budget distribution[10]

- IP/STREP: EUR 42 million of which a minimum of 30% to IPs and a minimum of 50% to STREPs
- CSA: EUR 8 million

Calls

FP7-ICT-2011-7

Objective ICT-2011.4.3 Digital Preservation

Digital preservation research focuses on developing technologies, systems and tools for safeguarding digital content. The objective is to preserve digital content in a more effective and cost-efficient manner while protecting its authenticity and integrity, significantly reducing the loss of irreplaceable information, and ensuring it may be reused in the future.

Target outcomes

a) **More reliable and secure preservation technologies and methods.** Research should cover techniques and tools for recovering loss and for repairing damaged digital objects as well as solutions guaranteeing the long term availability of newly created resources including 3D objects and models, and conceptual frameworks for quality assurance. Research should also analyse which currently available or emerging methods and technologies are most efficient and in which use context or for which kind of resources. Solutions proposed can go beyond digital objects, and target as well the long-term functionality of system for creation, management and storage of digital resources. This work should be underpinned by research aiming at a deeper understanding of how loss and damage occur and which degree of integrity is required for keeping resources useable.

b) **Technologies and systems for intelligent management of preservation.** Technologies to support the long term usability of digital resources (including high volume, heterogeneous and volatile content) through a life cycle approach to its preservation. Research should help to support human appraisal and selection processes through innovative technologies that embed reasoning and intelligence in the content itself. Keeping resources usable, i.e. meaningful and understandable overtime, includes taking account of and developing a conceptual understanding of evolving semantics, use contexts, and interpretations. Activities may cover solutions to identify and erase obsolete information.

c) **Interdisciplinary research networks** bridging technological domains and scientific disciplines concerned with information, and expertise in end-user needs.

d) **Promotion schemes for the uptake of digital preservation research outcomes** including outreach to new stakeholders and road mapping activities.

Expected impacts:

- Reduced information loss through better recovery and repair techniques and through deeper understanding of the reasons and implications of digital decay and other forms of data loss.
- Sustainable access to information: keeping resources not only available but also meaningful and usable.
- More efficient and effective selection of resources to be preserved and of appropriate preservation processes, methods and technologies.
- Wider adoption of research results by supply-industry and by end-users.

Funding schemes:

a) STREP; b) IP; c) NoE d) CSA

Indicative budget distribution[10]

Call

FP7-ICT-2011-9

Objective ICT-2011.4.4 Intelligent Information Management

Target outcomes

a) **Reactive algorithms, infrastructures and methodologies** (parallelisation, approximation, online processing, compression) for scaling data intensive techniques (including but not limited to machine learning, inference, statistical analysis) up to extremely large data volumes and real time performance. Implementations must be rigorously tested on extremely large and realistically complex data sets coming from diverse resources contributed by organisations with a clear stake in the solution and a clear path to deploying it if effective.

b) **Intelligent integrated systems** that directly support decision making and situation awareness by dynamically integrating, correlating, fusing and analysing extremely large volumes of disparate data resources and streams. This includes (but is not restricted to) recognising complex events and patterns that are today difficult or impossible to detect, aggregating and mediating opinions or predictions, offering alternative conceptualisations, guaranteeing timeliness, completeness and correctness, integrating categorical and statistical analyses. Visual Analytics should equally integrate data analysis and visualization. The effectiveness of such solutions will be evaluated against the concrete requirements of relevant professionals and communities and tested on appropriately- sized user groups and extremely large data resources from the respective domains (including, but not limited to, finance, engineering, government, geospace, transport, urban management).

c) **Framework and tools for benchmarking and exploring information management diversity** and comparing and optimising the performance of non mainstream data management architectures and computing paradigms, novel data structures and algorithms on extremely large volumes of data. While methodological rigour and scientific quality

and novelty are the main criteria for success, preference will be given to proposals that address a clearly identified industrial, scientific or societal concern or opportunity and/or bring together hitherto unrelated scientific or software engineering communities.

d) **Targeted competition framework speeding up progress towards large scale information management systems of global relevance**. The framework will be required to: identify a well justified industrial, scientific or societal objective that cannot be attained with the best performing current information management solutions; define detailed experimental conditions under which quantitative progress towards the objective can be reliably observed; implement a fair testing framework inclusive of data resources realistic in size and nature and capable of supporting large numbers of entrants; broadly advertise the competition; administer several testing rounds and publish the outcome of the competition with an appropriate analysis of performance issues and trends.

e) **Community building networks** and other initiatives designed to link technology suppliers, integrators and leading user organisations. These actions will disseminate results and best practices and address barriers hindering a wider deployment of research results, work towards establishing or advancing widely recognised standards and benchmarks and increase awareness of the potential of the technologies within broader audiences.

Expected Impact

- Reinforced ability for a wide range of innovators to tap data infrastructures and to add value beyond the original purpose of the data through data analysis.
- Reinforced ability to find, reuse and exploit data resources (collections, software components) created in one environment in very different, distant and unforeseen contexts.
- Value creation through extensive data collection and analysis.
- Increased economic value of data resources or data analysis services through standards for validation, provenance, accountability, access and privacy control.
- New scientific investigations enabled by large, interconnected data resources and attending infrastructure.
- Increased efficiency of organisations and better management of societal challenges (emergencies, planning, ..) through more timely and better decision making..

Funding schemes

a) STREP

b) IP, STREP

c) STREP

d) SA

e) CA

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

6.5 Challenge 5: ICT for Health, Ageing Well, Inclusion and Governance

This challenge addresses advanced ICT research for sustainable high-quality healthcare, demographic ageing, social and economic inclusion, and the governance of our societies. The Challenge covers the following:

- PHS research that aims for disease management and also targets rehabilitation and treatment at the point of need with a focus on specific diseases.
- VPH research focused on more elaborate and reusable multi-scale models and a VPH information infrastructure of larger repositories. Preparatory actions will aim at a grand challenge on a "Digital Patient", being the integration of patient-specific models for better prediction and treatment of diseases.
- Patient Guidance Services (PGS) to enable patients' active participation in care processes. A special emphasis will be given to semantic interoperability to enable integration of patient information from multiple sources and locations and to ubiquitous and secure access to these personal health records.
- Research on ICT for Ageing Well focused on developing service and social robotics and highly intelligent environments in support of the ageing population. This is complementary to the AAL programme (applied research, focused on smaller-scale projects with 2-3 years to the market).
- Research on ICT for smart and personalised inclusion addressing advanced solutions to improve social and economic inclusion by means of inclusive design, accessible, personalisable and human-ICT interfaces, social computing and advanced solutions for learning and skills acquisition as well as Brain-Neural Computer Interfaces (BNCI).
- Research into ICT solutions for governance and policy modelling addressing ICT tools for trusted governance and policy impact analysis. This research should help deal with future scenarios involving even greater complexity and citizens' involvement, in particular addressing the needs of the younger generation.

Objective ICT-2011.5.1: Personal Health Systems (PHS)

Target Outcomes

a) **Personal Health Systems for remote management of diseases, treatment and rehabilitation,** outside hospitals and care centres. Research will support innovations at system level and at component level if required. Solutions will be based on closed-loop approaches and will integrate components into wearable, portable or implantable devices coupled with appropriate platforms and services. Emphasis will be placed on: (i) auto-adaptive, self-calibrating and energy-efficient modules with multi-sensing, advanced on-board processing, communication and actuation capabilities; (ii) accuracy of measurements as well as remote control and reliable operation of the devices/systems; (iii) context-aware, multi-parametric monitoring of health parameters, activity, lifestyle, ambient environment and operational parameters of the devices; (iv) analysis, interpretation and use of the multi-parametric data, in conjunction with established or newly created medical knowledge, for shared patient-doctor decision support systems; (v) clinical workflows, guidelines and patient pathways to support remote applications; and (vi) education and motivation of users.

Each project shall undertake high risk research addressing only one of the domains below.

a1) ***Neurodegenerative diseases:*** focusing on remote management and treatment of patients at the point of need, addressing also the needs of their carers. Heterogeneous data (e.g., genetic data, images, movement recordings, interaction and behavioural data) will be used for assessment of patients' health status. Depending on the disease addressed, proposed approaches may employ neural recording, neurostimulation and/or drug delivery systems.

a2) ***Rehabilitation of stroke and neurological conditions:*** providing patient services at home, with telesupervision by health professionals as and when required. Solutions may build on robotic and haptic technologies, wearable systems, implants, human-computer interfaces, web services or virtual reality environments to facilitate continuity of personalised cognitive and functional rehabilitation. Heterogeneous data (e.g., biofeedback, monitoring of limb movements, behavioural monitoring and analysis) and predictive models will be used to assess patient status and progress, monitor risk factors and predict new episodes.

a3) ***Liver failure:*** ICT-enabled artificial liver to facilitate detoxification as remote transient therapy at the point of need, offering continuous care from hospital to home settings.

All projects will adopt scenario-based design and will develop novel service models to support transferability of healthcare outside hospitals and care centres. The target group is only patients with diagnosed conditions (not healthy individuals). In addition to strong involvement of clinical users, projects will also engage experts in regulatory approval. Projects will address user acceptance, patient compliance, patient data security and confidentiality. They will also address interoperability issues related to heterogeneous data sources, devices and links with electronic health records; the use of standards and of any suitable open software platform is recommended. Validation will aim to demonstrate the proof of concept, efficiency gains and, if possible, cost effectiveness of the proposed solution. Validation should include comparison versus currently accepted gold standards and include quantitative indicators of the added value and potential impact of the proposed solutions.

b) **Intelligent systems for the analysis of multi-parametric data**. Projects will focus exclusively on analysing multi-parametric data in the context of Personal Health Systems used for prevention or remote management of clearly targeted diseases or co-morbidities. Multi-parametric data may include physiological measurements, genetic data, medical images, laboratory examinations and other measurements related to a person's activity, lifestyle and surrounding environment. The developed systems will process and interpret such data for accurate alerting and signalling of risks and for supporting healthcare professionals in their decision making. This may be either by (i) correlating the multi-parametric data with established biomedical knowledge to derive clinically relevant indicators and/or (ii) creating new medical knowledge for diagnosing worsening of conditions and prompting early intervention. Projects may use patient data already available in databases or from other research projects or pilots. Creation of new patient data with the use of previously developed and tested monitoring systems is also possible. Adaptation of existing monitoring systems is eligible, but the development of new monitoring systems is not in scope. Projects will pay attention to security and protection of patient data. Validation will aim to demonstrate, with quantitative indicators, the effectiveness and the medical and economic benefits.

c) **One Coordination and Support Action** to deliver roadmaps for research and support to wide use of mobile eHealth (mHealth) solutions for lifestyle and disease management. The roadmaps will address elements such as: technology options for applications and services; any need for dedicated radio frequency bands for continuous provision of care; risk management, user acceptance, security and privacy; any need for update of medical guidelines, including methodology to deliver new knowledge to medical professionals and patients; business cases; reimbursement; and mapping of future mHealth applications to the regulatory framework of medical devices. Relevant experiences in developing countries will be considered.

Expected Impact

For target outcomes a) and b):

- Reduced hospitalisation rate and improved disease management, treatment or rehabilitation at the point of need, through more precise assessment of health status.
- Strengthened evidence base on medical outcomes, economic benefits and effectiveness of the use of Personal Health Systems in evolved care models.
- Reinforced medical knowledge with respect to efficient management of diseases.
- Contribution to a more sustainable European healthcare system through provision of high quality, personalised care, with better use of the available healthcare resources.
- Reinforced leadership and innovation capability of the industry in the area of Personal Health Systems, medical devices and services through introduction of new business models, creation of spin-offs and better exploitation of intellectual property contributing to products, standards and regulation.

For target outcomes a) and c):

- Accelerated establishment of interoperability standards and of secure, seamless communication of health data between all involved partners, including patients.

For target outcome a) only:

- Participation of essential stakeholders in the production of end-to-end solutions for personalised care. Reinforced national or regional commitment in deployment of innovative services following participation in R&D projects.
- Improved links and interaction between patients and doctors facilitating more active participation of patients in care processes.

For target outcome c) only:

- Improved understanding of the technology options, business and regulatory aspects for both private sector-driven and publicly-funded mobile solutions for healthcare services.

Funding schemes

a): IP/STREP; b) STREP only; c): CSA

Indicative budget distribution[10]

IP/STREP: EUR 59.5 million with the objective to support at least 2 IPs under a) in addition to STREPs [23] ; and up to 2 STREPs under b).

CSA: EUR 0.5 million (Up to one CSA will be selected with maximum duration of 24 months).

Call

FP7-ICT-2011-7

[23] Area coverage has priority in the selection of proposals in a). Hence, selection will initially be made among the proposals which are ranked first in the three areas of a1), a2) and a3), in terms of their relative scores. Further selection from the remaining ranked proposals is in terms of their relative scores, respecting the minimum number of IPs for a).

Objective ICT-2011.5.2 Virtual Physiological Human

Target outcomes

a) **Patient-specific predictive computer-based models and simulation** of major diseases integrating medical, biological and environmental data. Preference will be given to proposals that manage to explore the interaction and integration of environmental factors with medical and biological factors enabling the development of predictive models and simulation for understanding the evolution and progression of major diseases. These predictive models will allow bio-medical researchers to investigate the influence of environmental factors on major diseases and their interactions with other health factors. The use and benefits of the resulting models must be demonstrated for a specific clinical need covering the onset and the evolution of the disease. All major diseases could be targeted as clinical application.

b) **Development of ICT tools, services and infrastructure to obtain more elaborate and reusable multi-scale models** (e.g. models of diseases, organs) **and larger repositories** to show benefits of having both the data and models readily available. Projects should address at least one of the following activities: i) the robustness and reproducibility which are essential to allow models to be re-used when a model representing a physiological function is incorporated into a more comprehensive model. Standards for models and data, tools and repositories should be developed to achieve a high level of robustness and reproducibility of models for re-use; ii) the development of VPH Infostructure including a sustainable VPH model and data repositories. Appropriate tools (e.g. version control, archiving, upgrades…) and attributes such as usability and accessibility should be particularly addressed to ensure VPH community acceptance. The use of open environments and open-source software is expected to improve the accessibly and evolution of the repositories.

c) **One Coordination and Support Action** to develop an RTD roadmap preparing the ground for a future grand challenge on a "Digital Patient". The "Digital Patient" is a digital representation of the integration of the different patients-specific models for better prediction and treatment of diseases in order to provide patients with an affordable, personalised and predictive care. A road-map should be developed i) to consolidate the research so far, ii) to capture and quantify the needs and iii) to develop a vision and a sound ICT research agenda around the "Digital Patient

d) **Early demonstrators and proof of concept of digital representations of health status** of patients integrating different patient-specific data and models of organs into a more coherent representation of a "Digital Patient". Innovative digital representations of the health status of patients based on relevant data and models (medical, anatomical, physiological and genetic, etc) , are visualised and represented in 4D models and usable for care, personalized prevention and research.

Expected Impact

- More predictive, individualised, effective and safer healthcare.
- Reinforced leadership of European industry and strengthened multidisciplinary research excellence in supporting innovative medical care.

For a)

- Accelerated developments of medical knowledge discovery and management in particular through the exploration of environmental factors in predictive models of diseases.

For b)

- Improved interoperability of biomedical information and knowledge.

- Increased acceptance and use of realistic and validated models that allow researchers from different disciplines to exploit, share resources and develop new knowledge.
- Accessibility to existing knowledge by bio-medical researchers through the VPH repositories linking data with models will prove the large scale benefits of having both the data and models readily available.

For c)

- Availability of a common strategic research agenda on the "Digital Patient" between all relevant stakeholders.

For d)

- Proven concepts of digital representations of patient health status.

Funding schemes

a-b): IP/STREP; c) CSA d): STREP

Indicative budget distribution[10]

- IP/STREP in a) and b): See footnote[10]
- CSA: EUR 1.5 million. Up to one CSA will be selected.
- STREP in d): See footnote[10]

A maximum of EUR 3 million will be reserved for third country participants from USA, Japan, Canada, Australia, New Zealand.

Call

c): FP7-ICT-2011-7;

a), b) and d): FP7-ICT-2011-9

Objective ICT-2011.5.3 Patient Guidance Services (PGS), safety and healthcare record information reuse

Target outcomes

Projects are expected to address one of the following 2 application areas:

a) **Patient guidance services (PGS) for personalised management of health status.** The aim is to enhance the engagement of patients in care and disease prevention and improve health outcomes and patient satisfaction. The work focuses on semantic integration of patient health data into a personal health record system (PHR) that is ubiquitously and securely accessible by patients and their physicians and includes an environment for their cooperation. The users of the PGS will be primarily patients and the carers and healthcare professionals they authorise. The services to be supported will be identified in close cooperation with clinicians, patients and their carers and social services. Examples of services include shared decision support to treatment compliance; safety alerts and reporting; evidence based information and patient networking.

The PGS will interoperate with state-of-art wearable or portable, auto-adaptive, self-calibrating systems for health status monitoring and diagnosis. They take into account (i) the operation and acquisition of physiological data in non-clinically controlled environments and (ii) the variability in the population by adjusting clinical parameters and their thresholds to the individual's conditions. They will incorporate available modelling and predictive algorithms

to analyse patterns in behaviour or recorded data and to enable the shared patient-doctor decision support systems. The PGS will be capable of integrating the latest available medical knowledge and adapting to changes in it.

The personal health record systems will interoperate with heterogeneous and fragmented healthcare information systems. Security and privacy protection issues should be addressed.

b) **Tools and environments enabling the re-use of electronic health records.**
Development of an advanced environment for clinical research that enables seamless, secure and consistent integration or linking of clinical care information in electronic health records (EHR/PHR) with information in clinical trial systems. Results are expected to help health professionals avoid double data entry, assist in identification of patients for clinical trials and enable early detection of potential patient safety issues. Research will focus on the areas of improving semantic interoperability between EHR and clinical research systems. This will include the definition and validation of core data sets that enable scalable and standardised linking with EHR repositories. Proposals will address data protection and security needs and be fully compliant with all applicable legislation as well as best practice. Research results should be validated in use cases with a high potential for improving patient safety in the clinical research and epidemiology fields.

A significant part of proposals a) and b) will address semantic interoperability. Resources are to be targeted to use and complete the common shared info-structure (terminologies, health care record structures, and medical logic representations) that will be established by the PCP under the governance of the Network of Excellence described below**.**

c) **A Network of Excellence on semantic interoperability and European Health Infostructure.**
The aim is to engage leaders and organisations, including professional organisations, national competence centres, industrial associations and standards development organisations to define and implement a research agenda on the semantic interoperability of health information systems and particularly electronic health records. European and international organisations in the domains of medical terminology, record architecture, medical logic and workflow are expected to participate. The work will also include set up of the governance of a European virtual organisation for multilingual, multicultural adaptation of international classifications and terminology and propose means for the sustainability and governance of health information info-structure.

d) **Innovative services for patients and health professionals developed and validated against public sector needs through a joint Pre-Commercial Procurement** (PCP). The services should be based on mobile access to existing regional or national patient portals, personal health records systems or other systems and applications using patients' health information. It will improve the quality and efficiency of existing health care services by supporting mobility of patients, enabling secure and fast access anywhere in the EU to an individual's health data such as medication, emergency data and examinations using mobile devices.

Examples of services include communication between health services and patients at the point of need (e.g., scheduling appointments, alerts, emergency admissions, prescriptions abroad, interaction with pharmacists, feedback to carers about the changes in condition of the patient) as well as support to chronic disease management and lifestyle choices. Preference will be given to projects that include the display of patients' information on mobile or other devices in different languages so that patients can share their medical information with physicians in another country. Use of open standards and open source is encouraged. Applicable legislation, specifically Medical Device legislation covering certification, will be complied with. PCP shall be implemented according to the conditions outlined in objective 11.1 and Appendix 6.

Expected Impact

For target outcome a), b), c) and d):

- Common platform for a wide range of ICT-based healthcare services.
- Improve sustainability of Healthcare services by enabling better use of resources.
- Increased international competitiveness of European Healthcare Information Services and Software industry.
- Guidance on healthcare information systems issues in "green field" member states.
- Accelerated establishment of interoperability standards and of secure, seamless communication of health data between all involved partners, including patients.
- Wide-scale epidemiology based on Europe-wide Healthcare information system.

For target outcome a), c) and d):

- Better medical expertise access in remote areas, via improved decision-support systems.
- Support for patient mobility and patient safety through PHR accessed throughout Europe.
- Improved disease management and treatment through provision of personalised services.
- Reinforced participation of patients in care processes and health management.

For target outcomes b), c) and d):

- Faster medication innovation and lower costs through a more efficient research process.

For target outcome d) only:

- Wider access for patients to public health information data portals using mobile platforms.
- Standard mobile solutions for future implementations of closed loop applications.

Funding schemes

a-b): IP/STREP; c): NoE; d): CP-CSA

Indicative budget distribution[10]

IP/STREP: EUR 29 million with the objective to support at least one IP in a) and at least one IP in b)

NoE: EUR 3 million

CP-CSA: 3 million

Call

FP7-ICT-2011-7

Objective ICT-2011.5.4 ICT for Ageing and Wellbeing

Target Outcomes

a) **Service and social robotics systems for "Ageing Well":** The work should focus on integration of advanced robotics systems and intelligent environments to provide solutions to key issues of relevance for improved independent living and quality of life of elderly people and efficiency of care. Major challenges to be addressed include: self-learning robotics solutions, which can: adapt to the user needs and share contextual information with other artefacts in the surroundings of the user; navigate in unstructured environments

and perform precise manipulation of relevant objects; provide affective and empathetic user-robotic interaction, taking into account the acceptance by users. Development of basic robotics components is not called for.

b) **Smart and self-adaptive environments prolonging independent living**: Focus is on flexible ICT solutions able to provide early detection and adaptive support to changing individual needs related to ageing (e.g. increased risk of falls, depression, sleep deprivation, or cognitive decline), and support timely involvement of carers and family. The aim is to promote better prediction, prevention and support through long-term trend analysis of basic daily behavioural and physiological data, building on unobtrusive sensing and advanced reasoning with humans-in-the-loop. Major challenges to be addressed include: self-learning solutions building on open platforms, which can share contextual information with other artefacts in the surroundings of the user; low maintenance systems capable of graceful degradation in case of failure as well as affective and empathetic user interaction, taking into account the capabilities of elderly users.

c) **Coordination frameworks** to develop i) RTD roadmap and stakeholder coordination on ICT for "Ageing Well", as well as strengthening development of standards and international cooperation with North America and Asia. This should take into account work already started under the AALIANCE innovation platform (ref http://www.aaliance.eu). ii) RTD roadmap and stakeholder coordination on ICT for 'active ageing at work' establishing a sound ICT research analysis and exploration of possible ethical issues.

d) **Services for elderly people developed and validated against public sector needs through a joint Pre-Commercial Procurement** (PCP). The services should focus on enabling extended independent living of elderly people and support for higher efficiency and quality of care work based on robotics solutions. Examples of services include support to daily tasks, mediated social interaction with carers and relatives as well as support to mobility. Key stakeholders in the value chain of service provision should be involved, such as care service providers, insurance companies, housing organisations, relevant industry partners and public bodies. Involvement of users will be an essential element as well as appropriate consideration of safety and ethical aspects. Use of open robotics platforms and contribution to standards is encouraged. PCP shall be implemented according to the conditions outlined in objective 11.1 and Appendix 6.

Proposals addressing either a) or b) should have ambitious objectives at the level of a complete system and aim at breakthroughs. The proposed R&D should cover all relevant aspects to allow for operational validation including relevant service models, business models (also those with an active role of the elderly person), safety and reliability as well as ethical aspects. Participation of industry and service providers is important and it is essential that the work builds on and actively contributes to standards. A multi-disciplinary research approach is required. The work shall ensure involvement of elderly people, carers and other users in order to take account of the needs and acceptance of the target user groups and to ensure validation and impact analysis, by building on realistic test environments.

Expected impact

Novel "ageing well" concepts providing convincing indication of substantial efficiency gains[24] for care provision and augmented independence and quality of life for the ageing population.

- Improved competitiveness of EU industry through proven feasibility and impact to move the results into downstream RTD or innovation.
- Strengthened potential for Europe to become a global leader in the field of ICT and "ageing well", including development of global interoperability standards in the field.

For objective 5.4.a)

- Strengthened global position of European industry in service robotics for "ageing well" as well as significantly advanced state of the art in the field.

For objective 5.4.b)

- Proven concepts for early detection of ageing-related risks, substantial reduction in costs through standardisation and increased quality of life.

For objective 5.4.c)

- Reinforced consensus, common strategic visions and RTD roadmaps shared by relevant key stakeholders in Europe and beyond in ICT for "ageing well" and ICT for "active ageing at work".

For objective 5.4.d)

Effective cooperation and longer-term research-deployment linkage securing the sustainable implementation in real-life of innovation in robotics solutions for ageing well, with substantial improvements in care productivity and elderly quality-of-life

Funding schemes

a): One IP and STREPS; b): STREPs; c): 2 CSAs; d) 1 CP-CSA

Indicative budget distribution[10]

EUR 37 million with indicative targets of a) EUR 18 million; b) EUR 14.5 million; c) EUR 1.5 million of which i) EUR 1 million, ii) EUR 0.5 million d) EUR 3 million.

Call

FP7-ICT-2011-7

Objective ICT-2011.5.5 ICT for smart and personalised inclusion

Target Outcome

a) **ICT tools, infrastructures and devices for mainstream accessibility in daily life:** The objective is to support seamlessly accessible solutions and services for persons with disabilities, in various and changing settings (e.g. home, workplace, public transport, shops, education or medical centres, other public spaces, both indoors and outdoors). The research projects should focus on one or more of: 1) Virtual reality and simulation

[24] User oriented research approach will validate socio-economic impacts in the concrete application areas. E.g. for robotics the measure is to demonstrate that robotics assistance can be a cost-effective alternative to institutionalised care while improving quality of life.

approaches for developers to design daily life environments and explore potential user interactions building on previous work on 'virtual user'; and prototypes for ambient intelligence multimedia infrastructure (supported by networked sensors, terminals, etc) interacting with users' interoperable and portable IT devices; 2) Personalisable software-based assistive solutions supported through online/cloud-based platforms. This research should address generic and open solutions responsive to user physical, cognitive and mental capacities, preferences, and the ICT already available to the user. .

b) **Intelligent and social computing for social interaction, user empowerment and learning or skills acquisition for people at risk of exclusion**: Advanced ICT-enabled solutions -including social, affective and persuasive computing, and possibly serious games - for the empowerment of people with disabilities or people at risk of social exclusion, including people with low literacy, cognitively or mentally challenged, or with anti-social behaviour, which may include young people. This will aim at self-learning ICT solutions which take into consideration user profiling and feedback, in view to deliver personalised services and enhanced participation in work, education or training, social interaction, etc. Special attention will be paid to information representation, information appropriation and learning by users, and social dynamics, considering also intermediaries supporting final users.

c) **Brain-Neural Computer Interfaces** (BNCI) for assisting people with disabilities: Building on previous research, the BNCI foci now are: adapting BNCI sensor technology for out-of-the-lab use, fusion of BNCI into multi-sensor and multi-modal interfaces solutions, and data/pattern analysis for interaction with ICT-enabled devices and applications. Modularisation, interoperability, and smart processing of BNCI/sensor inputs for increased efficiency (e.g. through predictive approaches) are expected to be key aspects. Work on interoperability of BNCI devices, in particular, should consider potential contribution to standardisation. Research should also explore possible synergies with mainstream application domains, e.g. in gaming, virtual reality or alternative user-to-ICT input in complex multi-task settings.

d) **Coordination and Support Actions** to develop: i) a cooperation framework with Latin America on ICT for skills and empowerment of disadvantaged social groups and local communities, and on ICT for improving personal autonomy of people at risk of exclusion. ii) a cooperation framework at European or international level for promoting the development of accessibility guidance for advanced technologies, services and contents (including evaluation methodologies), with special focus on the internet, and for setting research agendas on e-accessibility.

In a), b) and c) it is essential to thoroughly address user requirements relating to issues such as privacy and other ethical aspects, safety, security and trust, and identity management. It is also very important to involve final and intermediary users at all stages of the research (from design to validation) while, especially for b), facilitating active user participation in any step of the innovation process.

Projects will consider viable business models and applications with high potential and measurable impact on individual quality of life and/or on society at large. Strong involvement of service providers (whether from commercial or public sectors) and other industry is expected. The projects should take account of existing standards and aim at their further development.

Projects should include comprehensive expertise while avoiding an excessive number of partners.

Expected impact

For a) and b)

- Significant progress on accessibility of ICT, advance human-machine interaction and intelligent computing by strong involvement of final and intermediary users.
- Increased user ability, notably of persons with disabilities, to carry out daily life activities and to interact with ICT.
- Improved competitiveness of Europe mainstream ICT industry, including through appropriate pre-standardisation.
- Higher levels of user empowerment and richer social interactions through personalised web-based assistive and social computing solutions.

For c)

- More advanced proof of concept of BNCI technologies and reinforced perspectives for mainstream exploitation.
- Augmented human capabilities through wider use of BNCI.

For objective 5.5.d)

- Reinforced international cooperation on ICT to support social inclusion and development.
- Common strategic visions and RTD roadmaps between relevant key stakeholders in ICT accessibility.

Funding schemes

a): IP (up to 3 IPs); b): IP/STREP (up to 1 IP and STREPs); c): IP/STREP (up to 1 IP and STREPs); d): At least one CSA for each area

Indicative budget distribution[10]

IP/STREP: EUR 33 million with indicative targets of a) EUR 15 million; b) EUR 9 million; c) EUR 9 million

CSA: EUR 2 million

Call

FP7-ICT-2011-7

Objective ICT-2011.5.6 ICT solutions for governance and policy modelling

Target Outcomes

a) ICT solutions for governance and policy modelling: Research will focus on the development of advanced ICT tools for policy modeling, prediction of policy impacts, development of new governance models and collaborative solving of complex societal problems.

This research will result in innovative ICT solutions (including open source solutions) that enable one or more of the following:

- Modelling new policy initiatives taking into account all relevant parameters.
- Performing societal simulations to forecast potential impacts of proposed policy measures.

- Development of tools that identify emerging societal trends as a result of the economic environment using innovative approaches such as non-classical economic modelling and reflexivity.
- Modelling and validating the next generation of public services as complex service systems, particularly taking into account the needs of the younger generation.

The work in this area should advance research in simulation and visualisation techniques, process modelling, gaming and mixed reality technologies while building on Web2.0/Web3.0, social networking, crowd-sourcing and dynamics methodology techniques. The resulting tools should exploit the vast reserves of Europe's public sector collective data and knowledge resources and should build on lessons learnt from complex systems modeling, including those at urban or regional scale..

Examples of fields of application can include, but are not limited to, urban planning policy, social and economic policies, life-long learning, mobility, demographics, recovery from the recent crisis etc, where the involvement of citizens through public consultations has been recognised as valuable. Stakeholders such as public administrations and policy institutes are expected to play a key role.

b) **Coordination and Support actions** should deliver: (i) an RTD roadmap to identify emerging technologies and potential applications at international level; (ii) an international network to promote cooperation of stakeholders working in these areas worldwide and encourage multidisciplinary constituency building. Participation of third countries is specifically encouraged for industrialised and emerging economies. Expectations are to fund one CSA under (i) with an indicative duration of 12 months, and one CSA under (ii) with an indicative duration of 24-36 months.

Expected Impact

- Improved prediction of impacts of policy measures leading to more efficient implementation of government policies and better identification of the benefits and consequences for citizens and businesses.
- Increased engagement of citizens and wider use of ICT tools resulting in higher potential of innovation concerning interaction of citizens with the government.
- Improved transparency of information related to the impact of economic decisions on society; improved capacity to react to the main societal challenges and increased trust of stakeholders and the public at large in governance**.**
- Strengthened competitive position of European industry (including SMEs) in cooperation platforms, modelling, simulation and visualisation tools as well as increased potential for wider use of those tools beyond EU level.

Funding schemes

a): IP, STREP; b): CSA

Indicative budget distribution[10]

- IP: EUR 7 million (maximum one IP)
- STREPs: EUR 17 million
- CSAs: EUR 1 million

Call

FP7-ICT-2011-7

6.6 Challenge 6: ICT for a low carbon economy

This Challenge explores how ICT can contribute to delivering a sustainable, low carbon society and help progress towards the Europe 2020 targets on climate and energy. ICT can assist in reshaping the demand side of our energy-dependant society, reducing energy consumption, and subsequently CO_2 emissions, in particular in electricity distribution, buildings and construction, transport and logistics, the public sector, rural areas and cities. The Challenge focuses on the following:

- Future electricity distribution grids applying seamless communications systems to increase the connectivity, management, automation and coordination between suppliers (including renewable sources), consumers and networks;
- Energy efficient design and decision support tools optimizing the energy performance during systems development and operation (e.g. modelling, simulation and planning, enterprise management systems, data centres);
- Water management, including demand-side management, integrated water resource management frameworks and comprehensive decision support systems;
- Energy-efficient buildings, neighbourhoods as well as urban and rural areas improving the buildings construction cycle, improving the use of energy beyond buildings, advancing complex urban systems, and optimising the dynamics of energy supply and demand in neighbourhoods and extended urban and rural communities. This research will contribute to the Energy-Efficient Buildings Public-Private-Partnership launched in 2008 as part of the European Economic Recovery Plan;
- ICT for low-carbon multi-modal freight and logistics covering technologies and services for multi-modal freight and logistics as well as ICT for clean and efficient multi-modal mobility for further improving energy efficiency and reducing CO_2 emissions in all modes of transport for passengers and goods;
- Cooperative Systems for low-carbon multi-modal mobility covering cooperative applications and services for energy efficiency and eco-friendly mobility as well as a European Wide Service Platform (EWSP) for services leveraging those cooperative systems;
- ICT for fully electric vehicles advancing the development and integration of major building blocks of the Full Electric Vehicle (FEV), and integrating the FEV with infrastructures. Projects supported under this objective will contribute to the European Green Cars Initiative, a Public-Private-Partnership launched in 2008 as part of the European Economic Recovery Plan.

Objective ICT-2011.6.1 Smart Energy Grids

The integration of local renewable energy sources represents a key technical challenge. The successful combination of smart processes (e.g. demand side/response management, real-time consumption management) and smart technologies (e.g. smart meters, intelligent home energy management devices) will enable energy efficiency and savings to be achieved.

Targeted Outcome:

Intelligent systems and integrated communication infrastructure that can assist in the management of the electricity distribution grids in an optimized, controlled and secure manner.

Key research challenges to be addressed:

a) Strengthening the distribution grid by providing control systems, management and decision support tools that enable the integration of renewable energy sources, both large scale production (e.g. wind and solar farms) and massively distributed production (e.g. residential and tertiary buildings).

b) Advancing security and reliability, as well as protection of equipment, fault detection and alert, and self-healing through development of the necessary high power electronics.

c) Data management infrastructures to allow electricity production and consumption to be measured, reported and controlled (and eventually credited or billed).

d) Home energy controlling hubs that will collect real-time or near real-time data on energy consumption data from smart household appliances and enable intelligent automation.

e) Building consensus on industry-driven open standards to ensure the interoperability of smart grids control and management systems.

Projects should focus on one or a combination of the previous points.

Consortia must be compact with partners each making substantial contributions.

In all cases, projects shall include an appropriate validation phase to draw conclusions for future deployment.

Expected Impact:

- Connection and operation of distributed and intermittent generators of diverse technologies enabled by ICT.
- Demand side and demand response management enabled by innovative decision support systems.
- Producers and consumers allowed to play a novel role in the management of their energy consumption.
- Quantifiable and significant reductions of energy consumption in the electricity distribution grid, leading to reduction of the overall environmental impact of electricity grids.
- Enhanced levels of reliability and security of electricity supply.
- For e), reinforced collaboration between the European electricity suppliers and distributors, energy equipment manufacturers of all sizes, and the ICT sector.

Funding schemes

a), b), c) and d): STREP

e): CSA

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

Objective ICT-2011.6.2 ICT systems for energy efficiency

ICT systems are becoming essential for energy-efficient design, decision support tools and systems to optimize the energy performance of operations (e.g. in enterprise management systems, in data centres). New levels of innovation and quantifiable benefits will require partnerships between process engineering specialists, software companies and standardisation experts as well as specific user communities.

Target Outcomes

a) Tools to optimize energy performance for planning, systems development and operation.

Definition of energy profiles and energy consumption patterns and their interrelations to support the development of ICT building blocks addressing energy efficiency and CO_2 emissions reduction. Incorporation of these building blocks into one of the following types of systems:

- Systems to support development and planning. Examples are: modelling, simulation and design tools to assess the full life-cycle energy associated with new products and systems before their realisation; decision support systems for urban planning to provide an understanding of the systems implications, in terms of energy-performance and cost-effectiveness, of different design and planning alternatives.
- Systems to optimise the energy-performance of operations. Examples are: enterprise management systems to implement energy savings and emissions trading across industries; system-oriented schemes for data-centre management that consider in addition to high efficiency power distribution architectures and ultra-high efficiency power supplies, also cooling, energy re-use for space heating, incorporation of renewable energy sources and connection with the electricity grid.

Appropriate validation of the resulting systems. Based on defined indicators, during this phase, projects shall record evidence of energy savings and CO_2 emissions reductions, total cost of operations versus potential benefits, user acceptance and replication potential and extract lessons that may be used in different settings.

b) To support the "Green Digital Charter"[25] based on the Commission Recommendation[26] on "mobilising ICT to facilitate the transition to an energy-efficient, low-carbon economy", Coordination and Support Action to enlarge the number of signatory cities, to develop common approaches, to identify and exchange best practices, including metrics and indicators, as well as coordination with similar initiatives, dissemination and public events. It shall also explore how best to link the Charter to other initiatives such as the Covenant of Mayors[27].

Consortia must be compact with partners each making substantial contributions.

In addition to partners with expertise in ICT, consortia must include partners from the relevant application domain. The final users must be involved in the validation phase but not necessarily as consortium partners.

Expected Impact

- Verifiable and transparent methods of measuring energy performance.

[25] http://ec.europa.eu/information_society/events/ict4ee/2010/charter/index_en.htm
[26] C(2009) 7604
[27] http://www.eumayors.eu/

- Strengthened and consolidated European excellence in engineering at the intersection of control engineering, computer science, communications technologies and power engineering.
- Quantifiable and significant reduction of energy consumption and CO_2 emissions, achieved through ICT.

Funding schemes

a) STREPs

b) CSA

Indicative budget distribution[10]

a) EUR 34 million

b) EUR 1 million

Call

FP7-ICT-2011-7

Objective ICT-2011.6.3 ICT for efficient water resources management

Water management enabled by ICT is a new and promising area with the objective to integrate real-time knowledge on demand and supply across water distribution networks and water sources. The work to be done calls for partnerships between ICT equipment providers, software companies and water authorities.

Targeted outcomes:

ICT-enabled solutions for integrated water resources management (IWRM), involving as key building blocks: innovative demand management systems, decision support systems and data management technologies.

The proposed ICT solutions shall involve robust and proven technologies permitting a holistic approach towards IWRM, and possibly include new data management technologies with real-time predictive capability demand forecasting, advanced metering, real-time communication of consumption patterns, adaptive pricing, and/or combined energy and water management schemes.

Projects should cover (i) research and innovative integration of solutions, (ii) substantial validation of these in at least two real-life operational environments in collaboration with responsible water authorities and utilities, and (iii) evaluation of their anticipated cost and benefits and market prospects.

Consortia must be compact with partners each making substantial contributions.

Expected impact:

- New partnerships between European water distributors, water management equipment suppliers and the ICT sector.
- Enhanced supervision of water networks leading to better management of supply and flows, and quantifiable water consumption reduction.

Funding schemes:

STREPs

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

Objective EEB-ICT-2011.6.4 ICT for energy-efficient buildings and spaces of public use

Achieving more energy-efficient buildings, neighbourhoods and urban areas will require further work on the buildings construction cycle, supported by partnerships between process engineering specialists, software companies, ICT equipment providers, and buildings and construction companies. Advances in complex urban systems calls for partnerships between some or all of process engineering specialists, software companies, RES (Renewable Energy Systems) providers, ICT equipment providers, buildings and construction companies, utilities companies, public authorities (planners).

Target Outcomes

a) Building Energy Management Systems integrating in a single system different energy efficient production/consumption sub-systems, such as renewable energy sources, solid state lighting, heat transfer, blind control, phase change materials, energy harvesting facades or electric vehicles deployed in spaces of public use. These systems shall be based on advanced control algorithms capable of learning from previous operations and situations, and load-balancing in near-real time.

Interoperation of these systems with other ICT-based sub-systems (e.g. for security, safety, comfort) will be considered an asset.

The proposed system shall cover in an integrated way the inside of buildings as well as the exterior and surrounding space. Examples of such spaces may include: a motorway service area, a football stadium with its surrounding parking space, a university campus, a shopping mall.

In addition to systems integration, proposals shall include a substantial validation phase focussing on the operation of the building(s) and surrounding space in real user conditions. During this phase, proposals shall record evidence of energy savings, total cost of operation, scalability of the solutions, and benefits that accrue, and extract lessons for those planning to deploy and finance such systems. Consortia must be compact with partners each making substantial contributions.

b) Coordination and Support Actions: Bringing together relevant stakeholders including process engineering specialists, ICT software and equipment providers, RES providers, energy companies (including ESCOs - Energy Service Companies), building and construction sector companies, as well as local and regional authorities, to:

- Extend the notion of energy-positive performance from homes and buildings to large areas including neighbourhoods and extended urban/rural communities in a holistic dimension;
- Analyse the relationship between producers, distribution companies and consumers of energy, new business models, opportunities for SMEs, and identify best practices and opportunities for knowledge transfer;
- Identify ICT standards related to the building and construction domain, and analyse their relevance and possible evolution;

- Support the establishment of European-scale actions spanning research, innovation, standards-setting and deployment of ICT infrastructures for energy-positive neighbourhoods"[28].

The tasks shall include drafting and up-dating public documents, organising expert's hearings and workshops, dissemination and networking events.

Expected Impact

- Contribution to the opening up of markets for novel ICT-based customized solutions for buildings operation and maintenance, integrating numerous products from different vendors.
- Quantifiable and significant reduction of energy consumption and CO_2 emissions achieved through ICT[29]
- Establishment of a collaboration framework between the ICT sector, the buildings and construction sector, and the energy sector.
- Identification of areas where standardisation work is required.

Funding schemes

a) STREP; b) CSA

Indicative budget distribution[10]

STREP: EUR 19 million

CSA: EUR 1 million

Call

FP7-2011-NMP-ENV-ENERGY-ICT-EeB

Objective EEB-ICT-2011.6.5 ICT for energy-positive neighbourhoods

Target Outcomes

Projects supported under this objective shall contribute to the European Energy-Efficient Buildings Initiative by developing management and control systems, and decision-support systems addressing the dynamics of energy supply and demand in neighbourhoods and extended urban/rural communities. These systems shall optimise the use of energy beyond the buildings (considering for instance street lighting, urban heat production, electrical vehicles), and they shall include the integration of renewable energy sources and the connection to the electricity distribution grid in order to take advantage of variable tariffs and diversity of supply.

In addition to technical developments, projects shall consider appropriate business models, how to split incentives, and engage end users and public authorities to deploying such systems.

Interoperation of these systems with other ICT-based systems (e.g. traffic management systems, Geographical Information Systems) that may be deployed in the area will be considered an asset.

[28] http://ec.europa.eu/information_society/activities/sustainable_growth/docs/elsa/elsa_report/ELSA-EnergyPositive-Report1.pdf
[29] COM(2009) 111

In addition to systems integration, proposals shall include a substantial validation phase. During this phase, projects shall record evidence of the benefits and total cost of operation, as well as the potential for scaling up solutions, for potential users.

Consortia must be compact with partners each making substantial contributions.

Expected Impact

- Contribution to the opening of a market for ICT-based district/community energy management systems.
- Establishment of a collaboration framework between the ICT sector, the buildings and construction sector, and the energy sector.
- Quantifiable and significant reduction of energy consumption and CO_2 emissions achieved through ICT.

Funding schemes

STREP

Indicative budget distribution[10]

Call

FP7-2012-NMP-ENV-ENERGY-ICT-EeB

Objective ICT-2011.6.6 Low carbon multi-modal mobility and freight transport

Target Outcome

a) **ICT for low-carbon multi-modal freight and logistics** covering technologies and services for multi-modal freight and logistics, and using new technologies such as RFID, wireless sensor networks and common platforms and architectures. The focus is on:

- Integration of different transport modes (road, rail, air and sea transport), following Europe's transport policy principle of co-modality, in particular between road transport and other modes
- Intermodal interoperable logistics management and tracking systems and Intelligent Cargo systems which support the decarbonisation of transport by providing real-time process and status information on cargo and its movements to users, for increased transport efficiency and timeliness and the integration of the intelligent cargo systems into the multi-modal transport data infrastructures.

b) **ICT for clean and efficient multi-modal mobility** for further improving energy efficiency and reducing CO_2 emissions in all modes of transport for passengers and goods:

- New tools, systems and services supporting energy-efficient driving and driver behaviour adaptation
- Environmentally aware route and access planning, intelligent road infrastructures, definition of digital map attributes for eco-routing and advanced multi-modal travel and traffic advice and information systems for individual and collective transport
- Methodologies for assessing the impact of advanced ICT in energy efficiency and CO_2 reduction, and in instantaneous emission models which take into account driver behaviour.

c) **Coordination and Support Actions**

- In the framework of the Intelligent Car Initiative, support to the eSafety Forum activities such as stakeholder consultations, road mapping and organising events and dissemination.

- Support to research agendas for energy efficiency, international cooperation, user awareness raising and dissemination of research results, international standardisation and harmonisation.

- Support the establishment of European large scale actions spanning research, innovation and deployment of service infrastructures for sustainable mobility and transport.

The Coordination and Support Actions should include relevant stakeholders in the domain.

Expected Impact

- Strengthened position of Europe's logistics and freight industries in the marketplace for low-carbon products and services
- Significant improvements in efficiency and environmental friendliness of mobility and transport in Europe; target: 25% reduction in GHG emissions in transport
- Full integration of intelligent cargo items into the multi-modal transport infrastructure, with special emphasis on urban multi-modal logistics
- Widening the market for new ICT-based mobility and transport services in Europe and worldwide.

Funding Schemes

a) and b): IP, STREP; c): CSA

Indicative budget distribution[10]

- IP, STREP: EUR 46 million, with a minimum of 50% to IPs and 30% to STREPs
- CSA: EUR 4 million

Call

FP7-ICT-2011-7

Objective ICT-2011.6.7 Cooperative Systems for energy efficient and sustainable mobility

Target Outcome

a) **Cooperative Systems for low-carbon multi-modal mobility** covering cooperative applications and services for energy efficiency and eco-friendly mobility based on the harmonised European Communications Architecture[30] and bidirectional vehicle-to-vehicle (V2V), road-to-vehicle (R2V) and vehicle-to-infrastructure (V2I) communication technologies:

- Design, development and testing of new cooperative and pro-active traffic and travel management and control strategies based on the availability of reliable real-time system-wide data, including handling of special events and recovery after incidents.

[30] Baseline European ITS communications architecture for cooperative systems developed under the EU funded specific support action COMeSafety, see http://www.comesafety.org/

- Addressing the interaction between the driver, the vehicle and the infrastructure, user acceptance and deployment of cooperative energy efficiency services, taking into account the needs of Fully Electric Vehicles such as integration with charging networks.

  Liability, privacy, reliability, security and Human Machine Interaction should be addressed as well. The focus should be on road transport, as this sector presents the largest challenges. Projects could also address all transport modes according to the principle of co-modality, and include smart urban mobility.

b) **European Wide Service Platform (EWSP) for cooperative system enabled services**, aiming at providing to the drivers and other users a large variety of energy efficiency, mobility, comfort and safety related services:

- Intelligent combination of wireless communication technologies, development of network and transport communication protocols and security and control mechanisms, and support to their standardisation.
- Development of the necessary EWSP subsystems for service development, discovery, provision and administrative operations
- Development of interoperable innovative services for the EWSP, based on Future Internet technologies and in coordination with activities under the Future Internet PPP of Challenge 1.

c) **Coordination and support actions**

- Dissemination of results, user awareness campaigns, assessments of socio-economic impact and training.
- In accordance with the specific cooperation agreements with Japan and the USA: active exchange of information and results, and international standardisation and harmonisation.

  The coordination and support actions should include relevant stakeholders in the domain.

Expected Impact

- Decarbonisation of transport. Significant improvements in energy efficiency and environmental friendliness of transport and mobility in Europe
- Improving the competitiveness of the European transport industry as a whole, and enabling them to continue to address global markets successfully. World leadership of Europe's automotive industry in the area of Cooperative Systems.
- Opening new markets for mobility, safety, energy efficiency and comfort services in Europe. Ensuring market leadership by Europe's industry in green products and services.

Funding Schemes

a) and b): IPs, STREPs; c): CSA

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

Objective GC-ICT-2011.6.8 ICT for fully electric vehicles

Full electric vehicles (FEV) means electrically propelled vehicles that provide significant driving range on pure battery based power. It includes vehicles having an on-board fuel based electrical generator (Range Extender based on Internal Combustion Engine or fuel cells).

Projects supported under this objective should advance the research, development and integration of major building blocks of the FEV, and integrate the FEV with infrastructures.

Target outcomes:

a) **Energy/Power Storage Systems**, targeting control system solutions for batteries only as well as batteries and super-capacitors integrated either at a pack-to-pack or at cell-to-cell level. Electronic architectures have to manage optimal charging and discharging rates of the cells in relation to their typology and operating temperatures. Sensors and networking capabilities should be developed for monitoring and controlling the energy/power storage system's efficiency, lifetime, reliability and safety, including monitoring and early warning of fault conditions environmental monitoring, temperature conditioning and shock protection/spark avoidance. Furthermore, high voltage switches and interconnects and system interfaces need to be developed. Electro-chemical material developments are excluded.

b) **Architectures for Energy, Communication and Thermal Management** Energy optimised systems are an essential element to ensure maximum FEV range. With a multiple voltage system, an optimised distribution of functions is necessary:: power-train, bilateral grid connection, on-board energy harvesting, heating and cooling conditioning systems, vehicle stability and comfort, lighting, driving assistance sensors, on board information and entertainment and other auxiliaries. Each layer requires its own optimisation and operated by real-time and fail-safe standard communication to assure the best compromise between safety, driving and comfort.

c) **Vehicle-to-grid Interface (V2G)**
Focus is on connection of the vehicle to the grid by enabling controlled flow of energy and power through safe, secure, energy efficient and convenient transfer of electricity and data. Related issues to consider include E/M compatibility, robustness, reliability, safety, security and impact on health and grid stability. Solutions should be independent of a specific platform, be based on pan-European consensus and conform to interface standards for Smart Grids.

d) **Vehicle Stability Control**

Focus is on control architectures with 2, 3 or 4 electrical motors for stability of the electric power train thus providing safety, comfort and fun-to-drive. Vehicle dynamics simulation and robust E/M compatibility have also to be addressed as well as generic and standardized, safe and redundant bus-based solutions for communication and control. Regenerative breaking, system faults like maximum torque / oscillating torque at a single wheel /two wheels and issues like controlled shut down procedures in case of a crash should be taken into account.

e) **Electric Drive and Electronic Components**

Partitioned and highly efficient power electronics devices, converter and inverter and electrical interconnects that simplify packaging and cooling, EMI-EMC designs, the management of high voltages, currents and temperatures and hardware-in-the-loop technology for algorithm and component testing. Projects should target the level of integration between the drive and the motor while maximising the efficiency of the drive over a wide range of operation of the motor as well as in relation to temperature excursions and voltage variability and fail safe tested components.

f) **Integration of the FEV in the cooperative transport infrastructure**

ICT-based interaction between the driver, the vehicle and the transport and energy infrastructures, for FEV trip planning and optimization including energy use and charging.

In order to compensate for the limited autonomy range, gains in energy efficiency, charging strategies and route optimisation by using of traffic information are needed to turn the FEV into a mass market product. Adaptive strategies, algorithms and operation modes are needed for the charge and discharge management of the FEV's that balance, predict the range and adapt to the energy needs of the user in respect of the properties of vehicle's battery and the grid. Research should also address opportunities for improving energy efficiency provided by automated driving and driver training.

g) **Functional Safety and Durability of the FEV**

Electrical and electronic components affect vehicle dynamics, safety and durability. Fail-safe concepts are an essential element of the system. Requirements and standards related to electromagnetic compatibility and health impacts of electromagnetic fields should be developed. Continuous improvements are expected against low frequency electromagnetic fields as well as on local sensing of currents and electromagnetic fields, on safe and robust components and subsystems. Research will also address adaptation and improvement of in-vehicle active safety for FEVs, integrated driver-vehicle – infrastructure safety, protection of vulnerable road users, and FEV emergency handling procedures. Moreover, test methods will be required.

h) **Coordination and Support Action "FEV made in Europe"**
One action for the coordination of a FEV Strategic Research Agenda for ICT, components and systems, for the clustering of R&D projects in the field, and for training, education and dissemination activities. The agenda should also investigate new usages for the FEV (e.g. last mile delivery and mobility for the elderly and disabled); it should cover standardisation measures; it should propose measures for harmonisation of national research policy measures and programmes, and also propose actions for international collaboration. The action should involve relevant electrical vehicle stakeholders.

Expected impacts:

- Improved energy efficiency and extended driving range of the FEV
- Reduced costs of the electronic components and the overall FEV at increased performance
- Mitigated constrains for the user of the FEV versus the Internal Combustion Engine vehicle
- The FEV seamlessly implemented in the smart grids and existing infrastructure
- Significant improvement of FEV's safety, comfort and new information and comfort services for FEV users.
- Strengthened global competitiveness of the European automobile, ICT and battery sectors. Market penetration of key components of FEVs.

Funding Schemes:

a, b, c, d) STREP in 2011

e, f, g) STREP in 2012

h) CSA in 2012

Indicative budget distribution[10]

a,b,c, d) EUR 30 million

e,f,g) See footnote[10]

h) See footnote[10]

Call

a,b,c,d) FP7-2011-ICT-GC

e,f,g,h) FP7-2012-ICT-GC

6.7 Challenge 7: ICT for the Enterprise and Manufacturing

The Factories of the Future (FoF) initiative is part of the European Economic Recovery Plan launched in November 2008 to respond to the global economic crisis. This Public-Private-Partnership (PPP) aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by improving the technological base of manufacturing across a broad range of sectors. The ICT contribution to this initiative aims at improving the efficiency, adaptability and sustainability of manufacturing systems as well as their better integration within business processes in an increasingly globalised industrial context. Challenge 7 is fully dedicated to supporting the FoF PPP.

The Challenge includes the areas:

- 'Smart factories' including application experiments of control and sensor-based systems, laser systems and industrial robots.
- 'Manufacturing solutions for new ICT products' addressing manufacturing processes for Organic Large Area Electronics (OLAEs) and organic photonics.
- 'Virtual factories and enterprises' addressing end-to-end integrated ICT allowing for innovation and higher management efficiency in networked operations and supporting the emergence of 'smarter' virtual factories and enterprises.
- 'Digital manufacturing' including products life cycle management, modelling, design and optimisation.

Research addressing this Challenge in particular will encourage international cooperation under the Intelligent Manufacturing Systems (IMS) scheme.

Objective FoF-ICT-2011.7.1 Smart Factories: Energy-aware, agile manufacturing and customisation

The capability to produce large varieties of sophisticated products requires manufacturing sites to be flexible, fast and reactive. Lean and easy-to-implement ICT enables those sites to be resource efficient, safe and cost effective.

Target outcomes:

a) **Demonstration and benchmarking of novel process automation and control (for discrete, continuous or batch industries):** Systems, strategies and tools for an integrated control and dynamic optimisation of factory assets. The challenge is to develop ICT driven approaches and scalable architectures (e.g. service-oriented architectures or other appropriate architectures) for next-generation production automation and control solutions with flexibility, autonomy, robustness and energy efficiency. Projects should address efficient aggregation of information across existing legacy systems[31] at all production levels, factory level optimisation of production processes, and include demonstrations in real industrial environments. The aim is to show the operational and economic benefits of new ICT-driven approaches in factories against today's process automation and control solutions.

b) **Large-scale validation of advanced industrial robotics systems** through user-friendly methods of interaction with, and tasking of, intelligent cooperative robotic systems (including new programming paradigms and direct physical interaction) and through robotics-enabled production processes. Research shall focus on methods that allow

[31] e.g. ERP, MES, SCADA, DCS

workers to productively and safely deploy robots without specialised training. Cooperation between human-robot and between robot-robot should aim to provide easy-to-access and personalised support for skilled or heavy duty tasks on the shop floor. Real-world validation of R&D shall demonstrate its large-scale applicability to flexible, small batch and craft manufacturing. Results should contribute to future benchmarking standards.

c) **Applications based on factory-wide networks of intelligent sensors and new metrology tools and methods**, demonstrating management of manufacturing information in real time and under harsh conditions, including planning, scheduling and dispatching. R&D should in particular address modularity, reliability/accuracy, safety and energy efficiency aspects of quality control systems and automation/handling equipment supporting discrete manufacturing down to lot sizes of 1. Results should support international standardisation.

d) **Lasers and laser systems for manufacturing and materials processing** with the following focus: i) High-brilliance active fibre and diode lasers (laser arrays) with nearly diffraction limited beam quality: simultaneous targets are multi kW continuous wave output power, efficiency of 40% or more, coupling into small diameter fibres (100µm or less for fibre lasers and 300µm or less for diode lasers); ii) New wavelengths and on-line adaptation of beam properties: novel lasers and laser systems opening-up new process windows and/or contributing to optimised process efficiencies. This includes widely tuneable lasers, ultra-short pulse lasers, versatile frequency conversion systems and photonic components enabling the on-line adaptation of essential beam parameters in order to produce stable beams of sufficient power and quality for the intended process.

Projects are expected to be industry-driven and to contain a strong validation element with quantifiable targets.

Expected impact:

- Strengthened global position of European manufacturing industry through the introduction of advanced automation into mainstream manufacturing and contributions to international standardisation
- Larger European market for advanced technologies such as electronic devices, control systems, new assistive automation and robots.
- Intelligent management of manufacturing information for customisation and environmental friendliness.
- Reinforced European leadership and industrial competitiveness of laser component and system producers and users and substantial improvement of manufacturing processes.

Funding schemes:

a) and c): IP;

b) and d): STREP

Indicative budget distribution[10]

Calls:

FP7-2012-NMP-ICT-FoF

Objective FoF-ICT-2011.7.2 Manufacturing solutions for new ICT products

Organic Large Area Electronics (OLAE)[32] is based on a combination of new materials and uses large area production processes to provide completely new applications and products that are generally thin, cheap, lightweight and flexible. Key to realising the potential is developing low cost, high volume and high throughput manufacturing technologies of electrical, electronic and photonic components. This objective aims at a "from lab to fab" approach i.e. bridging the gap between research prototypes and low-cost mass production methods. Applications range from OLED lighting, organic photovoltaics and printed batteries, to signage and displays, organic and large area sensor arrays, organic and printed electronics as well as flex/foil-based integrated smart systems.

Targeted outcomes

Feasibility demonstrators for industrial, low cost, high volume and high throughput manufacturing processes and production of organic and large area electronics and photonics products. Solutions should in particular make use of roll-to roll wet deposition, but could also address evaporation, hot-embossing, laser processing and other low-temperature processes. R&D will focus on addressing the main roadblocks such as patterning processes, resolution and registration accuracy, process stability, multilayer lamination, encapsulation, automation, in-line quality control, and architectures to cut production costs. Standardisation and end-of-life/disposal/recyclability issues should be addressed as appropriate.

Projects are expected to be industry-driven and the proposed work should include strong quality control, testing and validation elements in order to demonstrate the feasibility of the manufacturing at an industrial scale.

Expected impact

- New market opportunities for European manufacturing industry in new low cost, high volume and high throughput manufacturing processes for OLAE products tailored to meet key societal and economic needs; and, extending the range of applications of "conventional" industries (e.g. printing and plastic), into the OLAE field.
- Availability of European-produced OLAE products tailored to meet key societal and economic needs.

Funding schemes

IP

Indicative budget distribution[10]

Call

FP7-2012-NMP-ICT-FoF

Objective FoF-ICT-2011.7.3 Virtual Factories and enterprises

This objective focuses on end-to-end integrated ICT solutions that enable innovation and higher management efficiency in networked enterprise operations.

Target outcomes

a) **Distributed, adaptive, and interoperable virtual enterprise environments** for business innovation, extensive monitoring, evaluation, forecasting, risk assessment and

[32] OLAE covers organic electronics as well as organic photonics technologies.

prevention, e.g. through collaborative business intelligence, productivity, knowledge management and/or mixed reality tools. R&D should aim at integrating novel management methods and ICT to help virtual factories and enterprises move beyond existing operational capability.

b) **Real-time management of volatile manufacturing assets:** ICT tools and applications to support end-to-end management of tangible and intangible assets (e.g. inventories, stakeholder relationships, product configurations, production knowledge, skills) across the entire value chain. Proposed solutions should be validated for scalability, interoperability, reliability, and security.

c) **Component-based tools and architectures enabling the innovative dynamic composition of services** for product operation (maintenance, reliability, upgrades), and end-of-life use (re-manufacturing, recycling, disposal). The proposed solutions should help achieve efficient and sustainable lifecycle management of products and services.

d) **Internet-based, user-centric collaboration, sharing and/or mixed reality tools** supporting the emerging networked enterprise concepts. They should enable new manufacturing business models and practices that enhance and sustain the value of products and services (including value-added, service-enhanced products) by involving all relevant stakeholders in the innovation process, from R&D and design phases to after-sales.

Projects are expected to be industry-driven and to contain a strong validation element with quantifiable targets.

Expected impact

- Higher management efficiency of networked and sustainable business operations.
- ICT tools enabling the participation of SMEs in virtual factory environments.
- New business models and innovation scenarios for a low-carbon economy.

Funding schemes:

IPs/STREPs

Indicative budget distribution[10]

EUR 45 million, with a minimum of 50% to IPs and 30% to STREPs

Calls:

FP7-2011-NMP-ICT-FoF

Objective FoF-ICT-2011.7.4 Digital factories: Manufacturing design and product lifecycle management

The work addresses the early stages of manufacturing and engineering through interoperable models, engineering platforms, computer-assisted product and process development and analysis, and virtual prototyping and testing environments to reduce the need for physical mock-ups.

Target outcomes:

a) **Comprehensive engineering platforms** that enable cross-disciplinary information sharing, workflow integration and the capture of product-relevant knowledge (e.g. manufacturing process knowledge embedded in the models and the engineering tools), supporting the re-use of knowledge across stakeholders and the product lifecycle (e.g.

from use to design). Projects should also contribute to ongoing international cooperation activities (e.g. IMS) on sustainable engineering and on standardisation for long-term archiving of product information.

b) **User-intuitive tools for simulation and virtual prototyping with forward and backward compatibility** (e.g. from use to engineering) using finer digital models to increase accuracy and integrating aspects such as functionality, forming, painting and assembly. The work should also aim at interoperable models enabling the use of various aspects of design and engineering, model auto-generation and robustness (e.g. automated meshing and optimisation) as well as the use of CAD-, CAE-, VR-, volume-, fluid-, structure-, polygonal- and process models in the various engineering stages. The adaptation and scaling of engineering codes to next-generation high-performance multicore computing clusters should also be addressed.

c) **Tools for holistic modelling and simulation of full complex products and processes** using multi-physics and support for tolerance changes in the models. Digital modelling and simulation of product and process behaviour, e.g., regarding material properties from micro to macro scale (from the atomic level upwards) should also be considered.

Projects are expected to be industry-driven and to contain a strong validation element with quantifiable targets.

Expected impact:

- Reinforced European leadership in knowledge-driven platforms, tools, methodologies, product development and manufacturing.
- Accelerated product design and manufacturing, enabling new products to be realised with a considerably shorter time-to-production and time-to-market.
- Drastically improved accuracy, reliability and speed of simulation techniques for manufacturing processes and/or full complex products permitting design decisions earlier in the design process.

Funding schemes:

a) - b) IPs, STREPs

c) IPs, STREPs, CSA

Indicative budget distribution[10]

- IP, STREPs: EUR 33.5 million with a minimum of 50% to IPs and 30% to STREPs
- CSA: EUR 1.5 million

Calls

FP7-2011-NMP-ICT-FoF

6.8 Challenge 8: ICT for Learning and Access to Cultural Resources

The challenge addresses the need for flexible and efficient access to information and knowledge, for educational, training and cultural purposes. It focuses on advances in how we learn through ICT and on enhancing the meaning and experiences from digital cultural and scientific resources. It responds to societal (active and responsible learners) and economic needs of individuals and organisations (better skilled and creative workforce).

Research under this Challenge will fuel progress in a wide range of applications from schools to workplaces, museums, libraries and other cultural institutions. Individual personal spheres are being extended by advances in areas like pervasive network environments, social networking technology and mobile computing, rising the expectations of users and consumers of the digital learning and cultural resources in terms of level of interaction and engagement.

The aim is to exploit Europe's vast and exclusive cultural resources and learning traditions as a source of innovation and creativity, for businesses, researchers, educational organisations and the general public.

Objective ICT-2011.8.1 Technology-enhanced learning

Target outcomes

a) **Technology Enhanced Learning systems endowed with the capabilities of human tutors.** Research should advance systems' capabilities to react to learners' abilities and difficulties, and provide systematic feedback based on innovative ways of interpreting the user's responses - particularly in relation to deep/shallow reasoning and thinking. Research should advance systems' understanding and use of the appropriate triggers (praise, constructive comments, etc.) influencing learning. The systems shall improve learners' meta-cognitive skills, understand and exploit the underlying drivers of their learning behaviours. Solutions should exploit advances in natural language interaction techniques (dialogues), in rich and effective user interfaces and should have a pedagogically sound, smart and personalised instructional design (STREP).

b) **Educational technologies for science, technology and maths:** *(b1)* Supporting students to understand and construct their personal conceptual knowledge and meaning of scientific, technological and/or mathematical subjects. Technological solutions should take the learners through the complexity of a subject, activating and feeding curiosity and reasoning, and support the creative applications of the theory. (STREP; NoE) *(b2)* Supporting European-wide federation and use of remote laboratories and virtual experimentations for learning and teaching purposes. The service shall enable online interactive experimentations by accessing and controlling real instruments, or using simulated solutions. Open interfacing components for easy plug-and-play of remote and virtual labs should be made available to stimulate the growth of the network of labs. Research shall include work on the user interfaces that mediate the complexities of creation and usability of experiments, for specific pedagogical contexts in primary and secondary schools and higher education, including at university level. This part of the target outcome should be pursued by IPs that include large scale pilots.

c) **Advanced solutions for fast and flexible deployment of learning opportunities at the workplace (targeting, in particular, SMEs)**: enable faster, situated, just-in-time up-/re-skilling, and lower the costs/efforts of developing and maintaining quality instructional material to be used in continuing education and training processes. Solutions should aim at creating a networking environment that fosters cross-organisational learning and that will help

SMEs to adopt and sustain effective learning attitudes. Proposals must include research on novel business training models, and on how to overcome organisational, inter-organisational and individual barriers to widespread adoption of the developed technologies. This target outcome focuses specifically on the needs of SMEs in sectors without an established tradition in the adoption of learning solutions and facing innovation and competitiveness challenges deriving from efficiency needs or new processes/products development. Proposals should include SMEs and relevant professional associations. SMEs shall also be the final users of the solutions, and be actively involved in clearly justified, representative and sizeable pilots. (IP)

d) **Computational tools fostering creativity in learning processes**: innovative tools encouraging nonlinear, non-standard thinking and problem-solving, as well as the exploration and generation of new knowledge, ideas and concepts, or new associations between existing ideas or concepts. The aim is to support people's learning as well as the formation and evolution of creative teams by developing technological solutions that facilitate questioning and challenging, foster imaginative thinking, widen the perspectives and make purposeful connections with people and their ideas. (STREP)

e) **Exploratory activities** for fundamentally new forms of learning through ICT; establishment of a pan-European network of living schools for validations, demonstrations and showcases. (CSA)

For all target outcomes, projects should include a scientifically sound evaluation component.

Expected impact

- Unlock the potential of the individual by a stronger and smarter adaptation and personalization of educational technologies.
- Significantly higher level of effective, personalised, ICT-based tutoring, leading to its wide-spread penetration in schools and at home.
- Higher level of engagement of youngsters in science, technology and maths, through novel educational software and opening up opportunities to access and use of laboratory equipments and virtual experiments.
- Faster, more timely and more cost-effective up/re-skilling through learning technologies and their sustained adoption by SMEs.
- Emergence of new learning models, including models invoking creativity

Funding schemes

a) STREP; b) STREP/NoE (b1) and IP (b2); c) IP; d) STREP; e) CSA

Indicative budget distribution[10]

Call

FP7-ICT-2011-8

Objective ICT-2011.8.2 ICT for access to cultural resources

Target outcomes

a) **Technologies for creating personalised and engaging digital cultural experiences:** research should address adaptability of systems for personalised interaction with users. Research should investigate technologies that add value and new meaning to cultural digital artefacts and improve user engagement with cultural resources, for example through

smart, context-aware artefacts and enhanced interfaces with the support of features like story-telling, gaming and learning.

b) **Open and extendable platforms for building services that support use of cultural resources for research and education:** research should explore seamless and universal, but also customisable access to digital cultural resources across a wide range of technical formats (sound, image, 3D, text), including cultural resources/objects with diverse characteristics (e.g. languages, temporal, spatial). Usability should be demonstrated through large scale pilots and specific contextual use cases (e.g. functionalities that support active research, creation of new knowledge, meaning extraction...).

c) **Improved and affordable technologies for the digitisation of specialised forms of cultural resources, including tools for virtual reconstructions:** the focus is on innovative approaches for capturing, imaging, 3D (including movement) modelling, resulting in enriched virtual surrogates which convey and embed knowledge beyond the original object.

d) **Awareness raising of research results** through road mapping and support to validation and take up of such results in practical settings.

Expected impact

- Affordability and widespread availability of tools and services for releasing the economic potential of cultural heritage in digital form and for adding value to cultural content in educational, scientific and leisure contexts;
- Wider range of users of cultural resources in diverse real and virtual contexts and considerably altered ways to experience culture in more personalised and adaptive interactive settings;

Funding schemes

a) STREP/IP b) IP c) STREP d) CSAs

Indicative Budget distribution[10]

Call

FP7-ICT-2011-9