PART A

of the

2014 ECSEL MASRIA

2014 MultiAnnual Strategic Research and Innovation Agenda for the ECSEL Joint Undertaking

Elaborated by the Private Members Board

of the ECSEL Joint Undertaking representing:

the AENEAS Industry Association

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the ARTEMIS Industry Association

&

the EPoSS Industry Association

1. Introduction

The combination of nanoelectronics, embedded/cyberphysical systems and smart systems plays an ever-increasing role in the societies of today. It will be (or is already) present in almost all products and services around and is or will be in many cases the technological backbone or neural system of the humankind. It is a decisive set of elements as key enabling technologies in many innovations and solutions for societal challenges, and is therefore a very significant factor in the competitiveness, employment and prosperity of countries and regions.

The influence on competitiveness and employment has recently been described in a couple of documents:

- The high-level Strategic Research and Innovation Agenda of the ICT Components and Systems Industry, as represented by ARTEMIS, ENIAC and EPoSS ETPs, in June 2012 [1]
- The position paper by AENEAS and CATRENE on nanoelectronics and the related application areas, in Dec. 2012 [2]
- A press release of the Electronics Leadership Group, in Dec. 2013 [3]
- The high-level vision 2030 and opportunities for Europe by ARTEMIS-IA and ITEA, in Dec. 2013 [4]

The products and services in the digital value chain are getting more and more sophisticated and complicated, in such a way that no company alone can master all elements of their innovations that involve micro- and nanoelectronics, embedded/cyberphysical systems and smart/microsystems. Therefore we have to rely more and more on transnational pre-competitive collaboration including competitors and involving Research and Technology Organisations (RTO's) and universities. The pre-competitive transnational collaboration in Europe is stimulated significantly by funding with public money from the European Commission and Member States and is as such an important positive factor among all factors that play a role in achieving the level playing field of the European industry [1].

Fostering innovative SME's is a cornerstone of our strategy given the importance of SME's for the size and increase of employment in Europe these domains. Embedding them in the eco-systems of large companies, RTO's and academia, and giving them access to funds is a prerequisite for achieving this.

The new ECSEL Joint Undertaking is constructed to play a significant role in the collaboration of the key players in Europe in components and systems innovation in the upcoming 7 years. In the Council Regulation about the ECSEL JU is laid down that the Private Members Board, which represents the AENEAS Industry Association, the ARTEMIS Industry Association and the EPoSS Industry Association, elaborates a MultiAnnual Strategic and Research and Innovation Agenda (MASRIA).

This document, with its annexes is the first ECSEL MASRIA. The MASRIA looks out some 5 years, whereas the Strategic Research Agenda's of the ARTEMIS, ENIAC and EPoSS ETP's typically look out some 10 years.

This first edition of the ECSEL MASRIA is on the highest level based on "The high-level Strategic Research and Innovation Agenda of the ICT Components and Systems Industry, as represented by ARTEMIS, ENIAC and EPoSS ETP's [1]", that was issued in 2012.

This ECSEL MASRIA reflects in a pragmatic way the cooperation between the three associations and their members. All three associations come from a different history and have produced their SRA's and most of their other strategic documents independently.

This 2014 MASRIA consists of 4 documents:

A. Umbrella document (this document) based on [1]
    1. Introduction
    2. Vision, Mission and Strategy of the Research and Innovation of the ICT Components and Systems Industry
    3. Conclusion
    4. References
B. Annex 1: Nanoelectronics MASRIA within the scope of ECSEL, on behalf of AENEAS
C. Annex 2: Embedded/Cyberphysical Systems MASRIA within the scope of ECSEL, on behalf of ARTEMIS-IA
D. Annex 3: Smart Systems MASRIA within the scope of ECSEL, on behalf of EPoSS

2 Vision, Mission and Strategy

2.1 Vision

The vision driving the ICT Components and Systems Industries is of mankind benefiting from a major evolution in intelligent systems, a world in which all systems, machines and objects become smart, have a presence in cyber space, exploit the information and services around them, communicate which each other, with the environment and with people, and manage their resources autonomously.

In this vision the role of the European ICT Components and Systems Industries will be to (re)enforce their global competitive position by leveraging and aligning individual core competencies and strengths in design, in products and services delivery and in their European integration and production capabilities and infrastructures, while remaining viable and profitable.

An important vision element is that ICT based systems are addressing the challenges and opportunities created by today's and tomorrow's societal demands in health and wellbeing, energy efficiency and smart transport and smart communities, to mention a few.

The vision of the European ICT Components and Systems Industries is to provide Europe in a concerted approach with the controlled [see 4] access for creating the indispensable technology basis for new products, systems and services essential for a smart, sustainable and inclusive European 2020 society.

2.2 Mission

The mission of the European ICT Components and Systems Industries is to progress and remain at the forefront of state-of-the-art innovation in the development of highly reliable complex systems and their further miniaturisation and integration, while dramatically increasing functionalities and thus enabling solutions for societal needs.

"Remain at the forefront" and "miniaturise while dramatically increase functionality" are clearly prerequisites for realising the vision.

The experience that Europe has in R&D in ICT Components and Systems matches and in most cases surpasses the R&D capabilities elsewhere. Europe is at the forefront of many technologies, both established (like automotive, aeronautics or communication) and emerging (like medical- or energy-efficiency related research). Europe is therefore in the somewhat luxurious position that it can write in its mission "to remain at the forefront" rather than "to become at the forefront". Nevertheless, the worst thing to do is underestimating the competition. A healthy European industry is a prerequisite for achieving the mission. To "remain at the forefront" cannot be done by universities and scientific institutes alone. Neither can it be done without their contribution. Without a state of the art European industrial infrastructure it will not be possible for Europe to "remain at the forefront" of innovation. An industry led eco-system of SME's, large companies and academia supported by a public private cooperation is the preferred solution.

The "food chain" is rather complex in case of ICT Components and Systems Industries because a plurality of technologies is always needed to address ICT-services or to address societal needs. The R&D&I actors will answer the question what actions need to be taken with highest priority to "remain at the forefront". The answer, in the form of grand technology challenges is not "pick and choose". It is an action-plan that needs to be executed in its totality to accomplish the mission. Although the R&D&I actors will focus in specific time slots on some of the grand challenges, they will at the same time make sure that the total package can be timely executed.

From a shareholders perspective there exists a need for continuous miniaturization. Simultaneously users request an increased performance of systems with simultaneous increase of functionality thereby taking over complex human perceptive and cognitive functions. This is also a need both from customer and societal perspective. Perhaps even more important, this combination determines the dynamics of the industry as a whole. Looking backwards, it is an achievement of the industry since its existence. Looking forwards, the options, which become imaginable, when extrapolating the trend of miniaturisation and extending functionality, are mind-boggling. They are one of the most important reasons for the attractiveness of the industry and in particular the R&D&I for young people. The promise to continue on this track is the very reason for the strategic importance of the industry. This promise is the "adrenaline" for the R&D&I actors in the field.

2.3 Strategy

The vision and mission statements above demonstrate the two-fold role and responsibility of the R&D&I actors. They need to develop strategies that will lead to the accomplishment of the mission and therefore will be derived from the pan-European societal needs and – at the same time – technology platforms, competences and industrial infrastructure, which enable the respective industrial solutions.

The strategy of the European ICT components and systems industries is based upon exploitation of European strengths and opportunities

- **Exploiting strengths implies building on the leading positions in specific technology and application domains**
- **Creating opportunities implies for Europe to be positioned at the forefront of new emerging markets with high potential growth rates and to become a world leader in these domains**

Innovation is a key point for the strategy. Its efficiency increases significantly by efficient transnational eco-systems between industry, institutes and universities with support of efficient technology- and tool-platforms.

To illustrate some strengths, it is observed that Europe has demonstrated its capability to create innovation over the past 15 years with major success stories such as GSM mobile systems, automotive electronics applications, smart cards, lithography equipment and Silicon on Insulator (SoI), Fly by wire or Near Field Communication (NFC), just to name a few. Europe has a leading position in several domains including multi-market and industrial applications – such as lighting, robotics, automation, engine management, non-invasive medical treatment, chip cards and security –, mainly based on Software, Module and so-called More-than-Moore technologies and smart systems devices. Here, the value of existing cumulative knowledge and skills is extremely high and must be exploited through both evolutionary and revolutionary approaches. This will result in market penetrations of existing markets with innovative technologies and products.

The part of the strategy dealing with opportunities focuses on today's emerging markets including "Health and Well-being" and "Sustainability and Climate" as well as some specific areas within "Smart Transport" and "Inclusive Innovative Society".

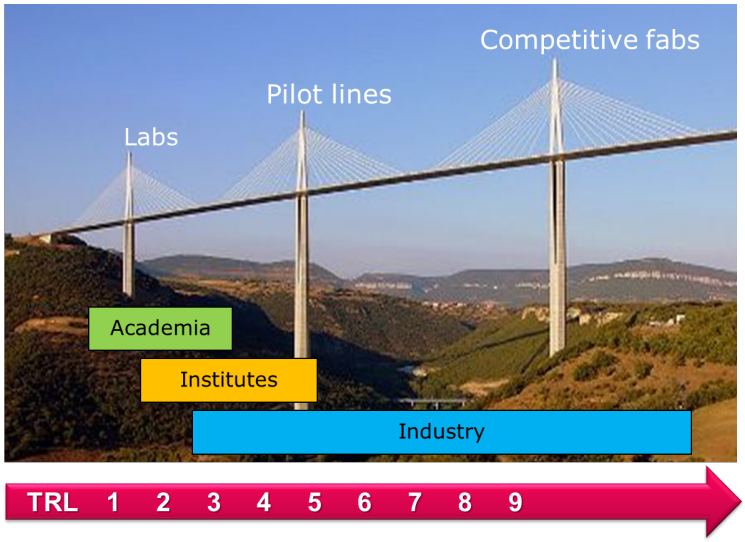
The synergy of strengths and opportunities will enable the European ICT Components and Systems Industries to expand their leadership position in Information and Communication Technology, Embedded and Smart Systems, Nanoelectronics, Advanced Manufacturing and Processing. The intimate co-operation with world-class R&D laboratories from academia and from large institutes such as IMEC, LETI and Fraunhofer as well as the involvement of highly specialised and flexible SMEs are the key elements for developing leading edge technologies and solutions.

2.3.1 The need of a healthy industrial infrastructure [pilot projects instead of pilot lines to be inserted in the text]

Although individual company strategies exclusively based upon design and R&D can prove quite successful, such an approach can never guarantee the competitiveness and strategic independence

of Europe as a whole. Therefore, Europe has to maintain a sufficient level of manufacturing to secure its future competitiveness on advanced integrated products and platforms. This holds in particular for the capital intensive parts of the industry, where salary levels differences play a lesser role.

It is of utmost importance to maintain and/or extent the expertise in Europe to the higher TRL[1]'s as recommended by the report of the High Level Group on Key Enabling Technologies. In this report Innovation is described with help of a metaphor: a bridge that crosses the valley between fundamental discoveries and the market. The TRL levels can easily grouped into metaphorical pillars of this bridge as indicated in the illustration below.



This picture is paraphrasing the KET report to illustrate the issues of the capital intensive industries. **"Pilot lines" as used in the picture should be read in a broader sense as pilot projects, which can be pilot lines for hardware production or pilot projects for systems.**

A healthy return of investment (RoI) is key to any innovation. Although this is the primary responsibility of the ICT Components and Systems Industries, the boundary conditions to achieve good RoI are set by Public Authorities and therefore Public Private Partnerships are essential to implement this strategy.

2.3.2 Elaborating the chosen strategy

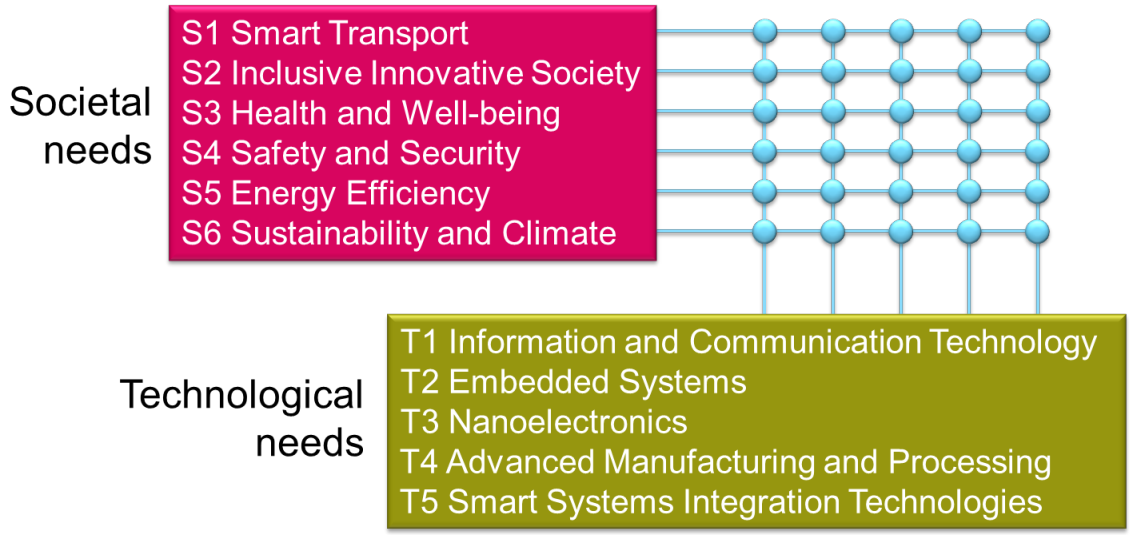
This chapter elaborates on the before mentioned strategy. 6 focussed domains are defined, each addressing important societal needs. With the first 2 domains ("Smart Transport" and "Inclusive Innovative Society") the industry continues to build on its existing strength (1st element of the strategy) and with the remaining 4 ("Health and Well-being", "Safety and Security", "Energy Efficiency" and "Sustainability and Climate") it exploits opportunities for Europe by positioning itself at the forefront of emerging markets (2nd element of the strategy).

The technological enablers for the contribution of the ICT Components and Systems Industries to these 6 before mentioned societal needs are defined by 5 technology work areas ("Information and Communication Technology"[2], "Embedded Systems", "Nanoelectronics", "Advanced Manufacturing

[1] Brief definition of Technology Readiness Levels:
TRL 9 = Actual technology system qualified through successful mission operations
TRL 8 = Actual technology system completed & qualified through test & demonstration
TRL 7 = Technology prototype demonstration in an operational environment
TRL 6 = Technology demonstration in a relevant environment
TRL 5 = Technology validation in a relevant environment
TRL 4 = Technology validation in a laboratory environment
TRL 3 = Analytical & experimental critical function and/or characteristic proof-of-concept
TRL 2 = Technology concept and/or application formulated
TRL 1 = Basic principles observed and reported

[2] ICT Technology in its broadest sense for those areas that are not covered by Embedded Systems, Nanoelectronics, Advanced Manufacturing and Processing or Smart Systems Technology (for instance in information/communication theory, non embedded-software, networks, infrastructure, etc.).

and Processing" and "Smart Systems Integration Technologies"). Work areas and technological enablers depend on each other as sketched in the figure below.



2.3.3 Further detailing of the developed strategy

The section 2.3.2 gives only the headlines of the developed strategy. Much more detail can be found in:

1. "Vision, mission and strategy, R&D&I in European Micro- and Nanoelectronics, 2013 updated part C"; Dec. 2013 (this document also serves as the SRA for the ENIAC-ETP and as input for the White Book of CATRENE) [5]
2. ARTEMIS-SRA by the ARTEMIS Industry Association (that incorporates the ARTEMIS ETP) issued in 2011 plus the addendum issued in 2013 [6,7]
3. EPoSS-SRA updated 2013 [8]

For the detailed Research and Innovation parts that are relevant for, and fit in the scope of ECSEL see Annex 1, Annex 2 and Annex 3 of the set of MASRIA documents.

3. Conclusion[3]

The scope of work for the ECSEL Joint Undertaking will build on the results obtained by the ENIAC and ARTEMIS Joint Undertakings, the European Technology Platform EPoSS and work funded through other national and European programmes. It will foster in a proper and balanced way new developments in, and synergies between the following main areas:

(a) design technologies, process and integration, equipment, materials and manufacturing for micro- and nanoelectronics while targeting miniaturisation, diversification and differentiation, heterogeneous integration; see ANNEX 1.

(b) processes, methods, tools and platforms, reference designs and architectures, for software and/or control-intensive embedded/cyber-physical systems, addressing seamless connectivity and interoperability, functional safety, high availability, and security for professional and consumer type applications, and connected services; see ANNEX 2.

(c) multi-disciplinary approaches for smart systems, supported by developments in holistic design and advanced manufacturing to realise self-reliant and adaptable smart systems having sophisticated interfaces and offering complex functionalities based on e.g. the seamless integration of sensing, actuating, processing, energy provision and networking; see ANNEX 3.

4. References

[1] "High-level Strategic Research and Innovation Agenda of the ICT Components and Systems Industry, as represented by ARTEMIS, ENIAC and EPoSS ETPs", June 2012; downloadable from: http://www.artemis-ia.eu/publications (High Level SRIA), or from http://www.aeneas-office.eu/web/documents/Strategic%20Research%20and%20Innovation%20Agenda.php or from http://www.smart-systems-integration.org/public/documents/publications

[2] "Innovation for the future of Europe: nanoelectronics beyond 2020", Dec. 2012; downloadable from: http://www.aeneas-office.eu/web/documents/innovation_for_the_future_of_europe_nanoelectronics_beyond_2020.php

[3] "Select industry group updates the roadmap on making Europe big in electronics", Dec. 2013; downloadable from: http://ec.europa.eu/digital-agenda/en/news/electronics-roadmap-europe

[4] "High Level Vision 2030 and opportunities for Europe", ISBN 978-90-817213-2-5,Dec. 2013; downloadable from http://www.artemis-ia.eu/publications (High level vision 2030 version 2).

[5] "Vision, mission and strategy, R&D&I in European Micro- and Nanoelectronics, 2013 updated part C"; Dec. 2013; downloadable from: http://www.aeneas-office.eu/web/downloads/strategic-docs/partc_vms_2013_final.pdf

[6] "ARTEMIS SRA 2011"; downloadable from : http://www.artemis-ia.eu/publications (Book silver edition).

[7] "Embedded/Cyberphysical Systems, ARTEMIS Major Challenges 2014-2020, 2013 Draft Addendum to the ARTEMIS SRA 2011; DEC. 2013; downloadable from: http://www.artemis-ia.eu/publications (SRA addendum 2013).

[8] "EPoSS SRA pre-print Sept. 2013", Sept. 2013; downloadable from: http://www.smart-systems-integration.org/public/news-events/news/eposs-sra-2013-pre-print-version-now-publicly-available

[3] Based on Art. 2 of the ECSEL Council Regulation