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Impact Assessment

Accompanying the document

Proposal for a Council Regulation

on the ECSEL Joint Undertaking

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INTRODUCTION

This document is the impact assessment for a Joint Technology Initiative (JTI) on electronic components and systems set up as a Joint Undertaking on the basis of Article 187 TFEU. It is proposed as part of the implementation of the EU Framework Programme for Research and Innovation Horizon 2020 [1].

Under the Seventh Framework Programme, two Joint Undertakings (JU) ENIAC and ARTEMIS were established respectively in the field of nanoelectronics and embedded computing systems. The objective of those initiatives was to increase and leverage private and public investments in research and innovation in two complementary domains of high importance for the entire industrial fabric in Europe. Their profiles and achievements to date are described in Annex 2.

Building on the experience gained with ENIAC and ARTEMIS, the present initiative is based on a simplified single structure, a focused scope of actions reinforcing the synergies between the areas of electronic components and embedded systems and a major simplification of the implementation modalities. The initiative is a central pillar of the EU's strategy for electronic components and systems in Europe. The strategy aims at drawing more than a €100 billion of additional private investment in innovation and production in the field, creating more than 250 000 induced jobs in the next 7 years, and ensuring the best use of electronics to spur growth across the economy.

The procedure that was followed is in accordance with the Commission's guidelines for ex-ante impact assessments [2].

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Organisation and Timing

The consultations on the new initiative in the field of electronic components and systems started in early 2011 and ran until March 2013. This included:

- Identification and analysis of economic data, carrying out literature searches and assessing results from R&D projects;
- Participating in the inter-service Impact Assessment Steering Group from June 2012 to December 2012;
- Carrying out a study on "Future Impact of ENIAC and ARTEMIS" from 16 July 2012 to 15 December 2012;
- Launching the second interim evaluation of ENIAC and ARTEMIS JUs on 10 September 2012;
- Organising and analysing stakeholder consultations:

- Public consultation on "Future Joint Technology Initiative(s) on electronic components and embedded systems", open between 20 July 2012 and 12 October 2012;

- Meetings with representatives of Member States and associated countries held on 6 July, 21 September, 18 October and 5 December 2012, 31 January and 3 March 2013;

- Consultation meetings with representatives of the 3 ETPs (AENEAS, EPoSS and ARTEMIS-IA) together on 18 February and 23 November 2011, 30 March and 18 October 2012, 5 February, 4th March, and 12th June 2013;

- Bilateral meetings with Member States that provide the highest contributions to ENIAC and ARTEMIS JUs: France on 3 October 2012, Germany on 12 October 2012, Austria on 17 November 2012, the Netherlands on 19 October 2012 and Italy on 26 November 2012; and

- Discussion with high-level representatives of industrial and academic stakeholders at the "European Nanoelectronics Forum 2012" in Munich on 20-21 November 2012.

1.2. Consultation of the IA Board

The Impact Assessment Board assessed the draft version of the present impact assessment and issued its opinion on 27 February 2013. The Impact Assessment Board approved the Impact Assessment Report and suggested certain improvements and modifications.

The Impact Assessment report was amended in line with these suggestions. In particular

- Information on the 2nd interim evaluation of the ARTEMIS and ENIAC JU is included and an assessment of the various options along the key recommendations of the 1st and 2nd interim evaluation is incorporated;

- The description of the policy options is improved;

- The impact of the options is assessed against the baseline option;

- The section on monitoring and evaluation is strengthened; and

- The structure of the Impact Assessment Report is improved with the detailed description of the context given Annex 1 to the report.

1.3. Inter-service Impact Assessment Steering Group (IASG)

The IASG was set up jointly with DG RTD's services dealing with the JTIs in their areas of responsibility (Innovative Medicines Initiative, Clean Sky, Fuel Cells & Hydrogen, and Bio-based Industries). The meetings of the IASG in 2012 contributed to the planning, coordination and discussion of the impact assessment reports of the new JTIs being considered under Horizon 2020. Besides DG RTD and CONNECT, the IASG gathered many services including SG, LS, BUDG, AGRI, COMP, EMPL, ENER, ENTR, ENV, ESTAT, HR, MARKT, MOVE, SANCO.

1.4. Consultation and Expertise

The impact assessment report draws on the extensive consultations with stakeholders from the electronic components and systems sector and with Member States as listed above. It also draws on the results of studies and evaluations of the current JUs and on the work of the High-Level Group on Key Enabling Technologies (KETs) [3].

The study about the Future Impact of ENIAC and ARTEMIS [4] examined notably the scope of the new initiative and the means to maximise its impact on technology progress and on competitiveness and growth for the European industry. The main results of the study are summarised below in Section 1.6.

In total more than 20 meetings were held with stakeholders.

In the meetings with representatives of the European Technology Platforms ARTEMIS, ENIAC and EPoSS, each representing some hundreds stakeholders, the desired scope of the new initiative was reviewed in detail. This resulted in the publication of a High Level Strategic Research and Innovation Agenda of the ICT Components and Systems Industry [5].

Public authorities were consulted through an informal "Public Authorities Reflection Group" set up in mid-2012. All Member States and Associated Countries to the Framework Programme were invited through the FP7 ICT Committee and the Public Authorities Boards of ARTEMIS and ENIAC JU. Fifteen States were regularly represented in these meetings. The consultation of Member States was essential as one of the options for the implementation of the JTI is a tripartite model in which the Member States financially contribute, similarly to the current ARTEMIS and ENIAC JUs.

A public consultation was launched on 20 July 2012. It was on-line for twelve weeks until 12 October 2012. The analysis of the contributions was published at the end of November 2012 [6]. A summary report is given in Section 1.5. Through the public consultation, the views from a wide set of stakeholders were obtained. Special attention was given to solicit opinions on the participation of SMEs.

Structures of the relevant industry associations and statistics of participations in ARTEMIS and ENIAC calls for proposals were analysed with respect to the SME participation/participant profiles. The objective was to assess whether the policy put forward has a positive impact on SMEs and provides effective incentives to facilitate SME participation.

For the economic analysis underpinning the problem definition, the report draws primarily on public domain data and recent studies conducted by the Commission. As indicated above this context is provided in Annex 1.

1.5. Results from the on-line public consultation

The on-line consultation was conducted through the institutional platform (IPM) of the European Commission between 20 July and 12 October 2012. It consisted of 21 questions covering the policy and economic context, the assessment of the current ENIAC and ARTEMIS initiatives, potential improvements and the model for future initiative(s) under Horizon 2020 as well as related performance indicators. The consultation was widely publicised through several institutional channels and repeated e-mailing campaigns to over 1,000 contacts representative of all stakeholder categories.

The consultation received 151 contributions. Figure 1 shows the distribution between categories of respondents.

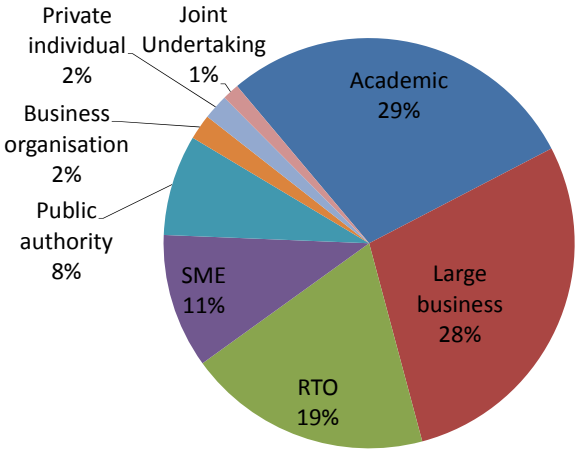


Figure 1 – Respondents to the public consultation

Companies and research organisations constitute more than 85% of the respondents. The representational goal of the consultation is thus achieved. The contributions originated in a large majority from the 23 European countries involved in the current JTIs, with more than 1/4 of the respondents from Germany and France. The industrial associations currently member of the ARTEMIS and ENIAC JUs responded for their constituencies (representing respectively 206 and 126 members) which gives their views more weight.

The respondents are active in all major sectors in which the use of electronic components and embedded systems is essential, showing the relevance of their views. Also, 60% of respondents have applied for funding from one or both of the current initiatives and half of them received funding. The highest degree of familiarity with the current JTIs is by industry and RTOs. Half of the contributors are involved in activities related to systems while semiconductor design and manufacturing is of interest to roughly 2/3 of the respondents. The large semiconductor companies that replied participate in both current JTIs. Half of the respondents are active in communications and computing.

Key directions for action and areas to tackle include the need for:

- Investing more in R&D&I and manufacturing,
- Increasing Europe's technology portfolio, and
- Strengthening the innovation ecosystem.

According to the respondents, this can be achieved by:

- Improving coordination of activities between EU and Member States, and
- Providing the financial means to compete at a global level

in order to:

- Achieve critical mass required for disruptive and/or breakthrough research,
- Provide level-playing field conditions to foster European competitiveness in the sector, and
- Provide public support for large-scale investments in research and innovation.

These latter three areas are strongly advocated by private companies. The highest priority for industry is to strengthen cooperation between the public and private sectors. Overall there is the expectation that the JTI will increase the European market share in electronic components and embedded systems.

How to implement and improve a future initiative?

Figure 2 shows that there is a balanced opinion regarding the different implementation options for a future JTI. The two industrial associations involved in the current JTIs least favour the bipartite JTI (irrelevant and neutral respectively) as it would pool a too small budget and has the same administrative burden as the tripartite JTI. The comments by the respondents indicate that their opinion is largely based on their experience with the current JTIs. They may not have fully grasped the impact of the potential improvements considered for a future initiative which may explain the somewhat lower scoring of the improved tripartite JTI.

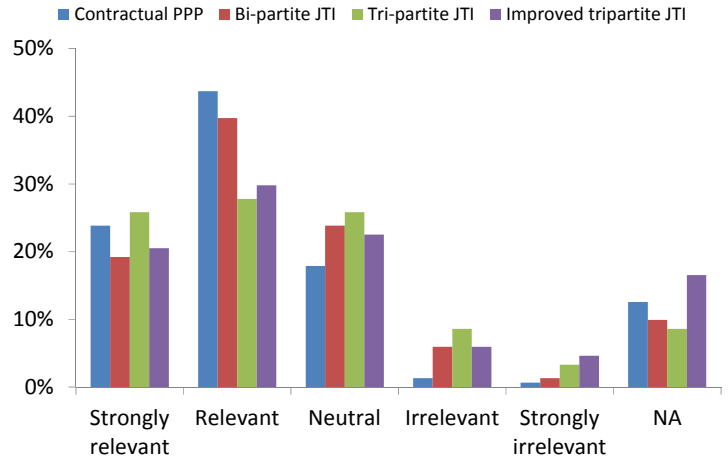


Figure 2 - Implementation model for future JTI

In Figure 3, the responses on potential improvements for a future JTI show a general agreement on the high importance of lighter financial rules and decision-making. The need for specific rules for participation in innovation activities (supporting higher TRLs) received a less strong support. The views on the single point of contact ("one-stop shop") are mixed although a majority of SMEs and academics expressed a strong desire. This reflects a need for simplification of administrative procedures.

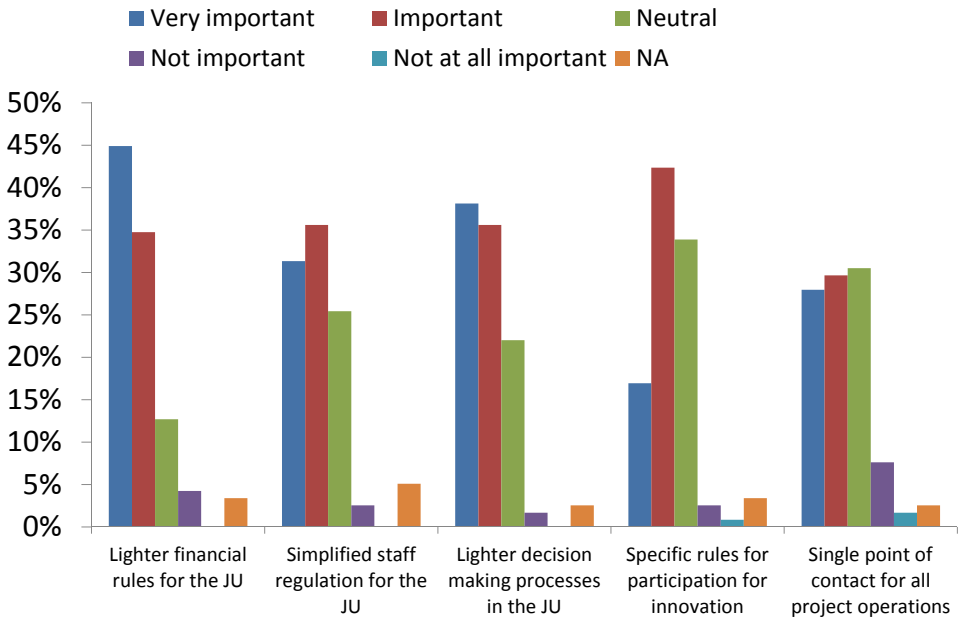


Figure 3 - Potential improvements

There is strong support for multi-annual commitments by Member States, for better synchronisation of procedures, for simplification and reduction of national rules, and for industry to keep research activities in Europe. The European Union should invest more in the electronic components and systems. Support for the latter view is followed closely by the wish to see more investment by Member States and also by industry (all above 60% of opinions).

Ex-post evaluation of JTIs' achievements

The evaluation of the two existing JTIs is positive in all criteria and is consistent between ARTEMIS and ENIAC as shown in Figure 4 and Figure 5.

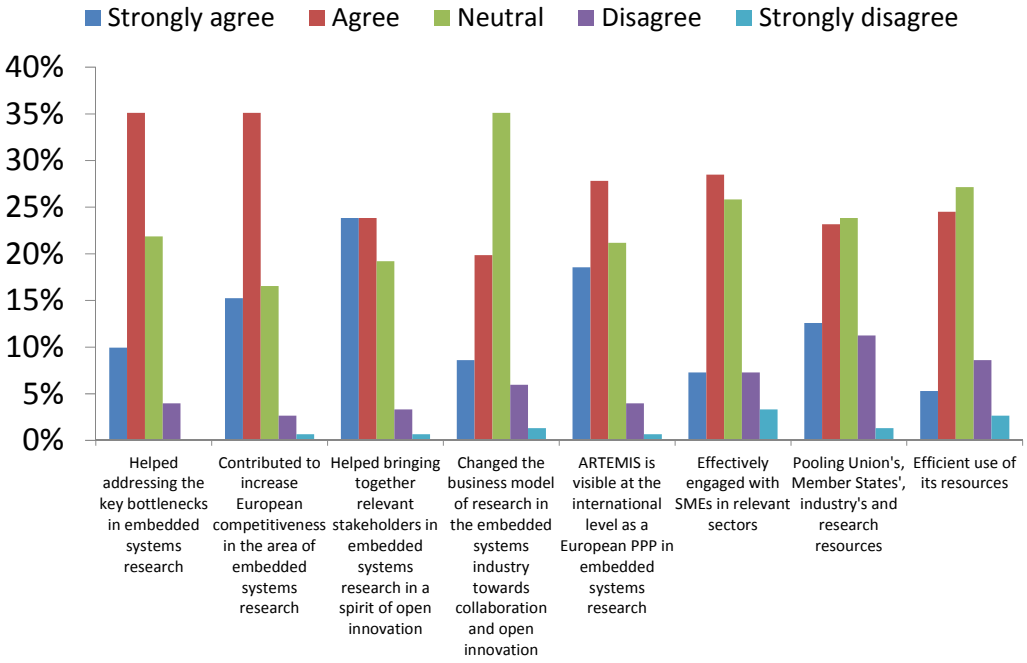


Figure 4 - ARTEMIS achievements

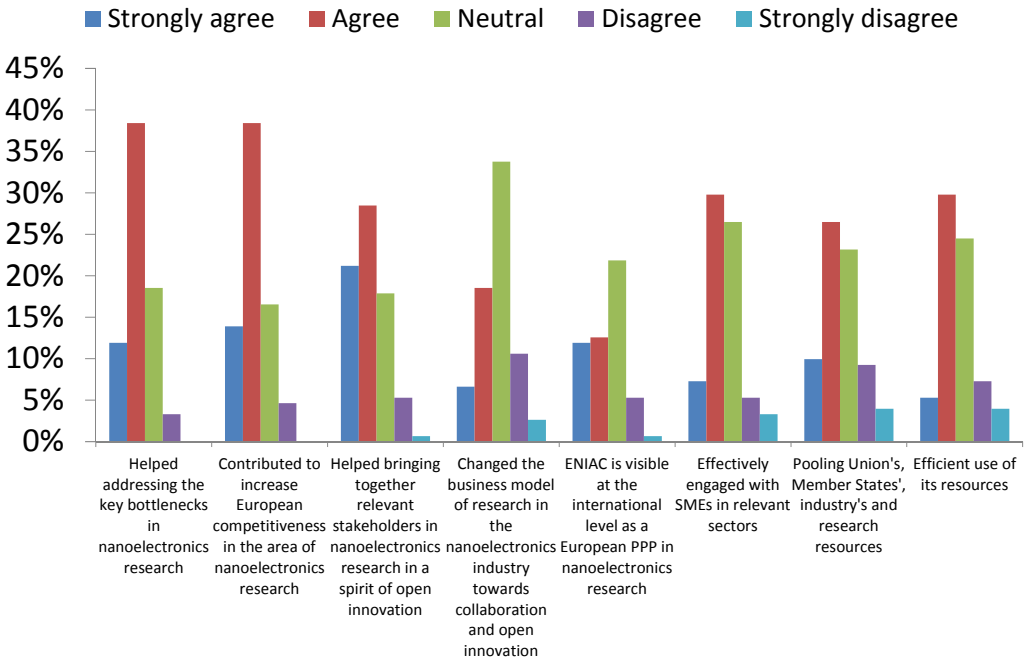


Figure 5 - ENIAC achievements

AENEAS indicates that '*the level of cooperation and collaboration is actually high in the domain*'. There is generally a more positive opinion on the role of the JTI in bringing together

the relevant stakeholders in the spirit of open innovation. The latter reflects mostly the strong agreement from the large companies in both initiatives.

Timeframe for impact

The evaluation of the coverage and the impact of the future JTI along the innovation chain (see Figure 6 and Figure 7) show an overwhelming support for projects with TRLs between 2 to 7 or 8 and a relatively short term impact at 2-5 years. It also shows the need for continuous support of upstream research to help new concepts emerge.

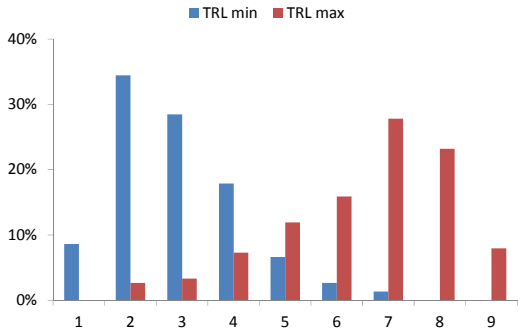


Figure 6 - TRL range

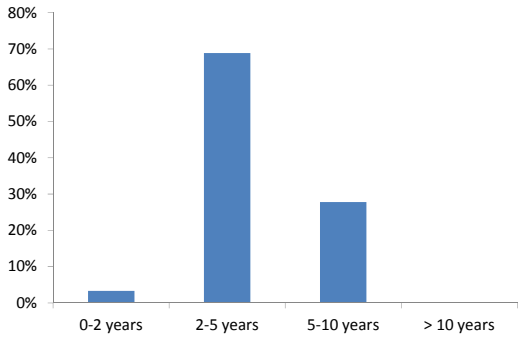


Figure 7 - Distance to market

System integration receives, by far, the highest rating as a priority theme for the future JTI focus, while design and prototyping/demonstrators is in second place. Large companies favour demonstrators, SMEs prefer prototyping. The majority of respondents, including the industrial associations, are in favour of a programme that is more roadmap-driven.

SMEs' position in the future initiative

SMEs are particularly keen on improving time-to-market. For them, the role of the JTI is to improve cooperation and coordination of the private sector on innovative demonstrators.

There is a general favourable opinion on the necessity of facilitating access to financing for SMEs. All stakeholders, except large companies, support higher funding rates for SMEs. Favourable rules for the participation of SMEs are seen as strongly effective, though this view is not strongly shared by large companies and RTOs.

1.6. Results from the study on future impact of ARTEMIS and ENIAC

The study [4] was conducted by a team of experts with extensive experience in the field of the current JTIs. The study consisted of desk research and about 30 interviews of a representative sample of stakeholders involved in the ARTEMIS and ENIAC JUs.

1.6.1. Main findings

According to the study team, the JTIs definitely need to be continued. There is a need to continue to support the European electronic components and systems industry in order to strengthen the position of the industry in global value chains and to reinforce the European innovation system in the global innovation network.

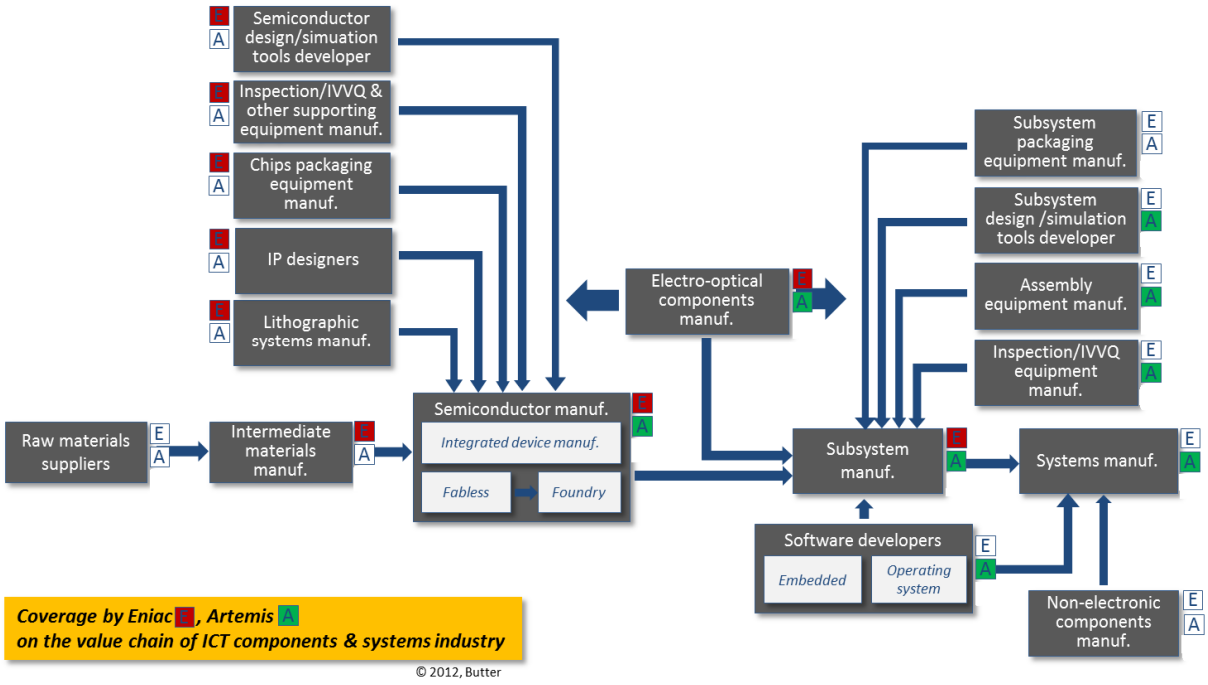


Figure 8 - Value chain coverage of ARTEMIS and ENIAC

As shown in Figure 8 there are complementarities and strong links between the various parts of the value chain covered by ENIAC and ARTEMIS. These links are set to grow as the components industry seeks to capture opportunities in the higher parts of the value chain. Embedded systems suppliers also seek to better exploit possibilities brought by the increasing performance and functionalities of components. Continued focused research and innovation actions along the tracks of the current two JTIs are needed. These actions should be led by appropriate stakeholders including SMEs.

Integration of operations of the two JTIs is advisable. This would involve setting up an efficient and effective one-stop-shop for managing programmes for the European electronic components and systems industry. Integration furthermore creates scope for cross-cutting activities. Large parts of the current research agendas could benefit from more strategic focusing.

1.6.2. Main recommendations

The recommendations on the shaping of the future JTI initiative are divided into two major groups: the first concerns the development of the research and innovation agenda and the second group deals with how to implement this agenda and related governance/funding issues.

Developing the research and innovation agenda:

To further develop the research and innovation agenda a number of conclusions can be drawn:

1. Focus on key areas from the double perspective of positioning EU industry in the global value chain(s) and strengthening the relevant parts of the European innovation ecosystem. In terms of building a research and innovation agenda, this has several consequences:
    - Maintain a clear focus on the European value added for the stakeholders (industry, Member States, research organisations and the relevant regions) to deliver more than the sum of national or single firm interests.
    - To maximise impact, address the whole innovation chain including higher TRLs (avoiding the so-called valley of death). This becomes even more important with the growing costs and risks of investment at higher TRLs. This may require an increasing involvement of users (firms and/or public organisations, e.g. automotive, aerospace, or healthcare and energy sectors) in the new JTI.
    - Balancing short term and long term interests and ensuring that each stakeholder group has its own role (industry for the market orientation, science for the longer term opportunities and public government for the general public interest) will be key issues.

2. A full integration of the research agendas of the two JTIs is not advised although there is a clear need to have continuity from electronic components to systems so as to avoid important gaps in the value chain. There are significant areas of synergy and some overlaps between the fields covered by the two running JTIs. Developments in technology (interdisciplinary fields) and markets (e.g. the further integration of complete systems on a chip) increase the importance of these synergy areas. It is therefore essential to create scope for cross-cutting activities between the agendas of the two running JTIs.

3. Agility and flexibility are needed. As the speed of developments increases and technological barriers narrow, the ability to respond fast – and not to "protect" obsolete trajectories – is needed. In line with the previous point, the new JTIs should create room for identifying and responding to new needs and opportunities which may come in parallel to the envisioned roadmaps.

4. The participation of SMEs is better than generally perceived (Figure 9) but needs strengthening. SMEs may actually benefit from clearly recognisable focus areas in the research agenda that are linked to specific parts of the industry value chain.

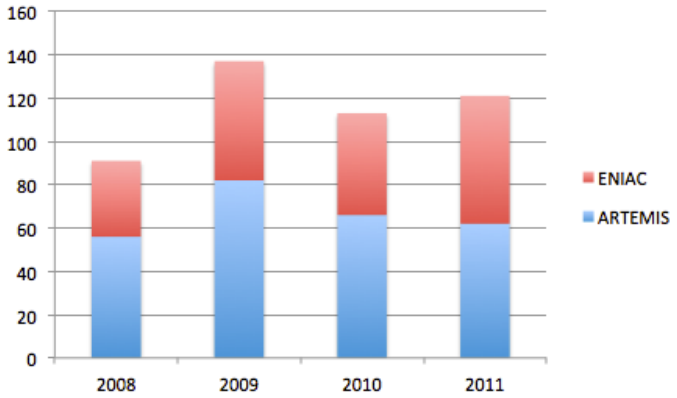


Figure 9 - SME participation in ARTEMIS and ENIAC projects

Implementing the research and innovation agenda:

With regard to the implementation of the research agendas and issues of governance and funding, the following conclusions were drawn:

1. Both the stakeholder analysis and the evaluation of the scenarios show a strong preference for a "one-stop-shop" organisation. Stakeholder preferences, the SWOT-analyses and the analysis underpinning the scenarios all confirm the need for continuation of the present tripartite model in which European Union and Member States' funding come together with industry funding[1]. The actual implementation of the tripartite model might be improved by integrating funding commitments from the Union with those of the Member States (and possible other sources in the future).

2. Continue working on aligning research agendas and priorities from a multi-level governance perspective to include regional and other funding (loans, etc.) options. Unified operations and making the one-stop-shop work requires considerable effort of coordination. It will require from industry an effort to focus and prioritise taking into account its own interests, the public interest, a visionary medium to longer term technological outlook and market opportunities. To achieve such a focus, high quality strategic analysis will be required including the identification of cross-cutting activities and relevant multi-level alignment of funding.

3. Moving the programmes closer to the market (e.g. by supporting higher TRLs in the form of pilots and other close to market initiatives) requires a highly professional and strategic management of the programmes as the supported activities become deeper entangled in the competitive operations of firms.

1.7. Stakeholders views - summary

From the above it can be seen that stakeholders consider the two existing JTIs in ICT as being of high value.

[1] This finding comes out of direct interviews at a time where further developments of the future JTI model were available compared to the situation at the time of the public consultation.

The current initiatives ENIAC and ARTEMIS JU involve industrial stakeholders (both large companies and SMEs) and the research community (universities and RTOs) from across Europe. Member States are directly involved in the governance structures and contribute financially. The industrial and research communities are represented through the industrial associations AENEAS and ARTEMIS-IA.

The consultations show that all actors are motivated and committed to the JTIs. According to industry, the JTIs helped bringing together relevant stakeholders and facilitated cooperation in the implementation of the industrial Strategic Research Agendas. The JTIs pooled private resources and public funds from Member States and the European Union.

For the new JTI, all stakeholders strongly support the following two main specific objectives:

- Achieve critical mass by pooling public and private resources; and
- Provide public support for large scale demonstrators and pilots.

The new initiative should facilitate efficient transnational research and support cooperation on innovation across value chains closer to the market. The design of complex electronic components and systems should be covered as well as manufacturing and technology development.

Member States insist on the most effective spending of public money in the interests of their national industries and research communities. All participating Member States acknowledge the importance of a strong industry in electronic components and systems. Member States showed interest in participating in a tripartite model, where the level of funding requires pooling of resources and stronger alignment of strategies at regional, national and EU level.

Some Member States are aware of the difficulties currently faced by participants, notably through the application of national eligibility criteria and the lack of synchronisation and alignment of national contracting and funding terms. Differences in national agreements create different terms of participation amongst the beneficiaries and lead to inefficiencies. This is a main difficulty signalled by stakeholders regarding the tripartite model for the JTI.

For SMEs ease of participation is of paramount importance. They strongly favour more targeted support, an opinion that is shared by the Member States.

The need for multi-annual financial commitments of public authorities is equally highlighted.

These various opinions have been taken into account when considering the options for the new JTI in electronic components and systems as set out in the remainder of this report.

2. PROBLEM DEFINITION

The next Framework Programme for Research and Innovation, Horizon 2020 [1], states the strategic importance of ICT for Europe and the ambition for building on Europe's strengths to boost innovation and grow business. ICT plays an essential role as it provides the key basic infrastructures, technologies and systems for economic and social prosperity and as it is at the origin of new private and public products and services. European industry needs to remain at the cutting edge of technological developments in ICT as many technologies enter a new

disruptive phase. This opens new opportunities. Electronic components and systems are at the core of all ICT products and services, and apart from being a significant industry by itself, are at the origin of many productivity improvements. They fuel innovation across the economy and have a key role in addressing societal challenges.

To address its aims, Horizon 2020 is structured around three complementary and interlinked priorities - Excellent Science, Industrial Leadership, and Societal Challenges. Within Industrial Leadership support is foreseen for research and innovation to achieve industrial leadership in key enabling technologies – including electronic components and systems. Important market failures such as private sector underinvestment in R&D and insufficient financing for growth of innovative SMEs will be addressed.

Two specific activity lines within the Industrial Leadership of Horizon 2020 concern the electronic components and systems:

- A new generation of components and systems: engineering of advanced and smart embedded components and systems. The objective is to maintain and reinforce European leadership in technologies related to smart embedded components and systems. It includes micro-nano-bio systems, organic electronics, large area integration, underlying technologies for the Internet of Things (IoT) including platforms to support the delivery of advanced services, smart integrated systems, systems of systems and complex systems engineering.
- Micro- and nanoelectronics and photonics: The objective is to build on the excellence of Europe in this key enabling technology and support the competitiveness and market leadership of its industry. Activities will include research and innovation on design, advanced processes, pilot lines for fabrication, related production technologies and demonstration actions to validate technology developments and innovative business models.

The specific objective 'Leadership in enabling and industrial technologies' will follow a more technology-driven approach to develop enabling technologies that can be used in multiple areas, industries and services. Applications of these technologies to meet societal challenges will be supported together with the Societal Challenges priority. Stakeholders representing the different perspectives must be fully involved in priority setting and its implementation. In certain cases, jointly funded public-private partnerships are to be set up.

The preamble to Horizon 2020 states that '*a greater impact should also be achieved by combining Horizon 2020 and private sector funds within public-private partnerships in key areas where research and innovation could contribute to Europe's wider competitiveness goals and help tackle societal challenges. The public-private partnerships in the form of Joint Technology Initiatives launched under Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework programme of the European Community for research, technological development and demonstration activities (2007-13) may be continued using more fit-for-purpose structures*' The set-up of a Joint Undertaking for R&D&I in electronic components and systems is an essential pillar for an EU-wide strategy to attract more private investment in support of an industry-driven European roadmap for leadership in the field.

2.1. Electronic components: An important industry with significant growth and a massive economic footprint

The electronics value chains already support an important part of the worldwide economy. This proportion will continue to increase as electronics becomes even more prominent in society and as products and services more heavily embed digital technologies. The figures below underline the importance of the sector:

- The worldwide value of the industry addressed by this initiative is in the order of some €230 billion ($300 billion) for the semiconductor industry and around €1.600 billion for the electronic systems.
- Despite the recent financial and economic setbacks, the worldwide market for semiconductor components (Figure 10) has continued to grow by 5% per annum from the beginning of the millennium. Further growth of the same magnitude has been predicted for the remaining part of the current decade [7].

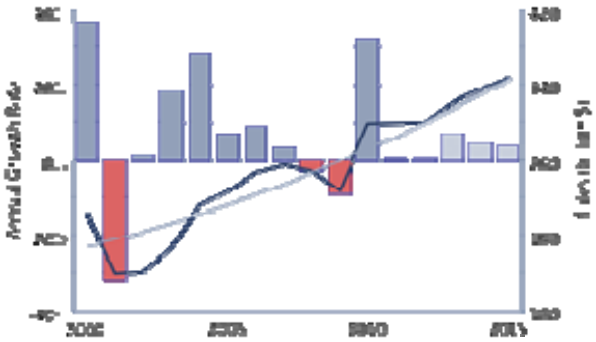


Figure 10 - Worldwide market

- Progress in semiconductors[2] is the main driver behind the high growth rates of the digital sector which has today a total value of around €3.000 billion worldwide.
- In Europe, more than 200.000 people are directly employed in the semiconductor sector alone with a growing shortage of skills.
- The impact of electronics on the whole economy, from automotive to health, energy, aerospace or agro industries amounts to 10% of the worldwide GDP.
- As an example, with the increasing electrification of cars and the move towards greener vehicles, electronics will represent more than half of the value of the car by 2020. It already represents more than a third of the value in today's medium and high range cars.

In brief, electronics is at the centre of improved productivity and sustainability of modern manufacturing, higher value products and innovation in services in all sectors.

2.2. Embedded systems: driving innovation across industry

Embedded ICT systems include the software, computing and networking technologies that are specifically designed in order to be integrated in all types of products and services such as but not limited to cars, planes, home appliances, medical equipment, factories or energy equipment. Their requirements depend on the physical systems in which they are embedded

[2] Advances in electronics follow a sustained "more for less" curve characterised as Moore's Law (doubling of performance for the same price every 18 months)

and often include efficient energy consumption, high safety and dependability features, and the ability to respond in real time as well as stringent size constraints. Embedded systems are the technology that enables the whole economy and society to benefit fully from ICT progress.

An important part of embedded systems is developed by end user companies such as automotive, energy, aerospace or engineering companies. However there is also a large community of suppliers of such systems, mostly SMEs but equally large companies. A rough estimate shows that there are more than two million people in the EU employed to develop, implement and maintain embedded systems mainly in user industry.

In 2010, the global embedded systems market accounted for around €850 billion. The overall industry is growing quickly (12% per year) and should reach €1.5 trillion in revenue by 2015. It is part of key markets of European industry. For example, between 7% and 12% in civil avionic costs are in embedded systems (hardware, software services) and up to 35% of R&D cost is in embedded systems. The figures are even higher in automotive with 25% of vehicle cost in embedded systems and 80% of product innovation coming from embedded systems.

2.3. Key technologies for addressing the societal challenges

Electronics components and systems are not only found in PCs and mobile devices; they also include the sensors, cameras and actuators in all types of artefacts including the smart grids for lower energy consumption or implants and sophisticated medical equipment for healthcare. They provide the building blocks for security systems, for safety and energy efficiency of transport systems and for food safety and environmental monitoring.

Nowadays there is not a single societal challenge in which electronics is not at the basis of innovative solutions to address that challenge.

2.4. Technological and economic context

Europe is facing two main challenges in the field of electronic components and systems:

- The need to be in control of the key elements of the value chain, i.e. "components and systems design", "components manufacturing", and "integration of electronic components into final products". The electronics value chain extends beyond manufacturing of chips and includes the whole user industry from automotive to aerospace up to web-based services. Each of its elements is essential to ensure sustainability of value creation from electronics in Europe[3].
- The need to cover the full innovation chain as e.g. highlighted by the KET report [3]. While there is excellent research capacity in Europe, the steps to innovation and industrial production need to be strengthened so that businesses and citizens can fully benefit from leading-edge technologies.

If Europe loses its electronics manufacturing capability/capacity the relevant supply chains and design activities may shift outside Europe and the competitiveness of the whole economic fabric depending on electronics will be at risk. To ensure control of the value chains and

[3] Including not only within the electronics sector but also across the economy

improve its innovation system, Europe needs to overcome following difficulties (see Annex 1 for further details):

- Fierce global competition and changing business models;
- Declining market shares of production;
- High costs of R&D&I and fragmented European landscape; and
- Fast-paced innovation, seizing the opportunities ahead.

2.4.1. Fierce global competition and changing business models

In electronics, a shift of production to Asia has been a major trend in the last 5 years as illustrated in Figure 11 [7]. This trend is reinforced by changing business models resulting in new industrial actors emerging with the foundry model. Foundries now already account for nearly 10% of the worldwide production and these are mainly located in Asia.

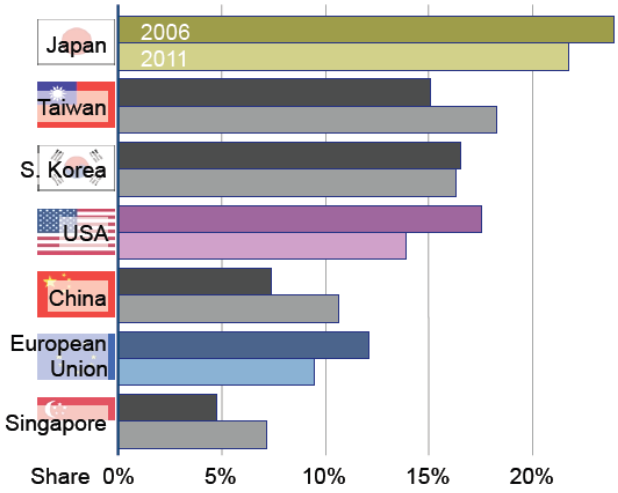


Figure 11 - Regional share of IC production

2.4.2. Declining market shares of production

Europe is home to 3 large European IDMs ranked 8th, 13th and 14th for worldwide sales in 2012 [8]. However, the market share of European semiconductor companies is declining and is presently below 10% as shown in Figure 12 [7].

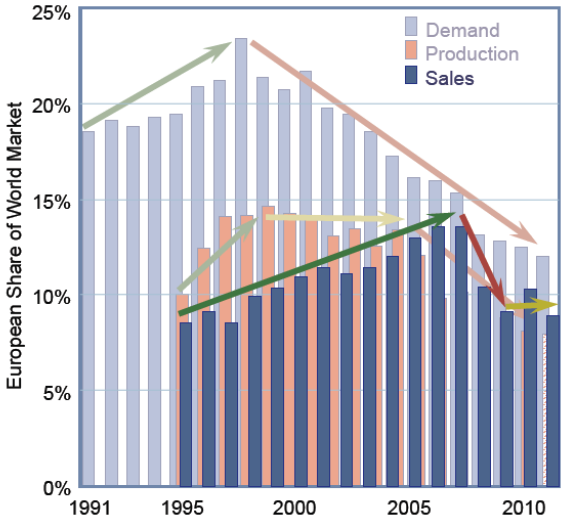


Figure 12 - European semiconductor market shares

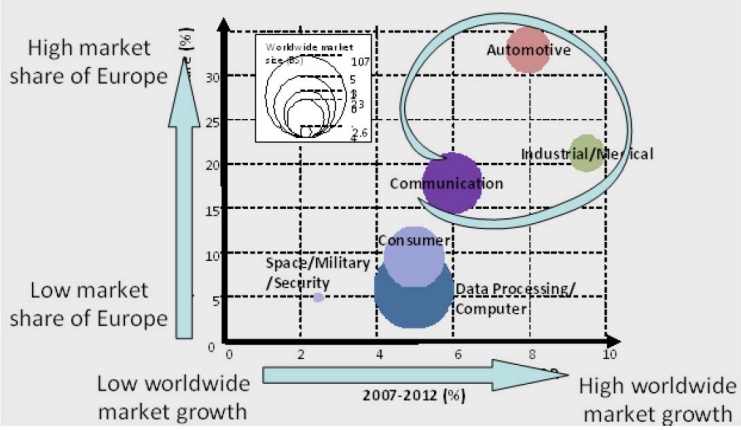
2.4.3. High costs of R&D&I and fragmented European landscape

Mastering complexity requires heavy investment in R&D&I and spending huge capital in production and design facilities as research on devices and production are intimately intertwined. Such investments can only be justified by volume production in particular through commoditisation (e.g. mass market products). This has led to a concentration of industry. It is estimated that nowadays a semiconductor company must capture a 10% share of the worldwide market to afford the investment to keep up with the state-of-the-art technology development.

Two main factors explain Europe's weaker position in this field. Those are underinvestment and fragmentation of efforts. Although in absolute terms investments by EU companies is in the order of billions of euros, investments remain relatively modest compared to the worldwide competition.

2.4.4. Fast-paced innovation, seizing the opportunities ahead

As illustrated in Figure 13 and Figure 14, the European industry and the affiliated research and innovation partners are well positioned in critical industrial areas. Europe has world leading companies in electronic components and systems in automotive [9], industrial automation, energy applications and communications. However, it is relatively absent in computer and consumer related components and systems that constitute a large part of the market [9].



Sources: Gartner (2008)

Figure 13 - European markets

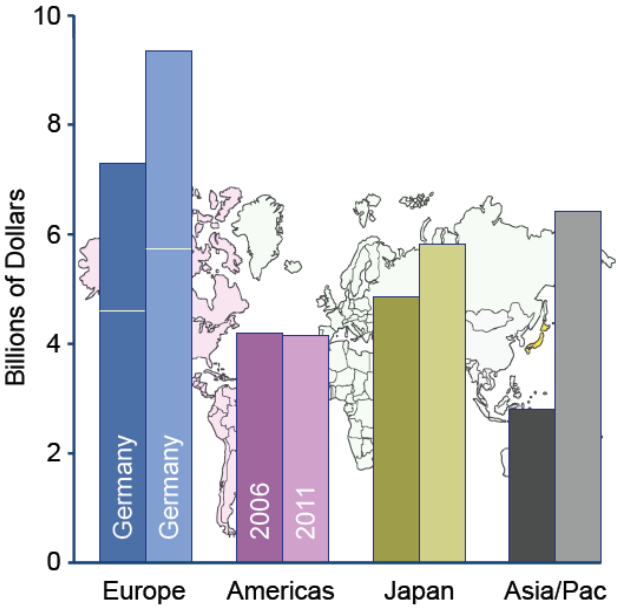


Figure 14 - Shares of automotive semiconductors

The outlook for embedded systems in Europe is challenged by two main factors. Firstly, generic ICT platforms at devices, applications and content level are mostly dominated by non-EU actors (e.g. operating systems, smartphones, and web-platforms for e-commerce or social networks). Secondly, embedded systems are increasingly networked and connected to the Internet[4] leading to new business opportunities but also to the entry of new players. The blurring of barriers between sectors such as the web industry and the embedded systems supply industry however also creates new opportunities. Seizing these will require notably more cross-sector sharing of tools and technologies that are today separate. Furthermore it will require more interaction between software development, hardware development and end-users.

[4] Embedded systems are increasingly referred to as "cyber-physical systems" to illustrate their role in connecting physical objects to the web

The close relationship between the electronic components industry and the industrial fabric and the proximity with systems integrators is therefore of paramount importance for Europe. At the same time, R&D in Europe needs to keep pace with worldwide competition. If the manufacturing industry would start to lose ground in Europe, R&D&I may disappear as well and with it the whole ecosystem, including the user industries.

2.5. Achievements and lessons learned from the current ENIAC and ARTEMIS JUs

2.5.1. Governance and objectives

Both the ARTEMIS and ENIAC JUs were set-up under the Article 171 of the Treaty (now Article 187 of the TFEU) along with the other JTIs (IMI, CleanSky and FCH). Both ENIAC and ARTEMIS JUs are tripartite initiatives mobilising funding from the EU, Member States and private members.

ENIAC and ARTEMIS JUs have similar governance structures as shown in Figure 15 [10].

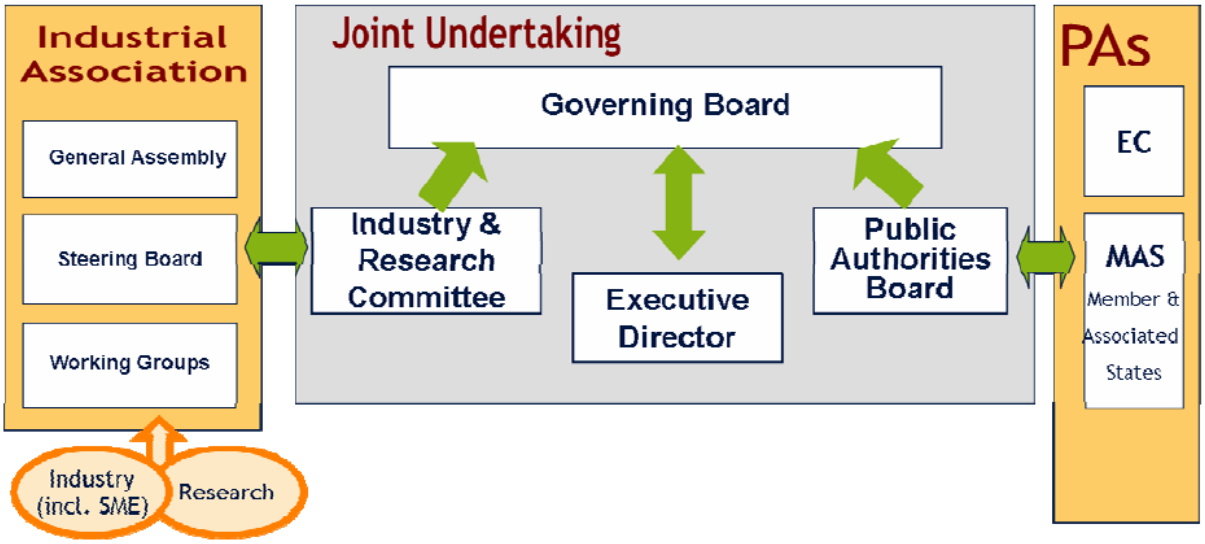


Figure 15 – Current JUs governance structure

The governance structure has four bodies as follows:

- Governing Board – The Governing Board has overall responsibility for implementing and supervising the execution of the JTI programme and takes all decisions of a strategic nature. 50% of the voting rights are for the Industrial Association and 50% for the public authorities (Commission and participating States). The distribution of the votes for the public authorities is established annually in proportion to the funds committed to the JTI's activities.
- Industry and Research Committee – It is inter alia responsible for the drafting of the multiannual strategic plan and the annual work programme.
- Public Authorities Board – Composed of national public authorities and the Commission. It is inter alia responsible for decisions on the allocation of public funds following open calls for proposals.

- The Executive Director – He/she is the legal representative of the Joint Undertaking and ensures its day-to-day management. A Secretariat supports the Executive Director in all his/her tasks.

The objectives of ENIAC and ARTEMIS JUs essentially are:

- To define and implement a research agenda in their fields.
- To support activities required for the implementation of the research agenda notably by awarding funding to participants in selected projects following competitive calls for proposals.
- To promote a public-private partnership aiming at mobilising and pooling public and private resources to increase the overall R&D investment in their fields.
- To achieve synergy and coordination of European R&D efforts.
- To promote the involvement of SMEs in its activities.

2.5.2. Achievements

Two interim evaluations of the current ARTEMIS and ENIAC JUs [11, 12] were completed in 2010 and 2012. Both interim evaluations confirmed that the original motivations for the establishment of the ARTEMIS and ENIAC JU are still valid and acknowledge the significant value and achievements obtained. Both evaluations highlight the crucial role of the Strategic Research Agenda (SRA). If the first evaluation was focused on addressing issues related to the start-up of the JUs, the second evaluation assessed the concrete impact of the two JUs. Many of the recommendations relate to the 'next generation JUs'. These recommendations have been discussed in the design of the new JU with the stakeholders and have been taken into account in the current Impact Assessment (see in particular in Section 2.6 and 3). The recommendations relate to e.g. the support of innovation-related actions (addressing higher TRLs), the use of a simpler financial regulation in line with the recommendations made by the 'Ideal house' group [13] and the need for appropriate metrics to measure the impact and the success of projects and the initiative as a whole. The second interim evaluation published its final report in May 2013.

In the period 2008-2011, the two JUs supported a total of 84 projects (44 for ARTEMIS JU and 40 for ENIAC JU). Annex 2 gives an overview of their results.

As reported by the ENIAC JU, the impact and leverage of the initiative on the semiconductor industry is observed in the following achievements:

- It defined and implemented a Strategic Research Agenda strengthening the relevant areas in which Europe improved its competitiveness by directing funding to the priority subjects, in particular to "Energy Efficiency" (29%) and "Materials, Equipment and Manufacturing" (25%).

- The first projects approaching completion in 2012 demonstrated significant advances of the state of the art in their respective fields, strengthening the global competitive position of the European industry.

- It leveraged the public investments, increasing the amounts contributed by the ENIAC Member States by a factor of 2.5 (from €62 million in 2008 to €150 million in 2012) and the EU contributions by a factor of 3.5 (from €35 million in 2008 to

€125 million in 2012). The private sector increased its contributions by a factor of 5 (from about €110 million in 2008 to an estimate amount exceeding €550 million in 2012).

- It engaged the whole ecosystem, allowing the countries with smaller national programmes in nanoelectronics to contribute to a combined level equivalent to the three leading nations.

- It created opportunities to contribute for the SMEs that represent the majority of the participating organizations with 41%, inducing collaboration of the large industry (29% of the participating organizations) and the academic and industrial research (30%).

- The project proposal, submission and evaluation mechanisms allow to execute the whole cycle within 7-9 months.

- It is thus far the only mechanism that already engaged in implementing the KET policy to the extent to which they are compatible with the existing regulations, rules and procedures, playing the role of a catalyst federating all contributors towards re-engaging the European semiconductor industry on a path of profitable growth.

- It induced a new quality of collaboration between the stakeholders that resulted in remarkable progress in the past and provides a solid basis for the future strategic perspectives.

As reported by the ARTEMIS JU, the following achievements are highlighted:

- The distribution of investment over the 8 ARTEMIS Strategic Research Agenda Sub-Programmes shows a large take-up of safety-critical systems (with 32%) and architectures (with 26%). Safety-critical systems are significant because of its high importance for the transport and health industries, attracting larger projects with directly relevant outcomes for industry. In the area of architectures fundamental technologies (especially for low-power-multi-core architectures) are introduced in industrial applications (i.e. respecting high system reliability demands).

- After four Calls, ARTEMIS JU has running projects representing a total R&D&I investment of €708 million, comprising €228 million national contributions, €116 million contribution by the EU and €363 million from industry.

- ARTEMIS JU has achieved its high-level goals of reducing fragmentation by enlarging the typical project 'footprint' at a European level.

- Creation of ARTEMIS JU "Centre of Innovation Excellence" (CoIE) - a formalization of the "Self-sustaining Innovation Ecosystem" concept. To date, there are three such CoIEs, notably on safety-critical (electronic) engineering, on process automation and on energy-efficiency in intelligent buildings.

- Two of these CoIEs are the kernel of two corresponding "ARTEMIS Innovation Pilot Projects" (AIPPs) that were selected in 2012.

- Of the 586 unique entities participating in ARTEMIS JU projects the high level of SME participation (36%) was made possible by the national contribution, favourable to SMEs and the emergence of local ARTEMIS networks supportive of SME integration, such as the ARTEMIS "mirrors" in Austria, Hungary, Denmark and Spain ("Prometeo").

As can be seen from the above, overall the two JUs demonstrated that they play a significant role as a catalyst in stimulating ambitious projects and increasing the engagement of the private sector. The JUs provide a framework in which national and European public authorities can combine support for topics of strategic importance. This capability has been convincingly demonstrated by the ENIAC JU in successfully jump-starting the implementation of the KET recommendations in nanoelectronics and by the ARTEMIS JU's in its first trial of large Artemis Innovation Pilot Projects within their call for proposals in 2012.

2.5.3. Issues in meeting the initial objectives

Besides the successes mentioned above, there are some particular problems faced by the JUs in meeting their objectives. The second interim evaluation identified a gap in the value chain existing at the system level, in disruptive product innovation and in computing and operating platform infrastructures. '*Europe's ability to meet such [related] challenges is threatened by significant 'gaps' – not only in research or general technological competence, but most significantly in the industrial value chain*'. Considering the interdependence of activities in ENIAC and ARTEMIS JU for putting products in the market, these findings clearly outline the need to address the whole value chain in the future initiative(s). On a general level, both interim evaluations of the ENIAC and ARTEMIS JUs identify the need to ensure that the initiatives implement an over-arching European strategy.

During the period 2008-2012, the total spending by the Member States participating in the initiatives amounts to respectively 395 M€ and 228 M€ for ENIAC JU and ARTEMIS JU. This is well below the 792 M€ and 738 M€ initially foreseen. In the case of the ENIAC JU the spending of the Member States is below the 1.8 MS/JU ratio indicated in the Council regulations.

Regarding the tripartite construction of both JUs, one important challenge ahead is in aligning content and procedure with the expectations and processes of the participating Member States. The experience so far however shows that it was possible to a certain extent to meet the objectives although with a ramping up slower than originally foreseen.

In addition to the above further more operational observations can be drawn from the present set-up:

- There is a lack of synchronisation of national procedures (for both contracting and payments) creating delays in the implementation of projects.

- The obligation for the participants to conclude two grant agreements (JU and national) constitutes an administrative burden.

- The variety of national eligibility criteria has an impact on the way consortia are built.

- The 'hard-coded' dependency between national commitments and the EU (1.8 ratio) hampered the EU budget execution when national contributions were low or when national funding rates deviated from the anticipated public funding ratio: 1/3 (JU) and 2/3 (national) ratio, in particular in the case of ENIAC pilot lines.

- Requirements of the EU Framework Financial Rules put a significant burden on the operations of the JU.

Those difficulties however were no show-stoppers but required continuous efforts from all parties to make the system work. Any future initiative would greatly benefit from addressing these up-front through a simplified operating model in line with the overall simplification goals as proposed in Horizon 2020.

2.6. Key problems and their drivers

In their analysis the interim evaluation panels of the ARTEMIS and ENIAC JU identified several issues to be addressed in the implementation of the Joint Undertakings in order to strengthen and improve their relevance, effectiveness, efficiency, and research quality. For completeness a succinct table is presented below where recommendations are bundled into six categories.

Table 1 - Synthetic presentation of the recommendations from the two interim evaluations [11, 12]

Recommendations	Ref[5]	Constituency
An integrated European strategy		
A mid- to long-term overarching EU research, development and innovation strategy in Electronic Components and Systems (ECS) should be clearly defined and used as a key 'driver' for funding decisions.	2-17	European Commission
Place greater emphasis on strategic, European aims in proposal evaluation & selection processes. Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy.	1-16 2-1	Joint Undertakings and Industrial Associations
ARTEMIS & ENIAC should continue their initiatives to be more closely aligned with ITEA2 and CATRENE, respectively, retaining some flexibility over the assignment of the most appropriate funding stream.	1-18 2-7	JTI-EUREKA coordination
Allow for a more efficient implementation		
Future JUs in these domains to continue the tripartite JTI model.	1-1	All
Construct/draft the new Council Regulations, as a PPP with reduced Financial Regulations and Staff Regulations.	1-9 2-8	European Commission
Regulations should allow JTIs to support innovation-related activities other than R&D.	1-10	European Commission
The ENIAC & ARTEMIS JUs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into one legal entity.	2-6	European Commission
Improved governance and strategic planning		
Focus the JU Governing Board on strategic issues and reduce its administrative burden in order to attract participation from high-level industry representatives.	2-9	Joint Undertakings
Engage better with the JTI constituencies so as to promote and facilitate participation in project proposals, especially by SMEs. AENEAS, should play a more active role in the definition of the overall objectives and strategy of the ENIAC JU and keep up to date the Strategic Research Agenda.	1-8 2-2	Industrial Associations
Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects.	1-7 2-4	Industrial Associations, Joint Undertakings

[5] See Annex 2 for synthetic tables of recommendations from the 2 interim evaluations. The first number refers to the first or second evaluation and the second number is the recommendation number.

Recommendations	Ref[5]	Constituency
Specific support mechanisms for enhancing the project management processes in JU projects should be developed and implemented. Management costs should be 100% funded by the EC for all JU projects.	2-14	Joint Undertakings and European Commission
Establish a mechanism for recovering some of their operation costs from non-member beneficiaries of the JUs.	1-13 1-15	European Commission, Joint Undertakings
Strengthened commitment and alignment with priorities of Member States		
Member States should commit to a multi-annual funding system.	1-2 2-12	Member States
Compliance with the JTI Council Regulations	1-3	Member States
Give early annual indication of support for specific topics.	1-5	Member States
Harmonisation of conditions of participation		
Regulations should allow JTIs to accept funding from other sources	1-11	European Commission
Member State participation rules, funding rates and procedures should be harmonised wherever possible. Regulations should allow the EU to make additional financial contributions for strategic purposes, projects which are mission-critical. An 'early warning system' to identify mismatches in funding of member states should be implemented.	1-4 2-10	Member States
The proportion of funding for projects targeting generic applications and services (applications projects) should be increased	2-5	ARTEMIS JU and Industrial Association
Streamlined operations including better monitoring and evaluation		
Establish processes to give early feedback to proposers.	1-17	Joint Undertakings
JU projects should be subject to only one joint JU and MS project review and reporting process.	2-15	Joint Undertakings and Member States
Lead the establishment of processes to monitor progress toward JU objectives.	1-6	Industrial Associations
Appropriate metrics and data gathering for measuring the impact and success of projects should be developed and used to support assessment of the benefits of these JUs.	1-14 2-16	European Commission, Joint Undertakings
ENIAC should monitor more closely and rigorously the actual and planned exploitation of project results, and the measures put in place by project partners to achieve such planned exploitation. A detailed deployment and commercialisation strategy for ARTEMIS project results should be defined.	2-3	Joint Undertakings

An integrated European strategy in electronic components and systems

The second interim evaluation recommended that the JTIs need an overarching European research strategy. Such a strategy would reduce fragmentation, avoid duplication of efforts, allow the development of a sustainable electronic components and systems industrial ecosystem and provide a means to address cross-cutting issues where components and embedded software interact. Furthermore such a strategy would allow a better positioning of different existing instruments including relevant EUREKA clusters and provide an effective means for European stakeholders to keep pace with technology, to get access to advanced components and to consolidate leadership in electronic systems for key economic sectors.

Provide a legal base for a more efficient implementation

Both interim evaluations recommended the implementation of the future JTI on a legal basis that is better attuned to the specificities of Public-Private Partnerships with a lighter administrative overhead and greater flexibility.

Improved governance and strategic planning

Both interim evaluations observed that the Governing Board spend too much time on operational monitoring and too little time on discussing strategic issues. The second interim evaluation noted that the administrative burden should be reduced in order to attract the participation from high-level industry representatives. Improved governance and the involvement of high-level industry representative will result in better and strategic planning that will engage stakeholders and better reflect the research priorities including those from the Member States. In this context the second interim evaluation report also indicated that industrial associations should play a more active role in the definition of the overall objectives and strategy of the JTIs and should engage more actively with stakeholders so as to promote and facilitate participation in project proposals, especially by SMEs, and develop and keep up-to-date the Strategic Research Agenda.

Strengthened commitment and alignment with priorities of Member States

Both interim evaluations recommended that Member States should commit to a multi-annual funding system. This would allow for strategic agenda setting (see above) and allow stakeholders to plan ahead. The latter is essential considering the size of the investments and the need for sustaining research over a longer period of time.

Harmonisation of conditions for participation

The interim evaluations highlighted the need for harmonisation between national procedures and criteria among the participating Member States. Member State participation rules, funding rates and procedures should be harmonised and synchronised wherever possible, adopting best practice as the guiding principle.

Streamlined operations including better monitoring and evaluation

Both interim evaluations recommended various recommendations as to how to streamline operations and provide for a better monitoring and evaluation. In particular it is recommended that the evaluation and selection process should be reviewed to improve the match of the project portfolio with the overarching strategy (see above). Appropriate metrics/key performance indicators should facilitate the evaluation of the progress towards the set objectives. The JUs are notably requested to improve the check of the exploitation plan at the proposal level and its follow-up along the life of the project and beyond. Furthermore the need for participants to sign two grant agreements (with the JU and the Member State) may delay the start of the projects. Projects supported in the JTI should be subject to only one (i.e. the JU) project review and reporting process.

2.7. Who is affected and how

The initiative targets the competitiveness of the European electronic components and systems industry. Industrial stakeholders are the primary actors. The initiative will support existing companies in improving their competitiveness and in growing/maintaining their manufacturing base. It will moreover support the creation and growing of new companies, in particular in the domain of design. It furthermore targets industry that depends on electronics to innovate such as the automotive, medical equipment, aerospace and energy industries. This constitutes a large part of European industry.

It will affect the European citizens by providing the technologies that are needed to tackle key societal challenges. Citizens will e.g. have an increased choice of energy efficient products with improved functionalities and access to new related services.

2.8. The need for public intervention

The Horizon 2020 Framework Programme identified that '*ICT underpins innovation and competitiveness across a broad range of private and public markets and sectors, and enables scientific progress in all disciplines. To master increasingly complex and multidisciplinary technology and business chains in ICT, partnering, risk-sharing and mobilisation of critical mass across the Union are needed. Union level action helps industry address a single market perspective and achieve economies of scale and scope. Collaboration around common, open technology platforms with spill-over and leverage effects allow a wide range of stakeholders to benefit from new developments and apply further innovations.*' This is getting truer as both hardware and software are intimately integrated in powerful systems giving more value to the system integrators. This requires much closer cooperation along the whole development value chain [6]. As indicated in section 2.4, this line of argumentation equally applies to electronic components and systems.

Through Horizon 2020 in general and Joint Technology Initiatives in particular, private companies can collaborate with partners across Europe at a scale that is not possible at national level [14]. In the public consultation both industrial and academic actors endorsed the need for support to collaborate at different stages of the innovation chain in order to ensure that research results actually reach the market and are not shelved in academic or industry research labs [6].

A public intervention is required to counter the threats and address the weaknesses hindering the development of this industrial sector in Europe (cf. SWOT analysis in Annex 1). Public support to collaborative research and innovation involving industry and academia will assist to:

- Maintain European public research teams at the leading edge in electronic components and systems and ensure the fast and broad industrial exploitation of technology leadership across Europe.
- Share the costs of risk-taking with the electronic components and systems industry in progressing the technology and its wider use given the huge spill-over on growth and jobs across the economy and the impact on addressing the societal challenges ahead.
- Join forces. Member States have their own priorities in promoting their industry but the level of support needed for this industry is beyond their individual resources. Fragmentation leads to duplication in R&D efforts. Furthermore only a few world leading clusters with significant industrial activity in electronic components and embedded systems exist in Europe. Hence '*EU players need to join forces. Better cooperation based on collaborative working and sharing between large OEMs companies and technology providers accelerate the product innovation on both sides … by coordinating business focus, research projects clusters provide a regional support network for SMEs through cooperation between academia and large OEMs industry*.' [15]
- Reinforce the existing European clusters in electronic components and the actively support of the creation of new clusters is needed to place Europe on a comparable footing to other players worldwide [16]. There is a need for action at the European level in order to pool resources and bring actors together, to provide the right level of scope and significant means to strengthen the industry. This support needs to provide a sustainable and adequate solution for Europe to face international competition.
- Structure and coordinate research and innovation, to ensure that also in the future there will be a manufacturing base in Europe and that European actors, especially users, have access to the latest technology developments and infrastructures. To reach this goal, it is critical to effectively leverage public funding at European and national levels.

2.9. The right to act

This European initiative is proposed in the context of the implementation of Horizon 2020, in particular the Commission's proposal [17] states that:

'*Joint Undertakings established in FP7 under Article 187 of the Treaty, for which further support may be provided under the above conditions*[6] *are: the Innovative Medicines Initiative (IMI), Clean Sky, Single European Sky ATM Research (SESAR), Fuel Cells and Hydrogen (FCH), and Embedded computing systems (ARTEMIS) and Nanoelectronics (ENIAC). The latter two may be combined into a single initiative.*'

2.10. Subsidiarity

The current ARTEMIS and ENIAC JUs provided a major opportunity to cooperate across Europe, create critical mass and leverage investments. Both interim evaluations [11, 12] strongly recommended continuing a similar initiative under Horizon 2020 considering that no single organisation or Member State could possibly address all the challenges of this industry.

[6] See the criteria which should be fulfilled by Joint Technology Initiatives under Horizon 2020 in section 0

Therefore, a coordinated action at European level is deemed to be the most appropriate approach.

The budgetary impact and EU contribution of this initiative are part of the global Horizon 2020 proposal and budget.

2.11. Baseline scenario

The baseline scenario is to implement the JTI on electronic components and systems by renewing the current ARTEMIS and ENIAC JU initiatives with the necessary adaptations to comply with the context of Horizon 2020. The two JUs could be set-up as 'PPP' bodies using a simplified financial regulation based on Article 209 FR. The necessary adaptations are notably concerning the rules for participation for Horizon 2020, e.g. the flat rate financing of participants,

As demonstrated through the various stakeholder consultations, there is a positive opinion in pursuing with public support to the sector, and industry is committed to invest significantly in Europe [18]. The renewal of the current initiatives would continue support for advanced electronic components and systems for the European industry and improve its competitiveness.

The baseline scenario is based on a status quo where no specific improvements beyond the above necessary adaptations are made.

In this baseline scenario a European strategy for micro- and nanoelectronics components and systems would rely on two separate initiatives that each have their own established dynamics and building on existing constituencies.

3. OBJECTIVES

3.1. General Objectives

The present initiative intends to go beyond the objectives of the current ENIAC and ARTEMIS JUs. The overall objectives of the present initiative are aligned with the European strategy on electronic components and systems, as recommended by the two interim evaluations (see Table 1). They translate in the following general objectives of the Joint Undertaking:

- to contribute to the development of a strong and globally competitive electronics components and systems industry in the Union;

- to ensure the availability of electronic components and systems for key markets and for addressing societal challenges, aiming at keeping Europe at the forefront of technology development, bridging the gap between research and exploitation, strengthening innovation capabilities and creating economic and employment growth in the Union;

- to align strategies with Member States to attract private investment and contribute to sound public finances by avoiding unnecessary duplication and fragmentation of efforts, and easing participation for actors involved in research and innovation;

- to maintain and grow semiconductor and smart system manufacturing capability in Europe, including leadership in manufacturing equipment and materials processing;

- to secure a commanding position in design and systems engineering including embedded technologies;

- to provide access for all stakeholders to a world-class infrastructure for the design and manufacture of electronic components and embedded/cyber-physical and smart systems;

- to build a dynamic ecosystem involving innovative SMEs, strengthening existing clusters and nurturing the creation of new clusters in promising new areas.

3.2. Specific Objectives

Specific objectives of the initiative aim at improving the European landscape in the electronic components and systems sector in order to remove roadblocks and to achieve the overarching objectives. They are:

- to structure and perform excellent research and innovation in the area ensuring optimal articulation between EU, national and regional investment programmes and industrial priorities;
- to mobilise and pool, when needed, public resources at regional, national and EU levels in support of electronic components and systems in Europe, creating critical mass and attracting private funding in the field;
- to facilitate multi-disciplinary research and innovation actions along the full innovation chain, covering Technology Readiness Levels 2 to 8, including manufacturing pilot lines and large scale application experiments, thereby reducing time to market and closing the gap between research and industrial exploitation;
- to bring together the actors in value chains, including users and SMEs, to address the inherent complexity in the design and manufacturing of electronic components and systems;
- to strengthen the ecosystem from component design to semiconductor manufacturing to embedded systems development to end users, from equipment and material suppliers to semiconductor manufacturers to systems engineering, from universities to RTOs to industry including SMEs; and
- to create and grow market opportunities for electronic components and systems in areas such as but not limited to automotive, transport, health, energy, security, telecommunications and digital media.

Going beyond the objectives of the current JUs, the initiative enlarges the scope of actions downstream in the innovation chains. It notably includes actions supporting focused platforms which will be widely accessible to further innovative developments, beyond the initial objectives of the current JUs. This will reinforce the leveraging effect of the initiative. The following table indicates the drivers underlying the proposed specific objectives and how these relate to the current JUs' objectives.

Table 2 - Links between the current JUs' objectives, recommendations from the two interim evaluations and the proposed JU specific objectives

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
Structure and perform excellent research and innovation in the area ensuring optimal articulation between EU, national and regional investment programmes and industrial priorities	<u>An integrated European strategy</u> • Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy • ARTEMIS & ENIAC should continue their initiatives to be more closely aligned with ITEA2 and CATRENE, respectively, retaining some flexibility over the assignment of the most appropriate funding stream <u>Allow for a more efficient implementation</u> • Future JTIs in these domains to continue the tripartite JTI model <u>Improved governance and strategic planning</u> • Focus the JU Governing Board on strategic issues and reduce its administrative burden in order to attract participation from high-level industry representatives	Define and implement a research agenda in their fields Achieve synergy and coordination of European R&D efforts
Mobilise and pool, when needed, public resources at regional, national and EU levels in support of electronic components and systems in Europe, creating critical mass and attracting private funding in the field	<u>Allow for a more efficient implementation</u> • Future JTIs in these domains to continue the tripartite JTI model <u>Strengthened commitment and alignment with priorities of Member States</u> • Member States should commit to a multi-annual funding system • Give early annual indication of support for specific topics	Promote a public-private partnership aiming at mobilising and pooling public and private resources to increase the overall R&D investment in their fields

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
	<u>Harmonisation of conditions of participation</u> • Member State participation rules, funding rates and procedures should be harmonised wherever possible. • Regulations should allow JTIs to accept funding from other sources • Regulations should allow the EU to make additional financial contributions for strategic purposes, projects which are mission-critical	
Facilitate multi-disciplinary research and innovation actions along the full innovation chain, covering Technology Readiness Levels 2 to 8, including manufacturing pilot lines and large scale application experiments, thereby reducing time to market and closing the gap between research and industrial exploitation	<u>Allow for a more efficient implementation</u> • Regulations should allow JTIs to support innovation-related activities other than R&D • The ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into one legal entity <u>Improved governance and strategic planning</u> • Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects • Specific support mechanisms for enhancing the project management processes in JTI projects should be developed and implemented. Management costs should be 100% funded by the EC for all JTI projects	Support activities required for the implementation of the research agenda notably by awarding funding to participants in selected projects following competitive calls for proposals

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
	Streamlined operations including better monitoring and evaluation • ENIAC should monitor more closely and rigorously the actual and planned exploitation of project results, and the measures put in place by project partners to achieve such planned exploitation A detailed deployment and commercialisation strategy for ARTEMIS project results should be defined	
Bring together the actors in value chains, including users and SMEs, to address the inherent complexity in the design and manufacturing of electronic components and systems	An integrated European strategy • Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy Improved governance and strategic planning • Engage better with the JTI constituencies so as to promote and facilitate participation in project proposals, especially by SMEs	Promote the involvement of SMEs in its activities
Strengthen the ecosystem from component design to semiconductor manufacturing to embedded systems development to end users, from equipment and material suppliers to semiconductor manufacturers to systems engineering, from universities to RTOs to industry including SMEs	An integrated European strategy • Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy Allow for a more efficient implementation • The ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into one legal entity	Promote a public-private partnership aiming at mobilising and pooling public and private resources to increase the overall R&D investment in their fields

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
	<u>Improved governance and strategic planning</u> • Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects	
Create and grow market opportunities for electronic components and systems in areas such as but not limited to automotive, transport, health, energy, security, telecommunications and digital media	<u>Streamlined operations including better monitoring and evaluation</u> • ENIAC should monitor more closely and rigorously the actual and planned exploitation of project results, and the measures put in place by project partners to achieve such planned exploitation A detailed deployment and commercialisation strategy for ARTEMIS project results should be defined	Define and implement a research agenda in their fields

3.3. Operational Objectives

Operational objectives include:

- to elaborate and keep an up-to-date industry-driven Strategic Research and Innovation Agenda (SRIA) for the European electronic components and systems industry;
- to implement the SRIA efficiently by initiating calls for proposals, evaluating proposals, awarding funding and monitoring projects including large scale pilot lines, technology platforms and application demonstrators selected through open, transparent and effective procedures, within the limits of available funds;
- to create synergies through closer and more strategic cooperation;
- to assist the exploitation of R&D&I results, supporting the development and growth of innovative SMEs in the sector;
- to ease the participation of R&D actors in projects with a truly European dimension, by ensuring simple and efficient rules and procedures;
- to provide access to state-of-the-art design and manufacturing infrastructures for electronic components and systems;
- to develop closer cooperation and ensure coordination/complementarity of European (in particular Horizon 2020), national and trans-national activities, bodies and stakeholders;
- to foster a comprehensive and fertile innovation environment in Europe; and
- to maintain a continuous stream of highly skilled graduates and trainees in the field, responding to growing industrial needs.

The following table indicates the drivers underlying the proposed operational objectives and how they relate to the current JUs' objectives.

Table 3 - Links between the current JUs' objectives, recommendations from the two interim evaluations and the proposed JU operational objectives

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
Elaborate and keep an up-to-date industry-driven Strategic Research and Innovation Agenda (SRIA) for the European electronic components and systems industry	<u>Allow for a more efficient implementation</u> • The ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into one legal entity <u>Improved governance and strategic planning</u> • AENEAS, should play a more active role in the definition of the overall objectives and strategy of the ENIAC JTI and keep up to date the Strategic Research Agenda	Define and implement a research agenda in their fields
Implement the SRIA efficiently by initiating calls for proposals, evaluating proposals, awarding funding and monitoring projects including large scale pilot lines, technology platforms and application demonstrators selected through open, transparent and effective procedures, within the limits of available funds	<u>Allow for a more efficient implementation</u> • Regulations should allow JTIs to support innovation-related activities other than R&D <u>Improved governance and strategic planning</u> • Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects • Specific support mechanisms for enhancing the project management processes in JTI projects should be developed and implemented. Management costs should be 100% funded by the EC for all JTI projects	Support activities required for the implementation of the research agenda notably by awarding funding to participants in selected projects following competitive calls for proposals

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
	<u>Streamlined operations including better monitoring and evaluation</u> • Lead the establishment of processes to monitor progress toward JTI objectives • Appropriate metrics and data gathering for measuring the impact and success of projects should be developed and used to support assessment of the benefits of these JTIs	
Create synergies through closer and more strategic cooperation	<u>An integrated European strategy</u> • Place greater emphasis on strategic, European aims in proposal evaluation and selection processes Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy <u>Allow for a more efficient implementation</u> • The ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into one legal entity <u>Improved governance and strategic planning</u> • Focus the JU Governing Board on strategic issues and reduce its administrative burden in order to attract participation from high-level industry representatives	Achieve synergy and coordination of European R&D efforts
Assist the exploitation of R&D&I results, supporting the development and growth of	<u>Improved governance and strategic planning</u> • Engage better with the JTI constituencies so as to promote and facilitate participation in project proposals, especially by SMEs	Promote the involvement of SMEs in its activities

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
innovative SMEs in the sector	• Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects <u>Streamlines operations including better monitoring and evaluation</u> • ENIAC should monitor more closely and rigorously the actual and planned exploitation of project results, and the measures put in place by project partners to achieve such planned exploitation A detailed deployment and commercialisation strategy for ARTEMIS project results should be defined.	
Ease the participation of R&D actors in projects with a truly European dimension, by ensuring simple and efficient rules and procedures	<u>Allow for a more efficient implementation</u> • Construct/draft the new Council Regulations, as a PPP with reduced, alternative Financial Regulations and Staff Regulations <u>Strengthened commitment and alignment with priorities of Member States</u> • Member State participation rules, funding rates and procedures should be harmonised wherever possible <u>Streamlined operations including better monitoring and evaluation</u> • Establish processes to give early feedback to proposers • JTI projects should be subject to only one joint JTI and MS project review and reporting process	

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
Provide access to state-of-the-art design and manufacturing infrastructures for electronic components and systems	<u>Allow for a more efficient implementation</u> • Regulations should allow JTIs to support innovation-related activities other than R&D <u>Harmonisation of conditions of participation</u> • The proportion of funding for projects targeting generic applications and services (Applications projects) should be increased	
Develop closer cooperation and ensure coordination/complementarity of European (in particular Horizon 2020), national and trans-national activities, bodies and stakeholders	<u>An integrated European strategy</u> • ARTEMIS & ENIAC should continue their initiatives to be more closely aligned with ITEA2 and CATRENE, respectively, retaining some flexibility over the assignment of the most appropriate funding stream • Allow for a more efficient implementation • Future JTIs in these domains to continue the tripartite JTI model <u>Strengthened commitment and alignment with priorities of Member States</u> • Give early annual indication of support for specific topics <u>Improved governance and strategic planning</u> • Focus the JU Governing Board on strategic issues and reduce its administrative burden in order to attract participation from high-level industry representatives • Engage better with the JTI constituencies so as to promote and facilitate participation in project proposals, especially by SMEs	Promote a public-private partnership aiming at mobilising and pooling public and private resources to increase the overall R&D investment in their fields

New JU's objectives	Recommendations	ENIAC and ARTEMIS objectives
Foster a comprehensive and fertile innovation environment in Europe	<u>Allow for a more efficient implementation</u> • Regulations should allow JTIs to support innovation-related activities other than R&D <u>Improved governance and strategic planning</u> • Lead the preparation of action plans for achievement of innovation ecosystem aims, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects <u>An integrated European strategy</u> • A mid- to long-term overarching EU research, development and innovation strategy in Electronic Components and Systems (ECS) should be clearly defined and used as a key 'driver' for funding decisions • Improve the match of the project portfolio to strategic European aims and ensure optimum coverage of key areas defined in the overarching EU ECS strategy and the work plans derived from such a strategy	
Maintain a continuous stream of highly skilled graduates and trainees in the field, responding to growing industrial needs		

3.4. How do objectives relate to the problem statement

In Figure 16, the objectives are mapped onto the problem statements and their drivers.

It shows that actions have been identified in order to address each major problem area. While it is recognized that the scope of a JTI can only partially respond to the overall economic challenges with which the electronic components and systems sector is faced, there is significant room for addressing main market failures in Europe such as under-investments and fragmentation of the strategies.

Combined with an efficient implementation, the targets set for the new initiative will provide better conditions for a more competitive European industry by fostering innovation in essential fields of the European economy.

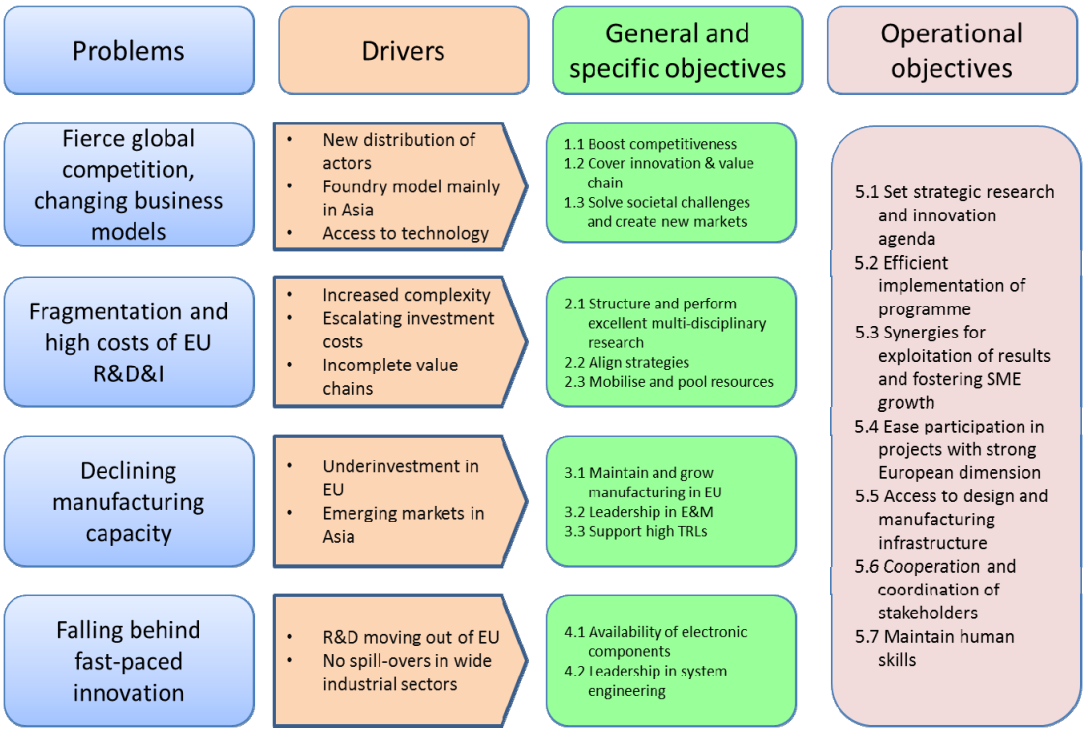


Figure 16 - Objectives matching the problem drivers

4. POLICY OPTIONS

4.1. Options

Article 19.3 of Horizon 2020 Framework Programme [1] describes the criteria to set up public-private partnerships. Public-private partnerships can be implemented either through a institutional or through a contractual agreement. An institutional PPP shall only be implemented where the scope of the objectives pursued and the scale of the resources required justify it.

Public-private partnerships shall be identified in an open and transparent way based on all of the following criteria:

(a) the added value of action at Union level;

(b) the scale of impact on industrial competitiveness, sustainable growth and socio-economic issues;

(c) the long-term commitment from all partners based on a shared vision and clearly defined objectives;

(d) the scale of the resources involved and the ability to leverage additional investments in research and innovation; and

(e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen.

A public-private partnership is an adequate tool to address the electronic components and systems sector.

In this context five main policy options are identified for implementing the JTI on electronic components and systems:

- Rely on the existing ENIAC and ARTEMIS initiatives by renewing and adapting their mandate in the new context of Horizon 2020 (baseline scenario – see Section 2.11);
- Undertake the planned activities without a dedicated PPP using the standard practices foreseen for collaborative projects under Horizon 2020;
- Launch a single new PPP replacing the existing ENIAC and ARTEMIS, which could take the form of:
    - A contractual PPP (without a dedicated legal entity);
    - A bipartite institutional PPP (a dedicated legal entity without Member State participation); or
    - A tripartite institutional PPP (a dedicated legal entity with Member State participation).

4.1.1. Option (a) Baseline - Business-as-usual: continue within Horizon 2020 with renewed ENIAC and ARTEMIS JUs

Considering the continued support of the Member States this baseline option capitalises on the experience gained in the ENIAC and ARTEMIS JUs and renews their present scope and set-up. Member States would have the option to renew or terminate their membership. The existing Industry Associations constituting the private part of the PPPs would continue to be involved.

This option requires the adoption of new Council Regulations to provide the legal basis to implement both ENIAC and ARTEMIS JUs' renewed objectives and new rules under Horizon

2020. This would provide an opportunity to improve the governance structures and simplify their modus operandi.

4.1.2. Option (b) Zero Option: use of the collaborative research projects under the EU Framework Programme Horizon 2020

This option allows the current JUs to accomplish their mandates by 2017, i.e. within the existing JU's no new activities after 2013 and a winding up in 2017. All running projects launched from 2008 to 2013 will continue to be supported by the current JUs. In this option all future public support at the EU level for electronic components and systems would happen within Horizon 2020 and no dedicated PPP body would be set up.

This option does not necessitate a new legal act. The R&D&I activities would be implemented through the standard EU funding programmes.

4.1.3. Adapting the scope of the new JTI

The Commission indicated in its report on the first interim evaluation of the JTIs [19] that there is a need for pooling resources in a joint JU in covering electronic components and systems. It stated that '*the Commission does not rule out that activities in areas addressed by ARTEMIS and ENIAC might be dealt with by a single JTI in the future. This might even cover a larger part of the value chain, addressing the burning issue of the trade-off between hardware and software and balancing technology-push and application-pull priorities. In addition, this would help increase the efficiency of the operational set-up*'.

'*Experience has shown that it is very difficult to exclude topics from one or other programme when exploring detailed options beyond high-level principles. Indeed, a large number of research subjects are addressed by both programmes (in the application and technology fields)* '.

Therefore, the following options are built on the strategic need to adapt the scope of the new JTI to encompass the full value chains for the electronic components and systems.

4.1.4. Option (c) Implement a contractual Public-Private Partnership

This option considers the setting up of a contractual PPP according to Article 19.2(b) of Horizon 2020.

As in the zero option, no dedicated legal act is needed and there is no specific involvement of Member States beyond the standard governance of Horizon 2020. With this option, there would be an SRA proposed by industry and a budget earmarked for the area. The European Commission services or an executive agency would manage the calls for proposals and the monitoring of projects. The work programmes would be elaborated by industry and approved by the Commission. There would be a contractual arrangement signed by the European Commission and relevant private partners.

4.1.5. Options (d) and (e) Implement a new institutional Public-Private Partnership

The institutional PPP is based on Article 19.2(a) of Horizon 2020. As in option (a), the JTI has to be implemented through a dedicated legal act based on Article 187 TFEU. In this case a single new Joint Undertaking with a budget ceiling would be established.

There are two ways to consider a new institutional PPP: with or without Member States participation.

Option (d) Implement a bipartite institutional Public-Private Partnership

A bipartite PPP involving private stakeholders and the EU (through the Commission) is a concept put forward by the European Commission for implementing long-term complex initiatives in other fields[7]. The operations are run as in the current initiatives but with EU contributions only. The Member States would not be members of the JU but could still be involved e.g. through an advisory board. As the Commission would be the only public funding body, the governance could be simplified, and only include a Governing Board, where private stakeholders and the European Commission are represented, the Executive Director, and some advisory committee(s) including a scientific committee and a Member States representatives group.

Option (e) Implement a tripartite institutional Public-Private Partnership

The tripartite PPP involving private stakeholders, Member States (on a voluntary basis) and the EU (through the Commission) capitalize on the experience of the existing ARTEMIS and ENIAC JUs. A new JU could take over all rights and obligations of the current ARTEMIS and ENIAC JUs to avoid duplicating legal structures. It would at the same time address the difficulties experienced with the current JUs by simplifying its operational model. As an example, the JU could be the one-stop-shop for contracting and payments of both EU and national contributions.

As for the two JUs in option (a) the governance structure of this JU would include a Governing Board in which the Commission, Member States and private stakeholders participate, a Public Authority Board, involving the Commission and the Member States, and the Executive Director.

Overall, except for option (b), the proposed options address the European need for better partnering in research and innovation [20]. For options (a), (c), (d) and (e), the Union budget ceiling would be communicated upfront.

4.2. Discarded options

4.2.1. No action at all

This option would mean stopping all public support at the European level for research and innovation in electronic components and systems. The option is discarded because it is contrary to the provisions of Horizon 2020 in which research and innovation in electronic

[7] The other JTIs currently implemented through bipartite JUs are Clean Sky, Innovative Medicines Initiative and Fuel Cells and Hydrogen.

components and systems is part of the specific objective "Leadership in enabling and industrial technologies" in the priority on industrial leadership.

4.2.2. Early winding-up

This option would mean that the two current JUs would be stopped by an early winding-up. Such option would be required should the evaluations of their achievements over the 5 years of their existence be negative. This is not the case. As a result, there is no need to terminate the JUs before their normal end of life in 2017.

4.3. Proposed budget

4.3.1. Operational budget

The table in Figure 17 provides a budget simulation for each option. In the simulation the following assumptions are made:

- In options (a) and (e) the contribution of the Member States is equal to the EU contribution. The contribution of industry would be the double of the total public funding as the focus of the tripartite model is on funding projects at a higher TRLs. The same applies for option (d) except that for this option there is no contribution from the Member States.
- In options (b) and (c) based on the funding rules proposed under Horizon 2020 the co-funding by industry is estimated at 60% of the actual costs.
- The EU contribution for options (c), (d) and (e) is slightly increased compared to options (a) and (b) to account for the extended scope. The annual EU funding for options (a) and (b) is based on the extrapolation of the spending in the current ARTEMIS and ENIAC JU.

The table shows that the tripartite model of options (a) and (e) offers the highest leverage factor for the EU contribution. Moreover, the options (a), (d) and (e) offer an increased 'security' for the partners as the budget ceiling is specified in a dedicated legal act. This is not the case for options (b) and (c).

Operational budget (average M€ / year)		Option (a)	Option (b)	Option (c)	Option (d)	Option (e)
EU	ARTEMIS	50	50	171,5	171,5	171,5
	ENIAC	125	125			
Member States	ARTEMIS	50	0	0	0	171,5
	ENIAC	125	0			
Industry	ARTEMIS	200	35	114	400	800
	ENIAC	500	85			
Total / year		1050	295	285,5	571,5	1143
Total (2014-2020)		7350	2065	1998,5	4000,5	8001
Total EU (2014-2020)		1225	1225	1200,5	1200,5	1200,5
EU leverage factor		6,00	1,69	1,66	3,33	6,66

Options (a), (d), (e) based on 70/30 or 70/15/15 average model

Options (b) and (c) based on average EU funding of 60% actual costs

Figure 17 - Operational budget

Option (e) would achieve an overall investment programme of some €8 billion by 2020. This would cover a significant contribution to the overall investment announced by industry over the same period for their entire eco-system [18]. It represents therefore a significant incentive.

4.3.2. Administrative budget

The table in Figure 18 provides a simulation for the administrative budget.

Options (d) and (e) are the most effective due to the economies of scale generated by the combination of two JUs into one single entity. Options (a), (d) and (e) are based on a 50/50 contribution industry/EC to the running costs of the JUs.

Administrative budget (M€ / year)		Option (a)	Option (b)	Option (c)	Option (d)	Option (e)
EU	ARTEMIS	1,25	10,5	10,8	2,1	2,1
	ENIAC	1,25				
	EC (3FTE)	0,5			0,5	0,5
Industry	ARTEMIS	1,25	0	0	2,1	2,1
	ENIAC	1,25				
Total / year		5,5	10,5	10,8	4,7	4,7
Total (2014-2020)		38,5	73,5	75,6	32,9	32,9
Total EU (2014-2020)		21	73,5	75,6	18,2	18,2
Winding up (2021-2024)		6			5	5
Total EU (2014-2024)		24	73,5	75,6	20,7	20,7

EU in options (b) and (c) based on 6% admin costs in FP

EC FTE in options (a), (d) and (e) for monitoring JU

Figure 18 - Administrative budget

In the case of options (a), (d) and (e), the resources required in the Commission for the actual monitoring of the JUs are added to the budget while in options (b) and (c) the standard administrative costs of the Framework Programme have been used. The latter would be lower in the case of an implementation through an Executive Agency.

The ratio of the administrative cost of the JU per million euro of operational expenditure for the preferred option (e) is in the same range as the one for the ERC Executive Agency [21]. It represents an overhead of only 1.3%[8].

5. ANALYSIS OF THE IMPACT

5.1. General impact

When assessing the global impact, it is necessary to consider economic, societal and environmental impact.

The economic impact covers:

- Competitiveness and investment aspects – the leverage effect of the initiative on the private and public funds and the scale of investment and critical mass. The initiative should impact the potential for cooperation along the innovation and value chains and the bridging from technology to innovation;
- Research and innovation – the synergy with industrial and national priorities, the extent to which the initiative will foster excellence, facilitate progress towards a European Research Area by addressing fragmentation and reducing duplication of efforts;
- Stakeholders – involving a broad range of stakeholders: industry – technology providers and users and including SME's, RTO's and universities, EU, Member States and regions and the citizen/consumer who is to benefit from the initiative;
- Leverage effect – the enabling characteristics of electronic components and systems induce an intrinsic leverage effect illustrated by enhanced growth and employment by companies investing and participating in existing public-private partnerships.

The societal impact examines:

- Employment – linked to the economic impact. The industrial sectors addressed by the initiative are a major direct employer of highly skilled and technical people. In addition a whole supply industry depends on it for employment as well as the economy in general for innovation and productivity;
- Potential to address societal challenges in domains relevant for the European citizens (e.g. transport, health, energy) – the development and deployment of electronic components and systems is critical for ensuring access to technologies indispensable for those societal drivers.

The environmental impact mainly relates to energy efficiency and waste management.

[8] http://intranet-rtd.rtd.cec.eu.int/int_com/docs/CBA_JU.pdf

5.1.1. Economic impact

5.1.1.1. Competitiveness and investment

All actors involved in the sector of electronic components and systems recognize that there is a significant size effect. Below some market size (dependent on the sub-segment addressed), companies become either isolated or subcritical at world level. What is true for the market is also true along the innovation chain. The capability to invest in innovative research and development highly depends on the market position of the companies. Therefore, the leverage effect of the European initiative on private and public investments is a key contributor to creating critical mass, thereby impacting the competitiveness of all actors involved. '*In an industry where technology and innovation play a key role, supporting research and development, international cooperation and harmonisation, and the position of SMEs is a crucial factor of growth*' [22]

It is clear that no Member State hosts all companies necessary to cover the whole chain of an application industry that heavily relies on electronic components and systems. By its collaborative nature, the initiative allows the creation of cross-European consortia in order to bring out the best of the European ecosystem and reduce fragmentation.

Option (a) provides for this in two subsectors of components and systems but does not exploit potential synergies which are possible in options (c) to (e). This synergy allows for more innovative electronic components and systems in the market.

5.1.1.2. Research and innovation

The primary target of the R&D&I initiative in the electronic components and systems is based on an industrial agenda. In view of the fast growing complexity and costs of the technology, cooperation is the only way forward to avoid unnecessary duplication, improve efficiency and reduce time-to-market for new innovative or improved products. The initiative would provide a unique structure to allow stakeholders to cooperate and to facilitate multi-disciplinary integration. The intention is that the initiative would cover higher Technology Readiness Levels allowing cooperation closer to the market innovation.

This will be more difficult to achieve through option (b), (c) and (d) as limited resources would be available. Moreover the more 'one size fits all' option (b) may not be well suited to allow for an optimal implementation of large scale pilots and demonstrators.

In this respect, the shared governance with industry and Member States is critical for an efficient and timely implementation of the industry-driven agenda. By sharing strategies on key aspects of R&D&I in the sector, the European Commission, the Member States (option (a) and (e)) and the industry will be able to improve the efficiency in aligning on critical and strategic aspects of the technological challenges of the sector.

5.1.1.3. Stakeholders

As the public consultation showed large companies are mainly interested in large scale European projects. These projects are instrumental to build scenarios, test options and in general allow cooperation with actors along value chains. European RTOs, linked with higher education research labs are essential contributors to early exploration and later validation of

new technologies. SMEs are a major contributor to the electronic components and systems sector as they provide technology and services along the value chain including e.g. design, prototyping and services for small volume production. Moreover they offer exploitation channels for integrating new technologies in innovative products and services. The participation of SMEs strengthens the European ecosystem from both the user and supply ends. SMEs will get access to technology and improve their innovation capability whilst allowing cost and risk sharing.

As hosts of industrial clusters in the electronic components and systems, regions will benefit from the increase of R&D&I activities. It is further envisaged that regions will make use of Smart Specialisation [23] to complement the initiative and build on existing industry clusters or equivalent concentrations. Such synergy will further pool resources.

Options (a) and (e) in which Member States are members offer a better possibility to coordinate national policies and allow for national stakeholders to contribute expertise in a larger European perspective.

At the end of the value chain consumers are the purchasers of the products or the users of final services. Improved, safer and more user-friendly products and services will result from the projects. A specific characteristic of electronic based products is that the final cost mostly remains constant while functionality improves from one generation to the next.

5.1.1.4. Estimated leverage effect

In the field of industrial systems where Europe is the strongest, the electronic components and systems do not provide end products on the market but rather building blocks of machinery, equipment and systems. Therefore it is difficult to estimate the leverage effect of the research and innovation actions funded in the frame of the JTI is a difficult exercise. Nevertheless as an enabling technology, this sector provides a multiplying effect in the economy through the uptake of advanced and innovative components and systems in all economic sectors. As argued in the KET High-Level Group report [3], '*the macroeconomic importance of KETs is that they can open up entirely new markets or underpin and enhance existing markets through accelerating technological progress with trickle-down effects on productivity and concurrent leaps in efficiency levels. In addition to feeding numerous full value chains, products based on KETs often serve as inputs of great value added that are integrated into more complex products. It is these subsequent applications that drive major economic growth and competitiveness.*' This illustrates the intrinsic leverage effect of this category of technologies. The leverage effect is not only on further investments by the companies within the sector but more significantly by the companies which take advantage of the huge benefits and competitive advantages that electronic components and systems provide to their business.

The above statement is illustrated by the following concrete example. The Eureka cluster Euripides2 acts in the field of smart and embedded systems, with activities very close to the JTIs (see table 1). Moreover the participants are largely similar with the ones participating in the current JTIs [22]. Their recent Vision, Mission, Strategy paper provides an estimate of the leverage effect of the public funding by indicating that '*studies of collaborative EUREKA projects clearly indicate that on the whole yearly sales growth is around 24% higher for EUREKA participating firms, and yearly employment growth is around 21% higher, compared to firms that had not participated in a EUREKA project*'. Furthermore, '*During the first two years after the project, participant's turnover grows twice as fast as non-*

participants, and after 4-5 years, participants outperform similar non-participants by about one third in terms of turnover growth. In addition, growth in exports for EUREKA participants is more than twice that of similar non-participants'.

5.1.2. Societal impact

5.1.2.1. Employment

The initiative fosters research and innovation in a very high-tech sector. It will directly generate highly qualified jobs. With around €700 Million of investment in R&D&I per year, it will employ more than 7.000 researchers and engineers but its impact on employment is much bigger.

The initiative tackles the 'valley of death' from research to market and is expected to create jobs across the electronic value chain including in user industries. A large number of indirect jobs are expected to be created. Studies indicate that for every job in the electronics sector at least 4 indirect jobs are created [3].

In a recent report the electronics industry estimates that some additional 250.000 direct and induced jobs should be created in Europe by 2020 [18] if a sufficiently funded, focused and coordinated European effort across the value and innovation chains is sustained. This will be through the growth of design and manufacturing in Europe's strongholds in vertical markets but also in core markets such as telecommunications and consumer electronics.

The integrated options (c) to (e) allow the creation of added value through cross-cutting activities between the different technological domains. This most likely will have a more positive effect on the employment potential compared to (a) and (b). Further to that, option (e) will probably have a much deeper impact on the value chains because of the size of the investment and the alignment with national priorities and hence can be logically expected to have a larger impact on employment.

5.1.2.2. Addressing societal challenges

The initiative will provide a large contribution to and solutions for societal challenges including on health, demographic change and wellbeing; secure, clean and efficient energy; smart, green and integrated transport; climate action, resource efficiency and raw materials; and inclusive, innovative and secure societies as set out in Horizon 2020. Electronic components and systems are general purpose enabling technologies that improve our modern lifestyle, reduce greenhouse gas emissions e.g. by better control of energy consumption (smart grid) and greener cars, contribute to the safety of vehicles, democratise communications and improve and reduce costs of healthcare.

There are areas where access to electronic component and systems technology is particularly important, in particular security, safety and privacy of the digital infrastructures. Similarly, safety-critical systems (e.g. in airplanes or nuclear plants or smart grids) require first hand access to enabling technologies.

As embedded in the current JUs' Strategic Research Agendas, tackling societal challenges will be addressed by continuity in option (a). But option (d) and (e) will further reduce duplication,

increase synergy and bridge laboratory research to demonstration between the components and systems to provide effective solutions to the market.

5.1.3. Environmental impact

5.1.3.1. Energy efficiency

The omni-presence of the new 'mobile' society forces the electronics industry to focus itself on developing low-energy consumption devices. This has spill-overs in other domains. Future products and services based on electronics will be far more efficient in energy consumption and energy management. In addition, the electrification of the transport systems and e.g. smart cities will heavily rely on efficient power electronics and electronics based integrated control systems.

Compared to the separate JUs in option (a), options (d) and (e) will better facilitate Europe's take up of such energy efficient solutions.

5.1.3.2. Recycling and materials

It is well known that end-of-life products, particularly electronic components contain many different materials, especially inorganic materials including non-environmentally friendly metals. As these are integral to the components and encapsulated throughout their lifetime, there is limited risk of these materials being released during their lifetime. Nonetheless, at the end of their life, components need to be properly handled to avoid detrimental pollution. Equally and more important recycling of precious metals is needed [24].

The initiative will not change the present landscape.

5.2. Impact of options

5.2.1. Impact of bi- or tripartite initiative

Both current initiatives in nanoelectronics and embedded systems are tripartite, their main characteristics being the combination of several funding sources. Member States managed the national grant agreements and payments; the funding of partners was based on national eligibility criteria. In practical terms, this meant that partners in projects had two contracts: one with the JU and one with the national authority. This increases administrative complexity and leads to additional overhead. As a result in the public consultation a slight preference was given for a bipartite initiative.

Options (a) and (e) are tripartite, options (c) and (d) are bipartite and option (b) could be termed a single-party model in which the Commission implements.

In the bipartite model, the leverage effect in terms of direct public funding would disappear. In these options, the Member States would not contribute directly to the European projects and the impact will thus be reduced with major consequences on the number of large scale demonstrators or pilot lines that could be supported. This will be a major drawback given the necessity and the readiness of industry to invest large scale projects including pilot lines.

Tripartite options (a) and (e) allow a pooling of several sources of financing in a coordinated way. They will allow for a significant part of the budget to be dedicated to support pilot lines and large scale demonstration platforms and achieve critical mass.

Option (b) will be a step backwards as it implies a reduction of the importance of an industrially driven Strategic Research and Innovation Agenda.

5.2.2. Impact of joining forces

It is important to compare option (a) and (e) in their impacts as they are based on the same tripartite model but differ in the implementation by having either 2 structures (option (a)) or one single structure (option (e)). Option (a) will bring a renewed set of two initiatives with two separate SRIAs. It may not allow to efficiently tackling the whole technology and value chains from components to systems. Option (e), with one structure and a common scope for action, would allow better coordination and cooperation between the various stakeholders and enable synergies in strategic aspects of the current SRIAs in areas such as efficient co-design of hardware/software, standardised operating systems or delineation of various functions into one or more components.

As there are many similarities among the operational management of the two current initiatives, joining forces in one JU is a sound way of achieving economies of scales in e.g. managing calls and monitoring all operational aspects, including financial reporting and auditing.

5.2.3. Specific impact on the various stakeholders

a/ Large companies

It is expected that tripartite options (a) and (e) will allow large companies to better achieve their goals through significant projects in accordance with national priorities. Bipartite options (b) to (d) may not provide sufficient financial resources. Organisations would face uncertainties on major projects as they will have to apply for several sources of public funding in an un-coordinated way. As a result essential parts of the projects may not be supported.

b/ SMEs

SMEs tend to address specific technologies rather than more general technology areas. Therefore, at first sight, option (a) appears the most appropriate for SMEs as it provides more focus. Option (b) lacks direct national involvement and as result may reduce SME participation (SMEs participation is around 20% in the Framework Programme whilst it is around 35-40% for the current JTIs). Options (c) to (e) are administratively better for SMEs as there is single contracting.

In option (e), SMEs will benefit from access to demonstration platforms. The "closer to market" emphasis will result in a faster return on investment, further counterbalancing the administrative burden. The wider technology scope may however not easily fit the specialist skills of SMEs. However, the high rate of SME participation in the current JTI's (option (a)) suggests that the benefits significantly outweigh the downside aspects in the case of option (e).

c/ Research organisations

The current participation of all major RTOs in the existing JU's is high. More emphasis on innovation and supporting projects at higher TRLs will allow RTOs to 'accompany' industrial partners to get closer to market innovation. Options (a) and (e) are likely to be preferred with a slight preference for option (e) as this will enhance visibility.

The involvement of other academic stakeholders is equally important as they cover specific technologies. It is expected that the implementation through either of the options will not have a significant impact on the participation of these actors.

d/ Industrial associations (European Technology Platforms, ETPs)

As industry representatives, the ETPs are directly concerned with the initiative. Their role is to coordinate the definition of an industry-driven common strategy in R&D&I. The current initiatives are a better way to bring forward their SRAs.

In this context, it appears that option (a) is the favoured option (as confirmed by the contributions of AENEAS and ARTEMIS ETPs to the public consultation). Option (b) would put the ETPs in the role of 'consulted organisations' with a more limited impact on the definition of work programmes.

The value of options (c) to (e) will be in coordination beyond actual constituencies to address issues such as complexity, fragmentation or exchange of information on key problems manner as well as in defining and implementing of a joint agenda.

On a practical level the increase of efficiency of the JU in option (e) will reduce the private financial contribution to the administrative costs.

e/ Member States

Member States contribute to the current initiatives by funding their industry and research organisations.

Options (b) to (d) represents a major change compared to the current situation and it remains to be seen whether without the additional contribution of the Member States a significant impact in the electronic components and systems sector can be achieved.

Option (a) provides Members States with the same frame as for the current initiatives. Option (e) allows for alignment, a more coherent and strategic vision on the whole sector and a pooling/combination of resources.

f/ European Commission

Leveraging sources of public funding, EU, national and regional, to mobilise private funding for R&D&I and the progress towards the European Research Area are main goals. Obviously option (a) will not allow the same leverage effect on R&D&I compared to option (e). Options (b) to (d) may lead to a decrease of the support to the sector.

On the EU side all options will make use of the same source of funds, i.e. the budget available under the LEIT part of Horizon 2020

6. PREFERRED POLICY OPTION

6.1. Comparing the options

Three interconnected levels of comparing options are presented. First the table in Figure 19 compares the merits of the options (b) to (e) against the baseline scenario (option (a)) with respect to fulfilling the objectives identified in section 3. The objectives in the table are grouped according to their contribution to one of the criteria of effectiveness, efficiency or coherence. This addresses the evolved technological and economic context faced at this point in time and ensures the objectives are consistent with the new landscape.

	Objectives	Option (b)	Option (c)	Option (d)	Option (e)
Effectiveness	1.1 Boost competitiveness	-	+	+	+
	1.2 Cover innovation & value chain	-	+	+	+
	1.3 Solve societal challenges and create new markets	-	-	=	+
	3.1 Maintain and grow manufacturing in EU	-	-	-	+
	3.2 Leadership in E&M	-	-	-	=
	4.1 Availability of electronic components	-	-	=	+
	4.2Leadership in system engineering	-	=	+	+
Efficiency	2.1 Structure and perform excellent multi-disciplinary research	=	=	+	+
	2.3 Mobilise and pool resources	-	-	-	+
	5.2 Efficient implementation of programme	+	=	+	+
	5.3 Synergies for exploitation of results and fostering SME growth	-	-	+	+
	5.4 Ease participation in projects with strong European dimension	+	+	+	=
	5.6 Cooperation and coordination of stakeholders	-	=	+	+
Coherence	2.2 Align strategies	-	=	=	+
	3.3 Support high TRLs	-	-	-	+
	5.1 Set strategic research and innovation agenda	-	=	+	+
	5.5 Access to design and manufacturing infrastructure	-	=	+	+
	5.7 Maintain human skills	=	=	=	=

Figure 19 - Comparing the options

On a second level, with respect to the criteria listed in the proposal for Horizon 2020 [1] to identify PPPs (see section 4.1), the comparison above demonstrates that:

- Options (a) and (e) offer most *added-value of action at Union level* (coherence);
- Option (e) has the strongest *scale of impact on industrial competitiveness, sustainable growth and socio-economic issues* (effectiveness);
- Options (a) and (e) show the strongest *long-term commitment from all partners on a shared vision and clearly defined objectives* (effectiveness and coherence);
- Option (e) is the strongest in the *scale of resources involved and the ability to leverage additional investments in research and innovation* (efficiency);
- Options (c), (d) and (e) allow for a *clear definition of roles for each of the partners* (efficiency and coherence).

The third level concerns the options in view of the improvements identified in the interim evaluations.

	Option (b)	Option (c)	Option (d)	Option (e)
An integrated European Strategy	-	-	+	+
Allow for a more efficient implementation	-	=	=	+
Improved governance and strategic planning	-	-	+	+
Strengthened commitment and alignment with priorities of Member States	-	-	-	=
Harmonisation of conditions of participation	=	+	+	=
Streamlined operations including better monitoring and evaluation	=	=	+	+

As a complementary comparison, the following table indicates how the proposed objectives can be addressed by the different options, i.e. how the different options can fulfil the recommendations underlying the proposed specific and operational objectives (Table 2 and Table 3)

Table 4 - Comparing the potential of the options to addressed the identified issues

Objectives	Option (b)	Option (c)	Option (d)	Option (e)
Specific objectives				
Structure and perform excellent research and innovation while improving articulation with national and regional efforts	-	=	=	+
Mobilise and pool resources	-	-	-	+
Support high TRLs	-	-	=	+
Constituencies involvement and complexity tackling	-	=	+	+
Strengthen the ecosystem	-	=	+	+
Leadership in system engineering	-	-	-	+
Operational objectives				
Set strategic research and innovation agenda	-	-	+	+
Efficient implementation of programme	-	=	=	+
Synergies for strategic cooperation	=	=	+	+
Exploitation of results and SME growth	-	-	=	+
Ease participation in projects with strong European dimension	=	=	+	+
Access to design and manufacturing infrastructure	-	-	-	+
Cooperation and coordination of stakeholders	-	=	+	+
Comprehensive and fertile innovation environment	=	=	+	+
Maintain human skills	=	=	=	=

In conclusion, the preferred option to achieve critical mass and high Return-on-Investment is (e) "*Implement a tripartite institutional Public-Private Partnership*", i.e. a partnership based on a roadmap for R&D&I with an extended scope from components to systems, a pooling of resources to support a significant number of large-scale actions crossing the valley of death, and the aligning of strategies and funding (regional, national and EU level).

This is also the conclusion of the study on the future impact of ARTEMIS and ENIAC [4] carried by independent organisations TNO and eutema. In the study four scenarios are considered: no JTI (corresponding to option (b) above), renewal of current JTIs (option (a) above) and a new integrated (either fully or partially) JTI (option (e) above). The degree of integration (full or partial) reflects the views expressed by many stakeholders that a new integrated JTI should offer room for a clear distinction of activities in the respective fields of nanoelectronics, smart systems and embedded systems. This has no direct consequence on the overall model of option (e).

In comparing those scenarios on the basis of their impact on (1) industry value chain, (2) strategic research agendas, (3) innovation and (4) governance and funding, they concluded that the scenario of a partially integrated JTI is the most favourable as shown in Figure 20.

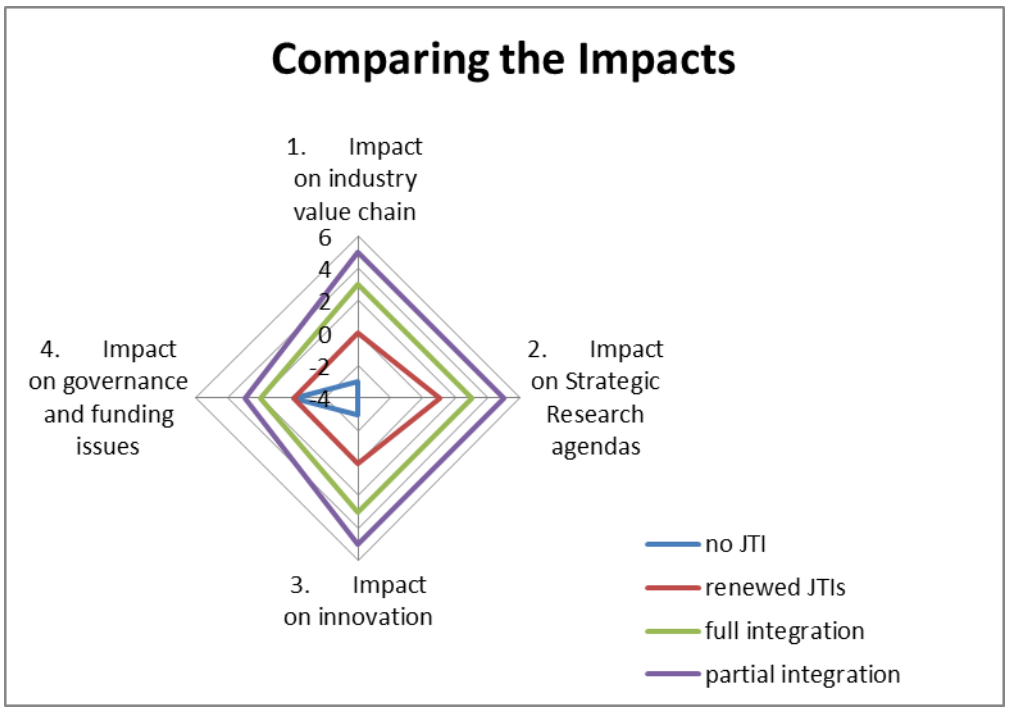


Figure 20 - Comparing impacts

6.2. Implementation and governance

Option (e) is to be implemented by setting up a new legal entity under Article 187 TFEU. It would take the form of a 'PPP body' using Article 209 of the Financial Rules [25], charged with indirect management according to Article 58.1(c)(iv). This approach would satisfy most of the demands from the private partners (more flexibility, less administrative overhead) as also expressed in the 'Ideal House' Group report [13].

The positioning of the new JTI reflecting its complementary character with the more advanced activities that would be covered by the 'standard' Horizon 2020 instruments is represented in Figure 21. The main drivers for the proposed delineation are the level of investment on the one hand and the industrial focus on the other hand. While the support of high TRLs clearly requires a pooling of resources, flexibility to support lower TRLs projects through either EU-only funding (i.e. implementing a limited bipartite within the JTI) or through national funding without EU contribution (implementing an inter-governmental mechanism within the JTI) should be considered.

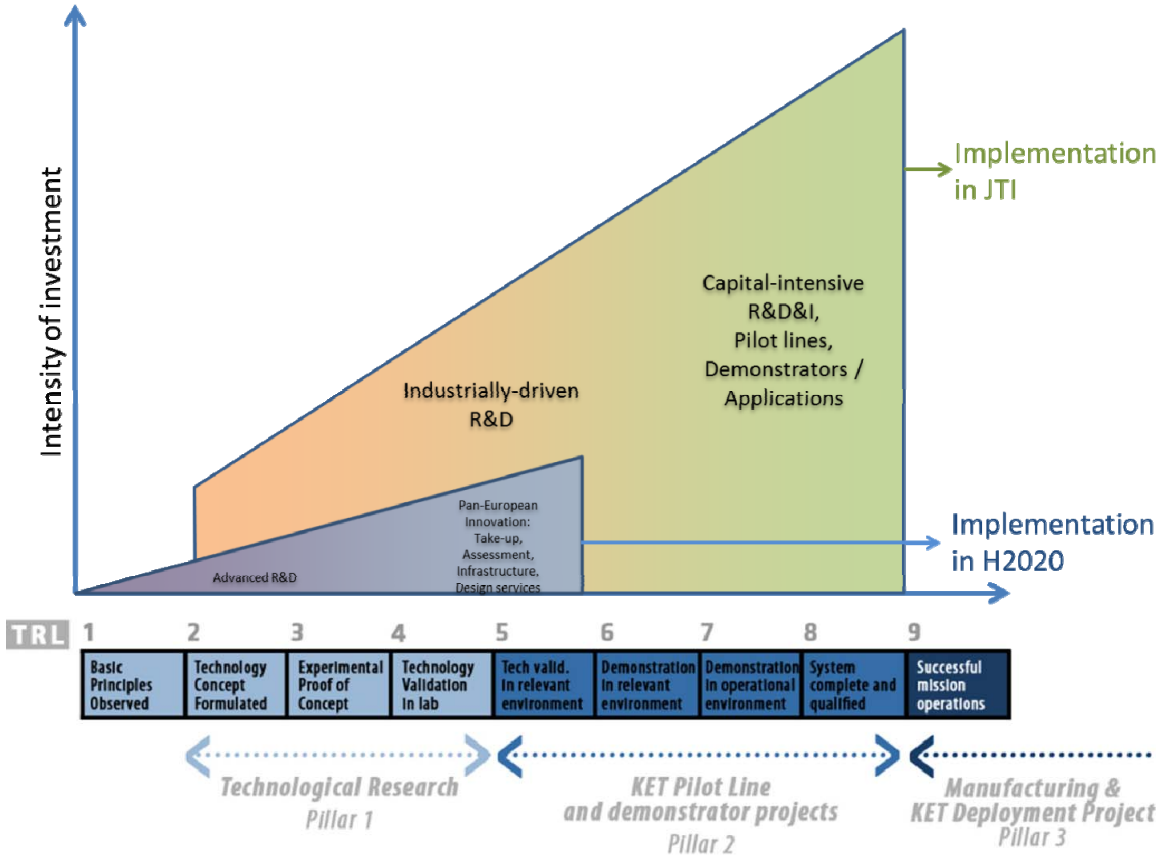


Figure 21 - Positioning of new JTI

Based on the observations drawn from the current JUs (as listed in section 2.5), a streamlined governance structure as illustrated in Figure 22 is envisaged.

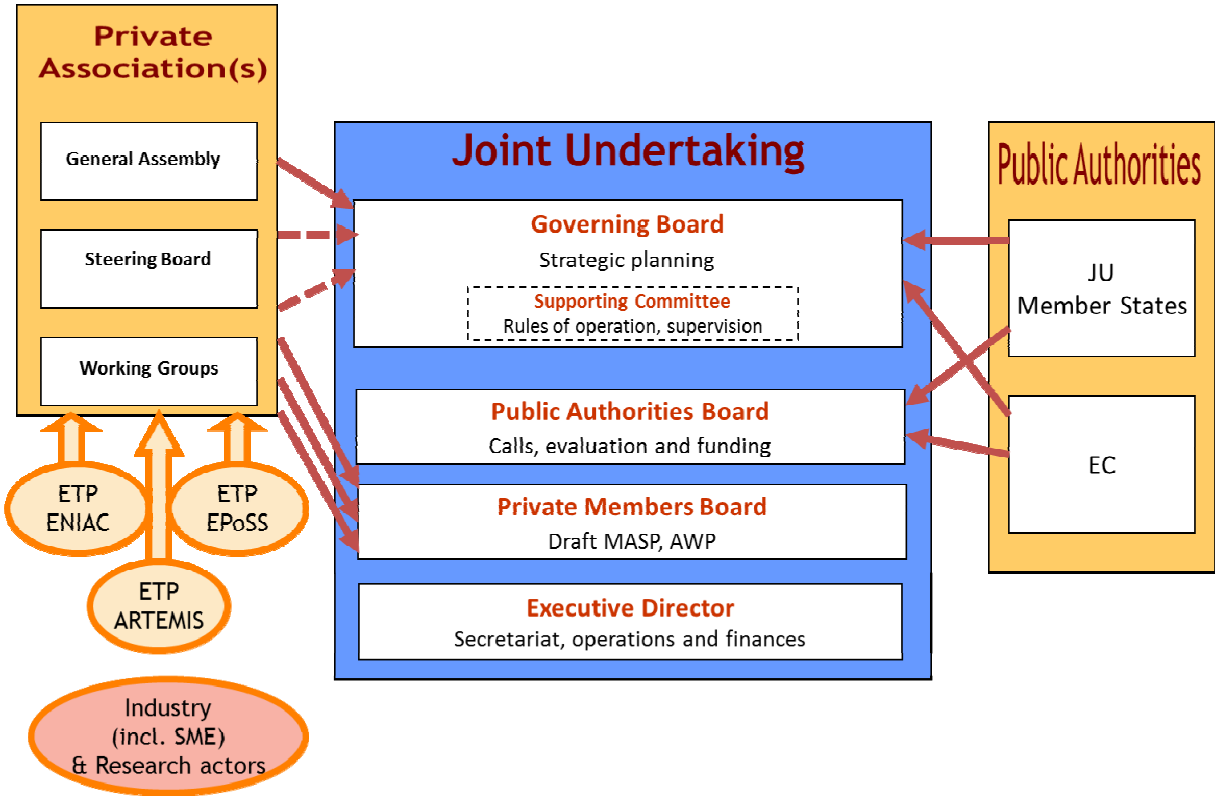


Figure 22 - JU governance structure

Compared to the current JUs, the proposed governance structure would ensure that the Governing Board focuses on the strategic aspects. An effective supervision of the operational aspects may be delegated to a Supporting Committee. The Supporting Committee could oversee 'standard' operational aspects and report to the Governing Board. It should be a light sub-structure with a minimal number of representatives from each of the members of the JU (public authorities, industry and the Commission).

The Public Authorities Board decides on budgets, calls for proposals and the funding of projects. The public members (Commission and Member States) participate in this board.

A Private Member Board ensures the definition and update of the SRIA, the multiannual strategic plan and annual work plan.

The three boards would operate under flexible conditions as they see fit, especially in view of the transition from the current JUs.

The Executive Director ensures the daily operations of the JU as well as the execution of the programme.

The operating principles of the new JU will aim at:

- simplification, by having single contracting; and
- a balanced sharing of public support of projects between Member States and the EU.

A limited set of derogations to the standard Rules for Participation established by Horizon 2020 might be required in order to cope with the above principles and take account of the

financial participation of Member States on the one hand and considering the nature of an industrially-driven PPP on the other hand where the private members are expected to contribute significantly more than in the standard Framework Programme.

7. EVALUATION AND MONITORING

Three levels of evaluation and monitoring will be organised. The top-level monitoring will fall upon the Governing Board of the JU, in which the Commission will be represented according to its share of the overall budget. The Executive Management will monitor the operations of the JU internally and will present an Annual Activity Report to the Governing Board along the lines of the Annual Work Plan. This will also be submitted to the EU budgetary authority in the context of the discharge procedure for the use of EU funds by the JU.

The Commission will present to the Council an Annual Implementation Report, including a report on the state of progress of the JU and on its financial position.

7.1. Mid-term and final evaluations

At the initiative level, the Commission will carry out mid-term and final evaluations of the JU with the assistance of independent experts based on desk research, interviews and data mining. These evaluations will look at the progress towards achieving the strategic objectives, the efficiency/effectiveness of the implementation and the commitment of the private members in and beyond projects. The Commission will communicate the conclusions of the evaluation to the Council and the European Parliament.

7.2. Monitoring the JTI progress

At the level of projects, a mechanism will be put in place to measure the progress and the quality of each project. In addition, the use and dissemination of results will be monitored during and after the project lifetime, in accordance with the recommendations of the 2nd interim evaluation panel (see table 1).

The progress towards the set of objectives of the JTI as identified in section 3 will be annually monitored against a set of Key Performance Indicators (KPI) as indicated in the following table. It is expected that the collection of information/data necessary for the monitoring will not lead to significant administrative costs as most of the data will have been collected through regular reporting, at project level and/or annually.

Objectives	KPI	Metrics (measured over period 2014-2024)
2.1 Structure and perform excellent multi-disciplinary research	Innovative and State-of-the-Art projects	➢ Quality of results as e.g. measured in number of peer reviewed publications ➢ Innovative R&D&I, at least 2 patents per 10 M€ funding ➢ Number and impact of breakthrough technologies
2.2 Align strategies	SRIA with priorities	➢ Commitment from all JU members ➢ Focus of SRIA commensurate with the available budget
2.3 Mobilise and pool resources	Budget execution	➢ Financial commitments by all JU members ➢ Contribution towards the 3% target for R&D&I
3.1 Maintain and grow manufacturing in EU	Create jobs in electronics industries Increase manufacturing plants in Europe	➢ Number of direct and induced jobs in Europe – progress towards creation of 250.000 induced jobs ➢ Number of state-of-the-art fabs in Europe as measured by technology node and wafer size
3.2 Leadership in E&M	Strategic cooperation on E&M issues	➢ Ranking and market share/volume of European E&M suppliers
3.3 Support high TRLs	Scale and impact of projects	➢ Number of new/upgraded pilot lines in Europe – at least 3 per year ➢ Number of demonstrators of integrated solutions – at least 3 per year ➢ Access and use by actors not directly implementing the pilot lines/demonstrators
4.1 Availability of electronic components	Take-up of new technologies by European application sectors	➢ European market share/volume for new solutions
4.2 Leadership in system engineering	Strategic cooperation on embedded and smart systems issues	➢ Ranking and market share/volume of European electronic systems suppliers

7.3. Monitoring the JU operations progress

The monitoring of the financial management of the JU is carried out annually by the European Court of Auditors. The operational capability of the JU will also be assessed by KPIs on an annual basis, reported by the Executive Director, in line with the following table.

Objectives	KPI	Metrics (measured over period 2014-2024)
5.1 Set strategic research and innovation agenda	SRIA	➢ Adoption of SRIA by all key players ➢ Clarity and focus as perceived by the stakeholders
5.2 Efficient implementation of programme	JU operations	➢ Time to grants (from call closing to grant signature) < 270 days ➢ Time to payment < 90 days ➢ Dissemination activities ➢ Project results
5.3 Synergies for exploitation of results and fostering SME growth	Industrial up-take of project results	➢ Number of spin-offs ➢ SME growth in terms of turnover and employment
5.4 Ease participation in projects with strong European dimension	Simplified rules for participation	➢ Industrial and SME participation rate – the latter ≥ 30% ➢ Reduction of administrative overhead
5.5 Access to design and manufacturing infrastructure	Availability and open access to State-of-the-Art infrastructures	➢ Access and use by SME's, including system integrators
5.6 Cooperation and coordination of stakeholders	Partnerships	➢ Composition of consortia – emergence of strategic alliances
5.7 Maintain human skills	Expertise available in Europe	➢ Availability of curricula/courses and effective take-up of professional training in line with industrial needs

In addition, a qualitative monitoring will be carried out on other important aspects such as:

- Openness and transparency of procedures;
- Coordination between JTI, other EU initiatives, and national and regional actions;
- Avoidance of conflict of interest;
- Financial auditing;
- Monitoring of good governance.

ANNEX 1 – CONTEXT OF THE INITIATIVE

A.1 The general context of ICT

ICT in this document refers to all technologies, products and services in the value chain from the equipment and materials needed to produce electronic components and systems, through to their design and manufacturing, to their integration in applications, including software and system engineering.

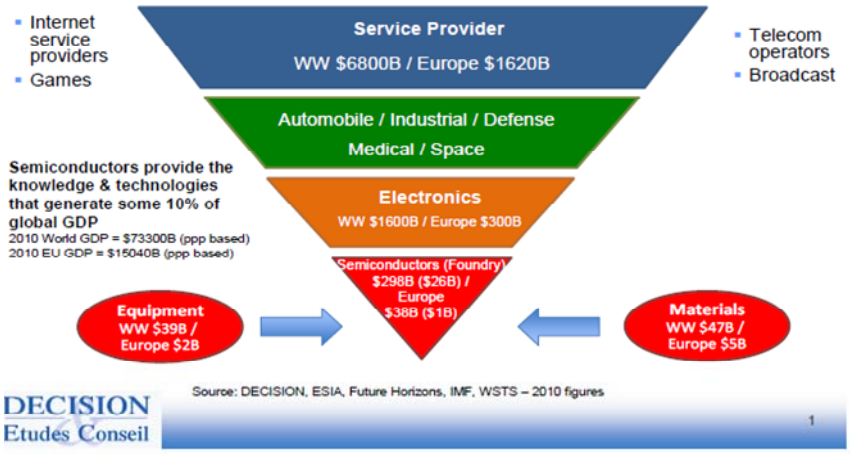


Figure 23 - ICT, a strategic "enabling" industry

A.1.1. ICT – an essential economic sector

The revenue of the ICT sector corresponds to some 10% of total worldwide GDP (2010 figures) [26]. In 2008, the EU ICT sector alone produced a value representing EUR 574 billion. This represented 4.7% of the total Europe Union GDP, of which 1% is in manufacturing and 3.7% are in services. It employed in total some 8.3 million people [27].

ICT contributes directly and indirectly to labour productivity, innovation and competitiveness [28]. It underpins most if not all sectors of the economy and is a main contributor to the economic growth [29]. It is well established that there is a '*pervasive impact of ICT-enabled hi-tech products on European industry performance and the EU economy. ICT, complementing the diversity of European industrial activities, play a growing and essential role as key enabling technologies. This complementarity enhances existing goods and services, giving those companies that embed ICT in their products and services the opportunity to develop (or maintain) the competitive edge on a global scale.*' [27]

The ICT sector leads other economic sectors in terms of R&D expenditure. In 2007, worldwide, it accounted for [29]:

- 25% of total business expenditure in R&D (BERD);
- 17% of gross expenditure in R&D (GERD); and
- Employed 32.4% of all business sector researchers.

A.1.2. Deficit of ICT sector innovation

Although the EU and the US have roughly the same GDP, the US levels of both business and public ICT R&D funding are the double of those in the EU [29]. In 2007, the US level of ICT BERD/ICT GDP was 0.72% while it was 0.30% for the EU indicating that there is a comparative under-investment in ICT R&D in Europe. The reasons are several fold: '*These factors include the competitive battle for the ICT industry among advanced economies, the innovative tensions affecting the industry ecosystem, the emergence of new large ICT markets and ICT knowledge flows, and the progressive transformation of the ICT industry from an engine of direct growth into a competitive asset as a key enabling technology for other sectors of the EU economy*.' [27]

As a result there is an innovation deficit when compared to competitor countries like the USA, Japan, South Korea or China. While, due to differences in patenting systems, it is difficult to make comparisons with Asia, the comparison with the USA is striking. Europe applies for roughly half the number of ICT patents when compared to the USA. This is in contrast to other sectors in which Europe does better than the US [30]. The EU is creating less value in ICT than the USA.

A.2 Electronic components and systems - a general purpose technology

Most, if not all, advanced products rely on electronic components and systems. The quality and capability of products most often depend on their electronic core. The 'electronics inside' allow for differentiation of products and services and determines the competitive position of its suppliers. Increasingly, the physical world (sensors, actuators, computer chips) meets the cyber world (computing in the cloud). In these emerging cyber-physical systems (CPS) a huge number of devices exchange data with one another, access web services and interact with people in increasing complex ways putting forward significant technology challenges. Electronic components and systems are a driver of innovation and growth in many key sectors of European industry including automotive, aerospace, health, manufacturing, telecommunications and consumer electronics [31, 32, 33].

Furthermore electronic components and systems are essential in tackling societal challenges from the reduction of greenhouse gases emission, to the optimisation of the use of transportation networks, to the facilitation of smart grids and personalised affordable health care.

The present initiative focusses on electronic components and systems and covers (i) micro- and nanoelectronics, i.e. data processing components, (ii) embedded systems and (iii) smart systems. These subfields are defined as follows:

- Data processing components are semiconductor components necessary for all data processing functions. They are found in all types of computers (microprocessors, microcontrollers, solid-state memories…);

- Embedded systems encompass all computer based systems which are not dedicated to data processing only, i.e. all systems performing electronic functions embedded in larger systems; and

- Smart systems include all other types of semiconductor components and systems built on them. They cover a wide variety of components including microsystems, power electronics, and e.g. radio-frequency components. Most of the smart systems embed data processing functions are connected to data processing components. The related components provide functionality to systems beyond computation and data processing.

The three subfields are complementary (see Figure 8) but present specific problem sets:

- Data processing components are very capital intensive;
- The design, engineering, verification and validation of embedded systems are software and human resource intensive; and
- Smart systems are often specifically designed for each application.

The revenues of the 3 subfields are summarised in the following figures.

- The revenues of the electronic components industry was 313 B€ worldwide in 2011. Its average annual growth rate is 5 to 6% [34, 26];
- Revenues of the electronic systems industry have been estimated at 852 B€ in 2010. Its annual growth rate is estimated at 12% for the next decade [15]; and
- The revenues of the diversified components used in smart systems is estimated at some 10 B€ worldwide in 2011. Its estimated annual growth rate is 13% for the next decade [26].

The electronic components and systems sector thus represents a significant part of the total GDP and is growing faster than the overall economy.

A.3 Technological and economic trends in nanoelectronics

A.3.1. Technology roadmap

The International Technology Roadmap for Semiconductors (ITRS) is the worldwide guideline for the development of the next generations of data processing components (i.e. microprocessors and memories) [35]. Based on the so-called Moore's law (doubling of computing component density every 18 months), it identifies the technical roadblocks and serves as catalyst to create a consensus on how to solve them.

The last decade saw the introduction of many new technologies necessary for the continuous increase of the density of the computing components. As the critical dimension of the fundamental unit of the components is reaching below 20 nanometres, the costs associated with the R&D and manufacturing of these component are becoming very high: it is estimated that more than 1 B€ is necessary for the R&D to develop each next generation of components and that a manufacturing plant will cost in the order of 10 B€ [36]. Simultaneously a transition to larger wafer sizes for the production of components is happening, form the current 300 mm to 450 mm [37]. This will keep the price of individual integrated circuits constant but will be accompanied by huge capital spending by the manufacturing companies

over the next decade. As a consequence the number of companies that can keep up with new technology developments is decreasing as the market share threshold to afford the next technology generation is increasing faster than the market size. It is estimated that a 20% annual increase of investment is needed to develop the most advanced components whilst the market increase of the order of 6% [38].

A.3.2. Business models

The industrial landscape changed significantly in the last 10 years. Historically the mainstream manufacturing companies, so-called Integrated Device Manufacturers (IDMs), designed and manufactured their components in-house. This business model was the consequence of the need to master the manufacturing technology to ensure the quality of the components. Until quite recently no company was willing to entrust another one to manufacture its components. Nevertheless for some specific niche markets, fabless companies (design companies without manufacturing capacity) emerged and an offer of "foundry" (manufacturing company without in-house design capability) started to grow rapidly.

The major fabless companies (not ranked in 2002 in the 25 largest companies of the sector) currently hold overall more than a 10% market share (growing from 1 to 6 ranked companies from 2003 to now). The total market share of fabless companies is currently estimated at 25% [39]. In parallel with the emergence of the fabless companies, foundry companies (manufacturing companies without design) grew accordingly from 5.3% in 2005 to 8.1% in 2012. In the last 15 years the market share of only one IDM (Samsung) steadily grew from 4% to 9.3%. With the exception of Intel and Samsung the market share of the other companies was below 4.5%. The 15% loss of market share of the 18 largest IDMs (without Intel and Samsung) can be attributed to the 15% gain by fabless companies (10%) and Samsung (5%) in the same period as illustrated in the Figure 24.

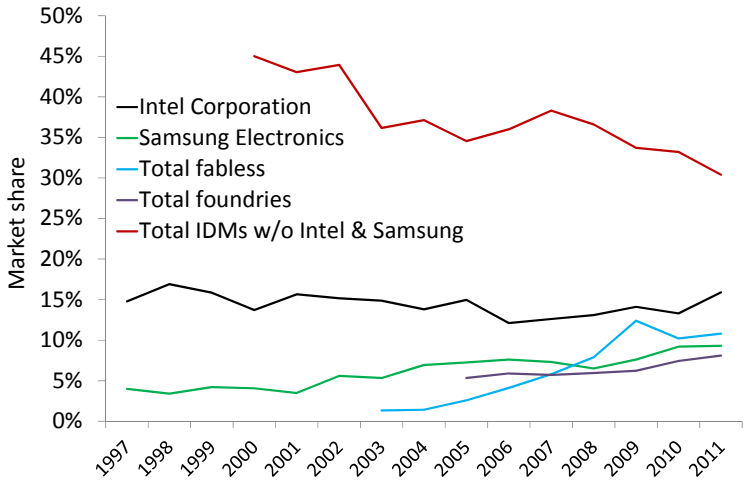


Figure 24 - Market share of semiconductor companies

The market share increase of Samsung is attributable to a full dedication to the mobile device strategy in a vertically integrated model. For the other companies losing market share may lead to a situation where a form of consolidation is inevitable. In particular major Japanese IDMs either merged (Renesas having taken the legacy of Hitachi, Mitsubishi and NEC semiconductor businesses), were acquired by competitors (Elpida was recently sold to Micron) or spun off and were dismantled (Fujitsu Semiconductors).

Europe is facing the problems identified above, notably the fast increase of R&D/manufacturing plant costs and increased complexity. In Europe there is currently not sufficient investment and limited access to volume markets. This is illustrated e.g. by the small number of advanced 300 mm wafer manufacturing plants in Europe [40].

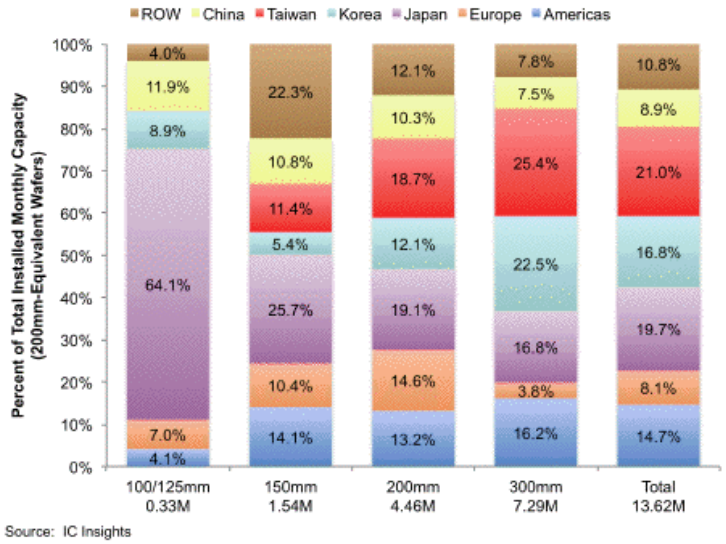


Figure 25 - Installed monthly capacity for each wafer size by geographic region (July 2011)

2 of the 3 European IDMs reduced their investment in R&D in the past decade. One European IDM is maintaining its R&D investment but its investment in manufacturing sites is relatively limited. This may lead to a Europe that is unable to manufacture advanced data processing components and that is becoming too much dependent on foreign company suppliers.

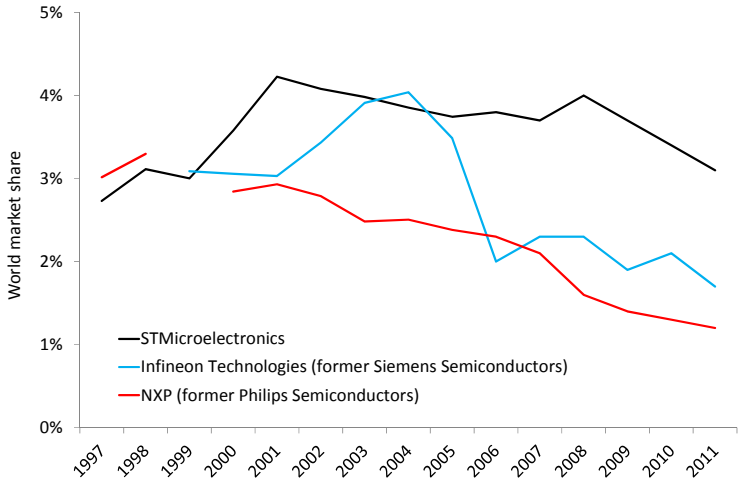
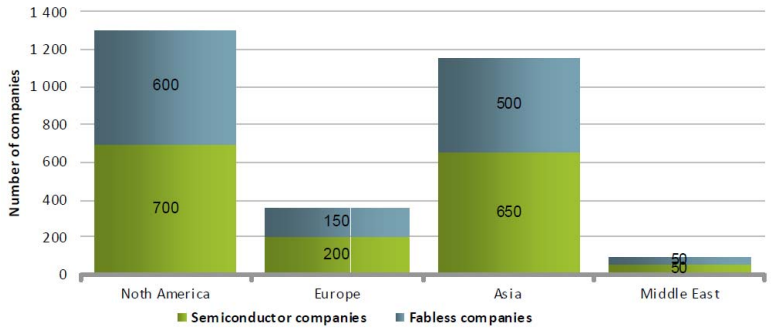


Figure 26 - Market share of European IDMs

This could be compensated by a European position in fabless business model. But as outlined in [9], '*in Europe, the ratio of fabless to semiconductor companies is 75% whereas it is 85% in US and 75% in Asia. If ratios are equivalent, there is a major discrepancy considering absolute figures which are not in favour of Europe. Indeed, Europe lacks fabless companies (150) compared to the US (600) and Asia (500). Moreover, no European fabless company is in the worldwide top 10 (8 US companies out of 10).*'



sources: Global Semiconductor Alliance (2008)

Figure 27 - Semiconductor/Fabless companies breakdown by region

The new "fabless/foundry" model will most likely not replace the IDM model as there are many cases/markets where the model is not profitable or suitable, e.g. in cases in which the user industry demands for product line maintenance for decades, such as in automotive or other industrial applications.

The complexity of the business models and the fabless/foundry model in particular is further put in perspective by referring to some recent announcements. Many IDMs divested away from capital intensive components manufacturing and now focus on the faster growing area of design. This led to offshore manufacturing in Asia. Counter to this recent announcements and merger and acquisitions (e.g. Google buying Motorola for mobile devices patents, Qualcomm envisioning to acquire manufacturing capability, Amazon intending to purchase part of Texas Instruments components activities) 'content' companies (especially in the US) show a growing interest in acquiring manufacturing capability.

A.3.3. Missing mass-volume markets

Europe is missing companies developing advanced consumer products [9]. '*Europe exhibits low performances on Data Processing and Consumers applications. These results on high volumes markets are correlated with the decline of European OEMs in these applications. The Communications sector is at the frontier, relying on the large Nokia and Sony Ericsson market positions.*' [9] The situation however is changing fast.

This situation is reflected further in the fact that the fabless companies worldwide mostly target consumer electronics, telecommunications and computers as their main market segments (see Figure 28) [41].

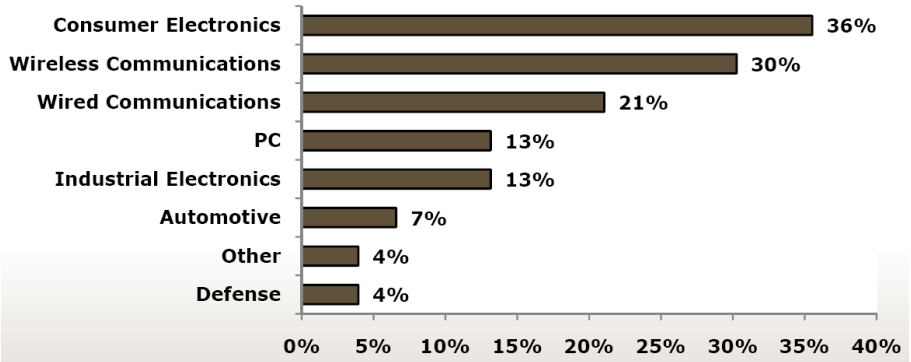


Figure 28 - Customer market segments of fabless companies

A.4 Europe's leading position in part of the electronic components and systems value chain

Europe is host to world class research and innovation and it developed a leading position in a number of high growth markets. European research institutes (e.g. Fraunhofer, LETI, imec in micro- and nanoelectronics, and Tecnalia, Politecnico di Torino or VTT in embedded systems and software) are world class and internationally recognised. Furthermore European university laboratories are part of large networks of excellence. This constitutes an essential asset that needs to be nurtured and enhanced as the industry clearly acknowledges [6].

'*Europe is well positioned on high growth market (Automotive, IMS). These still small but emergent markets are driven by worldwide champions like Bosch, Valeo, ABB, Siemens or Philips Healthcare, relying on high performance technologies developed upstream in the value chain. This reflects the importance of European OEM champions as drivers of the supply chain in emergent markets*.' [9]

A.4.1. Strengths but incomplete value chain in nanoelectronics

European strengths are very broad and diverse. To illustrate the Grenoble cluster, around STMicroelectronics and Soitec, developed an FDSOI technology[9] that allows for the design and manufacture of energy efficient nanoelectronics components at a less demanding complexity (strong reuse of existing processes and design tools). This technology is a strong contender in the field of mobile devices and holds the promise in many application sectors to further bring added functionality.

Remarkably, Europe has some of the most important equipment and material suppliers (e.g. ASML for EUV Lithography, the key and most risky equipment for further miniaturisation, SOITEC for substrate material, a key ingredient for new transistors or AIXTRON for manufacturing equipment).

In order to cope with escalating R&D costs in nanoelectronics, European companies cooperate in partnerships at international level. Illustrative examples are the partnering of STMicroelectronics with the IBM cluster in Albany, USA, or the investments of the 3 largest semiconductor companies in ASML.

Important efforts have been conducted at regional level notably in the last 15 years to build industrial and technology clusters in (nano) electronics[10]. In line with experiences gained around the world, the most successful clusters are often the result of sustained strategies based on a combination of policies including investment in R&D and in infrastructure. Furthermore the availability of skills and knowledge is an essential factor for deciding on investment by the private sector in this field.

Further, in the fabless world ARM based in the UK licences integrated circuit design, especially in the microprocessor segment. More than 70% of microprocessors in the world are currently designed by ARM, especially for mobile devices. The company increasingly expands its activities including into microprocessors for servers.

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9 FDSOI: Fully Depleted Silicon on Insulator

10 See the constituting clusters of Silicon Europe

Europe will benefit from strengthening these assets. Europe has many strengths, especially in the business-to-business markets and in the automotive, avionics and rail sectors.

A.4.2. Embedded systems: clear strengths despite fragmentation

Embedded systems are electronic products, equipment or complex systems containing computing devices and/or functional components and special software. Embedded systems are not externally visible and are normally inaccessible to the user. They bring intelligence to devices, objects and processes. Embedded systems are not solely dedicated to computing but are typically an entire part of a more complex product. As a single component is 'blind' to the outside world it needs to be connected to sensors ('eyes', 'ears') and actuators ('arms') in order to constitute a smart embedded system. This heterogeneity adds to the system complexity. In order to cope with this complexity progress on standardisation, open technology reference platforms and/or technological convergence are essential.

Complex systems across the embedded and the internet worlds will increasingly share common ICT resources and evolve to cyber-physical systems and 'smart spaces'. These will have to comply with stringent safety, dependability and time-constraints. Cyber-physical systems are powered by a computing continuum spanning embedded and mobile computing to warehouse-scale and high performance computing. Whereas data and network security was less critical in traditional embedded systems, connectivity to the outside world will have the consequence that security will become crucial. In terms of private R&D investment by sector using electronic systems, Europe is strong in all sectors except consumer electronics [15].

In the field of embedded systems, '*Europe benefits from strong OEMs base on Automotive and Aerospace & Defense sectors but also from smaller markets such as Electricity/Gas/Water utilities, and Energy Equipment. Stakeholder interviews inputs indicate that OEMs drive the innovation and technology development. In emergent software applications close collaboration between OEMs and Software vendor companies is considered critical for developing first products. In this context OEMs create a strong internal market for the SMEs. This is particularly important for small software companies which have mainly local operations and few international capabilities*' [15].

However, there are no dominant players in embedded systems opposite to what is observed with the component suppliers. The main reason for a balance among suppliers is because proprietary architectures and peripherals allow microcontroller (MCU) and digital signal processor (DSP) companies to differentiate themselves and because of the huge legacy investments in programming [15]. The fragmented market in Europe is strongly felt in the field of embedded systems. '*The supply side of the ESD software market is very fragmented. IDC estimates that there are about 430 European ESD software vendors but there are no more than 20 companies with turnover over 10 M€ which account to nearly the three quarters of the market. Dassault Systèmes and Siemens PLM are the two largest companies*.' At the same time '*Almost 95% of European ESD software vendors account just for 27% of the market. The activity of these small sized companies (turnover below 10 M€) relies mostly on local operations*.' [15]

A.4.3. Smart systems: world leader in components

Smart systems rely on functional components for sensing and interacting with the environment. They encompass a large set of diverse components that provide e.g. the radio frequency (RF) functions for all sorts of wireless communications, a wide range of sensing capabilities, for airbags or the mobile phone camera, or the handling of high voltages and currents for smart grids or green energy. All these components are developed along some form of technology roadmaps specific for each application area. This applies particularly to the microsystems (integrated microelectronics and micromechanical systems).

This brings inherent entry barriers to the field of (non-logic) functional components. Though these components are less R&D intensive they rely more on proprietary processes and design. This and the European strength in systems engineering helped Europe in developing and holding a strong position (European players are indicated by a red arrow in Figure 29).

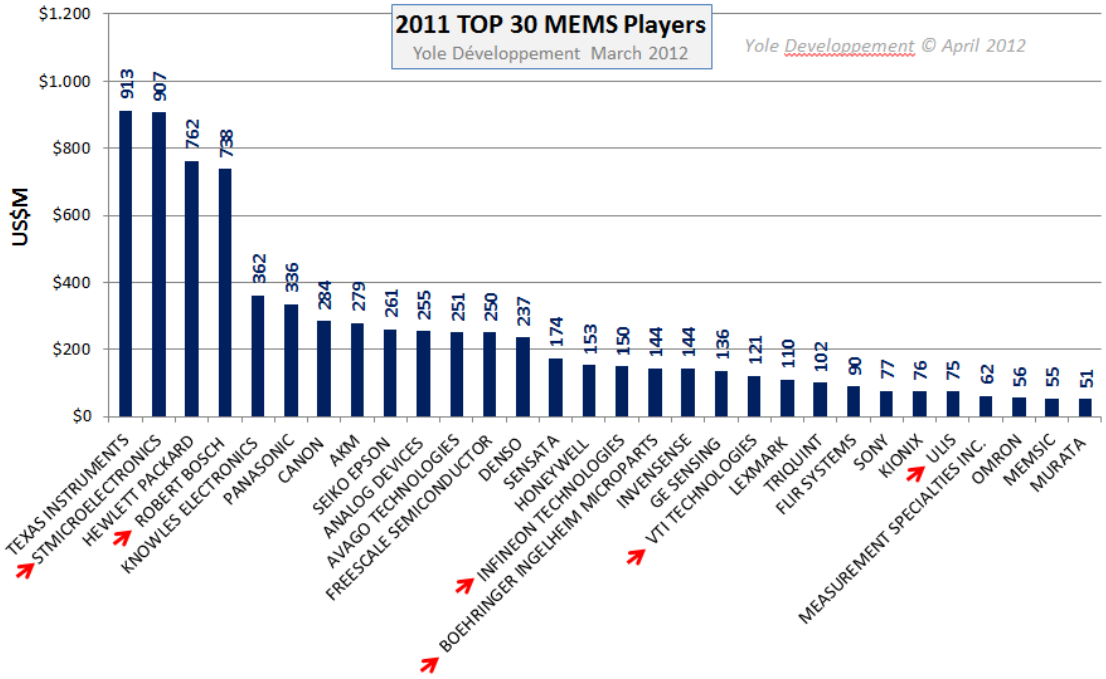

Figure 29 - MEMS companies ranking

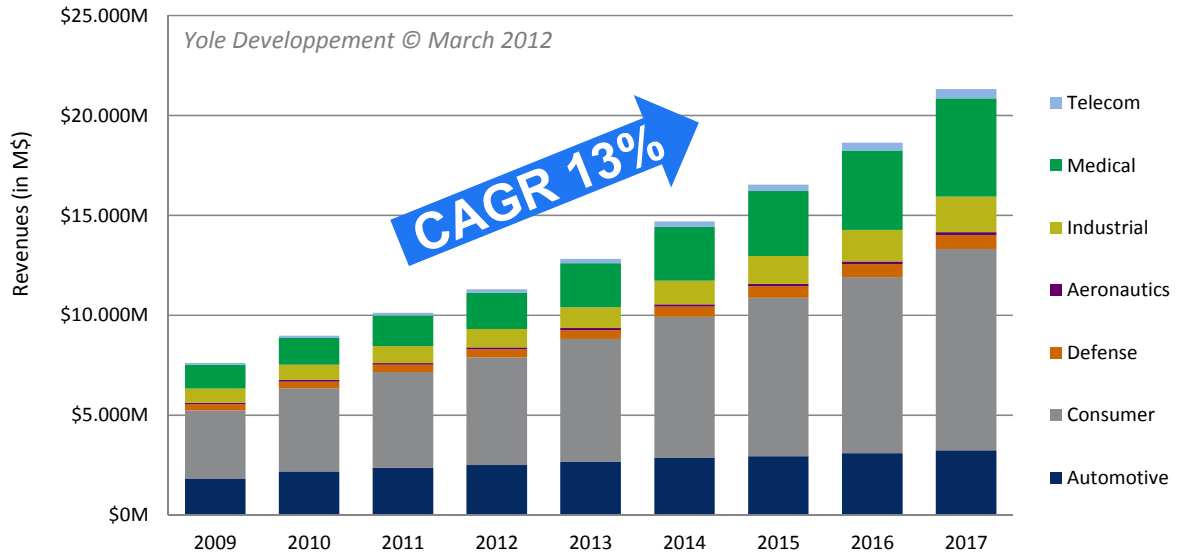

Figure 30 - MEMS market forecast evolution

While in the past markets tended to grow slowly, now the annual growth rate almost doubles the growth for computing components (roughly 13%, see Figure 29) [26]. This is attracting more and new actors. The market for functional components is equally consumer driven.

The strong position of the EU industry in automotive smart systems is an asset to build on. Four European IDMs (STMicroelectronics, NXP, Infineon or Bosch) are in the top 10 global suppliers. Other areas such as health and energy are or will become equally important.

A.5 Outlook

Electronic components and systems are the most R&D intensive part of the ICT. It is facing huge challenges related on the one hand to the substantial size of the needed R&D and on the other hand to the increasing complexity requiring multi-disciplinary technology development throughout the value chain.

The increase of systems design complexity results from several factors, including the proliferation of devices, the quantity of data, the diversity and richness of functions and services, interoperability and networking [15]. It is expected that the number of processing units will reach 100 per person by 2020 and most of them will be connected to some form of network to collect data from their environment and contribute to the ambient intelligence. '*The cumulative impacts of computing power available, new software technologies and the Internet allowed exponential growth functions and services provided by the systems and interoperability capabilities between systems. These two aspects – diversity and richness of functions and services on one hand, interoperability and networking on the other – now lead to levels of complexity never achieved previously*.' [15]

At the same time, the dividing line between electronic components and embedded systems is continuously evolving as more functionality is integrated at the component level. As the number of functions integrated in components increases their design is becoming more complex. Beyond and building on this component complexity there is an increase of the complexity of embedded system as well and the need for increased flexibility in the system design. The industry is building on this diversity and richness of functions and services to

differentiate and compete in supplying systems with increased capability. New approaches for managing the complexity of design are needed especially in networked architectures.

In some application sectors the competitive use of electronic components in Europe needs to be further developed. This is particularly the case in advanced products for consumer markets.

Europe is under threat of losing the strategic capability to produce electronic components [9]. The close relationship between the electronic component industry and the industrial fabric as well as the proximity with systems integrators is of paramount importance for Europe. The strategic importance of electronic systems in specific sectors such as automotive, aerospace, health or energy is significant. Electronic systems provide a large part of the added value in these sectors and are indispensable to maintain competitiveness. The table below presents an integrated summary of several SWOTs [4].

Strengths	**Weaknesses**
- Excellent R&D capabilities/capacities in industry, institutes and academia - Leadership in More-than-Moore technologies and applications - World leading technology and industrial clusters in the field - Market leaders in equipment and materials - Traditional strong position in electronic systems with high degree of specialisation in many fields - Leading position in important market segments and applications – e.g. automotive, healthcare imaging, industrial automation, security and communications - Sizable ICT home market in key application domains - Highly skilled employees with professional experience	- Insufficient alignment of Member States on a European ICT industrial strategy - Very limited role in large consumer product markets: desk/laptop/tablet/tv/smartphone - Limited and fragmented strategic deployment of ICT system solutions for societal challenges - No overall focus on high-tech products in the (decreasing) European manufacturing industry - Inadequate culture for commercialisation of inventions and R&D results - 40 % less patent applications than USA or Japan - Shortage of well-educated new talents, lack of systems thinking in education
Opportunities	**Threats**
- Growing markets for components and systems - Growing need for customised solutions and tighter user-supplier interactions - Growing complexity and prevalence of electronic systems in areas where Europe has strong industry (e.g. energy, transport, healthcare) - The need to address societal challenges, which creates new market opportunities - Increased procurement of innovative products and services in areas of public interest - Industrial exploitation of new materials and corresponding equipment - Expansion of PPPs and strong eco-systems will increase the attractiveness of Europe as location for manufacturing and R&D	- Fragmented regulatory frameworks preventing economy-of-scale exploitation - Uneven global level playing field - Weaknesses in European innovation ecosystem development - Lack of competitiveness with respect to production cost – labour, energy - Loss of major parts of technology and production expertise and as a consequence, risk of degradation in leading-edge R&D&I - Loss of major parts of proprietary intellectual property - Dependence on non-European operating systems for mobile and embedded applications - Dominance of non-EU actors from the Internet world swapping over to the world of embedded/cyber physical systems

ANNEX 2 – RECOMMENDATIONS FROM THE TWO INTERIM EVALUATIONS

First interim evaluation recommendations [11]

No.	Summary of recommendation	Time-frame
1	Future JTIs *in these domains* to continue the tripartite JTI model	Next generation JTIs
Recommendations for Member States		
2	Make multi-annual budgetary commitments	Now
3	Comply with the JTI Council Regulations	Now
4	Undertake benchmarking & alignment study on national practices	Now
5	Give early annual indication of support for specific topics	Now
Recommendations for Industrial Associations		
6	Lead the establishment of processes to monitor progress toward JTI objectives	Now
7	Lead the preparation of action plans for achievement of innovation ecosystem aims	Now
8	Engage better with the JTI constituencies	Now
Recommendations for the European Commission		
9	Lead the drafting of new Council Regulations with alternative Financial Regulations and Staff Regulations	Next generation JTIs
10	Regulations should allow JTIs to support innovation-related activities other than R&D	Next generation JTIs
11	Regulations should allow JTIs to accept funding from other sources	Next generation JTIs
12	Regulations should allow the EU to make additional financial contributions for strategic purposes	Next generation JTIs
13	Regulations should allow the Joint Undertakings to claim some of their operational costs from non-members	Next generation JTIs
14	The Commission should establish data gathering to support assessment of the benefits of these JTIs	Now

No.	Summary of recommendation	Time-frame
Recommendations for the Joint Undertakings		
15	Establish a mechanism for recovering some of their operation costs from non-member beneficiaries of the JTIs	Next generation JTIs
16	Place greater emphasis on strategic, European aims in proposal evaluation & selection processes	Now
17	Establish processes to give early feedback to proposers	Now
Recommendation for JTI - EUREKA co-ordination		
18	ARTEMIS & ENIAC should continue their initiatives to differentiate from and coordinate with ITEA2 and CATRENE, respectively	Now

Second interim evaluation recommendations [12]

Rec.	Summary of Recommendation	Relevant Constituency	Time-frame
1	E/ The ENIAC SRA, MASP, AWPs and Grand Challenges need to reflect more strongly a coherent European perspective, linking to an overarching European ECS research, development and innovation strategy, as proposed in Rec. 17 of this report.	ENIAC Industrial Association and the JU	Next Generation JTIs
	A/ The ARTEMIS SRA and work programmes need to reflect more strongly a coherent European perspective, linking to an overarching European ECS research, development and innovation strategy, as proposed in Rec. 17 of this report.	ARTEMIS Industrial Association and the JU	Now/ Next Generation JTIs
2	E/ The ENIAC Industrial Association, AENEAS, should play a more active role in the definition of the overall objectives and strategy of the ENIAC JTI and should engage more actively with stakeholders so as to promote and facilitate participation in project proposals, especially by SMEs, and to develop and keep up to date the Strategic Research Agenda	ENIAC Industrial Association	Now/ Next Generation JTIs
	A/ The ARTEMIS Industrial Association (ARTEMIS-IA) should re-double its efforts to synergise the European embedded system community	ARTEMIS Industrial Association	Now Next Generation JTIs /
3	E/ ENIAC project reviews, including a final post-project review that should be held, the panel concludes, between 6 and 12 months after the end of a	ENIAC JU	Now

Rec.	Summary of Recommendation	Relevant Constituency	Time-frame
	project, should monitor more closely and rigorously the actual and planned exploitation of project results, and the measures put in place by project partners to achieve such planned exploitation.		
	A/ A detailed deployment and commercialisation strategy for ARTEMIS project results should be defined.	ARTEMIS JU	Now
4	Projects should build appropriately upon previously developed ARTEMIS technology, making reference to what has been funded before with the intent of demonstrating novelty as well as re-use of results obtained in previous projects.	ARTEMIS JU	Now/ Next Generation JTIs
5	The proportion of funding for projects targeting generic applications and services (*Applications* projects) should be increased.	ARTEMIS JU and Industrial Association	Now/ Next Generation JTIs
6	The ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), should be integrated into a single organisation (one legal entity - an ECS JTI).	EC and future JTIs	Next Generation JTIs
7	ENIAC and CATRENE calls for, and selection of, proposals should be more closely aligned (e.g. by the use of common and/or complementary calls), with the relevant funding awarding bodies retaining some flexibility over the assignment of the most appropriate funding stream.	ENIAC JU	Now/ Next Generation JTIs
8	Construct the proposed integrated ECS JTI (of Rec. 6), or indeed any future JTI, as a PPP with reduced legal requirements.	EC	Next Generation JTIs
9	Focus the JU Governing Board on strategic issues and reduce its administrative burden in order to attract participation from high-level industry representatives.	JUs	Now/ Next Generation JTIs
10	Member State participation rules, funding rates and procedures should be harmonised wherever possible.	Member States	Now
11	a/ The JU should explore and develop appropriate mechanisms to create an 'early warning system' to identify mis-matches in funding of member states.	JUs	Now

Rec.	Summary of Recommendation	Relevant Constituency	Time-frame
	b/ In order to bridge financing gaps, intermediate funding should be allowed for projects which are mission-critical.	JUs and EC	Now/ Next Generation JTIs
12	Member States should commit to a multi-annual funding system.	Member States	Now/ Next Generation JTIs
13	Take steps (e.g. modification of evaluation criteria) during the proposal evaluation and selection process to improve the match of the project portfolio to strategic European aims and to ensure optimum coverage of key areas defined in the overarching EU ECS strategy (proposed in Rec. 17) and the work plans derived from such a strategy.	JUs	Next Generation JTIs
14	Specific support mechanisms for enhancing the project management processes in JTI projects should be developed and implemented. Management costs should be 100% funded by the EC for all JTI projects.	JUs and EC	Now/ Next Generation JTIs
15	JTI projects should be subject to only one joint JTI and MS project review and reporting process.	JUs and Member States	Now
16	Appropriate metrics for measuring the impact and success of projects should be developed and used for both current and future JTIs.	JUs	Now
17	A mid- to long-term overarching EU research, development and innovation strategy in Electronic Components and Systems (ECS) should be clearly defined and used as a key 'driver' for funding decisions.	EC	Now

ANNEX 3 – PROFILES OF THE ENIAC AND ARTEMIS JUS AND EPOSS ETP

Both JUs were set up for 10 years (2008-2017) with a financial contribution from the Seventh Framework Programme over the period 2008-2013. The present information gives an overview of the activities of the JUs during their first four years 2008-2011 for which full data are available. In 2012, the JUs extended their scope of work to include manufacturing pilot lines for ENIAC (as a result of the recommendations from the High-Level Group on Key Enabling Technologies [3]) and innovation pilot projects for ARTEMIS, both of which had a significant impact on their budget execution.

ENIAC Joint Undertaking

The focus of ENIAC is the semiconductor industry. The Multi-Annual Strategic plan [42] identifies 8 domains and 25 grand challenges (GC's) setting the scope of the programme. An overview of these is provided in the following table.

C#	Chapter	Grand challenge (GC)
1.	Automotive and transport	Intelligent Electric Vehicle
		Safety in traffic
		Co-operative Traffic management
2.	Communications and digital lifestyles	Internet multimedia services
		Evolution to a digital lifestyle
		Self-organizing network
		Short range convergence
3.	Energy efficiency	Sustainable and efficient energy generation
		Energy distribution and management- Smart grid
		Reduction of Energy consumption
4.	Healthy ageing and living	Home healthcare
		Hospital healthcare
		Heuristic healthcare
5.	Safety and security focuses	Consumer and citizen security
		Securing the European challenging applications
		Enabling technologies for trust security and safety
6.	Design technologies	Managing complexity
		Managing diversity
		Design for reliability and yield
7.	Semiconductor process and integration	Know-how on advanced and emerging semiconductor processes
		Competitiveness through semiconductor process differentiation
		Opportunities in system-in-packaging

8.	Equipment, materials and manufacturing	Advanced CMOS – 1xnm and 450 mm
		More than more
		Manufacturing

Chapters 1-5 are strongly focused on more market oriented research and development (transport, communication, energy, healthcare, safety &security), where the 6th chapter is enabling on design tools, chapter 7 on the more fundamental chips manufacturing processes and 8 on (supporting) manufacturing equipment. Figure 31 shows that the programme addresses strongly the semiconductor manufacturing part, but also the more subsystem oriented part of the value chain is addressed by Chapters 1-5.

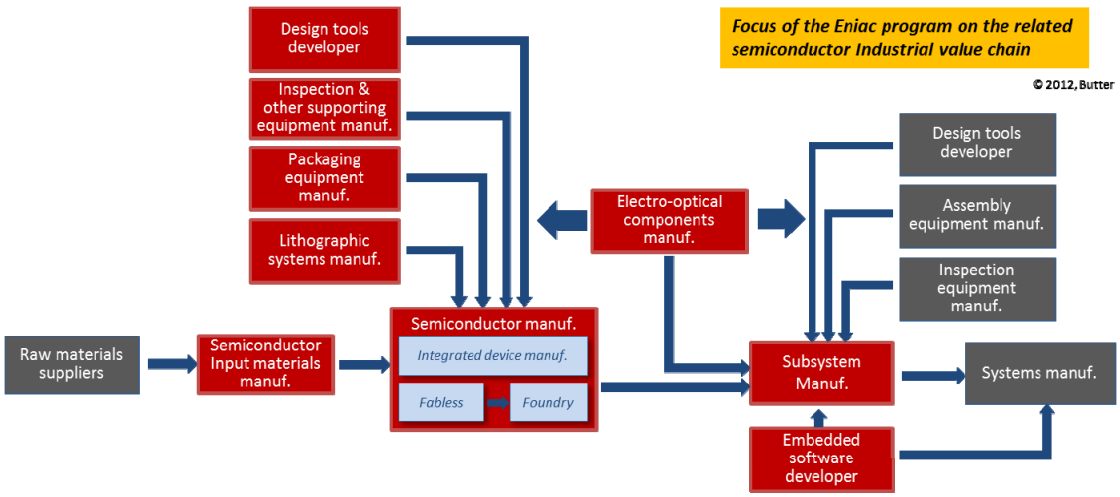

Figure 31 - Overview of value chain addressed by ENIAC JU

The 40 projects selected for funding in the period 2008 – 2011 cover all areas of research; their distribution is shown in Figure 32.

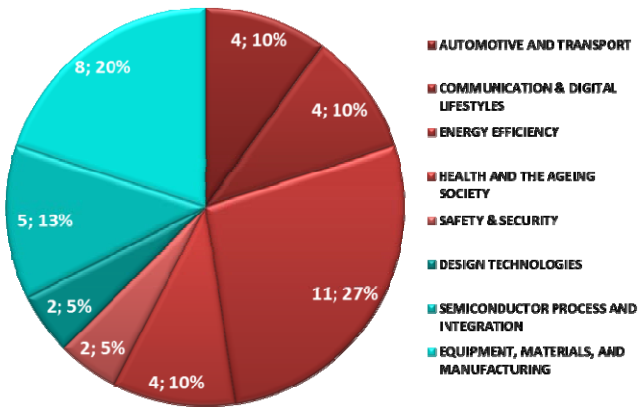

Figure 32 - Projects per area of activity

On average, there are some 20 participants per project from 6 different Member States as detailed in Figure 33.

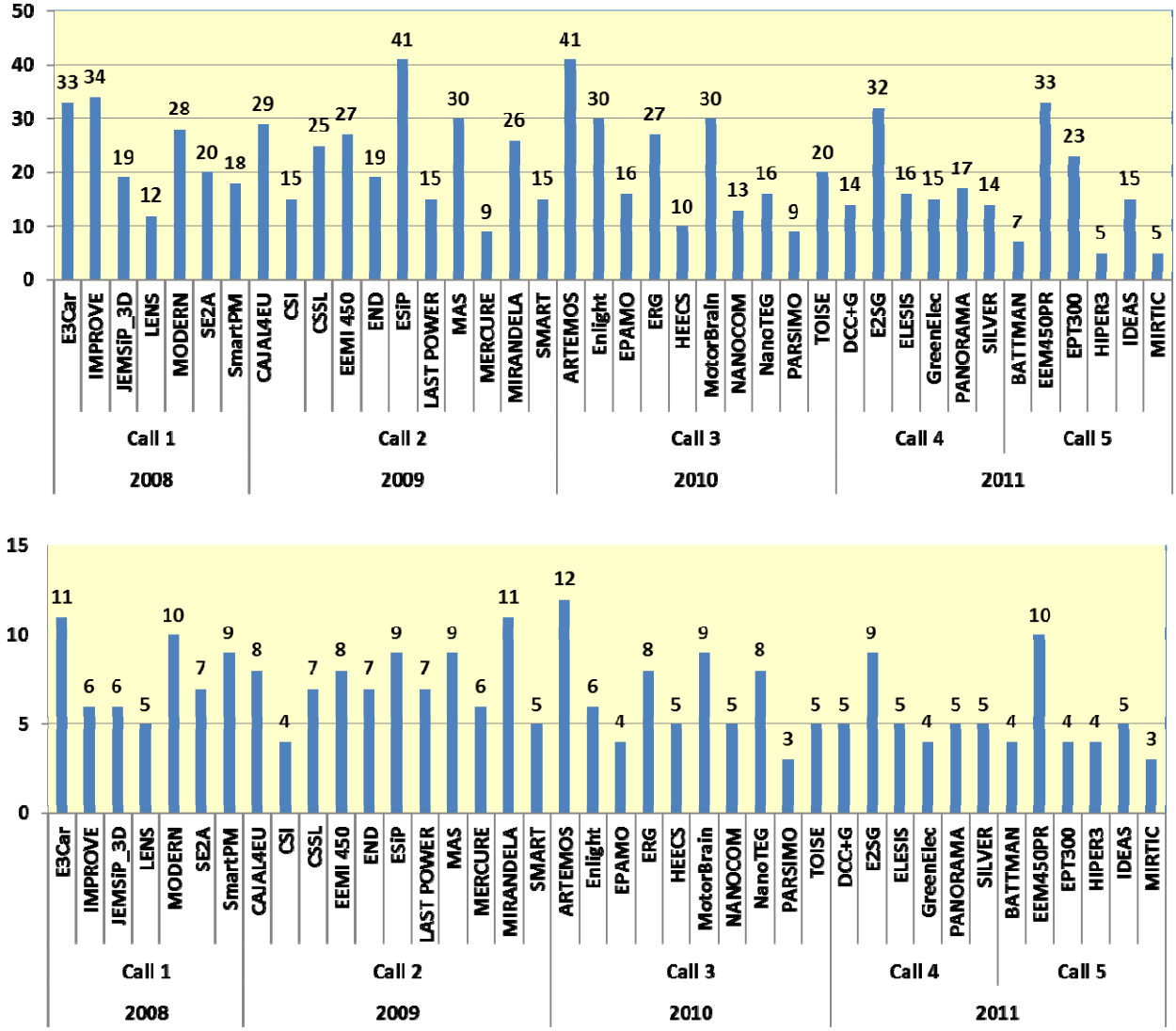

Figure 33 - ENIAC Projects 2008-2011

The participation of the R&D actors in the ENIAC JU projects is representative for an industry in which all players, large or small, public research or private companies have a significant part to play. Since the beginning, the projects exceed 800 participations of more than 400 non-affiliated organizations distributed as shown in Figure 34.

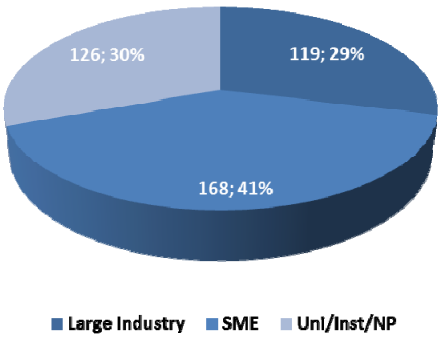

Figure 34 - Unique participants by type of organisation

In Figure 35, the results of the yearly calls for proposals demonstrate that the JU created a favourable environment for leveraging public (i.e. national) and private funds. The impact of addressing higher TRLs according to the KET report is remarkable in the 2012 forecasts.

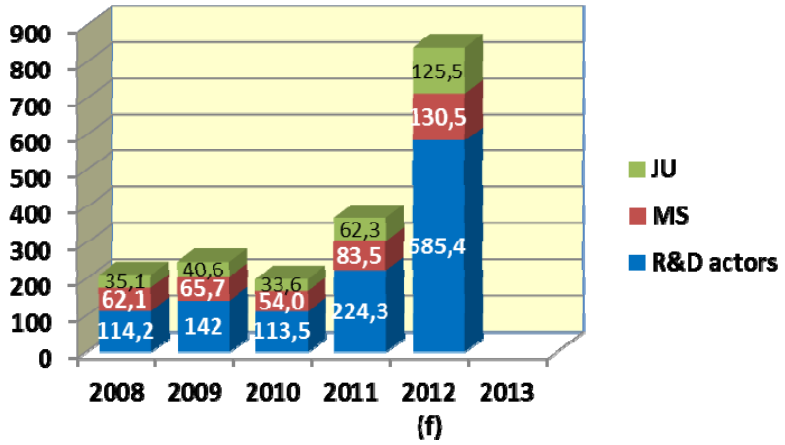

Figure 35 - Programme execution (in M€)

The distribution of funding per type of participants is shown in Figure 36. This is in line with the value chain and indicates that the differences in funding rates applied by the national authorities are geared towards more support for SMEs and academic/research partners.

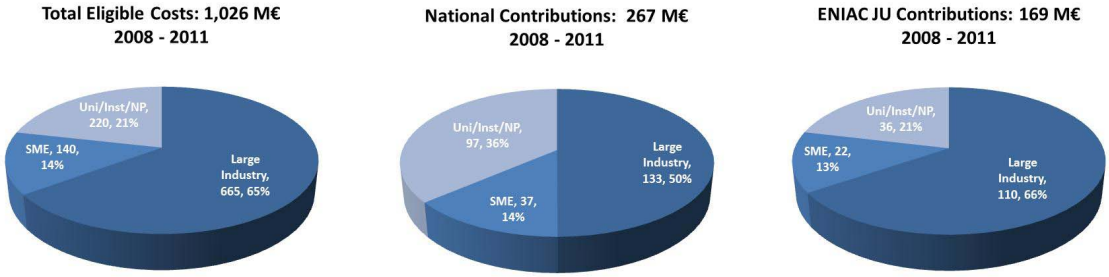

Figure 36 - Funding per type of participants

As examples of concrete achievements, the following projects were concluded successfully as a result of the first call for proposals in 2008:

- The project E3Car improved by 35% the overall efficiency of the electrical vehicles resulting in reduction of the energy consumption and reduced ecologic footprint. It innovated at the component, sub-system and system level, creating a view of the electric vehicle architecture adopted and further developed and implemented in several follow-up projects.
- The project IMPROVE advanced the state-of-the-art in virtual metrology, predictive maintenance and adaptive control plans, reducing by 30% the measurement steps in manufacturing, improving the up-time of the equipment items by 1%-5% and virtually eliminating disruptions caused by unexpected failure. It enables the European manufacturers to compete based on innovation and efficiency.

- The project LENS integrated results from various research activities improving the accuracy in photolithography by 40-50%, introduced new materials and demonstrated process integration schemes using dual exposure and pitch doubling technics that prolonged the applicability of the incumbent immersion tools for two more technology generation

ARTEMIS Joint Undertaking

The focus of ARTEMIS is the electronic systems industry, with special focus on the more market oriented sub-system industries. Special focus is on embedded systems. Three main research domains are distinguished in the Multi-Annual Strategic Plan [43] between: 1) Reference Designs and Architectures, 2) Seamless Connectivity and Middleware and 3) (System) Design Methods and Tools. A set of "ARTEMIS Sub-Programmes" are identified to further provide more focus and detail to the program objectives:

- ASP1: Methods and processes for safety-relevant embedded systems. This subprogram focuses on the transport, industry, healthcare and public infrastructure, looking at the enhancement of safety and efficiency. Its focus is on software development and architectural design.
- ASP2: Embedded Systems for Healthcare systems. Important needs for applications in this sub-programme are: gathering and (pre-) processing of data by a large variety of detectors, sensors, control treatment by various actuators, real-time processing of large volumes of data, high reliability, dependability and interoperability in complex heterogeneous environments.
- ASP3: Embedded Systems in Smart Environments. The overall goal is to provide methods, tools, technology and models with which developers will be able to build 'smart environments', i.e. ecosystems of smart and heterogeneous devices interacting with each other and with the environment, and cooperating together to provide a foundation for rapid local applications and service innovations.
- ASP4: Manufacturing and production automation. The main themes of this subprogram are embedded systems supporting sustainable, competitive, flexible, reconfigurable manufacturing and delivery of products, and the support of products over their complete life-cycle.
- ASP5: Computing platforms for Embedded Systems. The main themes of this subprogram are: 1) new architectures for embedded systems, addressing very high throughput (multi-core) embedded systems, low power (power management), as well as HW / SW architecture strategies; 2) new design paradigms that render the practical implementation of multi- and many-core solutions tractable.
- ASP6: Embedded Systems for the Security and Critical Infrastructures Protection. The focus is on embedded systems architectural, design and communication topics, ensuring seamless and secure communication/cooperation of heterogeneous embedded systems in large-scale dynamic networks using models/methods/tools for predicting complex, dynamic behaviour in distributed and cooperating embedded systems.
- Embedded Technology for Sustainable Urban Life. The subprogram calls for integration that crosses several technology domains and diverse application sectors. The research strategy is to develop a series of platform ecosystems that progressively converge to integrate the management of more resources in larger areas.
- ASP8: Human-centred Design of Embedded Systems. The aim is to promote technology development that supports designers to build intuitive Human-Machine Interfaces that

integrate naturally into operational environments and that are effective and easy to use, especially in safety critical domains.

Looking at the industry value chain in Figure 37, it is clear that more focus is given towards application oriented subsystems, but also the connection to semiconductor devices is relevant (ASP1, ASP5, ASP6). No attention is given to materials and semiconductor manufacturing equipment, but subsystem manufacturing equipment (and equipment for other manufacturing industries) is addressed (ASP4). Especially design tools for subsystem manufacturers are of importance.

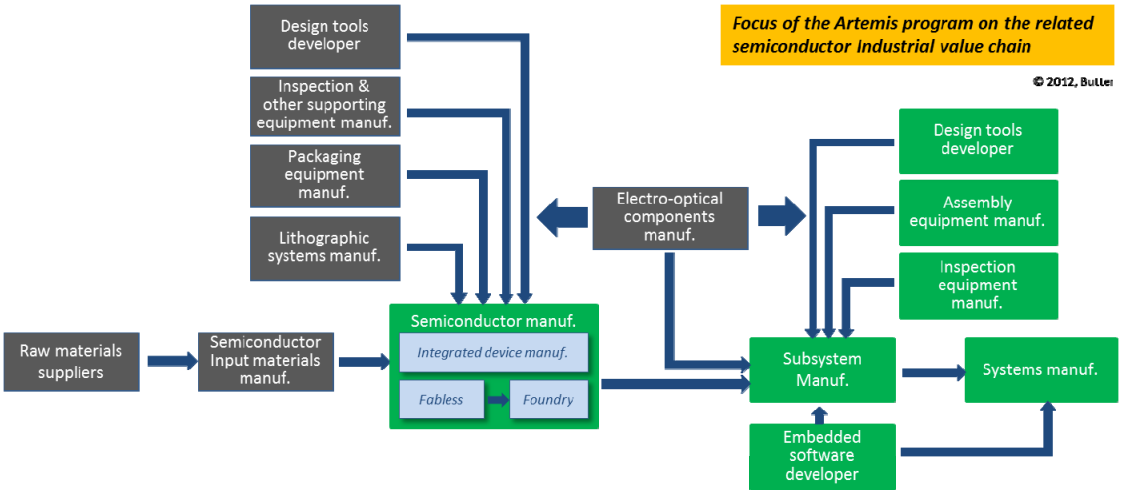

Figure 37 - Overview of value chain addressed by ARTEMIS JU

Looking at the subprograms, it becomes clear that the main focus is on embedded software. However, also the hardware architecture is relevant, as this is very often directly linked to software architectures. In some subprograms, attention is given to the development of new micro transducers (sensors and actuators) which are also important research topics for the EPoSS ETP. The manufacturing technologies are limited to enhancing equipment for the manufacturing of subsystems and systems.

The 44 projects selected for funding in the period 2008 – 2011 cover all areas of research; their distribution is shown in Figure 38.

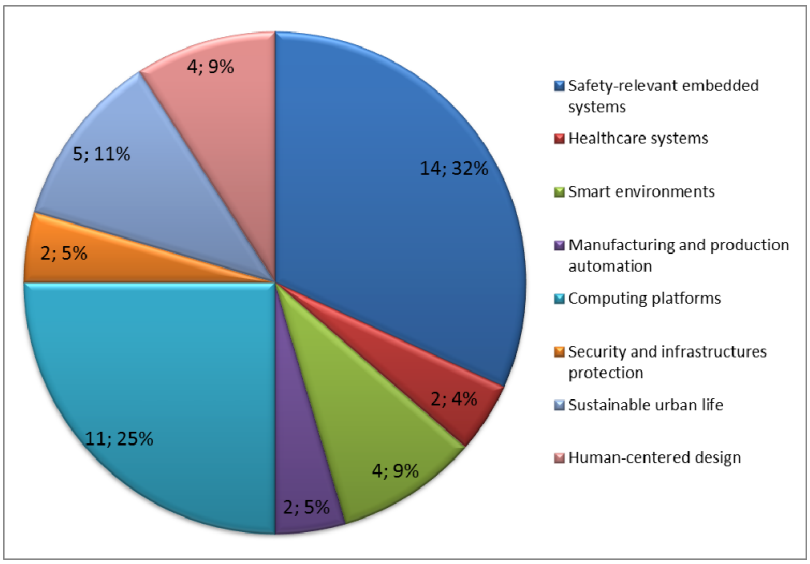

Figure 38 - Projects per area of activity

On average, there are some 20 participants per project from 6 different Member States as detailed in Figure 39.

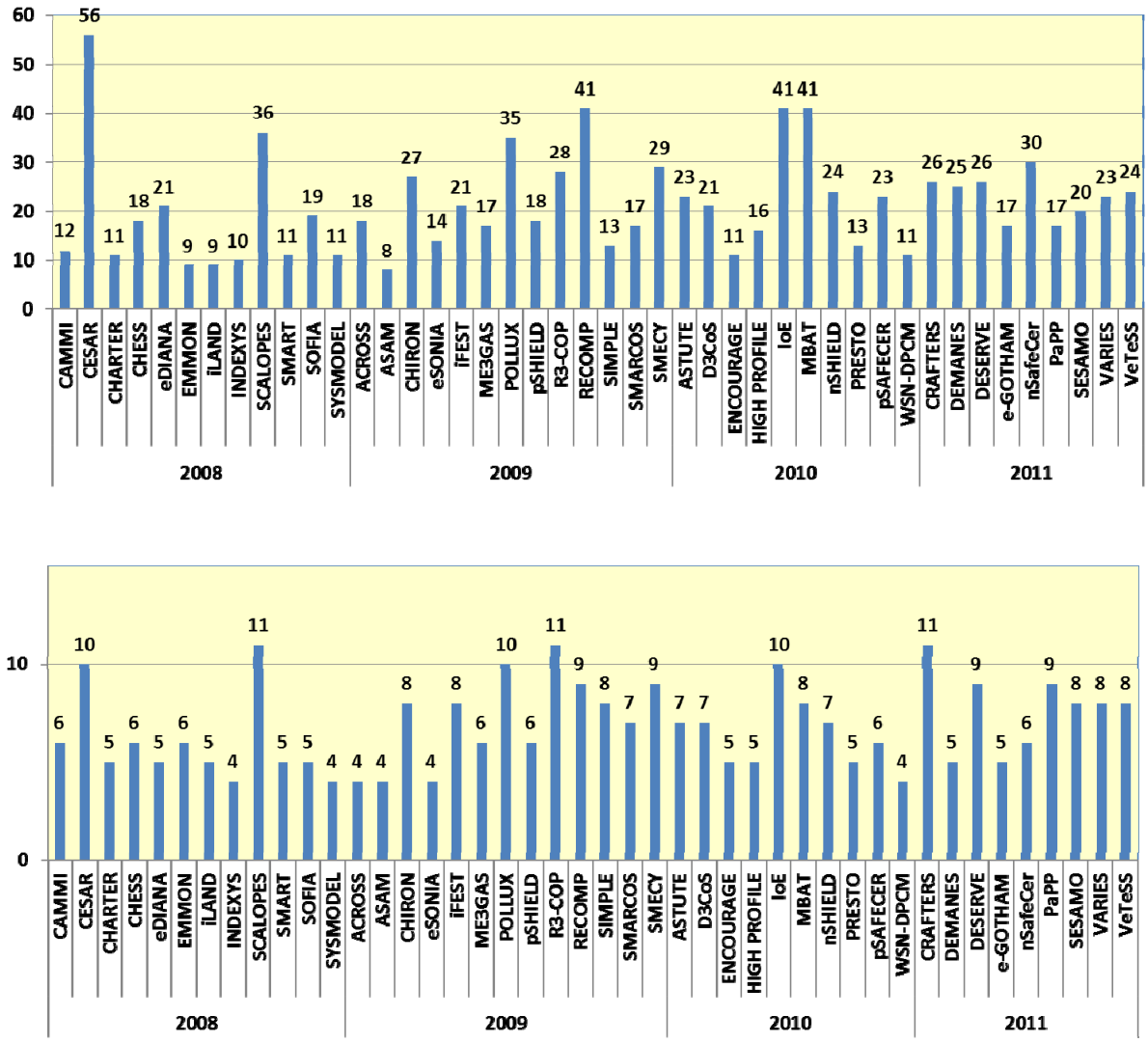

Figure 39 - ARTEMIS projects 2008-2011

The participation of the R&D actors in the ARTEMIS JU projects shows a balanced representation of all the players. Since the beginning, the projects exceed 900 participations of more than 500 non-affiliated organizations distributed as shown in Figure 40.

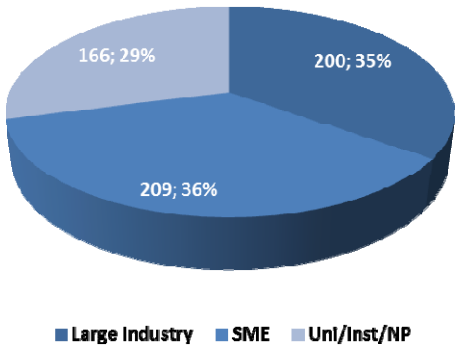

Figure 40 - Unique participants by type of organisation

In Figure 41, the results of the yearly calls for proposals show that the JU is leveraging public (i.e. national) and private funds but at a lower level than anticipated initially. The impact of calling for Innovation Pilot Projects explains the 2012 forecasts.

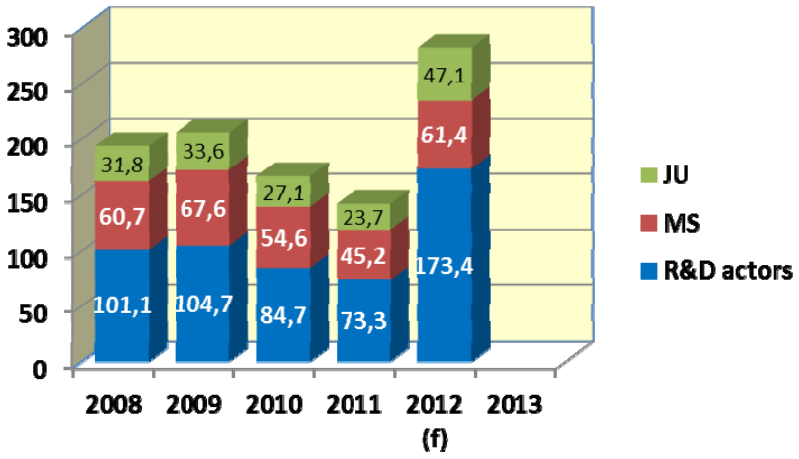

Figure 41 - Programme execution (in M€)

The distribution of funding per type of participants is shown in Figure 42. As for ENIAC JU, the value chain is well covered and the national authorities are geared towards more support for SMEs and academic/research partners.

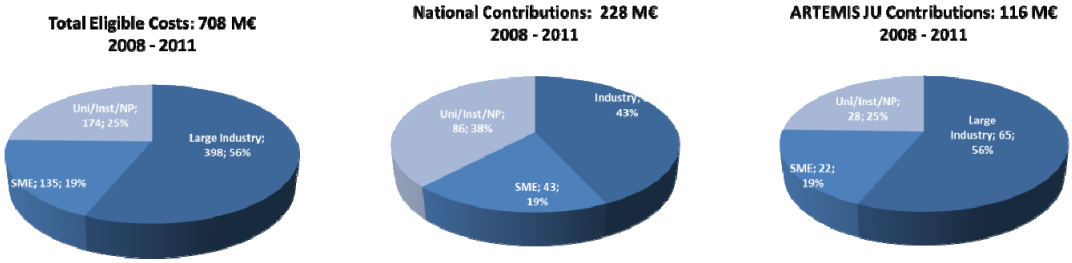

Figure 42 - Funding per type of participants

As examples of concrete achievements, the following completed projects from the call in 2008 are considered as flagships:

- CESAR (ASP1: Methods and processes for safety-relevant Embedded Systems): very large project – the largest in the ARTEMIS portfolio to date. Its importance, both in size and of its topic, has generated such gravitational pull that many projects have quickly "moved into orbit" and provide inputs to CESAR or make use of its output. It also lies at the heart of CRYSTAL – an AIPP from Call 2012. CESAR created a "Reference Technology Platform" (the CESAR RTP, or CRTP) and associated "Interoperability Specification" (IOS). In essence, this is a sophisticated toolkit to manage the plethora of other tools needed when developing SW-intensive products that demand absolutely highest standards of reliability. The CRTP allows relevant and interoperable tools to be selected for particular market/product requirements and generates a customised working environment in which these tools can be used to their best advantage.

- eDIANA (ASP7: Embedded Technology for Sustainable Urban Life): created and demonstrated a so-called "Middleware Platform" specification that allows various sensors and controls to communicate with each other, specifically aimed at energy management in houses and larger buildings (offices and/or residences). The middleware ensures that devices from different manufacturers can operate together, using wireless or wired technologies. It also foresees connection to larger, district-level networks such as "smart grids". The platform's functionality and usefulness in the retrofit scenario were tested on three medium-scale application demonstrators. The eDIANA consortium is at the heart of the recently certified ARTEMIS-IA Centre of Innovation Excellence "ES4IB" (Embedded Systems for Intelligent Buildings).

- INDEXYS (ASP5: Computing Platforms for Embedded Systems): developed and evaluated 3 different demonstrators, in the automotive, aerospace and railway industrial domains, allowing partners to patent the approach developed for the CAN Router - a star architecture device for the CAN network (the CAN bus, popular in automotive and industrial applications, was initially designed as a bus-architecture but INDEXYS has expanded it towards the more secure star-architecture). It also significantly influenced and contributed to the release of the SAE Standard for the Time-Triggered Protocol TTP.

EPoSS European Technology Platform

The focus of the EPoSS ETP is on supporting research and development in the subsystem and system manufacturing. Core to the program is the integration of smart systems. Based on the 2009 Strategic research agenda of EPoSS [44], the core technologies are: Materials, Micro/Nano effects, Packaging, Design, Smart power management, Signal and information processing, Energy conversion systems, Chemical and biological sensors, analytical systems and Vision sensors. The thematic priorities are structured according to the following application areas:

- Smart Systems for Automotive Applications, enabling a quicker move to the era of full electrical mobility. This includes: Smart Systems for the Management of Energy Storage Systems, Intelligent Power Electronic Devices, Active Control Units for Electric Motors & Wheels, Smart Integration of Range Extenders, Advanced Vehicle to Grid Connection Systems
- Smart Systems for Medical Applications, including the integration of micro-sensors and micro-actuators in products for cure and care that will provide the healthcare professional with more advanced and improved options to treat and take care of patients and will enable patients to attain a better quality of life, even when suffering from chronic diseases.
- Smart Systems for the Internet of Things, opening the way towards multi-dimensional, context-aware, and smart environments that can bridge the real, virtual and digital worlds by using wireless connectivity for energy efficient and environmentally friendly applications and services.
- Smart Systems for Information and Telecommunication, focusing on Personal connectivity and communication, High-performance variable components component level, Integration on module/subsystem level, Machine-to-machine connectivity, RF antenna and filter design for miniature, low-power designs, New scalable architectures.

- Smart Systems for Safety and Security, including low-cost personal smart secure portable objects and home protection systems which are affordable for consumers, and high-performance, high-efficiency systems for applications such as public transportation, stadiums, business and banking centres, administrative offices, public IT infrastructures, border security, water and energy distribution, telecommunications and other safety critical systems.
- Smart Systems for Aerospace, including the Electrical Aircraft (Sensors, Actuators, Networks); the Connected Aircraft (Communication, RF technology), the Intelligent Aircraft (Sensors, Actuators), the Efficient Aircraft (Sensors, Actuators. Power).

Looking at the industry value chain in Figure 43, the focus is on systems, but within the perspective of manufacturing of components and devices. Although limited attention is given to the fundamental research in semiconductor device development, still this link within the value chain can be of importance. Overall the program is focused on application products for distinctive markets and manufacturing equipment is not a priority.

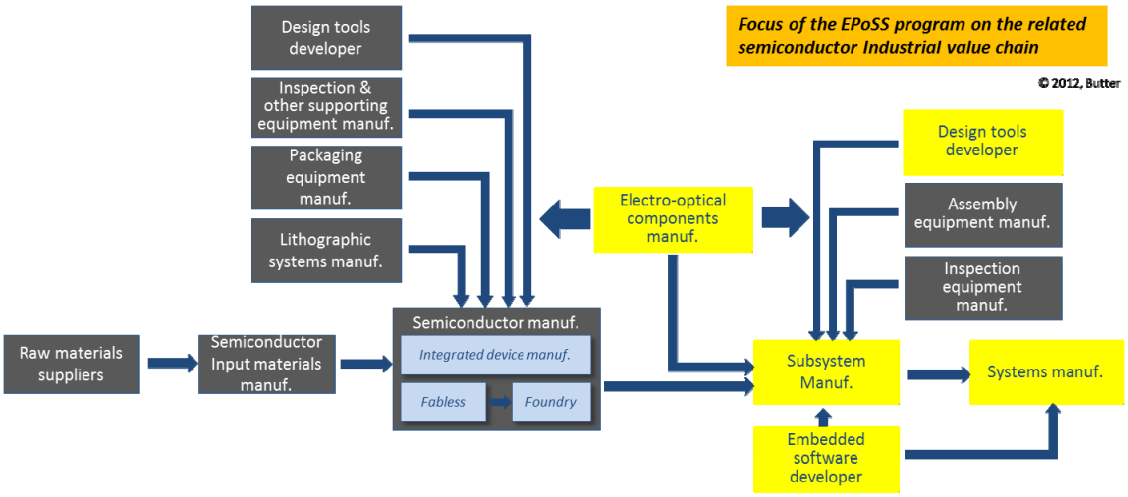

Figure 43 - Overview of value chain addressed by EPoSS ETP

So far, the EPoSS SRA was implemented via different means: the PPPs on the Green Car and Efficient Buildings, and 'regular' FP7 objectives in the ICT Work Programme. It was only loosely coordinated with the activities in ARTEMIS and ENIAC.

ANNEX 4 – FINAL REPORT OF THE STUDY ON THE FUTURE IMPACT OF ARTEMIS AND ENIAC

The final report of the study SMART 2012/0050 [4] is available in a separate document.

ANNEX 5 – SOURCES

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ANNEX 6 – GLOSSARY OF TERMS

AENEAS	Private non-profit organisation established under French law to represent the R&D actors involved in the ENIAC JU
ARTEMIS	European Technology Platform for embedded computing systems
ARTEMIS-IA	Private non-profit organisation established under Dutch law to represent the R&D actors involved in the ARTEMIS JU
ARTEMIS JU	Joint Undertaking implementing a JTI on embedded computing systems
E&M	Equipment and Materials
ENIAC	European Technology Platform for nanoelectronics
ENIAC JU	Joint Undertaking implementing a JTI on nanoelectronics
EPoSS	European Technology Platform for smart systems
ETP	European Technology Platform (grouping of R&D actors in a specific field, driven by industry who produces primarily a Strategic Research Agenda covering the key issues requiring a dedicated and joint effort)
Fab	Manufacturing plant for electronic components
Fabless	Company designing electronic components without own manufacturing capability (outsourcing to foundry)
Foundry	Company owning fab(s) and offering manufacturing services to fabless customers
IC	Integrated Circuit (also named 'chip')
ICT	Information and Communication Technology
IDM	Integrated Device Manufacturer – company designing and manufacturing its own electronic components
IP	Intellectual Property
JTI	Joint Technology Initiative – a Public-Private Partnership for R&D&I in a specific technology domain
JU	Joint Undertaking (as defined by Article 187 TFEU)
KET	Key Enabling Technologies (identified by a High-Level Group of experts as advanced materials, biotechnology, micro- and nanoelectronics, nanotechnology, photonics and manufacturing as a cross-cutting issue)

PA	Public Authority
PPP	Public-Private Partnership
R&D	Research and Development
R&D&I	Research, Development and Innovation
RTO	Research and Technology Organisation
SME	Small- and Medium-sized Enterprise
SRA	Strategic Research Agenda
SRIA	Strategic Research and Innovation Agenda
TRL	Technology-Readiness Level – a measure of the industrial maturity of a technological product or service (scale 1-basic principles to 9-successful mission operations)