5.4.1 Programme impact

The Council Regulations establishing the Joint Undertakings foresee a mid-term and a final assessment organized by the EC. The final assessment of ARTEMIS and ENIAC took place sometime before the final execution of the programme, in order to include the lessons learnt in the proposal for the ECSEL JU. The EP was interested in an assessment by the ECSEL management including all activities. This document has been provided, and is reproduced here in an updated version.

5.4.1.1 Fulfilling the Mission

The ARTEMIS and ENIAC JU had the mission to respond to the need for support for pervasive Information and Communication Technologies by increasing and leveraging private and public investment in the sector of nanoelectronics and embedded systems in Europe. We highlighted in previous Annual Activity Reports the “additionality” of the JU actions: they resulted in an overall increase of the investments, because existing instruments like the EUREKA clusters etc. continued their activities at the usual level. The first task has been to reach alignment between the national and European strategies; once this condition has been fulfilled, the programme experienced very strong engagements, even if the delay accumulated in the first three years could not be completely recovered. Altogether, the JUs selected for funding 104 projects, engaging 626 million € EU contributions, leveraging 912 million € national contributions and incentivising research and innovation with total eligible costs approaching 4 billion €: each euro contributed by the EU resulted in 6.4 euro research and innovation activity in Europe.

5.4.1.2 Contributions

1) Pioneering “Innovation Actions”

The ENIAC and ARTEMIS have been the first instruments that defined a new type of actions addressing higher technology readiness levels (TRL), called “Pilot Line” or “Innovation Pilot” projects. The JU projects selected for funding in 2012 and 2013 open the way for H2020 “Innovation Actions”.

At the end of 2013, ENIAC and ARTEMIS have selected for funding 17 such actions with total eligible research costs exceeding 2 billion euro.

2) A few remarkable results

The research and innovation generated in the programme created significant break-through solutions in important fields. Altogether, the JUs co-funded 104 projects with total eligible costs with almost 3,000 participations, encompassing the whole continent. A few of them are listed hereunder with some of the noticeable results:

- “Nanoelectronics for an Energy Efficient Electrical Car (E3Car)” demonstrated 35% energy savings, lower costs, improved reliability and shorter time to market: some of the innovations are already adopted in real-life applications as early as in the year immediately following the end of the project. This has been Europe’s largest research project in this field in the last four years, providing the frame for seven other electro-mobility projects with a total R&D budget of 180 million euro and over 100 participants. The project received the 2011 ENIAC Innovation Award, a distinction taking into account the opinion of the Public Authorities from the Member States participating in the JU.

- “Implementing Manufacturing science solutions to increase equiPment pROductiVity and fab pErformance (IMPROVE)” developed virtual metrology and predictive maintenance technologies demonstrating more than 10% throughput increase in manufacturing lines running a wide mix of products, improving Europe’s manufacturing competitiveness and prefiguring the Industry 4.0 concept. It has been one of the 10 finalists for the Best Project Award of the Industrial Technologies Conference 2012, Aarhus, Denmark, selected out of more than 900 projects funded under Framework Programmes 5, 6 and 7.

- “Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments (EMC²)” shall establish Europe as a leader in Embedded Systems
generating both novel software architectures and a complete tool set for highly adaptable, scalable and secure systems. They are demonstrated in automotive, avionics and space, industrial manufacturing, internet of things, and cross-domain applications. The project involves 99 partners from 19 European countries with a total budget around 100 million euro.

- “Efficient silicon multi-chip System-in-Package integration – reliability, failure analysis and test (ESiP)” demonstrated new ways to assure high quality and reliability in applications from consumer to aeronautics, generating innovative anti-counterfeiting solutions. 40 partners from 9 countries engaged total costs of 36.1 million euro in heterogeneous integration, developing technologies, analytical methods and characterisation techniques to create high value components with a variety of functions. It received the ENIAC 2013 Innovation Award.

- “CRitical sYSTem engineering AcceLeration (CRYSTAL)” shall reconfirm the European leadership in safety-critical systems, establishing an Interoperability Specification (IOS) and a Reference Technology Platform (RTP) as a European standard, providing ready-to-use, integrated tool chains with high technology readiness level. It engaged a budget of 82 million Euro to support 71 partners from 10 countries.

- “Enabling Power technologies on 300mm wafers (EPT300)” developed a best in class, leadership technology to reduce energy losses by up to 40% in energy generation, distribution and utilization, by building power devices on 300mm wafers thinner than paper. It has been selected by the European Commission as a “multiKET Pilot Line” demonstrator, and received the State Prize “Innovation 2013” of the Austrian Ministry of Economy, Family and Youth. The sequence of pilot line projects EPT300 >> EPPL >> eRAMP created the technology that justified a private investment of 250 million euro in Dresden.

- “Energy Efficient and Intelligent Lighting Systems (EnLight)” developed innovative solutions to exploit the full potential of Solid State LED Lighting integrated in intelligent lighting systems, demonstrating energy savings more than 40% beyond what is achievable by simply retrofitting conventional lamps. It was carried out by a 27-partner strong consortium from five European countries. It received the ENIAC 2014 Innovation Award.

3) Generation of intellectual property, dissemination

At the end of 2014, 59 projects reached technical completion; they generated 179 patents, 11 trade secrets, 12 trademarks, 1004 exploitable foreground intellectual property items and 3099 publications. These numbers will almost double when all projects will be completed.

5.4.1.3 Medium to long term impact

1) Impact on employment

The projects arising from the calls executed by ARTEMIS and ENIAC represent a total effort of 25,283 person.years. This indicates the total number of position in direct employment sustained by the actions of the Joint Undertakings.

Considering that the first projects started in 2009 and the last ones shall be close to completion in 2016 (eight years in total), more than 3000 full time equivalent positions have been occupied in average every year by researchers working in the projects incentivised by the ARTEMIS and ENIAC JUs.

Since the R&D intensity in our industry is around 15%, we can estimate that the total number of direct employees supported by the programme would be around 20,000 every year.

If we accept that our industry generates about 4 indirect and induced employments for each direct employment, as some specialised market studies seem to indicate\(^1\), then the programme would have sustained about 80,000 jobs per year.

\(^1\) For example: one direct job in the nanoelectronics company results in 2 indirect jobs to the suppliers and 2 induced jobs in services such as education, health, shops etc (B. Bougnoux, C. Genthon, J.-P. Laurencin, B. Reverdy, « Analyse de l’impact de Crolles 2 et de l’Alliance Freescale – Philips – ST Microelectronics sur l’emploi et le pôle économique Grenoble – Isère », Université Pierre Mendès France, Grenoble, 2005).

\(^2\)
2) **Impact on the industrial ecosystem**

The projects selected for funding by the ARTEMIS and ENIAC JU have been inclusive, being attractive for large and small countries, for large enterprises, small and medium sized enterprises, but also for academic and institutional research institutions.

At eco-system level, the majority of the participating entities are SMEs, making up more than 40% of the participants in the programme; the large enterprises and the academic or institutional research organizations represent about 30% each.

The 14 pilot line projects selected for funding by ENIAC included a large number of participants (338) from all across Europe (23 countries) although obviously the pilot line itself was mostly established at only one location.

The private sector participants in ARTEMIS created and labelled “Centres of Innovation Excellence” and “Tool Platforms” and supported through dedicated actions the inclusion of SMEs in the “innovation pilots”, a key enabler in establishing a real Innovation Environment in Europe.

3) **Impact on industrial leadership**

Numerous public announcements have highlighted industrial investments based upon technologies developed in the “pilot line” projects, as well as follow up research and innovation projects to further expand the capabilities. A few examples are listed hereunder:

- Infineon announced building a 300-mm fab in Dresden, the first high-volume fab for power semiconductors worldwide, to exploit the technologies developed in the pilot line projects coordinated out of Austria
- More than 50 European manufacturers are working together to establish at IMEC the only facility outside U.S.A. able to drive towards industrial maturity the next generation of semiconductor equipment enabling the transition to 450mm wafers and to sub-10 nm generations, now used to secure sustainable leadership of the European manufacturers (particularly in lithography)
- The arguably best semiconductor mainstream technology at this point in time (“Fully Depleted Silicon on Insulator”, or FDSOI) enabling up to 40% reduction of the power consumption in portable devices such as smart phones and tablets, developed in a series of “Pilot Line” projects coordinated by STMicroelectronics out of France, is in the process of being transferred into volume production
- The state of the art in safety-critical embedded systems has been markedly advanced and the European leadership position secured by orchestrating the largest cluster of projects on these topics; now the companies involved are progressing towards establishing standards for interoperable, certifiable technologies and implementation
- A European source for critical components sustaining harsh environments in applications such as Galileo satellite system etc. has been created and should start delivering demonstrators in the next year
- After the success of the Micro-Electro Mechanical Systems using piezoelectric or magnetic materials and 3D packaging, STMicroelectronics launched the next phase to address Micro-Opto-Electro-Mechanical Systems (MOEMS) etc.

4) **Impact on sustainability**

In the last about ten years, the European semiconductor manufacturers lost about half of their market share. In the last three years, encouraging signs seem to indicate that the downwards trend may be on the point to be reversed. The JU organization likes to believe, even if it hardly seems possible to demonstrate, that one contribution towards reversing the negative trend has been brought by the JUs actions, both through the direct funding of actions and through the pointed dissemination and communication activities aiming at increasing awareness and readiness to re-engage in competition. Among some of the most successful communication efforts are the numerous public presentations (more than 40 per year) and the 7-minutes video highlighting the success of the first five “Pilot Line” projects that helped creating sizable commitments both in the National Funding Agencies and in the private sector.
5.4.1.4 Conclusion on impact

The Public-Private Partnerships using a tri-partite funding model demonstrated considerable flexibility, effectiveness and impact in an industrial sector that is at the very heart of industrial innovation in Europe. After a difficult start due to the complexity of the model, once the strategies and priorities of the European Union, the member States and the research and innovation actors have been aligned, they have successfully initiated and executed a turn-around in industrial RD&I, with demonstrable positive outcome and exceptional leverage, complementing other initiatives.