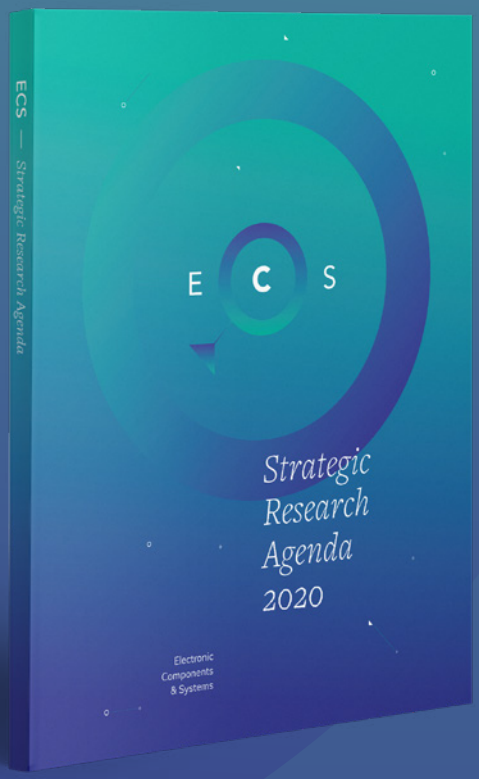
ECS SRA UPDATE

2020 VERSION



ECS-SRA 2020 UPDATE: RELEASE NOTES

Strategic Research Agenda 2020

Three industry associations, AENEAS, ARTEMIS-IA and EPoSS, are in the process of updating the ECS-SRA 2019, and will collect feedback from the electronics components and systems community during EFECS 2019. The final version of ECS-SRA 2020 will be available online shortly thereafter.

THE MAIN CHANGES IN THE ECS SRA IN BRIEF:

ECS-SRA 2020 Update: Release Notes

Based on analysis of the major applications fields where Europe must maintain and/or develop its leadership, and of the current and foreseeable technology capabilities, the ECS-SRA aims to identify the main focus areas for research and innovation in Europe in its field. To fulfil this mission, it must reflect the dynamics of our industry, characterised by continual technology advances and new applications being invented at an ever-increasing pace. Therefore, this cannot be a static document, and it will continue to evolve – with reviews every year and a major update every three years. This continuous process will enable all ECS stakeholders to be constantly aware of new emerging technologies, potential game-changers and the evolving long-term vision of the industry.

After the initial 2018 edition and a minor revision in 2019, the ECS-SRA has undergone its second update this year. This document summarises the changes/updates made to the 2019 edition that have resulted in the 2020 update.

General

For Chapters 1–10, all timelines have been adjusted to span the period 2020–29. The importance of ongoing and future breakthroughs in artificial intelligence, the technology developments they require and their impact across all application domains have been further d across all the chapters of this Strategic Research. The reduction of energy consumption for ECS is a focus, as it is key in terms of digitalisation and the broad implementation of artificial intelligence.

0. Introductory and Overview Chapter

Market figures were updated across Chapter 0 with the latest available data, and references added to increase clarity. The section on computing paradigms and software technologies was significantly expanded to help emphasise the growing trend of “artificial intelligence at the edge”, which provides European industry with many opportunities to play a leading role. A section on integrated photonics was also introduced.

1. Transport and Smart Mobility

This chapter has been expanded with some new analysis on the electrification of vehicles, including pedelecs and scooters. In addition, a paragraph has been added to emphasise the importance of the development of efficient methods and tools for virtual and real-world verification and validation, as well as certification of partial or fully automated vehicles. Finally, the importance of advanced sensor development, edge computing and embedded software development has been elaborated upon. A number of high priority R&D&I topics have been added with respect to the above changes, especially for Major Challenge 2.

2. Health and Wellbeing

The text here was further aligned with inputs from the ECSEL's HEALTH.E Lighthouse, resulting in some minor updates. Furthermore, updates were made in terms of the timing of activities and in market data.

3. Energy

The energy world is in transition: different energy sources are linked to achieving high efficiency, reliability and affordability. Renewable energy sources such as solar and wind power are changing the nature of the world's power grids. The centralised power generation model is gradually evolving into a distributed one, causing today's unidirectional power flows to become bidirectional. This situation requires intelligence and security features at each level of the grid and interfaces.

In the updated version, the following changes were made.

- Digitalisation in the smart grid will be one element to deliver smart energy from providers to consumers, and to control appliances in consumer homes to save energy, reduce cost, and increase reliability and transparency.
- A sub-chapter was added on Digitalisation and Energy: New Approaches, which includes information on artificial intelligence, while graphics and market data were updated and artificial intelligence/machine learning approaches were added as the introduction and implementation of AI will be a key enabler for smart power grids. AI approaches and an ECS supply chain for integrated applications in energy (IoT, usage of wireless for domotics to optimise energy usage, etc) will be required.
- Decarbonisation is possible, and can be less costly than current policies in the long run. The total energy system cost (including fuel, electricity and capital costs, investment in equipment, energy-efficient products, etc) could represent slightly less than the 14.6% of European GDP by 2050 in the case of CPI, as compared to 10.5% in 2005. This reflects a significant shift in the role energy plays in society. Exposure to fossil fuel price volatility would be reduced in decarbonisation scenarios as import dependency would fall to 35–45% by 2050, compared to 58% under current policies.

4. Digital Industry

This chapter has undergone major changes based on the initial gap analysis performed in the CSA-Industry 4.E, and the major challenges (MC) were redefined and rewritten. Therefore, in ECS SRA 2020 the following main challenges are now described.

- **MC1:** Developing digital twins, simulation models for the evaluation of industrial assets at all factory levels and over system or product lifecycles.
- **MC2:** AI-enabled cognitive, resilient, adaptable manufacturing.
- **MC3:** Developing digital platforms, and application development frameworks that integrate sensors/actuators and systems.
- **MC4:** Human-centred manufacturing.
- **MC5:** Sustainable manufacturing in a circular economy.
- Descriptions of the new major challenges were added, and all roadmap graphs were modified respectively.
- Apart from these upgrades, minor changes were performed in the section on digital farming. The main changes were on the following.
- Scope and ambition for digital farming: A new item was added on "Ensuring realistic costs for large-scale and multi-functional crop and livestock monitoring systems".
- Synergies with other themes/chapters were included, especially concerning the chapter on digital life.

5. Digital Life

This chapter only needed a minor update with respect to the 2019 edition, regarding:

- modernisation of some terminology in the area of AI;
- some extra example innovation areas were added in the table in Figure 32 in the introduction section 5.2;
- an extra synergy in section 5.5 on Synergies about Safety, security and reliability was also added.

6. Systems and Components: Architecture, Design and Integration

For this chapter, several additions were made regarding the importance of:

- standards;
- software engineering;
- artificial intelligence and machine learning, used (i) within ECS, and (ii) in the development and integration processes (i.e. for design space exploration and continuous development processes).

Market figures from a recent study (the Advancy Report) were also added in section 6.2.2.

While the number and content of the seven Major Challenges remain unchanged, some text on heterogeneous model management (in Challenges 3 and 4) and AI and machine learning (Challenge 5) was added, as was the most recent market figures (Yole Report) (Challenge 5).

The complete text of the chapter was streamlined, repetitions were eliminated and passages with similar meaning combined, resulting in a more concise version. In the Appendix, some new topics were added and existing ones updated, especially for Challenges 5, 6 and 7.

7. Connectivity and Interoperability

The Chapter on "Connectivity and Interoperability" has received a minor update with respect to the 2019 edition. Challenge 1 has been updated to add 6G R&D investigation into the scope, an area that will be addressed in more detail in the next release, and to include a discussion on the 250–325 GHz frequency band since the community is dedicating quite some effort on IEEE 802.15.3d standard development. Challenge 2 and 3 have also been updated based on work performed over several meetings and work groups.

8. Safety, Security and Reliability

In this chapter, only minor additions and reformulations/revisions were made to the major challenges.

9. Computing and Storage

In this chapter, there have been several additions:

- Computing now forms a continuum between extreme edge devices, edge devices, IoT, fog, cloud and HPC.
- Energy consumption of cloud/computing is a growing concern.
- AI requires much computing power (and therefore energy) for the learning and highly efficient accelerators for inference.
- GAFA and BATX are now developing their own hardware, and Europe has to act quickly to remain competitive.
- Open source hardware, such as RISC V, is becoming increasingly attractive.
- Software complexity is a real bottleneck.
- CPS implies multi-domain/multi-paradigm design and global system view, which is becoming an educational challenge.
- AI techniques can be used to help design better hardware and software.

10. Process Technology, Equipment, Materials and Manufacturing for Electronic Components & Systems

Throughout Chapter 10, a rewording to improve readability and to replace the coarse distinction between the “More Moore” and “More than Moore” sectors with a more technology-based terminology was achieved.

The Executive Summary was also adapted to strengthen the link to advancing applications, most importantly quantum information processing. The impact section was supplemented with a description of the impact on FET flagship initiatives such as graphene and quantum computing, on advanced education and training, and on the technology sovereignty in light of the growing strategic importance of a local base for KET.

The following changes were made in terms of the major challenges:

- Rewording of Major Challenge 1, “Develop advanced logic and memory technology for nanoscale integration and application-driven performance”, to add greater detail on nanowires, functional oxides, 2D heterostructures and high-performance switches.
- Rewording of Major Challenge 2, “Develop technology for heterogeneous system-on-chip (SoC) integration”, to add new building blocks, materials and applications.
- Rewording of Major Challenge 3, “Develop technology for advanced packaging and heterogeneous system-in-package (SiP) integration”, to add new applications – i.e. quantum computing and testing.
- Rewording of Major Challenge 4, “Extend world leadership in semiconductor equipment, materials and manufacturing solutions”, to use more technology-based terminology for the sub-challenges, and the addition of new technology challenges.

Long-term Vision

The long-term vision of the SRA has been edited with a minor revision. New computational models such as approximate computing have been referenced, and text enhancements have been made to include aspects of embedded and cyber-physical systems at the architectural or application level.

Appendices

The lists of contributors have been updated to reflect some additional experts being involved, and the list of acronyms has been updated.