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EVALUATION

Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)

Accompanying the document

Communication from the Commission to the European Parliament and the Council

Horizon Europe: Research and Innovation at the heart of competitiveness

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Annex 11: Evaluation of Chips JU

Annex to the Commission's interim evaluation of Horizon Europe

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This Annex on the evaluation of European partnerships ECSEL, KDT, and Chips Joint Undertakings integrates findings from an independent expert report by Technopolis¹. This report was commissioned by the European Commission, Directorate-General for Research and Innovation, and is part of the evaluation study on the European framework programmes for research and innovation for addressing global challenges and industrial competitiveness.

In the European Union's quest for technological sovereignty and global competitiveness, Joint Undertakings (JUs) such as the **Electronic Components and Systems for European Leadership (ECSEL)**, the **Key Digital Technologies (KDT)**, and the **Chips JUs** play crucial roles.

The **ECSEL JU**, established in 2014 under the Horizon 2020 (H2020) programme with a maximum EU contribution of almost EUR 1.2 billion, followed the ENIAC and ARTEMIS JUs to keep Europe at the forefront of essential technology developments². In 2021, the Council's adoption of the Single Basic Act (SBA) led to the creation of the **Key Digital Technologies (KDT) JU** under Horizon Europe, with a maximum EU contribution of EUR 1.8 billion³. The KDT JU focused on advancing electronic components, systems, and software to drive Europe's digital transformation in line with the European Green Deal. In 2023, the **Chips JU** was set up under the Chips Act⁴ and the corresponding SBA amendment⁵, with a maximum EU contribution of EUR 4.175 billion from Horizon Europe and Digital Europe, to reinforce Europe's technological sovereignty and increase the resilience of its semiconductor industry.

These partnerships, based on tripartite governance models involving the EU, participating states and industry associations (currently AENEAS, EPoSS, and INSIDE)⁶, aim to stimulate innovation and drive technological progress.

1. Effectiveness

The ECSEL JU, established under Horizon 2020, **aimed to strengthen the European electronic components and systems (ECS) industry**. Its specific objectives included developing a competitive ECS industry, ensuring the availability of ECS for key markets, and fostering economic and employment growth in the EU². The partnership effectively coordinated European R&D, mobilised public and private funding, and promoted the participation of small and medium-sized enterprises (SMEs).

The ECSEL JU **made substantial contributions to the European ECS sector** across various domains, and played a significant role in building a robust and competitive ECS industry in Europe. Via 96 projects, it facilitated collaboration between over 3 000 non-unique beneficiaries from various sectors. These collaborations resulted in over 400 patents filed, positioning the EU as a leader in the

¹ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings.

<https://op.europa.eu/en/publication-detail/-/publication/fab5b68d-8499-11ef-a67d-01aa75ed71a1/language-en>

² Council Regulation (EU) 561/2014 of 6 May 2014, establishing the ECSEL Joint Undertaking.

³ Council Regulation (EU) 2021/2085 of 19 November 2021, establishing the Joint Undertakings under Horizon Europe [...].

⁴ Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023, establishing a framework of measures for strengthening Europe's semiconductor ecosystem and amending Regulation (EU) 2021/694 (Chips Act).

⁵ Council Regulation (EU) 2023/1782 of 25 July 2023, amending Regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe, as regards the Chips Joint Undertaking.

⁶ See respectively <https://aeneas-office.org/>, <https://www.smart-systems-integration.org/>, and <https://www.inside-association.eu/>.

ECS sector⁷. The ECSEL JU also ensured the availability of electronic components for key markets by supporting projects that addressed challenges in transport, health, and the environment, thus maintaining Europe's competitive edge in application-led technology development. The combination of Member States co-financing and EU funding enhanced the efficiency of public support with a public/private funding ratio of approximately 1:1. This strategic coordination streamlined research and innovation activities across Europe, reducing duplication and fragmentation.

Another primary goal of the ECSEL JU was to **sustain and enhance semiconductor manufacturing capabilities** in Europe. By supporting projects that advanced manufacturing technologies and processes, it kept Europe at the forefront of manufacturing equipment and materials processing, maintaining its competitive position in the global ECS market.

The ECSEL JU also **excelled in fostering scientific research**, with its projects producing a high volume of scientific publications. The ECSEL JU helped strengthen the overall R&I performance of the European ECS ecosystem. Between 2014 and 2021, ECSEL JU projects generated an average of 2.5 publications per project, surpassing other programmes like 5G, Cybersecurity, Photonics, and Internet of Things (IoT) in scientific impact⁸. Joint publications by academia and industry, a key indicator of technology transfer, were prominent in the ECSEL JU projects, with 29% of its publications being academic-private co-publications. This reflects effective collaboration and knowledge exchange between sectors.

The ECSEL JU's contributions extended to **addressing key societal challenges**. By focusing on mobility, health, and the environment, the partnership supported technologies with direct benefits to society. Innovations in smart mobility, healthcare technologies, and environmental monitoring systems (for example) have improved the quality of life for Europeans⁹. The ECSEL JU's efforts in these areas underscored its commitment to using ECS technologies to solve real-world problems and enhance the well-being of the whole society. By contributing to the development of different solutions and technologies, ECSEL helped the EU address key societal challenges¹⁰.

Economically, the ECSEL JU has driven **growth and competitiveness** in the European ECS sector. Its projects attracted significant private investment, which, along with public funding, provided a strong financial foundation for research and innovation. The growth in SME participation and funding highlighted the partnership's role in fostering entrepreneurship and innovation within the ECS ecosystem¹¹. Technologically, the ECSEL JU has kept Europe at the forefront of semiconductor manufacturing and smart systems by supporting cutting-edge R&D.

⁷ KDT JU (2022), Annual Activity Report 2022. https://www.chips-ju.europa.eu/File/download.aspx?entity=shv_library&attribute=shv_file&ID=80086c90-76ca-ee11-9079-0022489e2eca

⁸ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 27-28.

⁹ For instance, InForMed (grant number 662155), Position-II (783132) and Moore4Medical (876190) are ECSEL projects, which brought innovations and new insights in micro-fabricated electronic medical devices and embedded intelligence applications that provide answers to the need for a more decentralised and personalised form of healthcare. These technologies improve the quality of life of people with diseases that include chronic diseases such as cancer, diabetes, heart and respiratory diseases, stroke, dementia and depression.

¹⁰ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 27. Deloitte, VVA (2020), *Study on the impact of ECSEL funded actions*, <https://www.chips-ju.europa.eu/DeloitteECSEL.pdf>.

¹¹ Deloitte, VVA (2020), *Study on the impact of ECSEL funded actions*.

The **KDT JU** followed on from the ECSEL JU under Horizon Europe in 2021, with the mission to enhance Europe's electronic components and systems capabilities. Its key objectives included boosting strategic autonomy, promoting scientific excellence, fostering innovation, and addressing societal and environmental challenges.

A change in the KDT JU was the inclusion of **top-down priorities** by introducing 'focus topics'. The KDT JU, like the ECSEL JU before it and to a certain extent the Chips JU after it, was an anomaly in Horizon Europe Pillar 2, as the vast majority of funding was assigned to work programme topics that covered the whole strategic research and innovation agenda (SRIA) rather than to specific challenges in the SRIA. The ECS strategic research and innovation agenda (ECS-SRIA) describes many diverse research challenges, which were collected from the JU's private members and their affiliates through a bottom-up process. The scope of the resulting SRIA is extremely wide and diverse, and is documented in over 500 pages. Every annual work programme established topics for both research and innovation actions (RIA) and innovation actions (IA) by simply referring to the whole SRIA for the scope of these topics. The focus topics¹² strategically complemented the bottom-up research to address specific well-identified challenges in parts of the ECS value chain. The top-down elements in the KDT JU's strategic programming were in line with European and national policy priorities, aiming for mastery of key digital technologies and digital autonomy. Focus topics addressed the EU's and Member States' priorities and were set by dedicated working groups. Roughly 25% of funding supported focus topics in the KDT JU, while the vast majority of funding was dedicated to bottom-up topics addressing the whole SRIA.

The KDT JU partnership achieved **notable progress** under Horizon Europe, contributing significantly to scientific excellence, societal well-being, economic growth, and technological innovation. By strengthening strategic autonomy, nurturing a dynamic ecosystem, and tackling critical societal and environmental issues, the KDT JU established Europe as a global leader in ECS.

One of the KDT partnership's primary goals was to contribute to doubling the value of ECS design and production in Europe by 2030¹³. Through research and innovation in strategic areas such as aerospace, automotive, and healthcare, the KDT JU **enhanced Europe's global ECS market position**¹⁴. SMEs played a crucial role, receiving 24% of public funding and contributing significantly to market-driven, commercially viable technological advancements. The collaboration among SMEs, large companies, and research institutions spurred the development of cutting-edge technologies and reinforced Europe's reputation as a leader in ECS research and innovation.

The KDT JU also prioritised **societal and environmental challenges**, aligning with the EU's energy efficiency goals. The partnership aimed to contribute to the EU's target of a 32.5% reduction in energy consumption by 2030, promoting energy-efficient and sustainable technologies to reduce carbon

¹² Please note that 'focus topics' are called 'topics' in the rest of Horizon Europe.

¹³ This objective has been redirected towards a target in the Digital Decade Policy Programme that states that by 2030 'the production, in accordance with Union law on environmental sustainability, of cutting-edge semiconductors in the Union is at least 20% of world production in value'. Progress in achieving this task is monitored under the Digital Decade Policy Programme. See Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022, establishing the Digital Decade Policy Programme 2030.

¹⁴ An example of a KDT project targeting the automotive sector is HICONNECTS (grant number 101097296), which develops a new automotive radar based on a single system on chip (SoC) with combined transceiver and processing in a new leading-edge node while increasing antenna integration with the Launcher in Package (LiP) to increase performance and reduce costs. An example of a KDT project targeting healthcare is Newlife (grant number 101095792). Newlife is developing digital healthcare solutions for remote screening and early detection of pregnancy risk factors. It uses non-invasive technologies to gather vital data on mothers and babies, which is analysed by artificial intelligence techniques.

emissions and support green technology. For example, the KDT JU introduced the topic ‘Eco-designed smart electronic systems supporting the Green Deal objectives’ in its 2022 work programme. The KDT JU produced technologies that can cut down power consumption (e.g. energy-efficient chips that consume less power), as well as processes that reduce energy and water usage in semiconductor manufacturing and in sectoral applications. Approximately two thirds of KDT JU projects have an impact or deliver a contribution to the Green Deal objectives¹⁵.

Furthermore, the KDT JU and related initiatives showed a strong commitment to **social inclusivity and diversity**^{16,17}, focusing on reducing the digital gender gap. Within the KDT JU, concerted efforts were made to encourage the active participation of women in the digital sector and to advance gender equality¹⁸. For instance, an event organised by the KDT JU and Euractiv focused on the digital gender gap¹⁹. Related initiatives, such as the ALLPROS.eu support action, made videos on inclusion in the semiconductor industry²⁰.

Economically, the KDT JU strengthened Europe’s microelectronics sector by fostering innovation and enhancing competitiveness. The involvement of SMEs and focus on strategic application areas stimulated economic growth and resilience. The partnership’s dynamic ecosystem attracted collaborations, further bolstering the economic landscape.

The KDT JU appears to have maintained a **balanced portfolio and ecosystem development**, fostering a dynamic environment with a mix of large and small projects. The largely bottom-up nature of priority-setting leaves the portfolio essentially to chance rather than setting it out by design. Exactly 30 projects were initiated in 2021-2022. Technologically, the KDT JU promoted semiconductor manufacturing, RISC-V building blocks, and edge AI, amongst others. Emphasising secure, reliable, and energy-efficient microelectronic technologies, the partnership ensured Europe’s leadership in technological innovation. The promotion of sustainable and green technologies positioned Europe as a leader in eco-friendly microelectronic solutions.

In an era where semiconductor technology underpins virtually every aspect of modern life, from consumer electronics to critical infrastructure, the strategic importance of having a robust and autonomous semiconductor industry cannot be overstated. Consequently, the **Chips JU** emerges as a pivotal public-private partnership aimed at not only reinforcing the European Union’s strategic autonomy in the semiconductor industry, but also propelling it to the forefront of global semiconductor innovation. The Chips JU aims to fortify the EU’s capabilities in semiconductor technology, thereby ensuring technological sovereignty and reducing dependence on external sources.

¹⁵ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 39. Another example is the PowerizedD project (grant number 101096387), which develops technologies for intelligent power electronics to enable sustainable and resilient energy generation, transmission and applications.

¹⁶ <https://events.euractiv.com/event/info/media-partnership-closing-the-digital-gender-gap-womens-participation-in-the-digital-economy>

¹⁷ For more information, see: <https://allpros.eu/events/bridging-skills-shortage-european-semiconductor-industry> and <https://allpros.eu/news/semiconductors-industry-deserves-more-women-board>.

¹⁸ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, p. 29.

¹⁹ <https://events.euractiv.com/event/info/media-partnership-closing-the-digital-gender-gap-womens-participation-in-the-digital-economy>

²⁰ For more information, see: <https://allpros.eu/events/bridging-skills-shortage-european-semiconductor-industry> and <https://allpros.eu/news/semiconductors-industry-deserves-more-women-board>.

Although it is too early to assess the full effectiveness of the new partnership, the Chips JU is making **significant progress** in achieving its objectives. Increased funding and strategic projects significantly bolster the EU's research and development capabilities in semiconductor technologies.

The Chips JU spearheads various projects and initiatives designed to achieve its ambitious objectives. These activities are broadly categorised into 'Initiative' and 'non-Initiative' activities, each playing a crucial role in advancing the semiconductor ecosystem within the EU. **Initiative activities** are primarily geared towards establishing foundational infrastructures and capacities necessary for semiconductor innovation and prototype production, in accordance with the European Chips Act's Chips for Europe Initiative (hence the name of the activities). By setting up a design platform and competence centres, the Chips JU provides critical support for SMEs and startups. These infrastructures offer access to state-of-the-art tools, technologies, and expertise, enabling smaller entities to innovate and compete on a global scale. Recognising the transformative potential of quantum computing, the Chips JU invests in advancing quantum chip technologies through collaborative R&D efforts to explore applications in various domains such as cryptography, optimisation, and simulation.

The Chips JU started with the establishment of **pilot lines**, a cornerstone action aimed at bridging the gap between research and commercial production. These pilot lines facilitate the scaling-up of laboratory innovations to industrial manufacturing, accelerating the time-to-market for new semiconductor technologies. Approximately EUR 1.85 billion is allocated to pilot line projects, ensuring the practical application of research through the establishment of new technologies before mass production²¹. In particular, EU funding of EUR 700 million targets the development of a pilot line for sub-2nm SoC technology, pushing the boundaries of semiconductor miniaturisation for next-generation devices. Additionally, EUR 420 million are allocated to a pilot line for FD-SOI technology for the 7nm node, offering a cost-effective and energy-efficient alternative to traditional silicon. A pilot line for advanced packaging and heterogeneous integration may receive up to EUR 370 million, enhancing device performance and reducing costs, while EUR 180 million are directed towards a pilot line on advanced semiconductor devices based on wide bandgap (WBG) materials, set to revolutionise power electronics. During summer 2024, a call was opened for a pilot line on advanced photonics integrated circuits (PIC), which may receive up to EUR 190 million, facilitating the development of reliable, scalable, and cost-effective PIC solutions, which will be particularly important for the next generation of high-performance computers, high-speed communications, and data centres²².

Together, these investments not only maximise the efficiency of the allocated budget but also position Europe's semiconductor industry at the **forefront of global technological innovation**. Through these efforts, the Chips JU ensures that Europe maintains a stable supply chain for new critical technologies, pushing the boundaries of what is possible in the semiconductor sector.

Non-Initiative activities continue the former KDT programme and encompass collaborative projects aimed at fostering innovation and addressing specific technological challenges. Funded under the Horizon Europe programme, these projects focus on critical areas such as RISC-V automotive processors, advanced packaging technologies, and sustainable semiconductor manufacturing processes. At the international level, collaborative efforts, such as the joint call with South Korea in

²¹ <https://digital-strategy.ec.europa.eu/en/news/europe-commits-semiconductor-innovation-new-testing-facilities>

²² <https://digital-strategy.ec.europa.eu/en/news/eu-invests-eu325-million-support-europes-semiconductor-innovation-ecosystem>

2024, aim to leverage global expertise and resources. This joint call with South Korea focused on areas such as heterogeneous integration and neuromorphic computing technologies, promoting cross-border innovation and knowledge exchange²³.

The research challenges behind the Chips JU are captured in the **ECS-SRIA**, which aligns with broader EU policy objectives such as the Paris Agreement and the European Green Deal. This agenda serves as a collection of challenges to achieve innovation in technologies relevant for ECS. By integrating technological sovereignty, sustainable growth, and global collaboration into its strategic plans, the Chips JU aims to ensure the EU remains at the forefront of technological innovation while addressing critical geopolitical, environmental, and other considerations. To achieve this, the Chips JU employs a top-down approach to provide longer-term strategic direction and ensure alignment with EU-wide objectives through the ‘focus topics’ set out above. This approach has several advantages, including coordinated efforts, consistent funding, and strategic alignment with broader EU and national goals. The increased use of focus topics allows the Chips JU to steer applicants towards specific areas identified in the SRIA which align with policy objectives and offer strategic value, such as neuromorphic computing, processors for the automotive domain, and environmental considerations. All Initiative activities are implemented via focus topics. These are complemented by a bottom-up approach that encourages grassroots innovation, addressing shorter-term industrial interests. The bottom-up approach involves engaging researchers, large companies, SMEs, and startups in the innovation process, ensuring diverse inputs and fostering creativity. By combining top-down and bottom-up approaches, the Chips JU mitigates risks such as fragmentation of efforts, inconsistent funding, and strategic misalignment, thus maximising the impact of its initiatives and reinforcing the EU’s leadership in semiconductor technology. Finding the **right balance between top-down and bottom-up approaches** requires continuous adjustments though.

2. Additionality

Launched in 2014, the **ECSEL JU** was pivotal in advancing Europe’s position in the global electronics sector. With a total budget of EUR 4.0 billion²⁴ allocated for the period from 2014 to 2020, the ECSEL JU aimed to consolidate Europe’s research and innovation capabilities in electronics. The partnership achieved exceptional direct leverage²⁵, slightly exceeding its target of 3 with an **actual leverage factor of 3.02** by mid-2024²⁶. This means for every euro invested by the EU, about EUR 3.02 were raised in private funding and co-financing by participating states. The partnership’s structure attracted significant private investment as well as public funding from the EU and participating states, with some Member States such as Italy and Romania using European Structural and Investment Funds (ESIF) to bolster their national contributions. However, 5 of the 25 participating states (Bulgaria, Cyprus, Greece, Latvia, and Slovenia) did not contribute financially, which limited their organisations’ access to funding.

²³ <https://digital-strategy.ec.europa.eu/en/news/eu-republic-korea-digital-partnership-joint-eurepublic-korea-chips-projects-announced>

²⁴ This total budget for the ECSEL JU only takes into account the private contributions committed by affiliates of the private members of the JU, excluding the contributions from the non-affiliates that may have arisen during the execution of the JU projects. Including the latter contributions would lead to a higher total budget for the ECSEL JU.

²⁵ Direct leverage refers to the difference between a project’s (or participant’s) total costs and the EU contribution given to a project (or participant).

²⁶ The figure is based on budgeted rather than actual cost data, including all project participants, so including non-affiliated members of the JU’s private members. Possible additional activities are not taken into account.

The **KDT JU**, which replaced the ECSEL JU in November 2021, operated with a significantly larger overall budget of around EUR 6.1 billion for 2021-2027, reflecting the growing importance of digital technologies and the need for increased investments. The transition from the ECSEL JU to the KDT JU revealed some challenges, particularly regarding the uniform approach to European Partnerships under the Single Basic Act. Despite these hurdles, the ECSEL JU's funding model proved to be robust. Stakeholders expressed satisfaction with the funding approach, appreciating the stability and predictability it provided. Under the ECSEL JU, beneficiaries received an average funding rate of 48% (EU plus national contributions), which led to substantial in-kind contributions from industry partners. Although possibly disadvantageous for SMEs and non-profit organisations compared to other partnerships or standard Horizon Europe funding rates, this model encouraged collaboration among large companies, SMEs, universities, and Research and Technology Organisations (RTOs), collectively advancing the EU's technological objectives. The KDT JU maintained the tripartite governance model and aimed to expand Europe's technological base in key digital sectors, with a notable shift towards a broader funding base and greater private sector involvement. Analysis of the KDT JU revealed varied funding levels among participating states. While Germany, France, and the Netherlands were top contributors, Eastern and Southern European countries contributed less funding⁷. Increased participation from countries like Greece, Lithuania, and Türkiye suggested broader engagement.

At 2.53 for 2021-2023, the direct leverage factor for the KDT JU is a little lower than for the ECSEL JU, and **slightly below the expected factor** of 3²⁷. The approach adopted in the KDT JU was that 70% of public funding should be matched by in-kind contributions from private partners, i.e. from affiliates of the three industry associations that are members of the KDT JU, which would lead to an expected leverage factor of 2.4. Beneficiaries are expected to receive a contribution by participating states that is commensurate with the EU contribution. The EU set funding rates for SMEs at 5 percentage points higher than for the ECSEL JU, to attract more small stakeholders, though this also reduced their in-kind contributions.

In response to the increasing strategic importance of semiconductor technologies, the **Chips JU** was established in 2023 as a continuation and expansion of the KDT JU's efforts. With a projected total budget of almost EUR 11 billion²⁸, including significant contributions from both the public and private sectors, the Chips JU aims to fortify Europe's semiconductor ecosystem and enhance its global competitive position. The partnership's budget reflects a substantial increase in funding, aligning with the EU's strategic priorities in semiconductor technology as expressed in the Chips Act²⁹. Expected contributions from the EU, participating states and private partners are ambitious, with an anticipated leverage factor of 1.6³⁰. These numbers, which do not include in-kind contributions to additional activities, are indicative of the partnership's ability to mobilise significant additional investments. As

²⁷ Figures are based on budgeted rather than actual cost data, including all project participants, so including non-affiliated members of the JU's private members. Possible additional activities are not taken into account. Status as of October 2024.

²⁸ Including budgets from the KDT period from 2021 to September 2023, and including both Horizon Europe and Digital Europe budgets. Excluding Digital Europe budgets, the Chips JU's total budget for R&I would be almost EUR 8 billion.

²⁹ See footnote 4 and Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Chips Act for Europe* (COM(2022) 45 of 8 February 2022).

³⁰ See footnote 5. Excluding Digital Europe budgets, the expected leverage factor would be 1.92.

the Chips JU progresses, attracting and making use of private sector contributions will be crucial for success and European competitiveness.

The landscape of semiconductor research and innovation in Europe has been significantly shaped by the activities and contributions of the ECSEL JU, the KDT JU, and the more recently established Chips JU, in which private contributions play a crucial role. The ECSEL JU set a high benchmark for leveraging European funding, while the KDT JU and the Chips JU reflect a continued commitment to enhancing Europe's position in key digital and semiconductor technologies. However, the Chips JU prioritises contributing to policy objectives rather than achieving high leverage factor numbers with rather untargeted R&I. Unfortunately, the exclusive focus on in-kind contributions to operational activities (IKOP) with marginal attention paid to in-kind contributions to additional activities (IKAA) in the three JUs was a missed opportunity to clarify how the resources and expertise of the private members and their affiliates are leveraged. The private members could do more to coordinate the European R&I landscape across a wide range of activities, from early-stage research to market deployment, thereby strengthening Europe's leadership in digital and electronic technologies. Including IKAA and **coordinating the wider European R&I landscape** could be a contribution to maximising the impact of future partnerships beyond Horizon Europe.

3. Transparency and openness

The ECSEL, KDT, and Chips JUs have demonstrated a **high degree of openness to new participants**, with calls for proposals being fully open to all prospective project participants, and not just affiliated members of the industry associations AENEAS, INSIDE, and EPoSS. This openness is crucial for fostering innovation and broadening the participant base, particularly for entities such as SMEs, universities, and RTOs that might not be able to commit to long-term association memberships due to financial or administrative constraints.

To expand the partnership and involve new members, the ECSEL, KDT and Chips JUs have established several **mechanisms to ensure continuous openness and transparency** in their operations. These mechanisms are essential for attracting and retaining new participants, and include public consultations, open dialogues, webinars, and brokerage events designed to facilitate networking and project formulation among stakeholders and potential new entrants.

Participation data from the **ECSEL JU** indicates that a significant proportion of participants were newcomers, with 54% of applicants in 2014 being new to the initiative. Around 40% of entities participating in the submission of a proposal in a certain year did not participate in previous ECSEL calls³¹. This figure has remained stable, demonstrating sustained interest from new organisations. Of the 2 529 new applicants over the lifetime of the ECSEL JU, 44% were SMEs, 36% were large companies and 19% non-profits (academia, RTOs, etc.)³². Among the applicants, 172 long-standing organisations participated 8 or more times in ECSEL JU proposals. During the life of the ECSEL JU, 44 new entries joined this group of 8 or more participations. Among them, 15 were large companies, 17 were SMEs, and 12 non-profits.

³¹ ECSEL (2020), Annual Activity Report 2020, Table 7. The percentage of new entities was quite constant over the ECSEL life time, ranging from a maximum of 54% in 2014 to a minimum of 39% in 2016 and 2019. See <https://www.chips-ju.europa.eu/AAR2020.pdf>.

³² ECSEL (2020), Annual Activity Report 2020, Table 8. See <https://www.chips-ju.europa.eu/AAR2020.pdf>.

The **participation of SMEs** and a diverse range of stakeholders in ECSEL projects enriched the ECS ecosystem. The ECSEL JU increased funding to SMEs over time, demonstrating a commitment to nurturing small businesses. The share of funding to SMEs increased from 12% in 2014-2015 projects, via 13% in 2016-2017 projects, to 15% in 2018-2020 projects³³.

Similarly, the **KDT JU** attracted a substantial number of new participants. The share of newcomers in KDT JU projects accounted for 28.6% of participants, and a share of 12.0% of EU funding was allocated to these newcomers. Among the 258 unique newcomers, the majority were SMEs (around 58%), followed by large companies (around 37%)³⁴. It is still very early to assess data from the **Chips JU**, since the first calls were recently launched and grant agreement preparations are ongoing.

Despite the theoretical accessibility of these JUs to new stakeholders, **practical obstacles often arise**. The intricate nature of the partnerships, unfamiliar funding processes, obscure differences with standard Horizon Europe practices, and challenges in obtaining relevant information can significantly hinder new participants, especially SMEs. While industry associations can alleviate some of these difficulties, their support might come with associated costs. Membership of an industry association does come with advantages³⁵, such as the ability to influence the ECS-SRIA and to be represented in the governance of the JUs, as well as the opportunity to access international networks and potentially engage in the supply chains of major companies. While participation in the Chips JU may encourage membership in industry associations, it is not mandatory to join. This setup can lead to ‘free riding’, where project participants who are not association members benefit from the efforts and expenses of the three associations contributing to the activities of the JU. Insufficient membership can hinder the associations’ ability to meet financial and in-kind contribution obligations as private JU members.

To mitigate the challenges for SMEs in particular to access these partnerships, the JUs have implemented **various support measures**. For instance, the KDT JU has increased funding rates for SMEs, aiming to alleviate financial burdens and simplify participation processes. In the KDT JU, SMEs accounted for 43% of participants and received 24.5% of the total EU funding, indicating an improvement in engagement by SMEs compared to the ECSEL JU³⁶. Moreover, the introduction of variable membership levels by the industrial associations aims to make membership more attractive to SMEs and other small stakeholders.

The Regulations’ **targets for SME participation are currently met** by the KDT/Chips JUs: the percentage of SMEs in the total number of participants in indirect actions is 43%, well above the target of one third, and the SMEs’ share of public (EU) funding is 24.5% (target: at least 20%). This success illustrates the partnerships’ commitment to fostering a diverse, competitive, and innovative ecosystem that includes a strong presence of SMEs.

While significant strides have been made in increasing SME participation and funding, **ongoing challenges need to be addressed**. Future partnerships must continue to refine their frameworks to support SMEs, fostering an inclusive and dynamic innovation ecosystem while adhering to legal

³³ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 28.

³⁴ Share of participation from newcomers in Horizon Europe based on CORDA data (reference date HE 19/06/2023).

³⁵ For information on memberships benefits, please refer to: <https://aeneas-office.org/membership/membership-benefits/>, <https://www.smart-systems-integration.org/benefits-membership-eposs>, <https://www.inside-association.eu/membership>.

³⁶ Source: RTD data.

obligations. Therefore, in planning a possible next generation of institutionalised partnerships in the next framework programme for research and innovation (also known as ‘FP10’), it is crucial to reassess the balance between the rights and obligations of the industry associations, in particular their voting rights versus their contributions to the administrative costs of the JU Office.

With respect to **inclusiveness**, the private members of the JUs established comprehensive and inclusive consultation processes for formulating their ECS-SRIA. This involved significant engagement with a broader spectrum of stakeholders, including industry professionals, research institutions, SMEs, and public authorities. The ECS-SRIA, developed with contributions from over 300 experts, is refined continually through feedback from events such as the European Forum for Electronic Components and Systems, ensuring diverse stakeholder perspectives are incorporated. It has guided research and innovation priorities across initiatives such as PENTA, EURIPIDES, and their successor Xecs. The other side of the coin is that the ECS-SRIA is extremely wide and diverse in scope, and not specifically written for the ECSEL, KDT, or Chips JUs or their objectives.

Transparency is further enhanced through the public dissemination of funding decisions, project outcomes, and strategic documents, fostering trust and collaboration among participants and the broader community. The ECSEL and KDT JUs followed transparent decision-making protocols by documenting and publicly disclosing their processes. This openness enabled scrutiny and accountability, ensuring balanced decisions reflecting a broad spectrum of interests and expertise. Regular public consultations solicited feedback from various stakeholders, promoting an inclusive approach to setting priorities and strategies. The partnerships’ commitment to transparency included a comprehensive website with key documents and decisions, supporting informed engagement and easy access to information.

Similarly, the **Chips JU** demonstrates a **commitment to transparency and openness**. By documenting decision-making processes, transparently reporting on funding allocation, and maintaining an accessible information platform, the Chips JU fosters accountability and inclusiveness. However, despite its strong transparency and openness practices, the Chips JU faces some challenges that could be addressed to further enhance its effectiveness. There is an opportunity for improved dissemination and reporting on the outcomes and impacts of funded projects. Providing detailed evaluations and analyses of project results would offer deeper insights into the Chips JU’s contributions to advancements in semiconductor technologies, thereby enhancing understanding and accountability. Therefore, to further strengthen public trust and operational effectiveness, the Chips JU should focus on improving the timeliness of information dissemination and providing more detailed reporting on project outcomes.

4. Efficiency

The following table reports, for the period 2014-2023 for ECSEL, KDT, Chips JU, the **total operational costs (OC)**, EU contributions; Validated IKOP; Financial contributions to operational activities by JU partners; Eligible project costs funded by non-JU members to project activities; Contribution from Member States and international organizations to project activities), and **total running costs (RC)**, commitment appropriations EU voted budget and contributions from sources other than the EU). No certified **IKAA** (In-Kind contributions to Additional Activities) were registered. See also Annex 4.4.1 for a comparison of operational expenditure and administrative expenditure of Joint Undertakings and EIT KICs of the period 2014 -2023.

Operational and administrative expenditures of ECSEL, KDT, and Chips JU (2014-2023)

(source: CORDA)

The table includes data for ECSEL, KDT, and Chips Joint Undertakings. **OC**: Operational Costs; **IKAA**: Certified IKAA; **RC**: Running Costs

	2014 [EUR]	2015 [EUR]	2016 [EUR]	2017 [EUR]	2018 [EUR]	2019 [EUR]	2020 [EUR]	2021 [EUR]	2022 [EUR]	2023 [EUR]	Total
OC		601,773,455	571,870,726	728,283,102	663,007,578	784,961,565	629,538,212	654,617,257	632,212,353	595,535,601	5,861,799,848
IKAA	-	-	-	-	-	-	-	-	-	-	-
RC		5,277,706	5,360,000	5,470,000	5,198,000	5,200,000	5,150,000	4,390,000	4,976,000	6,301,000	47,322,706

The **ECSEL JU** operated under Horizon 2020 with a budget allocation that balanced research and innovation actions (RIAs) and innovation actions (IAs). The latest were assigned most of the EU funding (65%) thanks to the ECSEL JU's focus on higher technology readiness levels (TRLs), while RIAs received 35% and four coordination and support actions (CSAs) received 0.3% of the total EU funding. Some of the collaborative R&I projects included pilots and demonstrators aimed at transferring capabilities and results from lower TRL research activities into application domains. The average EU funding per project was approximately EUR 12 million.

Regarding operational efficiency, the ECSEL JU funded **96 successful proposals out of 321 eligible submissions**, resulting in a success rate of 30%³⁷. This relatively high success rate was caused by mild oversubscription rates, leading to moderate competition among applicants. Administrative processes were streamlined, and improvements were made in accessibility and reduced administrative burden for participants. Regarding applicant costs and administrative burden, the ECSEL JU's administration faced challenges due to its complex governance structure, which occasionally slowed decision-making processes. However, the JU's efforts to streamline application and evaluation processes helped mitigate some of the administrative burden for participants.

The KDT JU is a very efficient partnership according to its budget data. The table above shows for 2022 and 2023 operational expenditure and running costs that can be partly attributed to the ECSEL and KDT JUs. A better reflection of efficiency for KDT is the ratio between administrative and total budget, as documented in the SBA regulation. According to that metric, the KDT JU shows the highest efficiency of all JUs, not even taking into account that its total budget ignores the contributions by participating states³⁸.

In the **KDT JU**, the relative share of EU funding allocated to RIAs and IAs did not change, and the average EU funding per project remained stable at approximately EUR 12 million. Stakeholders perceived a suitable balance between high and low TRL projects, with roughly two thirds of the funding allocated to high TRL projects (TRL 5-8) and one-third to lower TRL projects (TRL 3-4)³⁹. The KDT JU primarily funded standard IAs and RIAs, achieving a higher success rate of 55% for its 30 successful proposals out of 55 eligible submissions. This change can be attributed to a more focused approach and the introduction of specific topics under Horizon Europe that led to higher-quality consortia. The simplified administrative procedures and more agile governance model

³⁷ Based on CORDA data (reference date Horizon 2020 15/11/2021).

³⁸ Internal analysis by DG BUDG (2021).

³⁹ ECSEL, KDT, and Chips JU work programmes typically contain statements indicating that 'research and innovation actions (RIA) and innovation actions (IA) essentially differ by the Technology Readiness Level (TRL) and therefore by the reimbursement rates' and that the activities of RIAs resp. IAs have their centre of gravity at TRL 3-4 resp. TRL 5-8.

contributed to faster project turnaround times and better resource allocation. The average time to grant for the KDT and Chips JUs is 214 days, with 93% of grant agreements signed within 8 months.

Compared to the ECSEL JU, the KDT JU maintained a **similar staffing structure** with 30 staff members. ECSEL/KDT staff costs rose steadily, from EUR 2.9 million in 2018 to EUR 3.9 million in 2022, reflecting increased investment in human resources to manage increasing workloads. The total administrative budget for the KDT JU increased with roughly 50% compared to ECSEL, necessitating more extensive management and coordination efforts.

The **Chips JU** represents a monumental leap in Europe's semiconductor R&D landscape, underpinned by a robust financial structure from two programmes. With a cumulative budget of EUR 4.175 billion sourced from Horizon Europe (EUR 2.725 billion) and the Digital Europe Programme (EUR 1.450 billion), the initiative underscores Europe's commitment to enhancing its semiconductor capabilities.

However, the transition from the KDT JU to the Chips JU, while marked by notable advancements, is creating **new challenges and opportunities**, including significant human resources issues because of the need for new recruitment and the establishment of new administrative and operational processes⁴⁰. The introduction of new capacity-building initiatives, such as pilot lines, adds to the complexity by mobilising funds from the Digital Europe Programme and Horizon Europe, and by involving joint procurement activities. To address these challenges, clear procedures for proposal submission and evaluation are in place to promote timely and effective project implementation. The Chips JU Office requires new competencies for joint procurement activities. Continuous assessment is crucial to further streamline processes and reduce bureaucratic delays.

5. Coherence and synergies

The European partnerships ECSEL, KDT and Chips JUs have demonstrated **significant alignment** with relevant regional, national, and EU policies and programmes. For instance, the German framework programme for research and innovation 2021-2024 on microelectronics is guided by objectives such as obtaining technology sovereignty, developing electronics that are trustworthy, contributing to climate protection, etc.⁴¹ Similar objectives can be found in the Chips Act and are brought into the Chips JU by the Commission, Germany, and other participating states. Such alignments are essential to fostering a comprehensive and integrated approach to technological advancement and economic growth across Europe.

The **ECSEL JU** established **connections with various areas** such as IoT⁴², AI, and cyber-physical systems. This alignment was coherent with the Horizon 2020 framework programme, particularly in addressing fragmentation in research efforts and fostering innovation across sectors such as automotive, health, and manufacturing. A main element in this strategy were the ECSEL Lighthouse Initiatives – Industry4.E, Mobility.E, and Health.E – which played roles in bridging the gap between

⁴⁰ European Court of Auditors (2021), Annual Report on EU JUs for the financial year of 2021. See https://www.eca.europa.eu/lists/ecadocuments/jus_2021/jus_2021_en.pdf.

⁴¹ BMBF (2020). *Mikroelektronik. Vertrauenswürdig und nachhaltig. Für Deutschland und Europa*. https://www.bmbf.de/SharedDocs/Publikationen/de/bmbf/5/31639_Mikroelektronik_Vertrauenswuerdig_und_nachhaltig.pdf?__blob=publicationFile&v=7

⁴² In particular the IoT Large Scale Pilots under the work programme Cross-cutting Activities 2016-2017, https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-focus_en.pdf, and the Platforms and Pilot projects under the 2018-2020 ICT work programme, https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-leit-ict_en.pdf.

research and market application. These initiatives enhanced Europe's competitiveness by focusing on socio-economic objectives and creating ecosystems along relevant value and supply chains, aligning closely with the Commission's approach in H2020 to cluster projects for greater impact.

The ECSEL JU's activities exhibited **strong synergies with other parts of Horizon 2020**, including missions, clusters, and specific programmes, ensuring that technological advancement benefited a broad range of sectors. There were strong interactions with other initiatives via linkages directly with the ECSEL JU and via the three industry associations⁴³. For instance, the Industry4.E Lighthouse Initiative's collaboration with ICT Innovation for Manufacturing SMEs (I4MS) and the Factories of the Future partnership aligned with the broader Industry 4.0 paradigm. Collaboration extended to partnerships with entities such as the European Road Transport Research Advisory Council (ERTRAC) for smart mobility, creating a coherent ecosystem that supported innovation in smart production and mobility.

However, despite some successes, the **ECSEL JU Lighthouse Initiatives** were discontinued in the transition to the KDT JU. Not everybody was entirely satisfied with the execution of these initiatives. In terms of implementation, two out of the three lighthouse initiatives were led by industry players. However, the needs of the key stakeholders from the respective industrial sectors were seen as not having been adequately analysed and considered in these lighthouse initiatives.

The **KDT JU** expanded its scope by addressing a broader range of technology domains⁴⁴ such as specific aspects of AI, communication technologies, and photonics. This expansion was in line with the EU's strategic priorities, such as the Digital Decade strategy¹³, and it enhanced synergies with other parts of Horizon Europe and other programmes such as the European Digital Innovation Hubs⁴⁵. Synergies are crucial for maximising impact and ensuring that technological advancements benefit multiple sectors.

Approximately 25% of the EU budget allocated to the KDT JU's activities was **aligned with other European partnerships**⁴⁶, illustrating a strong commitment to integrated and cohesive innovation efforts. The KDT JU actively fostered synergies by engaging with numerous partnerships and initiatives under Horizon Europe, such as the AI, Data and Robotics Partnership⁴⁷, the Smart Networks and Services (SNS) JU⁴⁸, and the Photonics Partnership⁴⁹, among others. Such alignments were built-in by design⁵⁰ and reflect the KDT JU's approach to fostering innovation across a spectrum of technological and application domains. Focus topics in the KDT calls promoted collaborations, addressing strategic challenges and contributing, for instance, to the European AI strategy. Notably, the coordination with the SNS JU led to the integration of microelectronics-based solutions for 6G networks within the 2023 SNS work programme, which is an example of practical and impactful collaboration. The synergies also extended to application domains such as health, automotive, and

⁴³ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 20.

⁴⁴ DG RTD (2022), Performance of European Partnerships: Biennial Monitoring Report 2022 on Partnerships in Horizon Europe.

⁴⁵ <https://digital-strategy.ec.europa.eu/en/activities/edihs>

⁴⁶ Biennial Monitoring Report (BMR) Survey Results (2022), responses provided by the KDT JU.

⁴⁷ Official website of the AI, Data and Robotics Association (Adra): <https://adr-association.eu/>.

⁴⁸ <https://smart-networks.europa.eu/>

⁴⁹ Official website of the Photonics21 European Technology Platform: <https://www.photonics21.org/>.

⁵⁰ See report *Coherence and Synergies of candidate European Partnerships under Horizon Europe*, https://research-and-innovation.ec.europa.eu/system/files/2020-10/ec_rtd_coherence-synergies-of-ep-under-he.pdf.

aerospace, ensuring that advancements in microelectronics supported broader technological and societal goals. Additionally, specific calls under the KDT JU have been designed to align with long-term strategies involving other EU initiatives, such as the EuroHPC JU⁵¹. The development of open-source RISC-V building blocks is a notable example, where selected actions are linked with other projects under RISC-V topics, fostering a collaborative ecosystem with shared governance and intellectual property frameworks.

Moreover, the KDT JU has effectively mobilised national resources and coordinated them with EU research and innovation programmes. For instance, the 2021, 2022, and 2023 calls were co-funded by national authorities, amounting to EUR 555 million⁵². This substantial national co-funding highlights the **strong alignment and mutual reinforcement between national and EU-level investments in digital technologies**.

The **Chips JU** builds on the foundation laid by the ECSEL and KDT JUs, expanding focus areas to include advanced semiconductor technologies, quantum chips, pilot lines, and more. The Chips Act aims for coherence and synergies through the Chips for Europe Initiative, strategic investments in production capacities, and crisis response mechanisms. In combination with other EU initiatives, such as the Recovery and Resilience Facility, and cross-national initiatives, such as the Important Project of Common European Interest in microelectronics and communication technologies⁵³, a coordinated and comprehensive approach to semiconductor technology development can be constructed.

In terms of EU programmes, the Chips JU **continues aligning with other partnerships**, such as Made in Europe, the EuroHPC JU, the Quantum Computing Flagship, the Photonics Partnership, and the AI, Data, and Robotics Partnership. Examples include the calls on the photonics pilot line²² and quantum chips⁵⁴ in 2024, and the prospective topics on AI chips and RISC-V as defined in the outline for the 2025 work programme⁵⁵. This alignment enhances the Chips JU's ability to leverage synergies and achieve greater impact, for instance in photonics, RISC-V, and edge AI. As the projects mature, these synergies are expected to yield significant advancements in Europe's digital landscape, contributing to the EU's competitiveness and innovation capacity in the global arena.

6. EU added value

The collaborative efforts of the ECSEL and KDT JUs have had significant success in **harmonising strategic research and innovation agendas across Europe**. This alignment has reduced the fragmentation of activities by coordinating national R&I efforts, thereby establishing a true European Research Agenda in the ECS domain, and by bridging gaps between application domains with a focus on foundational technology layers and cross-sectional technologies that serve as common enabling technologies.

One of the key accomplishments of the ECSEL and KDT JUs has been their ability to **attract substantial funding from industry**, which has led to increased investment from both the private and public sectors within the microelectronics domain. This heightened interest and support can be

⁵¹ https://eurohpc-ju.europa.eu/index_en

⁵² This number only includes calls launched by the KDT JU and therefore excludes the calls on pilot lines under the Chips for Europe Initiative that were launched by the Chips JU at the end of 2023.

⁵³ https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3087

⁵⁴ <https://digital-strategy.ec.europa.eu/en/news/eu-invests-eu65-million-quantum-chips>

⁵⁵ https://www.chips-ju.europa.eu/File/download.aspx?entity=shv_library&attribute=shv_file&ID=89dddd30-193a-ef11-8409-000d3a65bb7d

attributed to the alignment of projects with often shorter-term industry activities. Under Horizon Europe, the refocusing of the JU projects to address longer-term industry challenges – such as competitiveness, supply chain resilience, technological sovereignty, and sustainability – has encouraged European companies to unlock investment for more strategic purposes. Additionally, active engagement with SMEs and the start-up community in these projects has created new business opportunities. Indeed, the refocusing efforts under the KDT JU towards value chains have supported a mix of low and high TRL activities, attracting a diverse range of participants through its open calls, and enhancing the overall impact and reach of the initiatives.

The added value of the **Chips JU** is evident through its capacity to mobilise resources and expertise across Member States, thereby strengthening the European semiconductor ecosystem. The programme's emphasis on technology leadership, skills development, and setting up new infrastructure in the EU, highlights its strategic importance in boosting Europe's global competitiveness. By helping address strategic dependencies in semiconductor technologies, the Chips JU enhances Europe's autonomy in this critical sector, reducing reliance on non-EU sources and bolstering competitiveness. The projects funded under the Chips JU banner are expected to yield innovative outputs that are reshaping the electronic-devices landscape. For instance, the development of pilot lines for sub-2nm FinFET and 7nm FD-SOI technologies will mark a significant leap forward. These advancements are critical for next-generation electronic devices, offering unparalleled performance, energy efficiency, and miniaturisation capabilities. Additionally, the pilot lines launched under the Chips for Europe Initiative are expected to foster increased collaboration.

The **tripartite approach**, which involves co-funding and joint decision-making, promotes coordination with national activities, contributing significantly to the European Research Area in the microelectronics field. The critical mass achieved through tripartite funding enables large-scale projects of national and industrial importance which individual companies or national funding bodies may not be able to undertake alone. However, outcomes are still influenced by national priorities, and balancing the Commission's goal of expanding focus topics with the specific priorities of participating states remains a challenge, especially when participating states do not have clear strategies for the semiconductor sector⁵⁶ and when everything and nothing is a priority for the private members.

Despite the success, there is still **more work needed to eliminate the existing fragmentation within the sector and to combine resources from various initiatives**. Ensuring sustained or increased industrial investment levels requires projects to be driven by industrially relevant research that is strategically linked to industrial roadmaps. Increased funding may attract more applicants and generate a leveraging effect by incorporating additional resources and industrial funding. This approach should enhance Europe's industrial competitiveness in semiconductor technologies, which are crucial for the digitalisation of Europe's industry.

7. Relevance

Established in 2014, the **ECSEL JU** played a crucial role in enhancing Europe's leadership in technology development, fostering a strong and competitive ECS industry, and ensuring the availability of ECS for key markets and societal challenges. The partnership effectively bridged the gap between research and market exploitation, contributing to economic growth and employment

⁵⁶ Jan-Peter Kleinhans, 'The Missing Strategy in Europe's Chip Ambitions', <https://www.interface-eu.org/publications/europe-semiconductor-strategy>.

within the EU, by adopting a market-pull, supply-drive approach. The substantial project participation of over 3 000 organisations, including leading semiconductor manufacturers and systems companies, highlighted ECSEL's relevance and attractiveness to industry stakeholders. Operating a bottom-up approach, it aligned with the short-term interests that industrial actors had at the time. Collaborative efforts by stakeholders helped formulate the ECS-SRIA, which the ECSEL JU took over as its SRIA. At the time, the SRIA organised research into key applications (e.g. smart mobility, society, energy, health, production) and essential technology capabilities (e.g. semiconductor manufacturing, technology, equipment, materials, design technology, cyber-physical systems, smart system integration). This matrix provided a wide roadmap for research and innovation. Major industry challenges were addressed through extensive projects, influenced by H2020 objectives and strengthened by Lighthouse initiatives in industry/manufacturing, mobility, and health.

Launched in 2021, the **KDT JU** succeeded the ECSEL JU with an expanded focus on key digital technologies critical for Europe's digital transformation. Its strategic goals aimed to boost industrial competitiveness, ensure EU digital autonomy, support the Green Deal through sustainable technologies, and advance intelligent ECS-based systems⁵⁷. This alignment with Horizon Europe's objectives ensured that the KDT JU remained relevant by addressing current technological and market needs, including edge AI and next-generation computing. The ECSEL JU faced criticism for its lack of (top-down) strategic direction⁵⁸. This was addressed to some extent in the KDT JU by introducing 'focus topics', which enabled longer-term targeted responses to policy priorities. Funding was pre-allocated to these topics, influenced by the European Commission, public authorities, and industry partners. These topics targeted strategic challenges and fostered greater synergy throughout the value chain. By addressing both low- and high-TRL activities, the JU ensured comprehensive coverage across the innovation spectrum. The industry associations restructured the ECS-SRIA to focus on foundational technology layers, cross-sectional technologies, and key application areas. The annual updating of the ECS-SRIA, involving extensive stakeholder consultations, ensured that the KDT JU could in theory swiftly adapt to evolving market and policy needs, aligning with the EU's strategic priorities, such as the Digital Decade and the Green Deal. Nevertheless, this was compromised in practice by the dominance of the bottom-up approach in work programmes, coupled with the SRIA's extremely wide and diverse scope.

The **Chips JU** also addresses the critical issue of technology leadership. This partnership directly supports the EU's goals of technological sovereignty⁵⁹ and economic security⁶⁰ ensuring that Europe remains at the forefront of semiconductor research and development. The Chips JU is designed with inherent flexibility to respond dynamically to the fast-paced semiconductor industry. It aims to stay relevant amidst rapidly changing technological and market conditions. This flexibility is essential for fostering innovation and ensuring that new semiconductor technologies can swiftly move from research to market deployment. Via a slight shift, the Chips JU assumes greater responsibility for lower TRL activities previously under the 'standard' Cluster 4 work programmes, with the opportunity to allocate full EU funding to RIAs with a TRL of up to 4. Furthermore, pilot lines within the Chips for Europe Initiative serve as capacity-building endeavours for research and innovation

⁵⁷ European Commission (2021). Horizon Europe Strategic Plan (2021-2024).

⁵⁸ European Commission (2017), Interim Evaluation of the ECSEL Joint Undertaking (2014-2016) Operating under Horizon 2020.

⁵⁹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Chips Act for Europe, COM(2022) 45, 8 February 2022.

⁶⁰ Joint Communication to the European Parliament, the European Council and the Council on 'European Economic Security Strategy', JOIN(2023) 20, 20 June 2023.

prototype lines, helping industry explore new technologies. Potential gaps between the pilot lines and industrial applications need to be addressed by collaboration between pilot line consortia and the industry associations.

The ECSEL, KDT and Chips JUs have been **pivotal in advancing Europe's strategic objectives in technology leadership and digital transformation**. These partnerships have continuously aligned their objectives with the evolving needs and challenges posed by the EU's framework programmes, particularly Horizon 2020 and Horizon Europe. The flexibility in adjusting objectives, activities, and resources has been instrumental in the JUs maintaining their relevance. Nevertheless, it remains a challenge to find the right balance in work programmes between longer-term strategic priority setting and shorter-term industry needs, supporting low- and high-TRL activities, addressing R&I and capacity building, etc.

8. Directionality

The **ECSEL JU** played a key role in addressing the need for excellent science and industrial leadership under Horizon 2020, targeting goals such as competitiveness and sustainability through a fully bottom-up implementation. Funded activities followed this approach, with proposals often addressing the private members' shorter-term research challenges contained in the ECS-SRIA. Valuable key areas included advancements in power electronics for electric vehicles and support for transformation. However, the bottom-up implementation led to a fragmented approach, leaving the alignment of projects with broader EU policy objectives and strategic priorities to chance. The need for a more directional approach was obvious⁵⁸.

Building on the lessons learned from the ECSEL JU, the **KDT JU** adopted a more focused approach by implementing focus topics. These topics guided applicants towards areas identified in the SRIA that aligned with EU policy objectives, such as edge AI, processors for automotive, and environmental sustainability. This hybrid strategy, which combines bottom-up innovation and top-down strategic direction, enhanced the alignment of KDT JU projects with EU goals. The KDT JU continued to drive the digitalisation of industries, addressing almost all key strategic orientations (KSOs) with significant impacts on sustainability and the Green Deal. For instance, technologies developed under the KDT JU aimed to reduce power consumption and optimise semiconductor manufacturing processes. Approximately two thirds of KDT JU projects have positively impacted or contributed to the Green Deal, although there is still potential for a more explicit integration of sustainability objectives.

The transition from the KDT JU to the **Chips JU** marked a significant development in Europe's strategic efforts to secure its position in the global semiconductor ecosystem. The Chips JU's directionality is heavily influenced by the European Chips Act, emphasising technology leadership, strategic autonomy, increased resilience of the European semiconductor sector, and increased insights in supply chains. The Chips JU particularly targets the EU's strategic objective of technology leadership. The partnership employs a hybrid model that balances strategic direction with bottom-up innovation, ensuring flexibility and alignment with EU goals. When rightly balanced, this approach could leverage the strengths of both strategies, fostering innovation while maintaining strategic coherence. This is reflected in the continuous review and update of the ECS-SRIA, which ensures that the main objectives remain relevant amidst changing geopolitical situations and market trends. Key focus areas outlined in the ECS-SRIA include sustainability goals, such as eco-design, circularity, sustainable manufacturing, and reducing greenhouse gas emissions. However, more

important for priority-setting than SRIA reviews are the selection and definition of appropriate topics in work programmes.

9. International positioning

As the world increasingly relies on digital technologies, Europe's positioning in the semiconductor industry has become a **strategic priority, both economically and geopolitically**. Recognising this, Europe is taking decisive steps to strengthen its presence in the global semiconductor market. This effort is not merely about economic gains; it is also a matter of geopolitical significance, ensuring technological sovereignty and security, as highlighted by Article 22(5) of the Horizon Europe Regulation.

At the heart of these endeavours lies the importance of **international cooperation**, which is pivotal for advancing research and innovation in the semiconductor industry⁵⁹. By fostering collaborative efforts across borders, Europe aims to drive forward technological advancements, secure supply chains, and maintain a competitive edge in this crucial field. The international positioning of the ECSEL JU, KDT JU, and Chips JU reflects the evolving strategies of the European Union for the semiconductor sector.

Despite the **ECSEL JU's** significant contributions to the semiconductor sector, the partnership faced challenges in establishing a clear strategy for international collaboration. The ECSEL JU's international collaboration was not systematic and lacked a formal strategy, except for the involvement of European Economic Area countries Norway and Iceland and associated countries such as Türkiye and Switzerland. Participation from organisations from countries outside Europe, for instance from third countries such as the United States, Brazil, India, and Tunisia⁶¹, was sporadic and primarily driven by individual project needs rather than by coordinated efforts.

Like its predecessor, the **KDT JU** faced limitations in developing a clear international collaboration strategy. Regarding international engagement and participation, the KDT JU experienced a slight increase in participation from associated countries and maintained a stable level on involvement from EU13 countries^{62,63}. However, systematic collaboration with non-European countries was still lacking. The KDT JU maintained the primary focus on supporting research and innovation among organisations from its participating states, with an increasing emphasis on technological sovereignty and strategic autonomy. The focus on high TRL activities and commercial sensitivities posed challenges for international collaboration. The involvement of industry associations AENEAS, EPoSS, and INSIDE in the International Cooperation on Semiconductors (ICOS) project⁶⁴ enhanced visibility and identified promising global scientific collaborations.

Regarding **international standardisation**, the KDT JU's impact was mainly through individual projects. The ECS-SRIA recommends standardisation activities on (for example) standards for chiplet interconnect schemes, interoperability standards for edge devices, certification and safety standards

⁶¹ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 41.

⁶² EU13 stands for the group of Member States that joined the EU since 2004.

⁶³ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 68.

⁶⁴ International research cooperation for the growth of European industry (grant number 101092562).

for systems-of-systems, and more⁶⁵. The ECS-SRIA 2023 highlights the importance of standardisation and interoperability, aligning with private members' strategic initiatives. However, there was no dedicated working group for standardisation within the partnership, leading to fragmented efforts despite some notable achievements.

The **Chips JU** represents a strategic shift towards positioning Europe as a global leader in semiconductor technology. This partnership aims to enhance research and innovation and capacity building to maintain technology leadership in future. Under the Chips Act, international collaboration agreements have been signed with like-minded countries such as Canada, India, Japan, Singapore, South Korea, and the United States. A notable example is the joint call with South Korea²³ in 2024, involving a significant investment to strengthen cooperation and economic resilience in the digital sector. This international collaboration focuses on joint R&D in semiconductor technology enhancing supply chain resilience, driving technological innovation, and boosting market competitiveness. By fostering global cooperation, the international partnership aims to create resilient supply chains, develop cutting-edge technologies, and influence global standards and policies.

10. Phasing-out preparedness

Under the Horizon Europe Regulation, all partnerships are required to formulate **appropriate measures ensuring phasing out of EU funding** in the absence of renewal. Partnerships could continue their activities and achieve their goals even as EU funding decreases over time. This necessity is outlined in Article 10.2(c) and Annex III of the Horizon European Regulation, as well as the Single Basic Act⁶⁶.

Integrating phasing out strategies into the partnership's overall strategy is essential because European partnerships are intended to be longer-term and should aim for sustainability. Achieving independence from EU funding can be difficult though, given that this funding often acts as crucial support for the networks and supporting offices involved. However, developing a phasing out strategy does not mean that the partnership will end. Instead, it should be seen as an opportunity to **transition and reflect** on the partnership's unique contributions, its alignment with EU policy goals, and its broader economic impact and acceptance. The KDT JU evolved into the Chips JU in 2023 to implement some of the objectives of the European Chips Act, in particular the majority of the Chips for Europe Initiative. The change to the Chips JU was also used as an opportunity to fine-tune governance provisions, to reassess administrative budgets, and to cater for lower TRL activities with the goal of supporting a comprehensive innovation pipeline covering low- and high-TRL research. The evolution of the KDT JU into the Chips JU saw considerable growth not only in scope and budget but also in the personnel involved in the partnership's Office.

In December 2023, the Chips JU's Governing Board adopted the **initial segment of the phasing out plan**⁶⁷, which included administrative and operational adaptations with the aim to allow the JU to proceed in its activities in case of EU funding under the next Framework programme would not be available. The partnership is expected to adopt an updated phasing out plan in 2025. The plan should outline potential future scenarios that serve the best interests of the JU's members, including the EU.

⁶⁵ AENEAS, EPoSS and INSIDE (2023), ECS-SRIA 2023.

⁶⁶ [Council Regulation \(EU\) 2021/2085](#) establishing the Joint Undertakings under Horizon Europe.

⁶⁷ Chips JU Governing Board decision GB 2023.61 'Phasing out plan', https://www.chips-ju.europa.eu/File/download.aspx?entity=shv_library&attribute=shv_file&ID=b52fcc51-a6d4-ee11-904d-0022489e2472.

A well-structured and comprehensive plan is crucial for the phasing-out of the Chips JU to ensure that objectives are achieved, and that the impact of its initiatives is maintained. By emphasising project completion, knowledge dissemination, financial management, stakeholder engagement, and sustainability, the phasing out plan should facilitate a smooth transition and provide lasting benefits for the EU semiconductor industry.

Interviews with Chips JU members and office staff suggest that **the Chips JU cannot sustain its activities without continued EU funding**⁶⁸. The Chips JU's office emphasised the critical need for ongoing and strengthened initiatives under the partnership in the context of digital transformation. They attributed this need to the intense competition from regions outside the EU, the rapid pace of innovation in the digital sector, and the swift and sometimes disruptive changes occurring in key parts of value chains. The Chips JU's office pointed out that, given the pivotal role of key enabling technologies across numerous application fields, supporting them through robust partnerships was essential. The European Commission noted that a transition at the end of the partnership could take various forms, such as continuing with the same legal status and new objectives, implementing the bottom-up part separately via various possible formats, reducing or eliminating EU funding with compensation from other sources, merging with other partnerships, becoming entirely private, and others.

Where the European Commission decides to propose a continuation/transition at the end of the Joint Undertaking, **a future partnership** will need to build on experience from previous European partnerships. It will also need to meet the increasingly stringent societal, economic, and technological impact criteria set by the EU. Therefore, the goals and scope should be adapted to the evolving geopolitical landscape and ongoing technological convergence. This could involve expanding beyond microelectronics to include pertinent aspects of advanced photonics, quantum computing, and other technologies.

⁶⁸ Horizon Europe and the Digital & Industrial Transition – Interim Evaluation support study. Phase 2 – Horizon Europe. Institutionalised partnership report. ECSEL & Key Digital Technologies (KDT) Joint Undertakings, page 50.