SEMI Europe Comments on White Paper on Artificial Intelligence

A European approach to excellence and trust

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Summary

SEMI Europe welcomes the European Commission's communication "White Paper on Artificial Intelligence – A European approach to excellence and trust" and appreciates the opportunity to provide its feedback on this crucial matter for Europe's competitiveness.

The Internet of Things (IoT) is, simply put, built on three levels: platform, enterprise and edge. To date, most systems have been cloud-centric, where sensor data is collected from the edge but processed and analyzed at the enterprise or platform levels. Artificial Intelligence (AI) applications, however, are increasingly demanding recognition of patterns instantly, such as people or cars in fully autonomous transportation systems. Such critical applications cannot afford cloud-to-device roundtrip and cannot rely on wireless communications as they are based on terabytes of data coming from HD cameras, radars, lidars and other high-speed sensors. In such cases, data needs to be computed directly where it is collected, *e.g.* at the edge. This makes the edge an increasingly crucial pillar of future IoT systems and AI applications.

Edge AI is a great opportunity for Europe as the world leader in embedded electronics, MEMS, sensors and imagers. Thanks to its strategic position in the global electronics value chain, Europe maintains a competitive advantage in emerging AI technologies and is best situated to be a center of excellence in Edge AI globally.

SEMI Europe makes the following policy recommendations pertaining to Europe's new AI approach for the consideration of the European Commission, the Parliament and the Council:

I. Focus on Europe's strengths in Horizon Europe and Key Digital Technologies Joint Undertaking and invest in microelectronics R&D that brings AI to the edge,
II. Establish a technology-centric and pan-European Testing and Experimentation Facility for Edge AI, supported by the Digital Europe Programme,
III. Expand AI hardware manufacturing through Important Projects of Common European Interest,
IV. Prioritize advanced AI skills in the Digital Europe Programme, Erasmus+ and Pact for Skills.

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Introduction

AI is driving game-changing capabilities with huge impacts on our lives: voice-activated devices, self-driving cars, algorithms diagnosing cancer or predictive crop monitoring systems. The list goes on as AI harbors secrets to applications that extend beyond our imagination. This future is enabled by microelectronics-based platforms (chips and systems) that generate (sensors), transmit (communication), store (memory) and analyze (processors) data.

Three major drivers propelled this resurgence: advances in computing and processing power enabled by Moore's law for microelectronic devices; innovative software algorithms leveraging continuing advances in hardware; and data explosion from billions of nodes on the Internet of Things (IoT) on networked platforms. Advances in chip design and manufacturing are, therefore, indispensable to enabling AI capabilities. This massive transformation unlocks globally new business opportunities of ~$65 billion by 2025 for AI-related microchips[1] and $15-20 billion for semiconductor manufacturing equipment and materials, growing five times faster than the rest of the market.

Until recently, AI developments have been focused on the cloud and computations have been performed, by and large, remotely in data centers. Edge AI – the concept of computing data directly where it is generated thanks to IoT sensors placed in smart objects with some data processing on board – is now challenging this cloud-centric approach. While the cloud will still complement the edge by pooling (too) big data and training AI inference algorithms that run on the device, future AI applications will be increasingly built at the edge.

By the end of 2020, more than 750 million Edge AI chips – chips or parts of chips that perform or accelerate machine learning tasks on-device, rather than in a remote data center – will be sold. The Edge AI chip market is predicted to continue to grow much faster than the overall chip market. By 2024, sales of Edge AI chips are to exceed 1.5 billion units. This represents annual unit sales growth of at least 20 percent, more than double the longer-term forecast of 9 percent compound annual growth rate (CAGR) for the overall semiconductor industry.[2]

Running AI algorithms on the device, compared to in the cloud, comes with critical advantages such as reduced latency, enhanced reliability, increased security and privacy and efficient use of network bandwidth, to name a few. By processing large amounts of data locally, Edge AI reduces the risk of personal or business data interception or misuse. AI at the edge eliminates the round-trip journey to the cloud and offers real-time responsiveness. Low-power microchips allow devices with small batteries to perform AI computations on the device and lowers energy consumption by processing only the data that is useful. Embedded Edge AI chips decrease the cost of data storage and bandwidth, as only the useful data analyzed in real time. The advantages offered by Edge AI make significant contribution to EU public policy goals including Europe's security, environmental sustainability, and competitiveness.

Against this background, below are SEMI Europe policy recommendations to provide guidance to the EU and Member States in developing and implementing a strategy that supports Europe's AI leadership.

[1] McKinsey & Company, 2019: Artificial-intelligence hardware: New opportunities for semiconductor companies

[2] Deloitte, 2019: Technology, Media, and Telecommunications Predictions 2020

SEMI Europe policy recommendations underpinning Europe's AI leadership

I. Focus on Europe's strengths in Horizon Europe and Key Digital Technologies Joint Undertaking and invest in microelectronics R&D that brings AI to the edge

Edge AI microchips are increasingly used both in consumer/stand-alone and professional/embedded systems. The latter are growing much faster than the former, with a predicted CAGR of 50 percent over the next five years. Professional/embedded electronics, including automotive, medical, industrial, robotics, aerospace and security-related electronics, is a key sphere where Europe holds a central position globally. Europe's electronics share in global production, unsurprisingly, is the highest in the segments where Europe's industry is well-positioned. The EU automotive industrial base is very competitive, and the EU automotive electronics sector is the global leader as it produces 27% of the global automotive electronics, ahead of China (20%) and North America (18%). The EU also holds a strong position in industrial applications and produces 20% of the global industrial electronics. The EU generates 22% of the global aerospace/defense/security electronics and 19% of the global medical electronics.[3]

SEMI Europe fully supports Europe's new AI approach aiming at capitalizing on Europe's strengths in industrial and professional markets. Building on Europe's competitiveness and strategic position in the global electronics supply chain, Edge AI should be the cornerstone of Europe's new approach to AI. Only by investing significantly in embedded electronics, Europe can seize new growth opportunities arising from the next wave of data generated in smart connected objects and computing at the edge. Furthermore, SEMI Europe welcomes the Commission's proposal urging Member States to revise the Coordinated AI Plan by the end of 2020. Most of the current national AI strategies of Member States do not explicitly reflect the way in which data processing will drastically shift towards smart objects and do not seem to prioritize Edge AI. SEMI Europe recommends the European Commission to closely work with Member States to elevate the position of Edge AI in national strategies.

The upcoming Horizon Europe, with its extensive EU funding, and the Key Digital Technologies Joint Undertaking (KDT JU), with its strong EU and Member States funding mechanism, should play a pivotal role in positioning Europe as the center of Edge AI by pooling public and private resources and capitalizing on Europe's strengths in embedded electronics. SEMI Europe welcomes the proposal to extend the scope of future electronics-related EU research and to integrate software, photonics, bioelectronics and flexible electronics into KDT JU. That said, KDT JU should still be centered on Europe's competitive electronics design and manufacturing technologies including semiconductor material and equipment, microchips, FD-SOI, advanced packaging, MEMS, sensors and imagers that enable IoT, supercomputing, rapid data processing at the edge and hyper-connectivity at low power. Additionally, SEMI Europe suggests that materials informatics should be supported in future EU AI-related R&D programmes in order to establish data analytics protocols across the microelectronics ecosystem. Furthermore, KDT JU should focus on transportation and medical industry requirements, as key end users for Europe. Given the extended scope foreseen in KDT JU, compared to ECSEL JU, SEMI Europe supports the proposal to double the R&D efforts to €10 billion in KDT JU, twice the volume of ECSEL JU.

[3] DECISION & Carsa, 2020: Study on the Electronics Ecosystem – Overview, developments and Europe's Position in the World

II. Establish a technology-centric and pan-European Testing and Experimentation Facility for Edge AI, supported by the Digital Europe Programme

SEMI Europe fully supports the Commission's plans to establish Testing and Experimentation Facilities (TEF) through the Digital Europe Programme. Considering Europe's key strengths in the global AI landscape, the Commission should prioritize the inauguration of a technology-centric and pan-European TEF for Edge AI hardware (AITEF) and federate the synergies of key European research and technology organizations (RTOs) and companies in the field of micro- and nano-electronics under a common platform.

AITEF will play a vital role in accelerating the development and market uptake of embedded electronics that enable major Edge AI applications, amongst others, in smart health, mobility, manufacturing and agriculture. AITEF is envisaged to serve as Europe's overarching platform for demonstration and validation of pre-commercialized AI technologies. This will allow taking the results of earlier R&D projects out of the lab and drive them from technology readiness levels (TRL) 3-5 to 5-7, shortening the time-to-market of new products. This involves making demonstrators; performing yield analysis and statistics on small but relevant volumes of devices; validating them to specific needs of various AI use cases in Europe; and building prototypes that are ready for the market uptake by companies.

It is important to underline that AITEF, supported by the Digital Europe Programme, will not launch new R&D programmes. AITEF's main focus will be deployment of pre-commercial innovations that are already funded by Europe's R&D programmes such as Horizon 2020 and ECSEL JU and that are available at Europe's leading RTOs specialized in micro- and nano-electronics. Such non-commercialized innovations, however, require testing and validation before placing on the market. In this regard, AITEF will play an instrumental role in connecting Europe's R&D with manufacturing capabilities and accelerating the transition from lab to fab. It is the ambition of the AITEF to take Edge AI innovation out of Europe RTO power houses and accelerate the introduction of innovation in the European industry.

AITEF should be designed to incorporate complementary testing and experimenting capabilities of RTOs and future products and services of the microelectronics supply chain including design houses, equipment, materials and integrated device manufacturers (IDMs) and foundries located in Europe. AITEF's role, therefore, will be to develop, test and validate Edge AI hardware and streamline the production of new electronic components by IDMs and foundries in Europe.

III. Expand AI hardware manufacturing through Important Projects of Common European Interest

While Europe's public-private partnerships in R&D are globally admired, the EU and Member States should, in parallel, launch bold investment programmes that support capital-intensive, risky and complex manufacturing activities in Europe. Investing in AI-related research alone does not necessarily translate into keeping the innovation bar high. A strong European AI ecosystem requires keeping microelectronics research and manufacturing activities as close as possible.

Having understood the crucial role of having a strong national industry, countries around the world are making heavy government-backed investments to build domestic fabs. For instance, China's "Made in China 2025" initiative, which establishes an Integrated Circuit Fund to support the development of AI-related hardware, calls for $150 billion in funding to replace imported semiconductors with homegrown devices. In June 2020, U.S. lawmakers proposed the Chips for America Act providing $22.8 billion in aid to the US semiconductor industry.

In 2018, the European Commission approved €1.75 billion in public support from France, Germany, Italy and the UK to fund the IPCEI (Important Projects of Common European Interest) Microelectronics. In addition to the €1.75 billion in public support, the project is courting €6 billion in private investment, seeking to enable technologies for key applications such as autonomous and electric mobility as well as smart manufacturing and home devices. These technologies require participants to collaborate in areas that need complementary expertise, paving the way for developing energy-efficient chips, next generation power semiconductors, smart sensors with higher performance and accuracy, advanced optical equipment and compound materials beyond silicon.

That said, the cost of R&D and manufacturing in microelectronics is increasing and technology development is becoming extremely complex, with a state-of-the-art fab costing easily more than €10 billion. The technological, industrial and geopolitical reality in which the current IPCEI Microelectronics was conceived, compared to the context in which it is now being implemented, has drastically changed. The microelectronics industry in Europe is now contemplating the set-up of a second IPCEI. SEMI Europe urges the EU and Member States to reinvigorate the manufacturing of microelectronic chips and systems enabling Edge AI in the second IPCEI Microelectronics as well as other IPCEIs that are planned for clean, connected and autonomous vehicles, smart health, industrial internet of things and cybersecurity.

IV. Prioritize advanced AI skills in the Digital Europe Programme, Erasmus+ and Pact for Skills

Continuous innovation is the oxygen of microelectronics and AI powering the development of highly customized solutions by the workforce with technical expertise in engineering. In addition, capabilities such as smart applications require workers with growing knowledge in software and data analytics. While the microelectronics evolution since the 1980s has been swift, education curricula in Europe, however, have not matured at the same pace, opening a gap between the worlds of industry and education and imposing a fragmented school-to-work transition for many young graduates.

Against this background, the SEMI – Deloitte Survey "Workforce Development: A Critical Industry Issue[4]" shows that the global electronics industry is increasingly reporting difficulty filling open positions in engineering disciplines related AI, machine learning and digitization. Likewise, in 2018, the German industry registered a shortage of 337,900 workers in STEM[5]. Another report[6] indicates a shortfall of 173,000 skilled workers as 89% of STEM businesses struggle to recruit in the UK. If the current trends continue, China and India will account for more than 60% of the OECD and G20 STEM graduates, and Europe will be lagging behind with 8% of STEM graduates by 2030.[7] Europe is behind

[4] SEMI – Deloitte, 2018: Workforce Development: A Critical Industry Issue
[5] IW, 2018: STEM Report
[6] STEM Learning, 2018: Skills shortage costing STEM sector £1.5bn
[7] OECD, 2015: Education Indicators in Focus

its peers in developing AI talent as well. The U.S. employs twice as many AI-skilled individuals than the EU, despite the American total labour force being just half the size.[8]

Europe's high-tech sector including microelectronics, also suffers from strikingly low female participation in STEM education and careers. Females account for only one in six ICT students in Europe and are represented only 17.2 percent of all ICT specialists employed in the EU[9]. According to a LinkedIn report, AI skills in Europe are generally held by men and only 16% of AI workers are women.

The upcoming Digital Europe Programme's Advanced Digital Skills Pillar, the newly announced Pact for Skills and Erasmus+ Programmes are well-positioned to accelerate the development of advanced AI skills in Europe. They should also a play a powerful role in diversifying and strengthening Europe's AI talent pipeline by paying attention to underrepresented groups. Future EU education programmes should support work-based learning, which helps students develop the knowledge and practical job skills needed by businesses. Innovative dual-learning programmes, apprenticeships and industrial master's and doctorates are shining examples that are already paying off in some parts of Europe. Work-based learning is vital to remaining competitive in the long run, in particular in rapidly emerging technologies such as AI. In addition, as the conventional education-work-retirement path is becoming outdated, reskilling and upskilling are essential responses to ongoing technological transformations and labour market transitions. Future EU-funded education programmes should, therefore, support the reskilling and upskilling of adult workers in order to develop the digital skills needed to remain productive and innovative. Such reskilling and upskilling programmes should be supported by integrating massive open on-line courses into work-based learning or classroom teaching to provide the ideal educational environment.

Conclusion

The Commission's White Paper on AI indicates Europe's willingness to move forward to capture the huge potential ahead in the rapidly emerging AI technologies. SEMI Europe would welcome the opportunity to discuss the above-mentioned policy recommendations with the European Commission, the Parliament and the Council. The microelectronics sector is a key enabler and remains ready to work together with all interested stakeholders to develop new avenues of growth to reinforce Europe's AI leadership.

About SEMI Europe

SEMI Europe is the European arm of SEMI, the industry association connecting more than 2,400 semiconductor and electronics manufacturing companies worldwide, including nearly 300 European headquartered businesses. SEMI members are responsible for the innovations in materials, design, equipment, software, devices and services that enable smarter, faster, more powerful and more affordable electronic products. Since 1970, SEMI has built connections that have helped its members prosper, create new markets and address common industry challenges together.

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[8] LinkedIn, 2019: AI Talent in the European Labour Market
[9] Eurostat, 2018: Girls and women under-represented in ICT