Challenges in Advanced Computing and Functionalities International Cooperation on Semiconductors

Addressing Generic Challenges in the Semiconductor Ecosystem through International Cooperation

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Why does international cooperation matter?

Semiconductor supply chain is highly complex and global

- with most industrial actors being multinational companies anyway

Scientific and technological challenges are gigantic and call for collaborative effort

- in particular with respect to environmental impact

International cooperation can play a constructive role against geopolitical polarisation

- in fostering fair competition, trade and market access

WP4 Cooperation Framework

Objectives: Using inputs from WP2 (economic landscape analysis of the EU and non-EU semiconductor value chains) and WP3 (technology scanning and foresight), this work package aims to:

- identify generic needs and challenges in the semiconductor field for which international cooperation driven by public authorities is **critically important and develop a prioritized list** of such needs; **publish the results**
- identify potential cases of **complementary cooperation** with other countries/regions that address critical challenges or needs, both for the field of Advanced Computation and Advanced Functionality
- prioritize these concrete cases by applying societal, environmental, economic, scientific and policy-driven **filters**

Task 4.1: Identifying key needs of cooperation

Task 4.1 - Identifying key needs of cooperation driven by public authorities

(**UGent**, CNRS, SINANO, TYNDALL, FRAUNHOFER, AENEAS, VDI/VDE, TU Delft, UGent)

M1-M15

- Identify generic challenges and needs in the semiconductor field at large for which international cooperation driven by public authorities is critically important (such as standardization, infrastructure gaps, skilled workforce gaps, critical application areas, critical research needs, risk mitigation against calamity and conflict, reliable supply and marketplace for Europe, etc)
- Make a longlist of such challenges and needs
- Reach out to public and corporate stakeholders to collect feedback about the long list through one-on-one interviews
- Prioritize the longlist (from an EU-perspective) and derive a short list of most critical needs for international cooperation
- Publish a white paper about the results of this task

Fifteen Challenges

1. **Manufacturing Fabs**
   Chip manufacturing infrastructure in the EU is missing or is outdated
2. **Process Flow**
   Chip manufacturing infrastructure is available in EU but process flow is missing or is outdated/uncompetitive
3. **Foundry Access**
   Foundry access and associated PDK are missing: a. globally; b. in EU
4. **Second Source**
   Critical dependence on one chip manufacturer (no second sourcing)
5. **Disruption**
   Critical dependence on non-EU chip manufacturer(s) which are subject to substantial risks of disruption (commercial, environmental calamity, political, military, cyber risk…)

Fifteen Challenges

6. **Competition**
   Competition from non-EU chip manufacturers is very strong
7. **Workforce**
   Human resource challenges: insufficient skilled workforce, insufficient ability to attract talent, insufficient training and reskilling programs, poor gender balance
8. **R&D Capability**
   Insufficient availability of R&D capability in the EU or insufficient access to R&D infrastructure for technological POC and feasibility
9. **IP-core**
   Missing access to IP-core or other blocking IP issues
10. **Supply Chain: Goods**
    Critical risks or bottlenecks in the supply chain of goods for EU-companies (materials, energy, gas, tools, other goods)

Fifteen Challenges

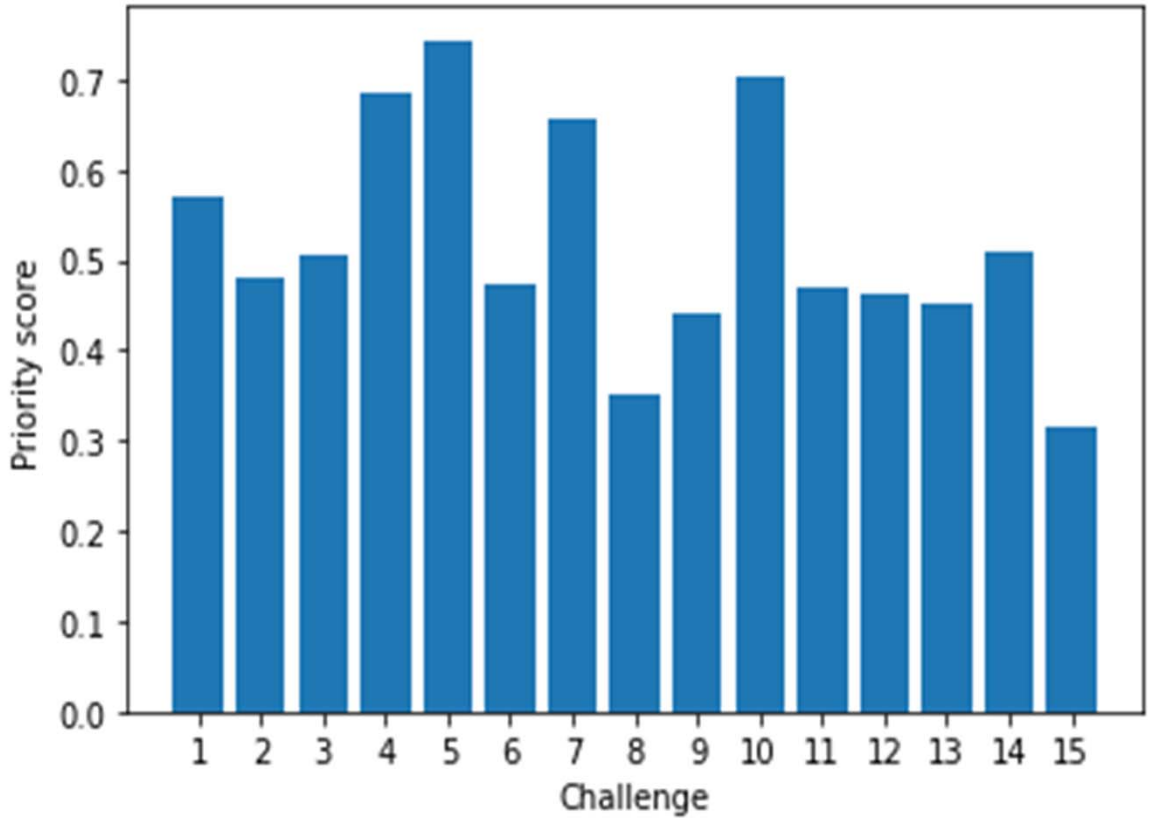
11. **Supply Chain: Services**
    Critical risks or bottlenecks in the supply chain of services for EU-companies (services for EDA, assembly and package, test, other)
12. **Investment**
    Insufficient investment capability (corporate and VC) across the supply chain, in particular for startups and SMEs
13. **Export Limitations**
    Commercial restrictions in the context of dual-use export control
14. **Environmental Impact**
    Challenges with respect to the environmental impact of the semiconductor industry
15. **Social & Governance**
    Challenges to meet social and governance goals, in particular social/political acceptance of major new initiatives.

Feedback from semiconductor experts

1. How critical is the challenge for Europe?
   a. Most critical
   b. Very critical
   c. Somewhat critical
   d. Not so critical

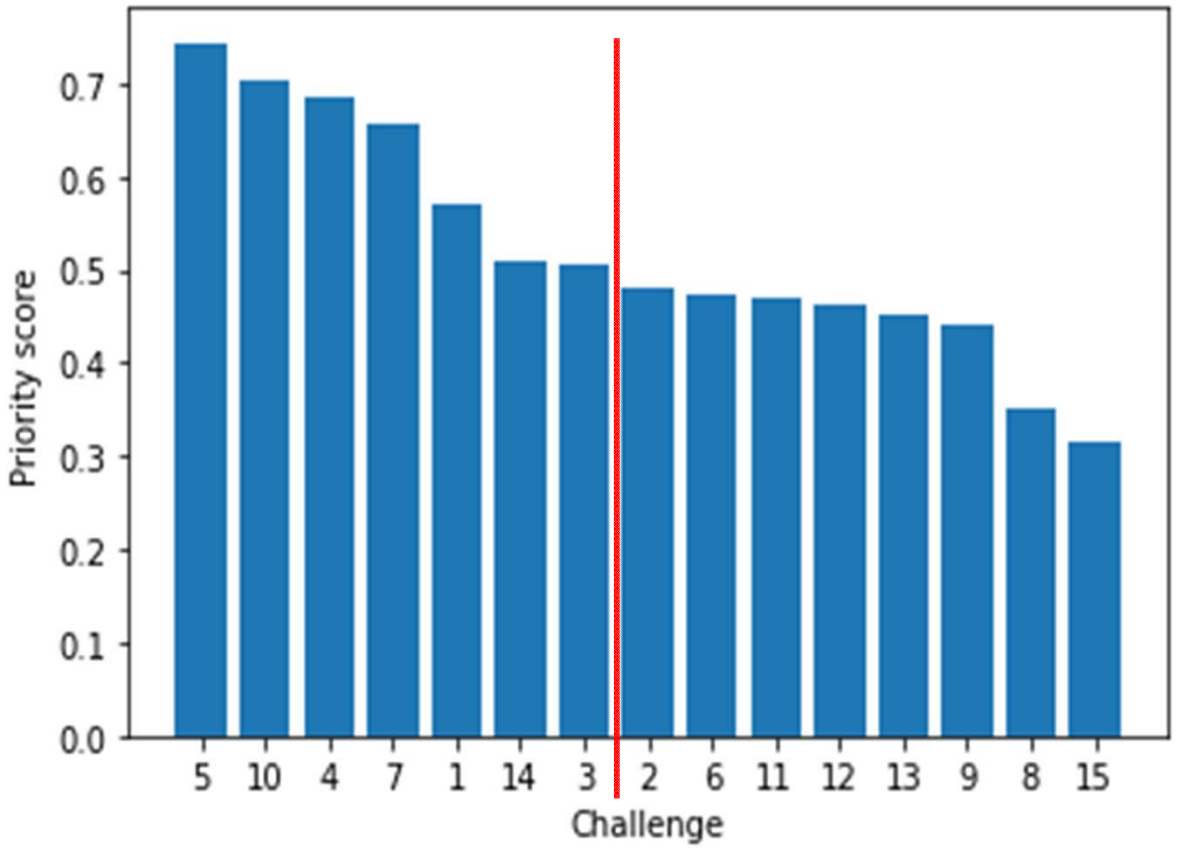
2. How important is international cooperation for addressing the challenge?
   a. Most important
   b. Very important
   c. Somewhat important
   d. Not so important

Prioritisation



1: Manufacturing Fabs
2: Process Flows
3: Foundry Access
4: Second Source
5: Disruption
6: Competition
7: Workforce
8: R&D Capability
9: IP-Core
10: Supply Chain: Goods
11: Supply Chain: Services
12: Investment
13: Export Restrictions
14: Environmental Impact
15: Social & Governance

Prioritisation



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Challenge 5:

Critical dependence on non-EU chip manufacturer(s) which are subject to substantial risks of disruption

Attributes:

Many potential reasons for substantial disruption

- Decisions by shareholders
- Environmental (earthquake, climate change, nuclear accident…) – to fab or to its supply chain
- Political (or even military)
- Cyber attacks
- Pandemic
- …

Cooperation options:

Attract non-EU manufacturers to establish capacity in Europe

Strategic agreements between fabs on compatibility of process flows

Joint cooperation agreements with countries/regions with respect to master plans to mitigate disruption

Challenge 10:

Critical risks or bottlenecks in the supply chain of goods for EU-companies (materials, energy, gas, tools, other goods)

Attributes:

Apart from a few heroes, Europe is not so strong in materials and tools, and lacks raw materials

Cooperation options:

Build strategic cooperation agreements with countries/regions outside EU to address respective gaps in a balanced way - balance may require a high-level negotiation process involving other economic sectors

Challenge 4: Second Source

Critical dependence on one chip manufacturer (no second sourcing)

Attributes:

Absence of second sourcing can be life threatening to a company and even to an entire economic sector

Cooperation options:

New fabs (see challenge 1)

Strategic agreements with the one and only chip manufacturer to reduce the risk

Challenge 7:

Human resource challenges: insufficient skilled workforce, insufficient ability to attract talent, insufficient training and reskilling programs, poor gender balance

Attributes:

The talent shortage in the semiconductor ecosystem is expected to become massive

Three lines of attack:

- Increase the influx of new skilled people
- Reskill people
- Change work methods with stronger use of digitalization and standarisation

Cooperation options:

Beyond a certain scale, attracting talent from other regions/countries can be politically sensitive and requires judicious negotiation

Joint education and training programmes

International standardisation

Challenge 1: Manufacturing Fabs

Chip manufacturing infrastructure in EU is missing or is outdated

Attributes:

Europe lacks manufacturing infrastructure for many semiconductor technologies, including sub-10nm CMOS-nodes

Given the extreme investment cost of a fab, many new projects have a joint public-private character

Cooperation options:

Joint initiatives, with considerable public and regional funding, with non-EU companies in case of onshoring

Strategic cooperation framework in case of friend-shoring and offshoring by an EU-company

Challenge 14: Environmental Impact

Challenges with respect to the environmental impact of the semiconductor industry

Attributes:

The environmental cost of semiconductor manufacturing is substantially large

Two lines of attack:

- Technological developments
- Political choices

Cooperation options:

Collaborative R&D to accelerate the development of cleaner technologies

International agreements to create standards to establish a level playing field (possible including import restrictions if standards are not met)

Challenge 3: Foundry Access

Foundry access and associated PDK is missing: a. globally; b. in EU

Attributes:

Foundry access is critical for fabless users, especially for Small and Medium-sized Enterprises

An MPW-modality is very important at the product development stage

Lines of attack to establish foundry operation:

- Establish new foundry
- IDM extends its offering with foundry modality
- R&D institutes go beyond R&D and offer small volume manufacturing

Cooperation options:

International alliances of fabless users may build critical mass to negotiate with industry and public authorities to establish a foundry-like access

Whitepaper

Whitepaper

"Generic Challenges and International Cooperation in the Semiconductor Field - A European Perspective"

ready for publication through the ICOS-website

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Your feedback

1. Name a **subject area** for which you consider international cooperation to be critically important – try to be **specific**
   (e.g. GaN R&D; PFAS-challenge; manufacturing infrastructure in EU for sub-22 nm CMOS nodes; standards for heterogeneous integration)
2. Name a **country** (outside EU) with which, in your opinion, cooperation is important and viable
   (e.g. Japan, USA, India…)
3. Name a combination of **subject area and country** for which you consider international cooperation to be a viable win-win

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