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METIS Skills Strategy

Léo Saint-Martin, Senior consultant and Associate at DECISION Etudes & Conseil

Thursday, November 18, 2021

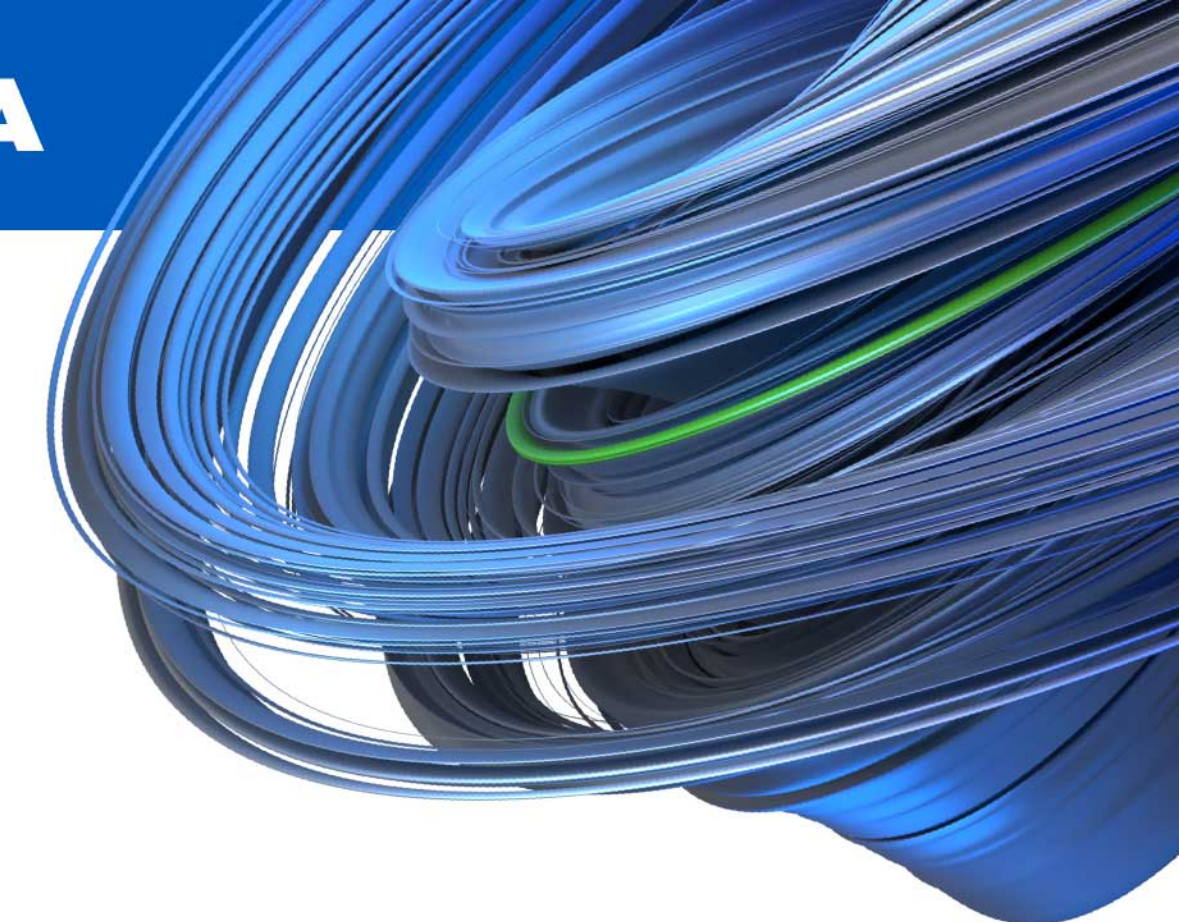


**I) The METIS Skills Strategy,
developed in 2020**

II) Overview of the results

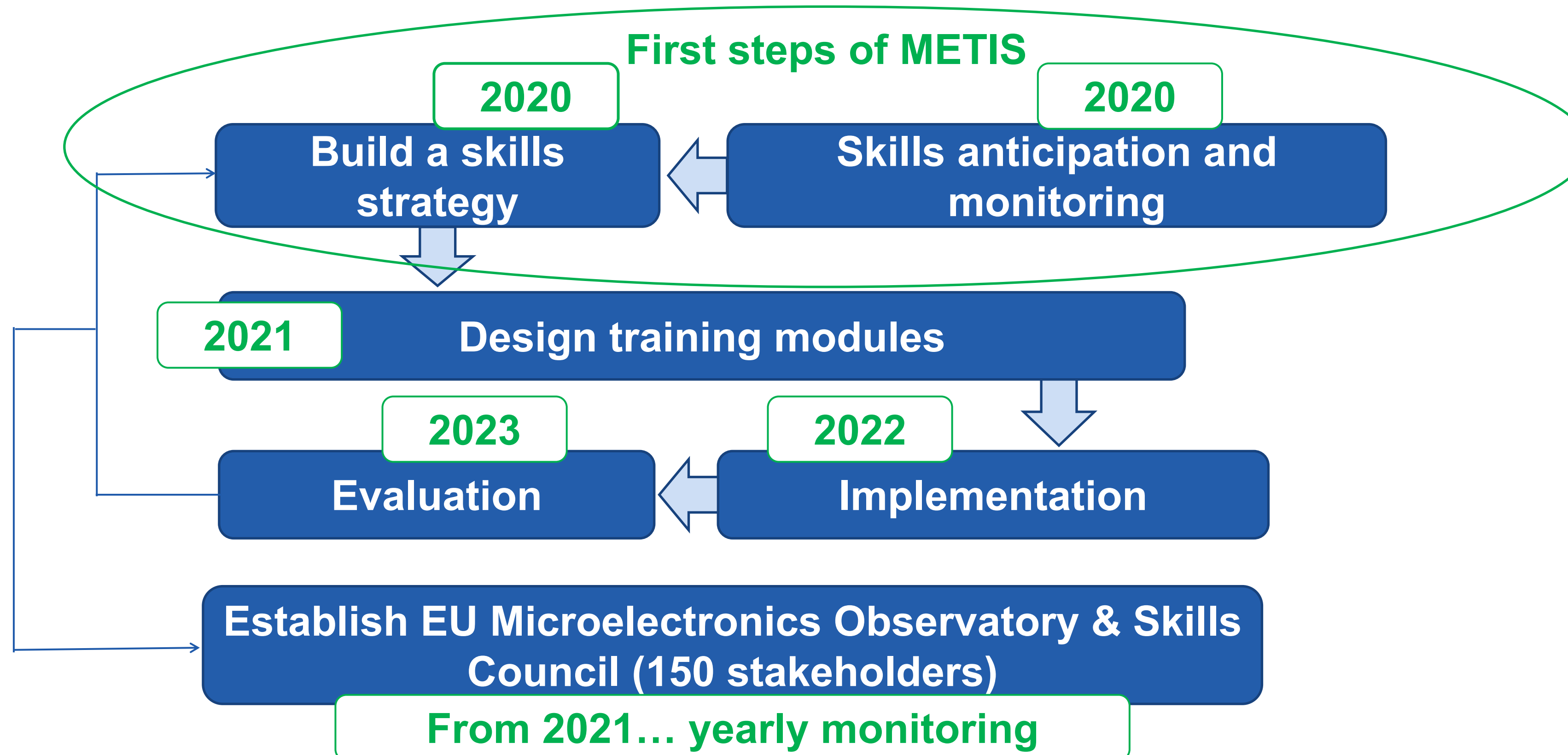
III) Next steps

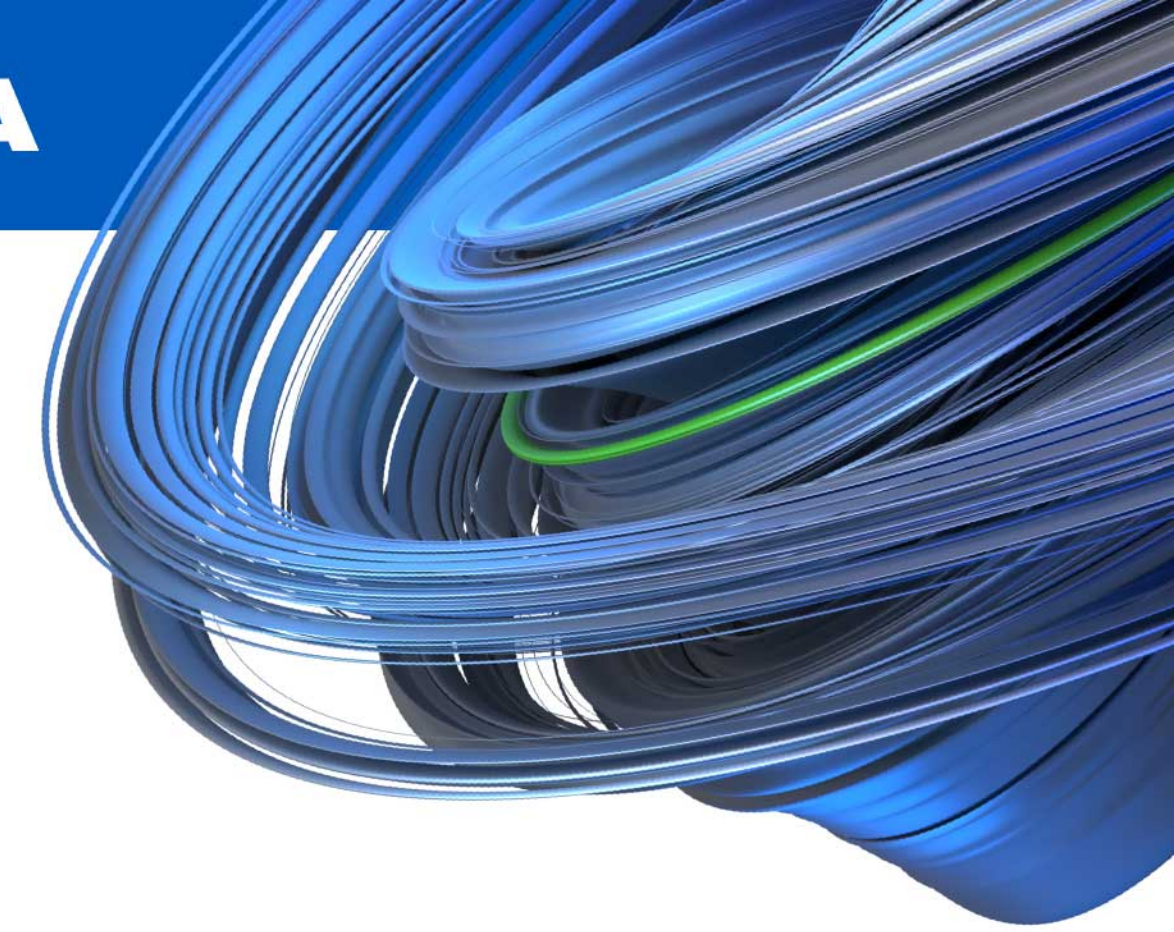
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Brief overview of the METIS project:

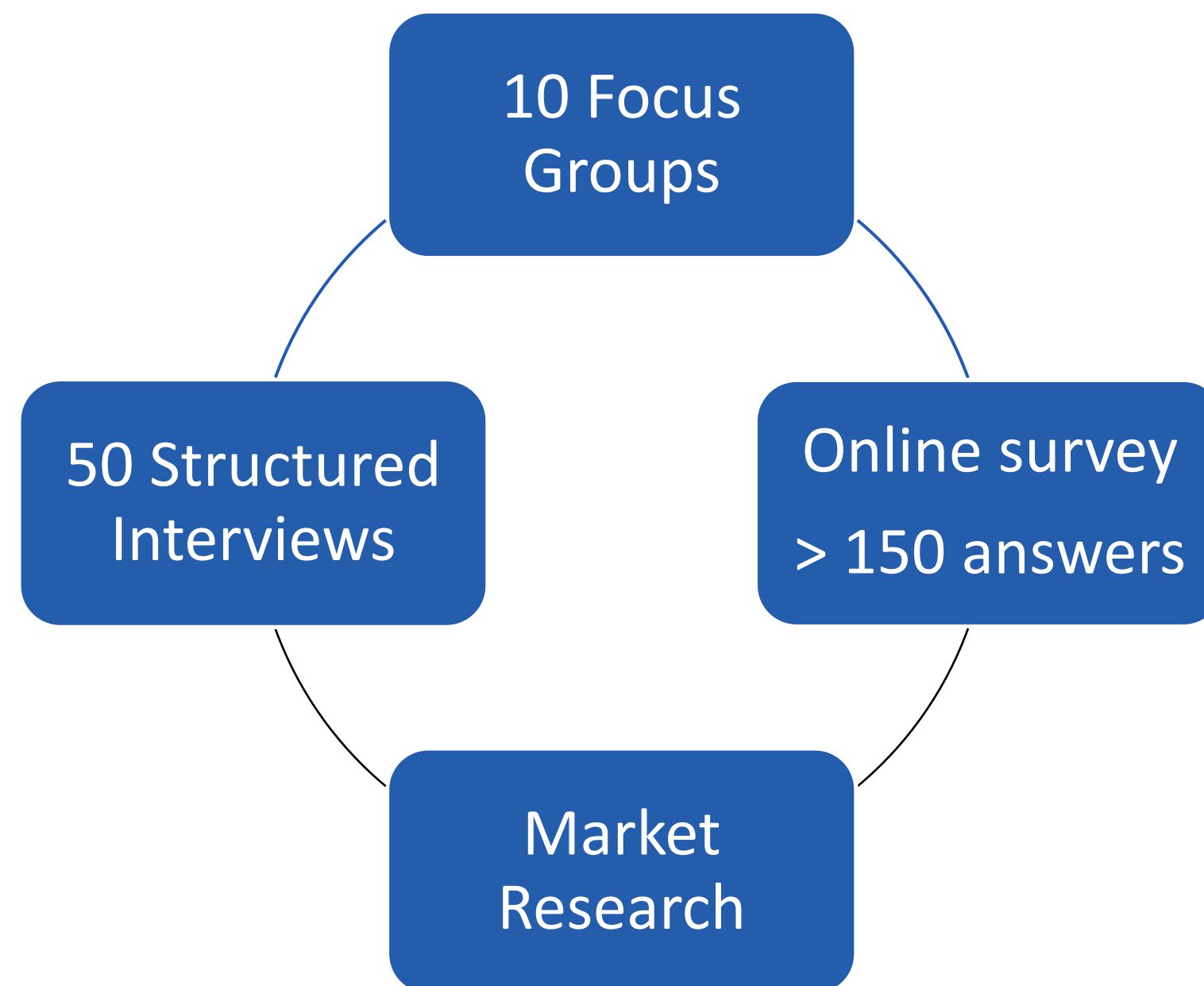
- METIS = MicroElectronics Training Industry and Skills
- A Sector Skills Alliance on Microelectronics, co-funded by Erasmus+
- 19 partners from 13 countries, coordinated by SEMI Europe





In 2020: EU sectoral skills strategy, skills anticipation and monitoring

- Multi-stakeholder's approach to skills identification



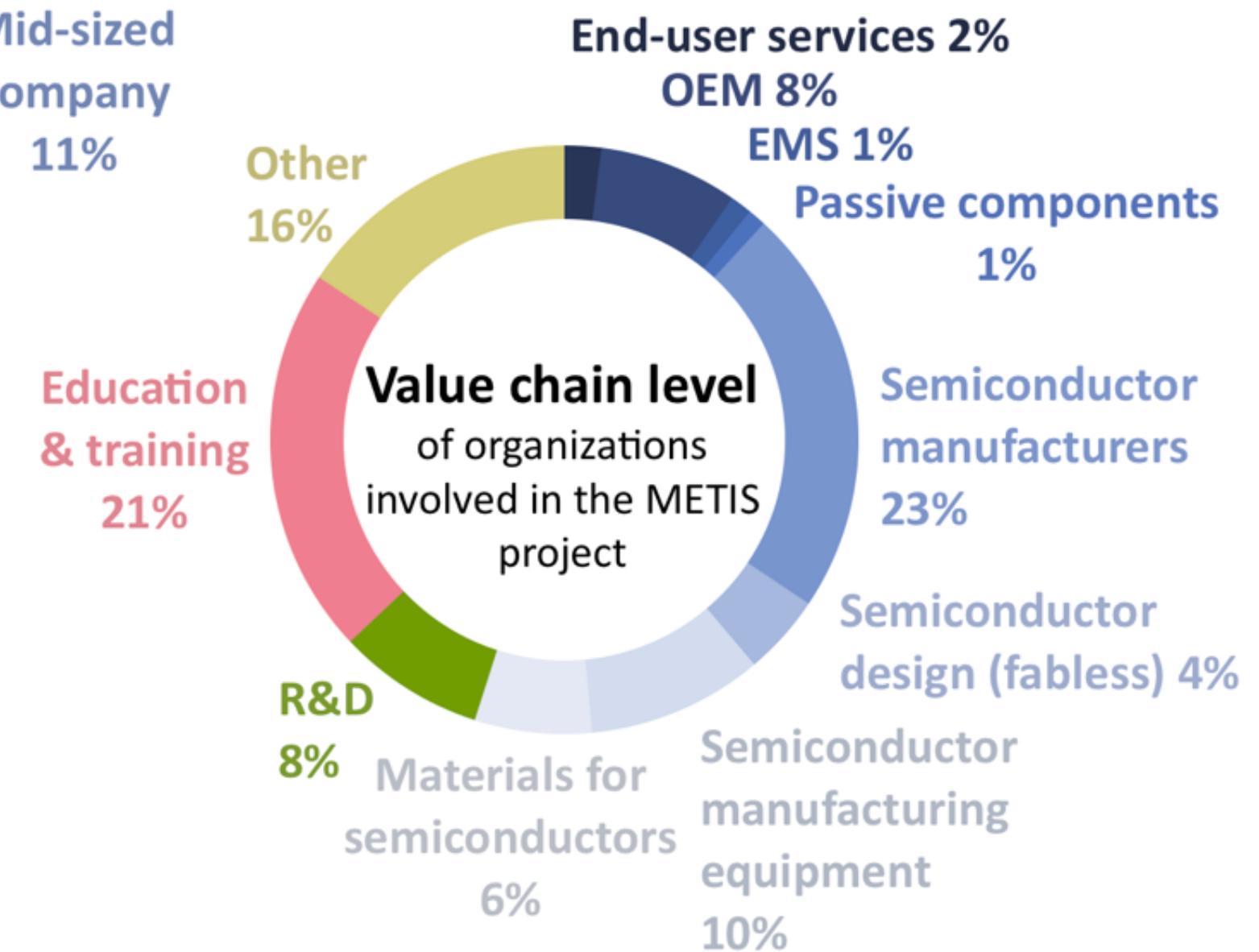
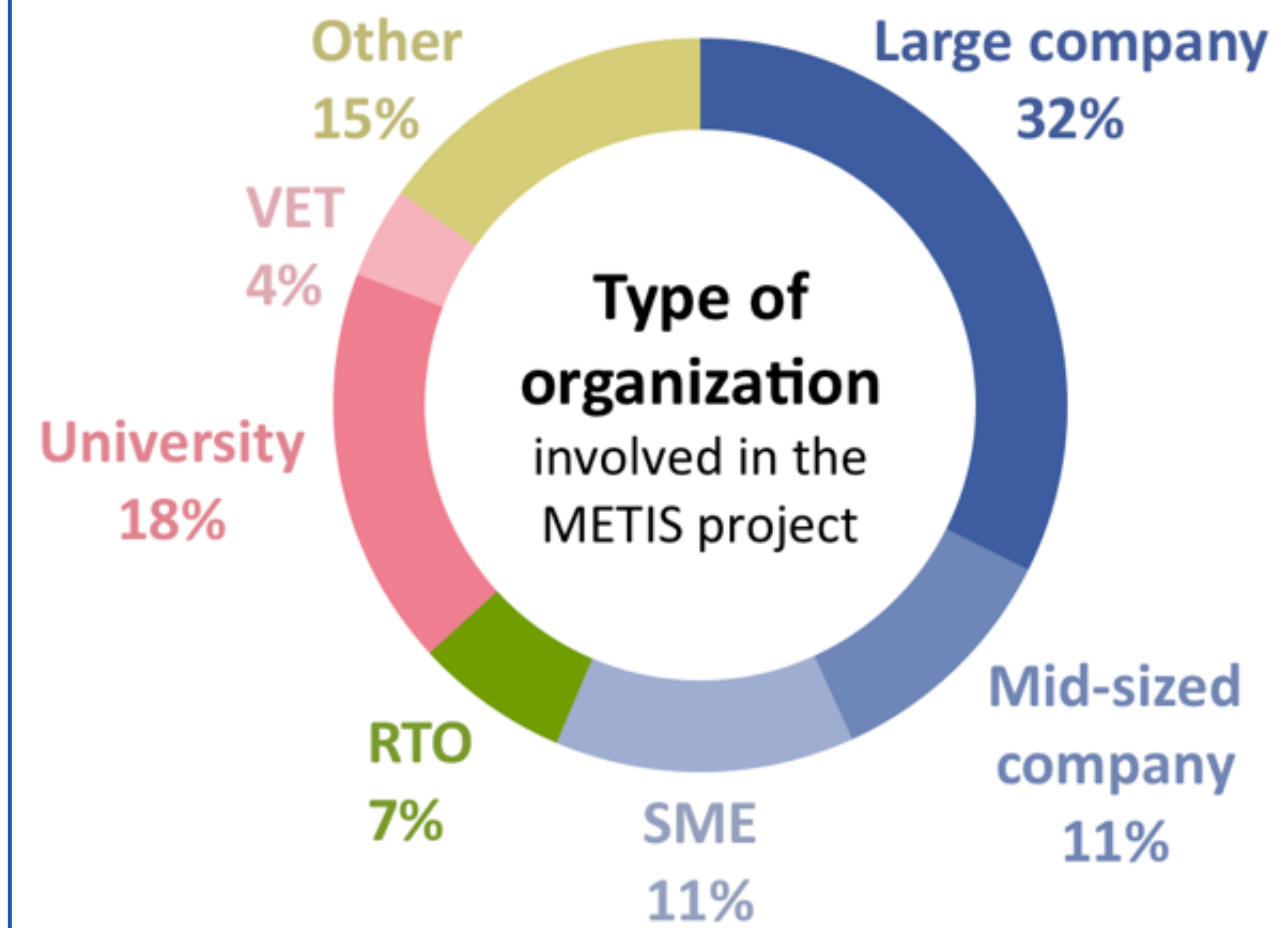
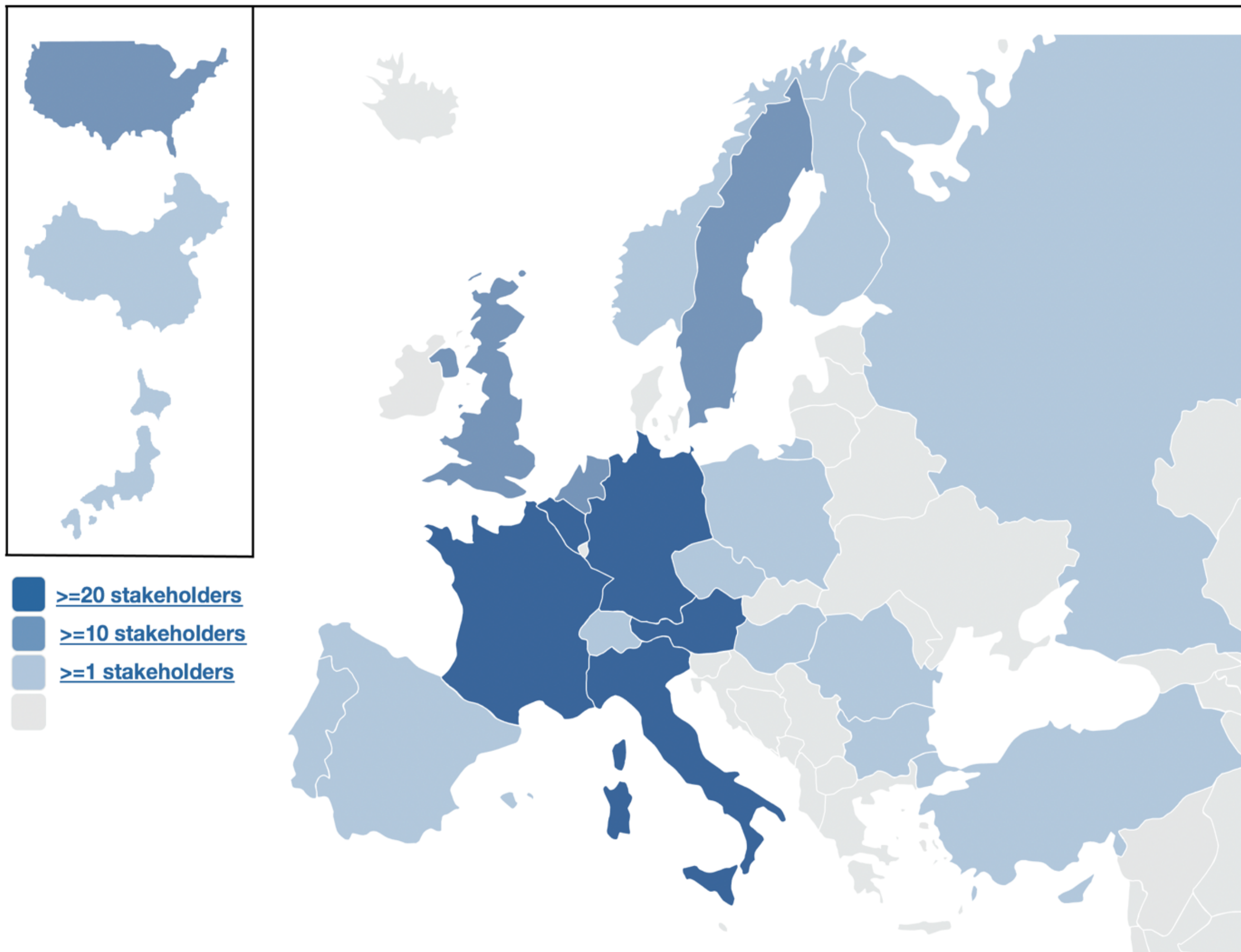
2 reports

- ▶ **Skills and Occupational Profiles for Microelectronics**
- ▶ **METIS Skills Strategy**

Organisations having participated in the METIS Skills Strategy, Skills Anticipation and Monitoring

- 251 stakeholders of 159 organisations engaged
- Representative for more than 125 000 microelectronics jobs across Europe
- 30% of the European microelectronics workforce
- 24% of respondents were women (More than the average of the sector in Europe)

Map - Nationality of stakeholders engaged in METIS



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Overview of the results

- **Identification of the most critical microelectronics job profiles**

1. Design engineers
2. Software engineers
3. ...

- **Identification of the most critical skills and knowledge**

1. Technical skills
2. Soft skills
3. Environmental & social skills

- **Occupational blueprint by job profiles**

1. Process engineers
2. Test engineers
3. ...

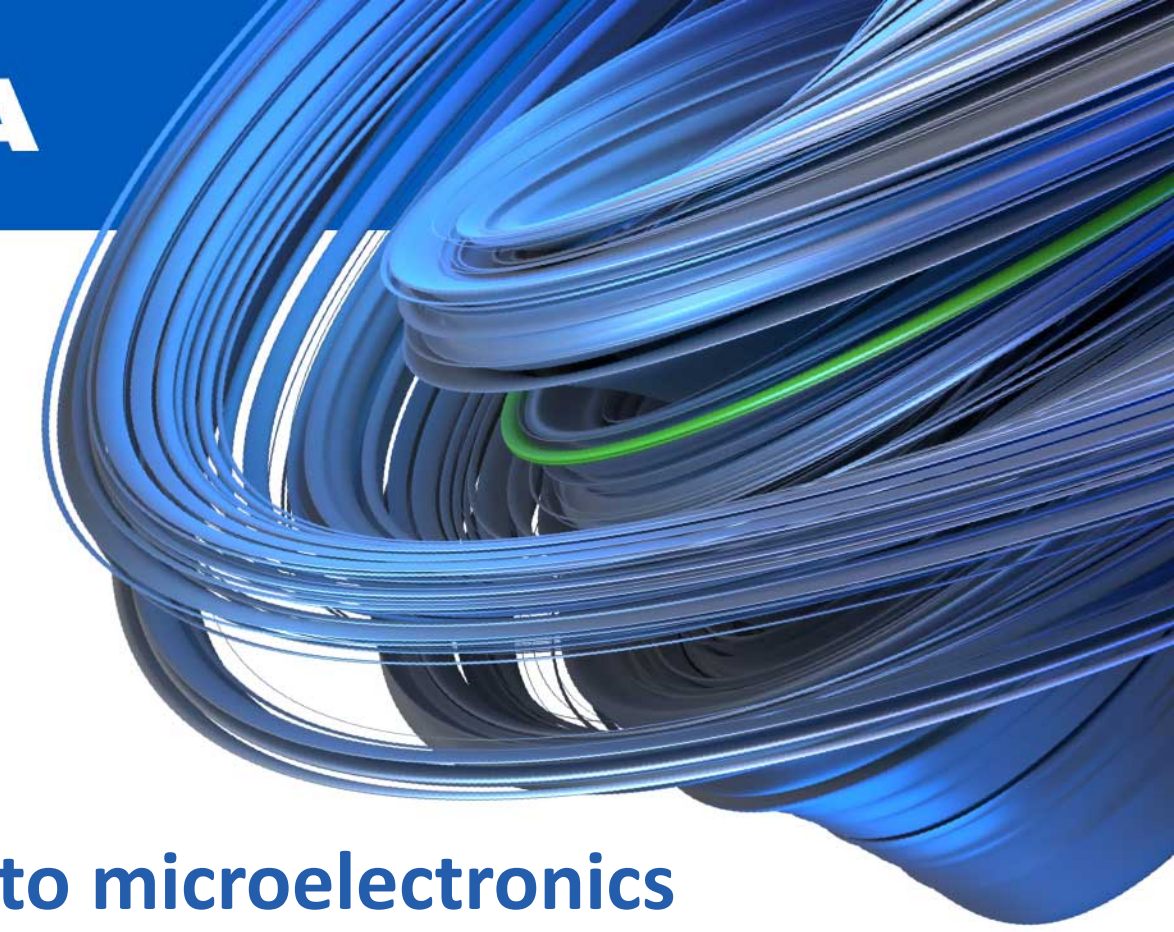
- **Design of 4 new ESCO profiles linked to microelectronics**

Microelectronics designer, microelectronics smart manufacturing engineer, microelectronics materials engineer, microelectronics maintenance technician

- **Recommendations for training modules**

1. Basics of manufacturing
2. Design
3. Manufacturing
4. Test and quality
5. ...

- **Policy recommendations regarding the structure of EU curricula**



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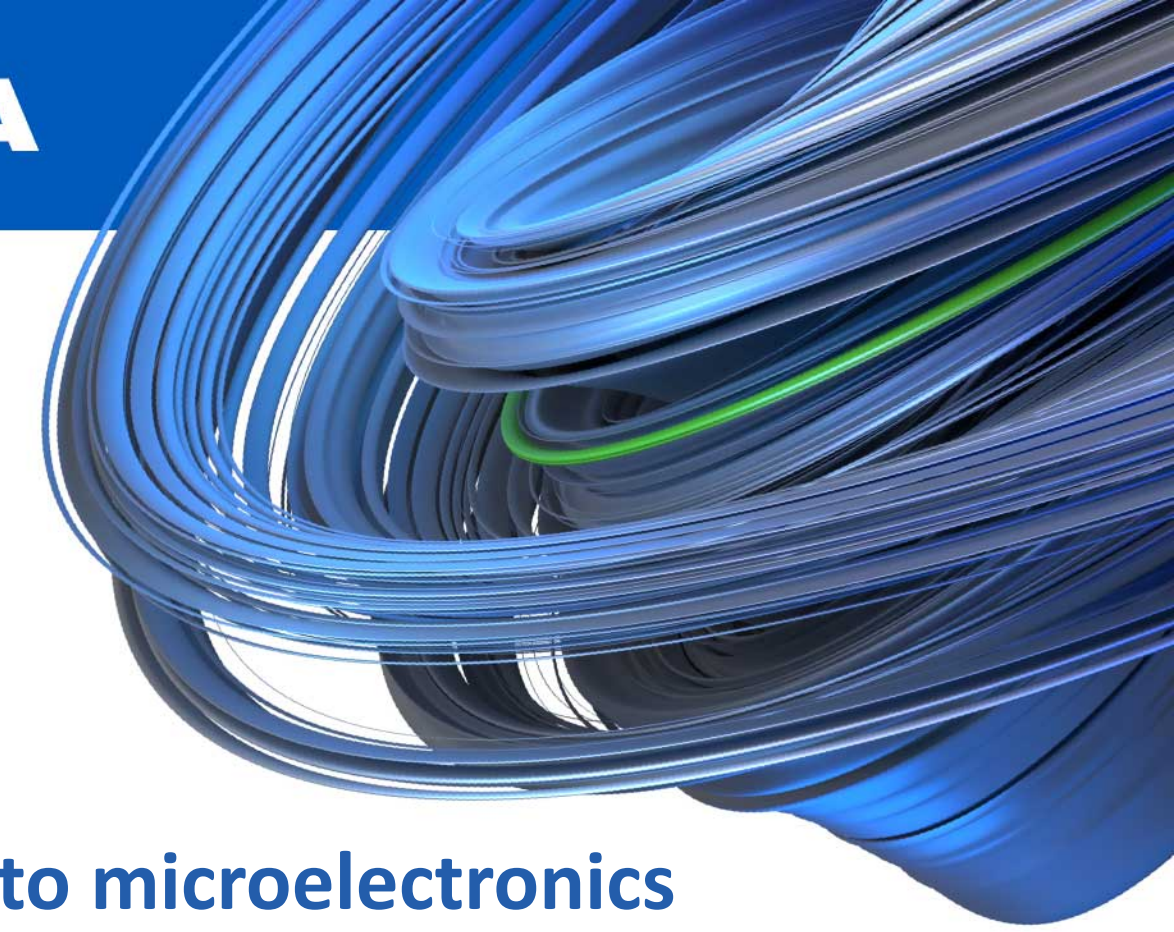
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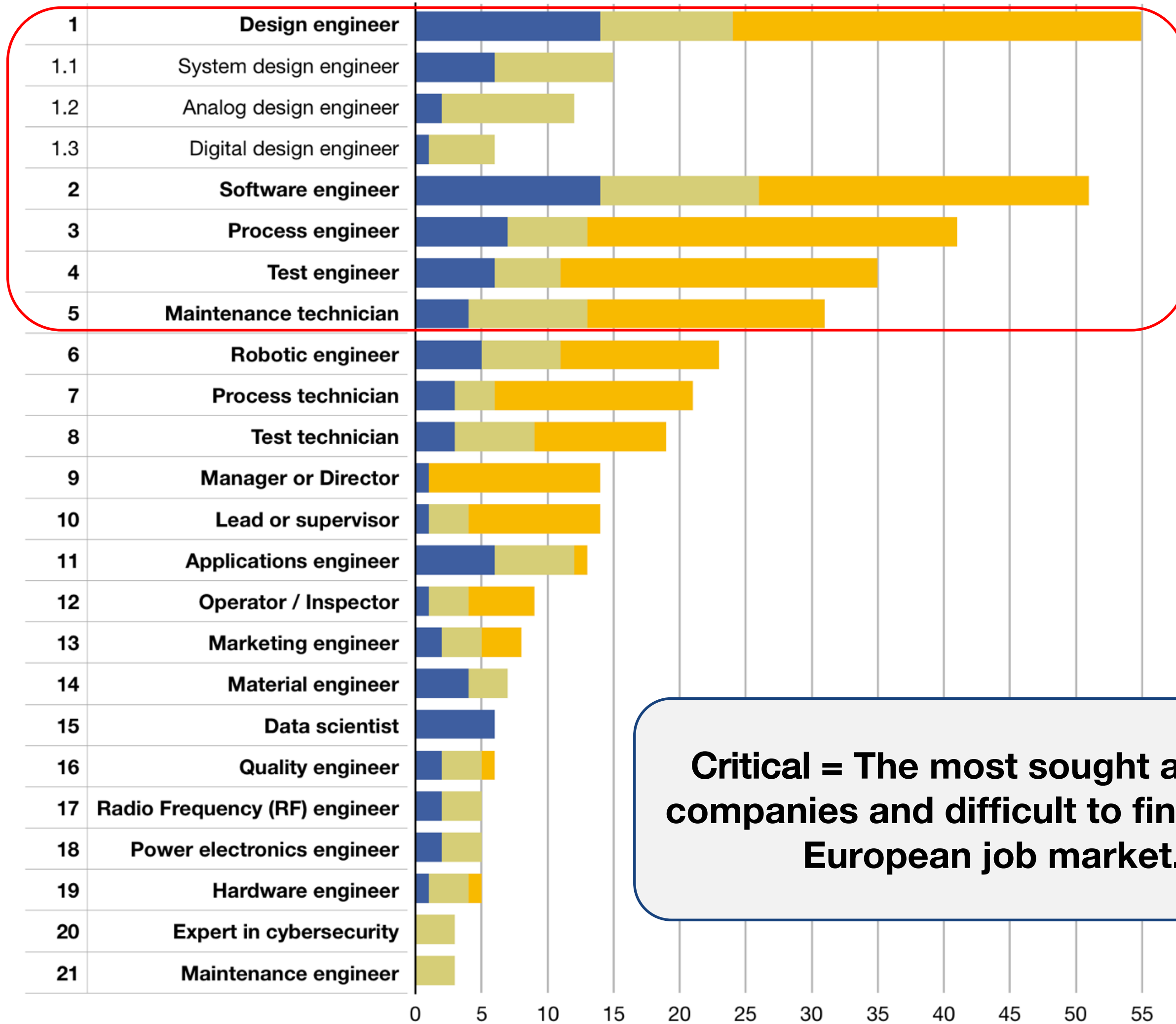
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The 21 job profiles identified as the most critical for the European microelectronics industry

Number of stakeholders indicating the profile as critical:

- From interviews
- From focus groups
- From online survey



Critical = The most sought after by companies and difficult to find on the European job market.

N°	Job profile	Alternative names / Description	EQF at entry level
1	Design engineer	Designer	6-7
1.1	System design engineer	System designer, Product Architect, System Architect (HW/SW), System Development Engineer, HW/SW co-designer, System expert	7
1.2	Analog design engineer	Analog designer, Analog/Analog IC/Mixed-signal/ RF-IC Design Engineer	6-7
1.3	Digital design engineer	Digital designer	7
2	Software engineer	Controls and software engineer, Software developer, Solution engineer, Computer software engineer, Embedded/Firmware/Cloud software engineer, Software designer, Software design engineer	6-7
3	Process engineer	Manufacturing engineer	6-7
4	Test engineer	Component Verification & Validation Engineer / Lab-Verification & Validation Engineer / Field Service Engineer	6-7
5	Maintenance technician		5-6
6	Robotic engineer	Automation engineer	6-7
7	Process technician	Manufacturing technician	5-6
8	Test technician		5-6
9	Manager or Director		7-8
10	Lead or supervisor	Lab supervisor, shift leader	7-8
11	Applications engineer	Application engineering expert, Field applications engineer, Product development engineer, Product Manager, Requirement engineer, Industry 4.0 expert, Industrial power electronics expert, Supply chain manager with basic SC material knowledge	6-7
12	Operator / Inspector		5-6
13	Marketing engineer	Digital Marketing expert	7
14	Material engineer	Material experts, Specialist for new materials, Chemist	6-7
15	Data scientist	Dat analyst	6-7
16	Quality engineer	Quality expert, Requirement engineer, Reliability engineer. Understands both customers claims and technical fields. Coordinates quality assurance tasks, continuous improvement of processes, supplier quality (incoming material testing)	6-7
17	RF engineer		7
18	Power electronics engineer		7
19	Hardware engineer	PCB design & test engineer	6
20	Expert in cybersecurity	Similar to the security skills required for software engineer, but with a deeper knowledge level	7
21	Maintenance engineer		7

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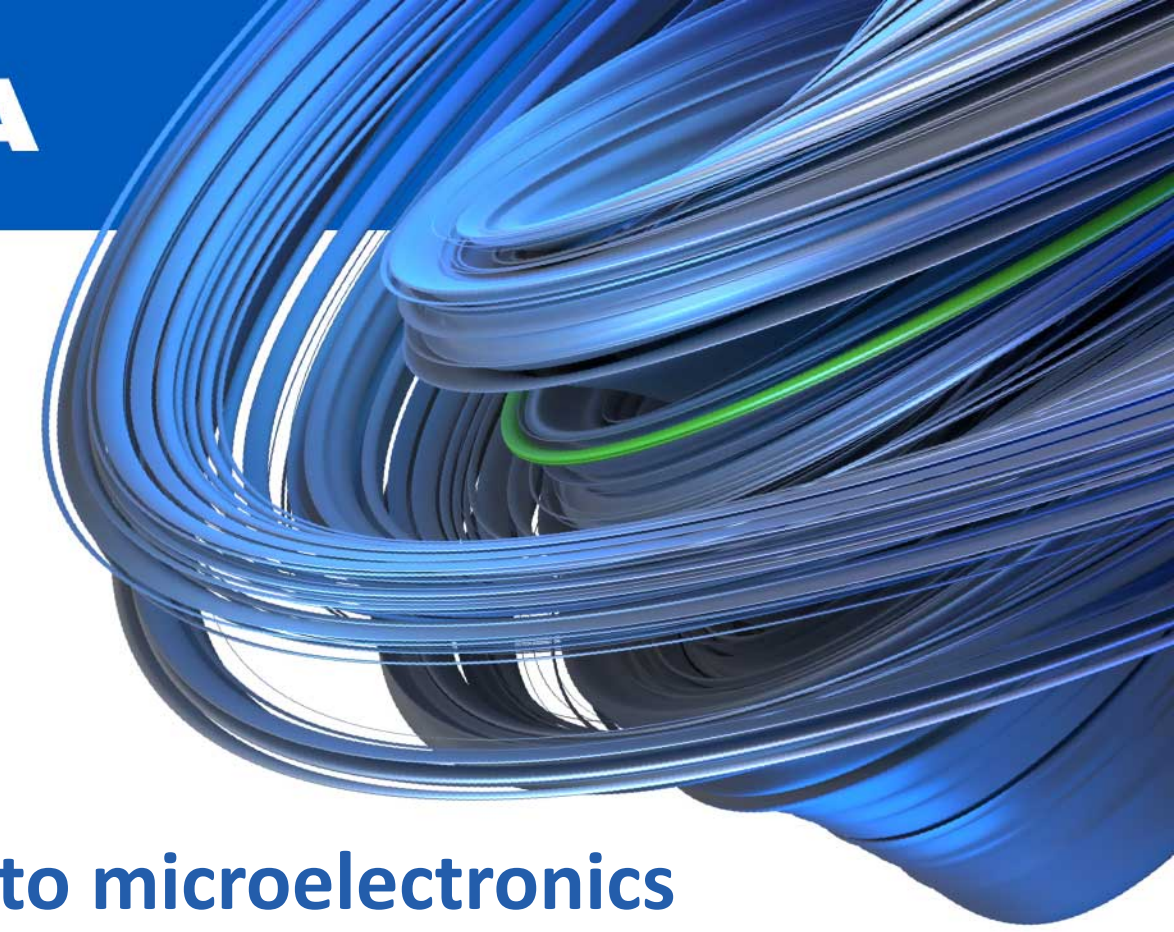
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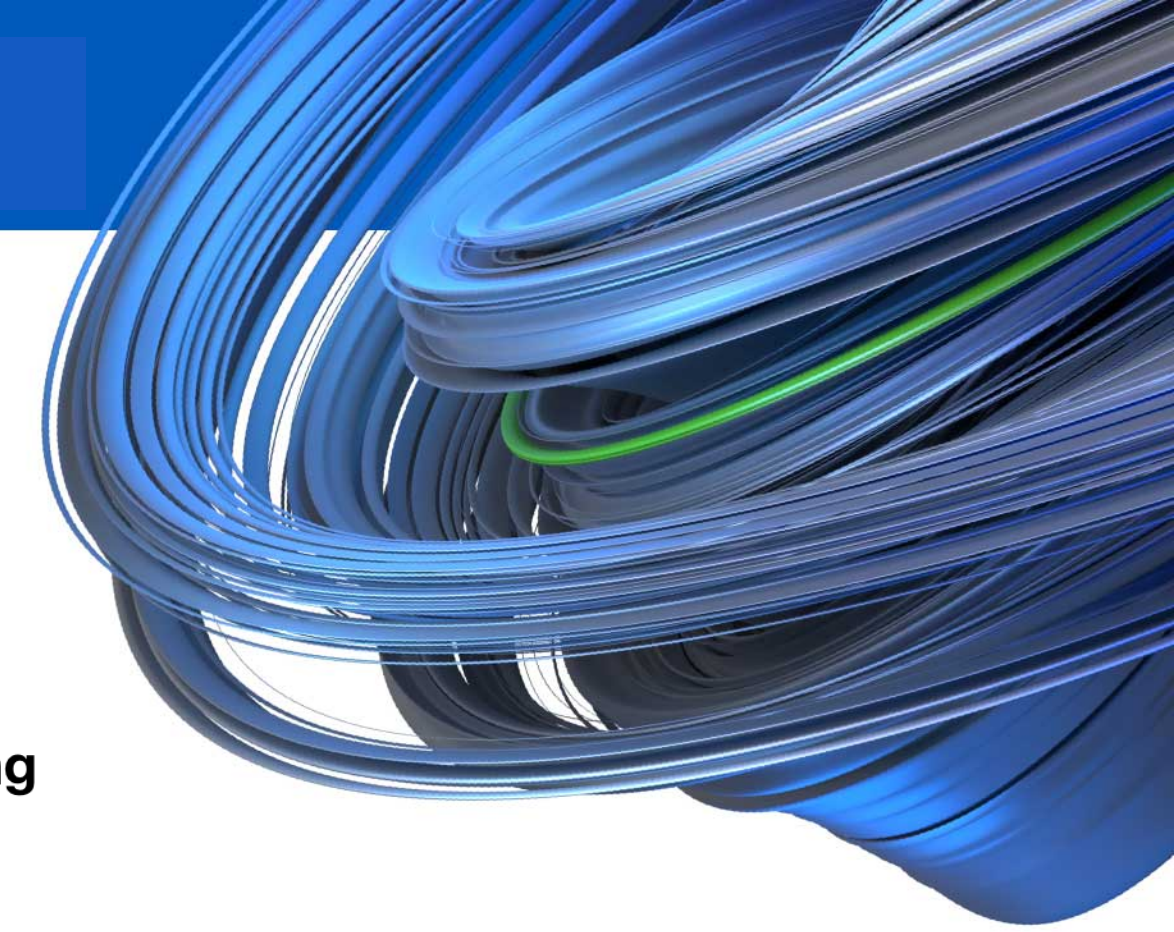
Microelectronics designer, microelectronics smart manufacturing engineer, microelectronics materials engineer, microelectronics maintenance technician

- **Recommendations for training modules**

1. Basics of manufacturing
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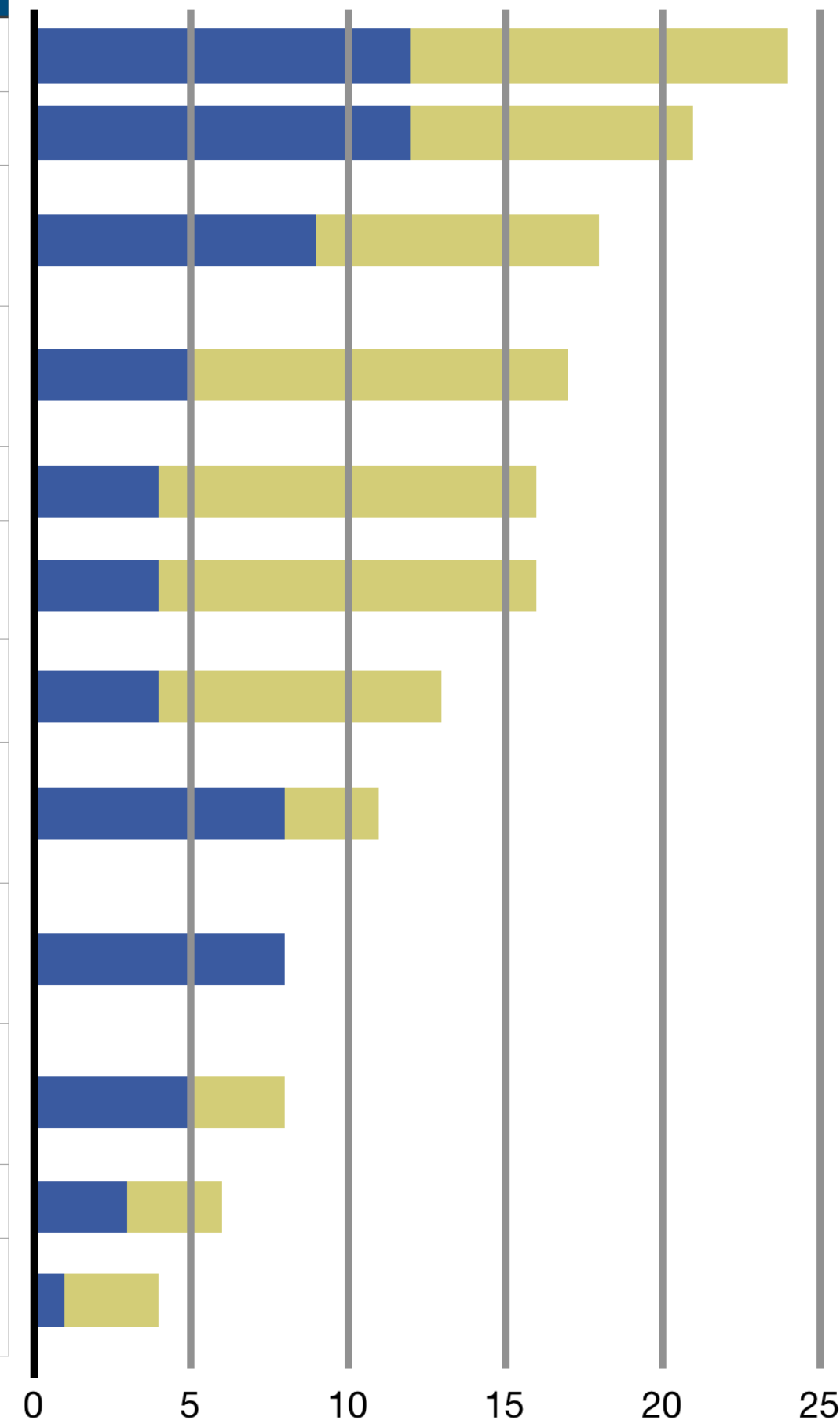
Great variability depending on job profiles.

Main trends summarized in the table below.

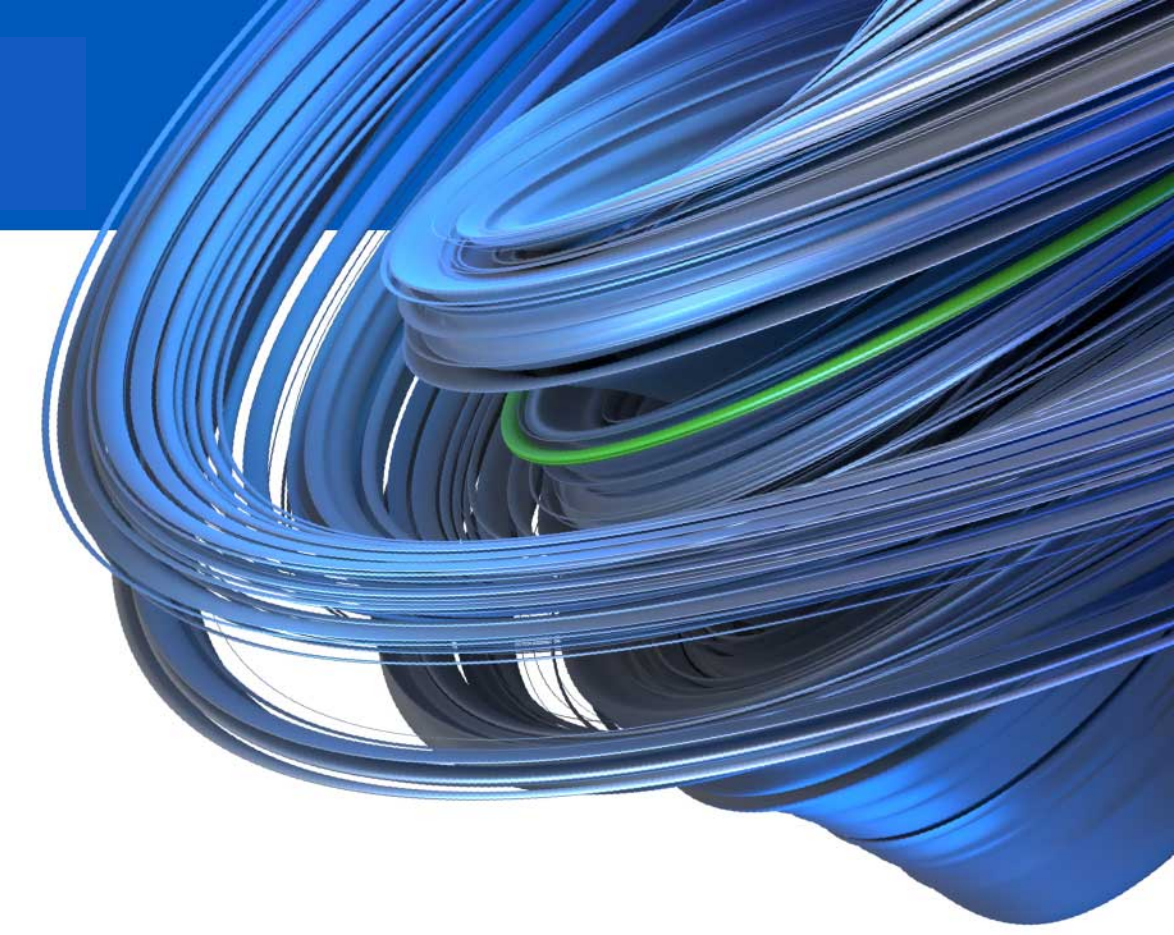
N°	Skill / Knowledge	Alternative names	Skill / knowledge required at Educational level (EQF)	The skill / knowledge is mandatory / optional	
				Mandatory	Optional
1	Systems architectures	System engineering	7	System design engineer	Design engineer
2	Data analysis	Big data	6-7	All profiles	-
3	Artificial Intelligence / Machine learning	Especially for software engineers, test engineers and design engineers	6-7	Software engineers / Data scientists	Other profiles. Important for Design engineers, Test engineers
4	Knowledge of applications		7	Application engineers / Material engineers / Design engineers / System design engineers / Software engineers	Other profiles
5	Quality / reliability		6-7	Process engineers	Other profiles
6	Hardware / Software (HW/ SW) integration	Hardware / Software co-design	6-7	Design engineers / System design engineers / Software engineers	Other profiles
7	Security	Security-by-design / Cybersecurity	6-7	Expert in cybersecurity / Software engineers / Robotic engineers / Process engineers / Test engineer	Other profiles
8	Knowledge of new materials	Knowledge of new materials and their applications	6-7	Process engineers / Material engineers	Other profiles
9	Software skills	Shift from hardware to software affecting most of the profiles	6-7	Software engineers / Data scientists / Robotic engineers / Process engineers / Materials engineers / Power electronics engineers / RF engineers	Other profiles
10	Analog design	Analog / Analog IC / Mixed-signal / RF-IC design	7	Design engineers and especially analog design engineers	-
11	Environmental awareness		4	-	All profiles
12	Social inclusion and diversity		4	-	All profiles

Number of stakeholders indicating the profile as critical:

- From interviews
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Critical =
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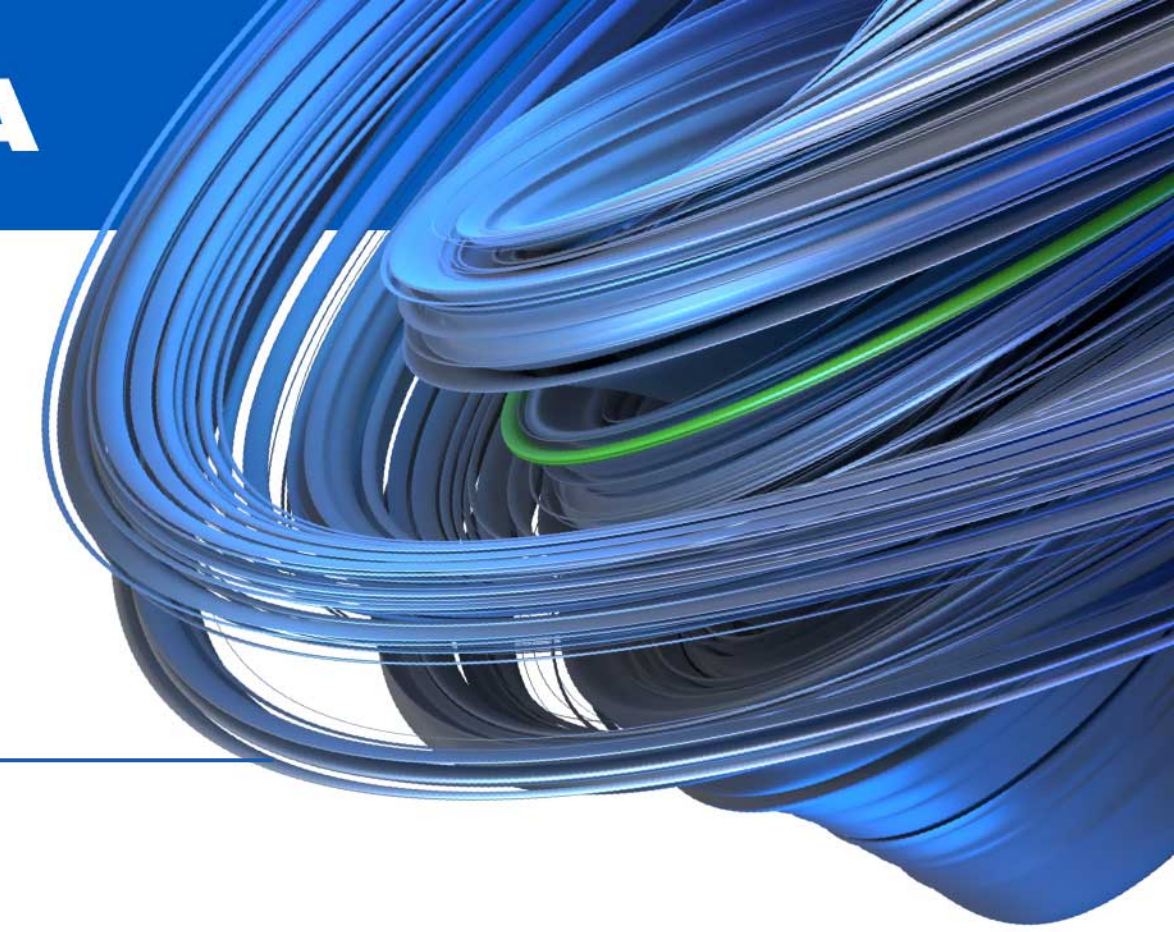
- Overall considered as almost as important as technical skills.
- Most critical soft skills required:
 1. **Teamwork & communication:** Increasingly complex topics, so teamwork and collaboration between teams become crucial. Ability to summarize complex topics for non-experts.
 2. **Creativity:** Innovation capacity, ability to propose new ideas, new processes, new designs, to use new technologies, new applications.

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Occupational blueprints by job profile (E.g., design engineer)

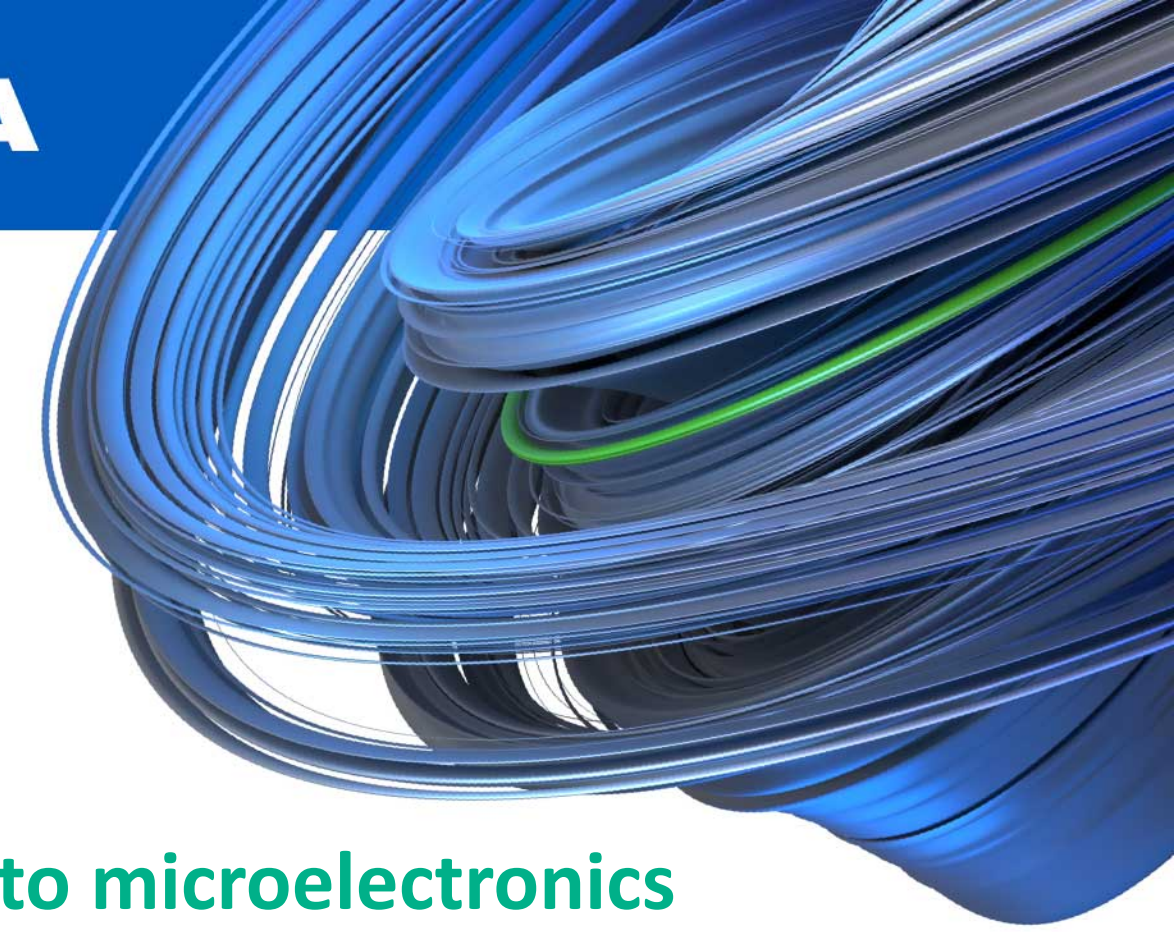


- Educational level of hires
- Seniority of profiles recruited
- Level of difficulty to find skilled candidates
- Average duration to fill a vacant position
- Average duration of the training of new hires to become productive
- Minimum education level
- Field of study of the workforce
- List of associated skills
 1. Description
 2. Difficulty to find
 3. Importance of the skill
- Associated skills that should become the most important by 2025

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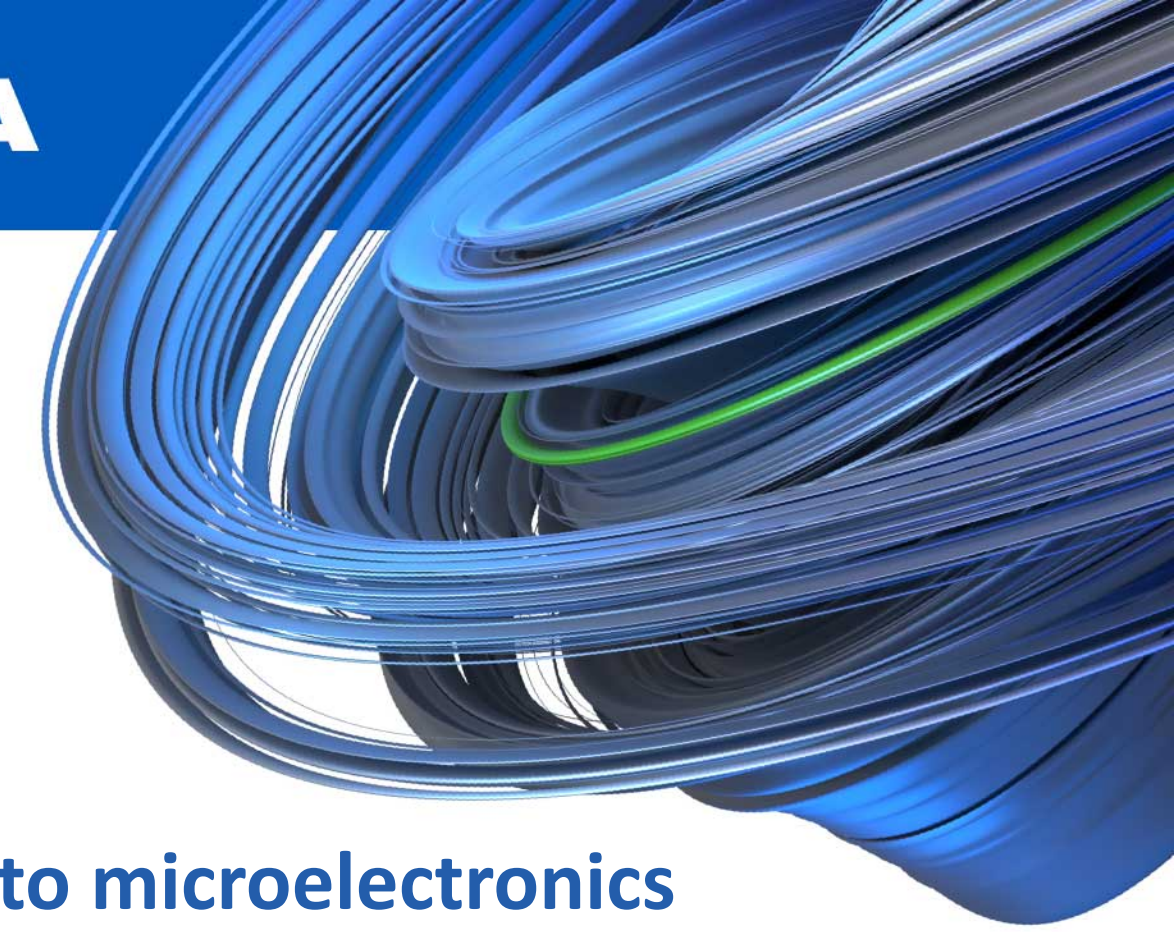
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Recommendations for training modules

- 1) **Basics of manufacturing:** Standardized maintenance & testing techniques, production processes & equipment...
- 2) **Fundamental knowledge in microelectronics:** analog & digital design, introduction to materials...
- 3) **Design**
 - Basics of design
 - Advanced design / System design
- 4) **Manufacturing**
 - Manufacturing engineers
 - Manufacturing technicians
 - Maintenance technicians

5) Test and quality

- Test engineers
- Test technicians

6) Other advanced skills

- Transversal skills: Quality / reliability issues, ability to link materials, products and process with end-user applications.
- Advanced materials & associated environmental issues
- Power electronics engineering: packaging, design, power management...

7) Key competences & innovative thinking

- Digital skills: AI, data analysis, security, software & embedded software coding.
- Environmental & social skills: Circular economy, diversity...
- Soft skills: Teamwork, communication, creativity...

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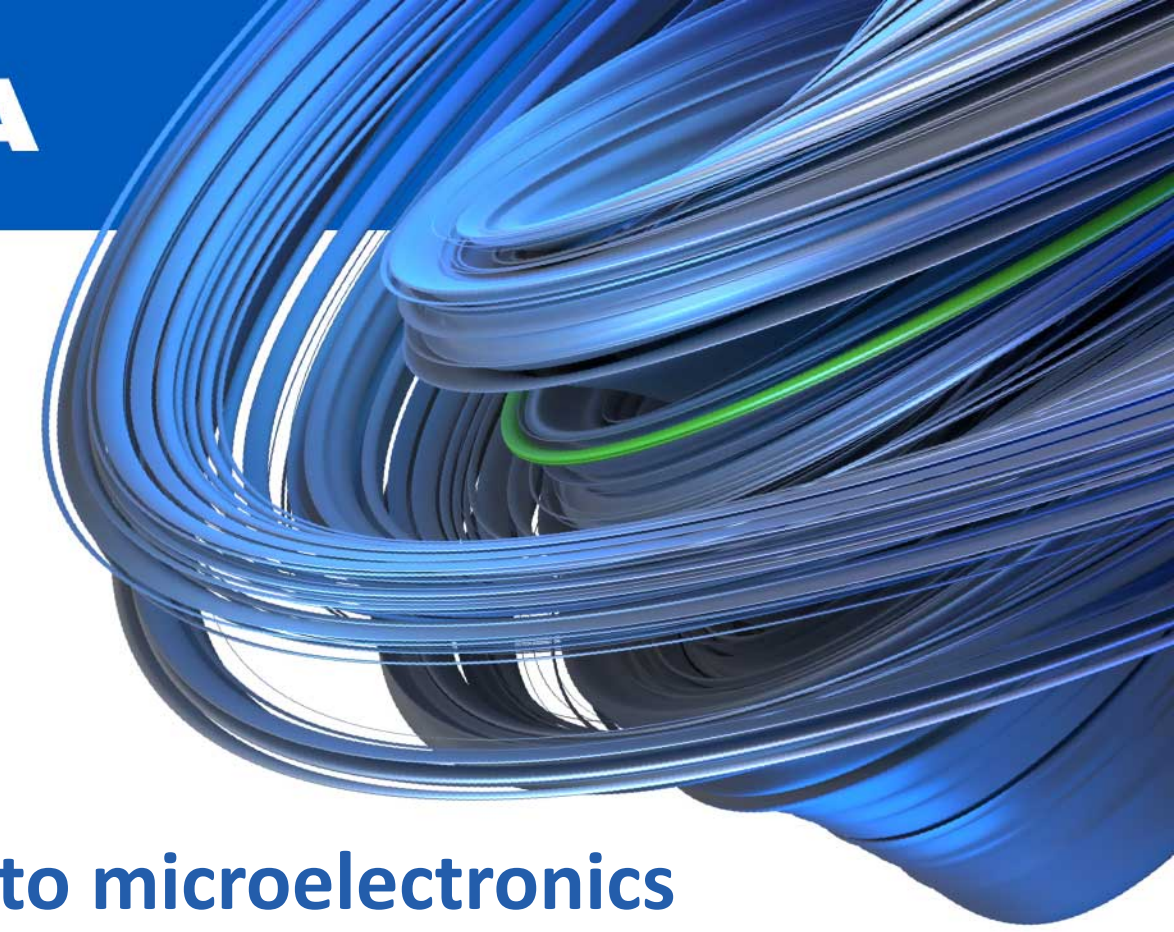
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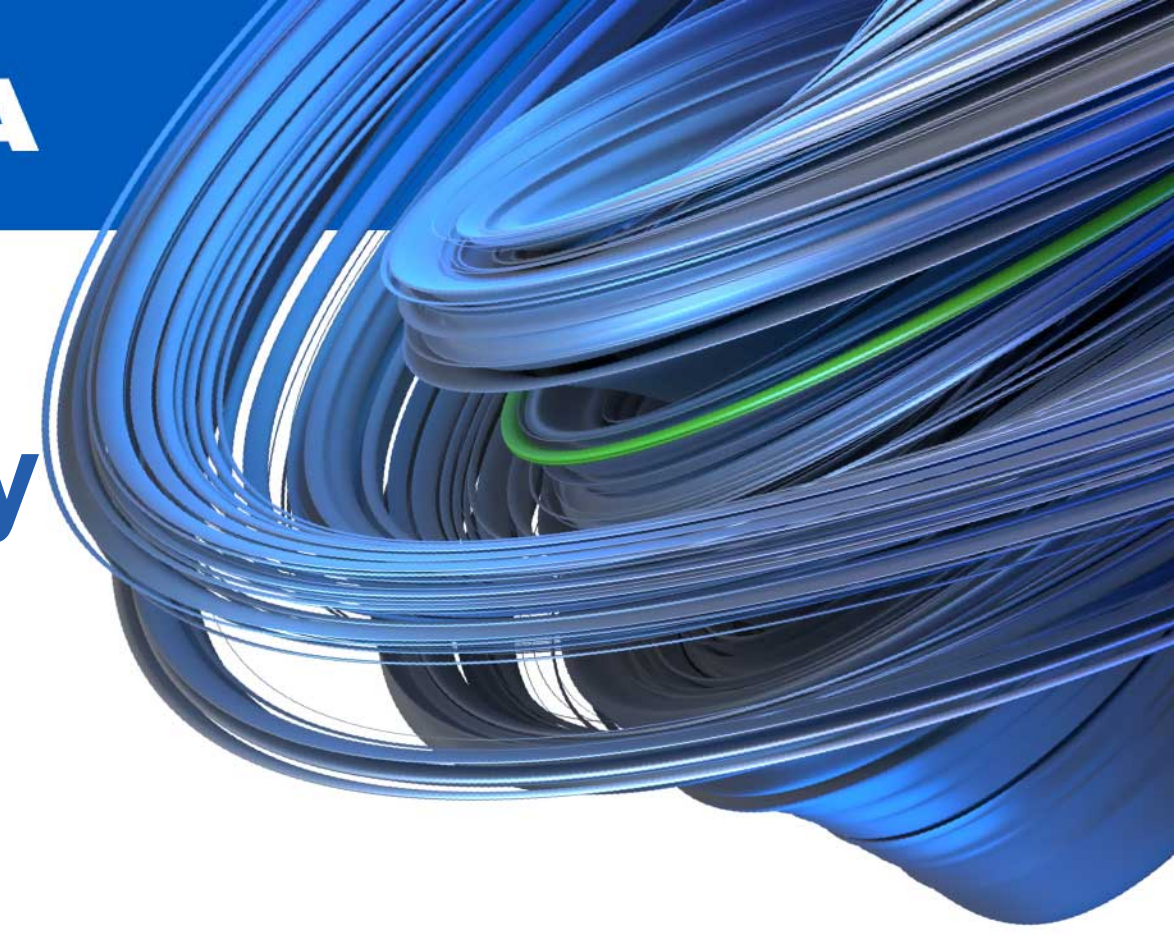
Recommendation 1) Involving the microelectronics industry in the education process

Actions:

- 1. Develop internships, apprenticeships, PhDs and graduate training programs co-organized (and co-funded?) by Universities and industrials.**
- 2. Generalize the use of experts from the industry as teachers at the University.**
- 3. Generalize the organisation of regular presentations of companies at Universities.**
- 4. Develop life-long training programs:**
 - Companies' involvement in the design of Universities and VET training programs.
 - Universities' courses hosted by companies' facilities.
 - Generalization of worked-based training.
 - Generalize co-funded and co-organized projects between Universities and companies.

Recommendation 2) Developing clusters and networks favoring dialog between industry and education representatives

- METIS
- Microelectronics Pact for Skills
- Microelectronics EU Industry Alliance
- ...

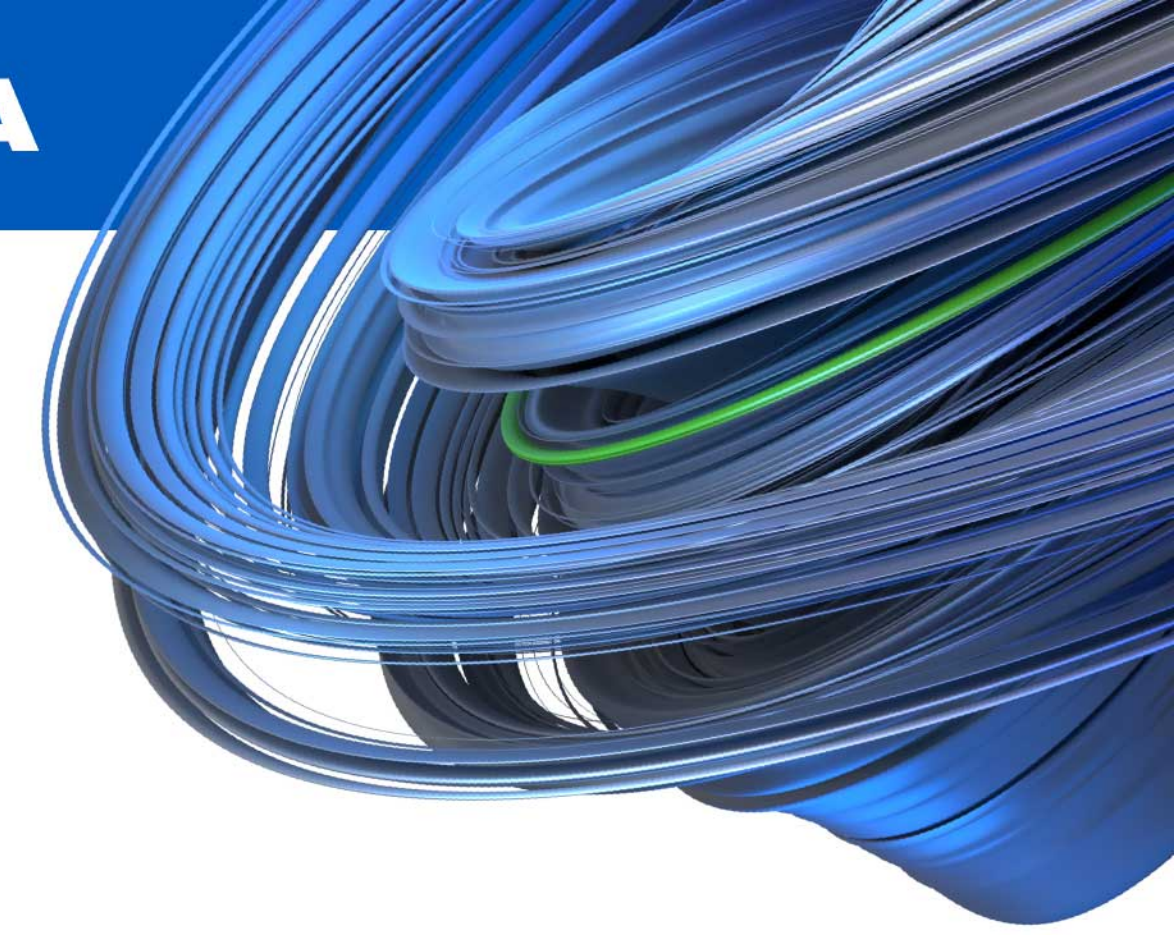


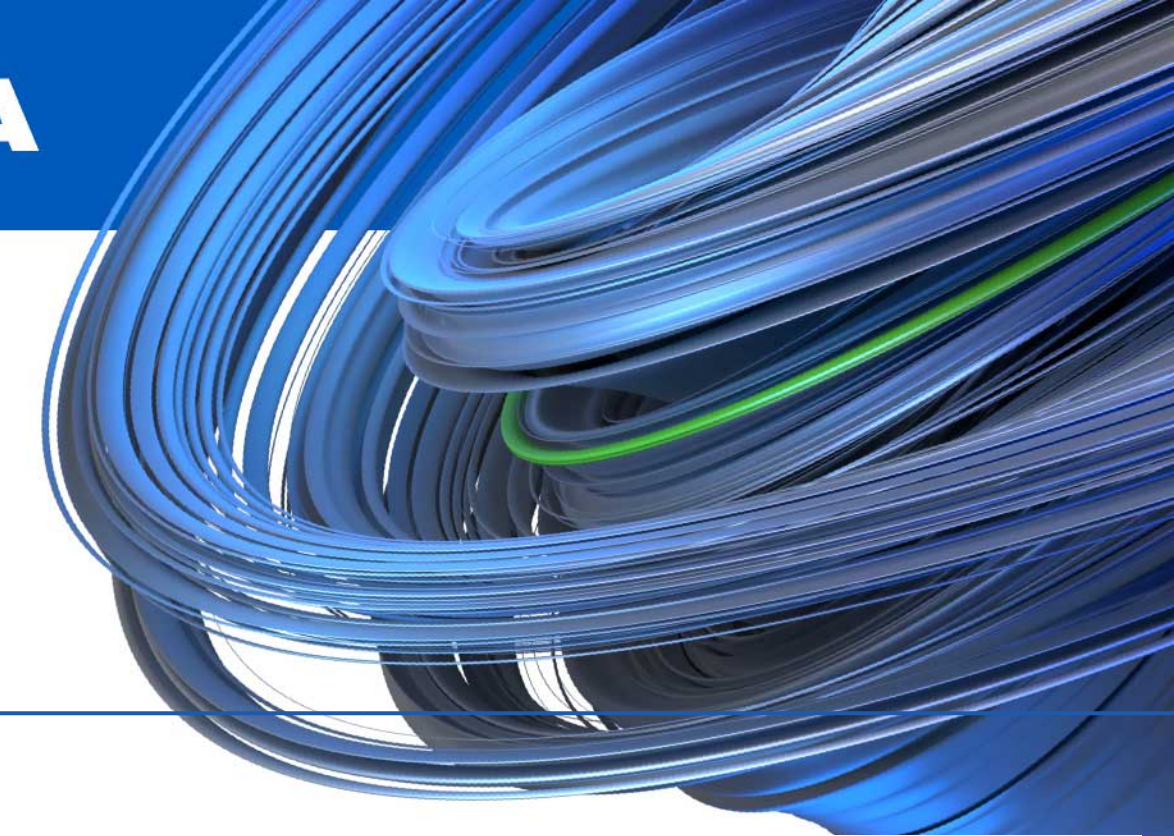
Recommendation 3) Improving the image of microelectronics through communications campaigns

Goal: Rise the level of interest in microelectronics and attract talents.

Actions:

- Communication campaign to the public.
- Teaching microelectronics-related topics at early stage of the education system (before EQF 4).
- Actions to raise the interest of students in STEM educations for technical jobs, electrical engineering and microelectronics.





Recommendation 4)

Sponsoring state-of-the-art manufacturing infrastructures to be shared by large companies, education players, SMEs and R&D players

State-of-play

- Small EU manufacturing base compared to other regions, and smaller in proportion years after years.
- Sovereignty & resiliency issue.
- Difficulty to maintain state-of-the-art R&D without applied R&D to state-of-the-art production processes. Special difficulty of access to manufacturing facilities for SME.

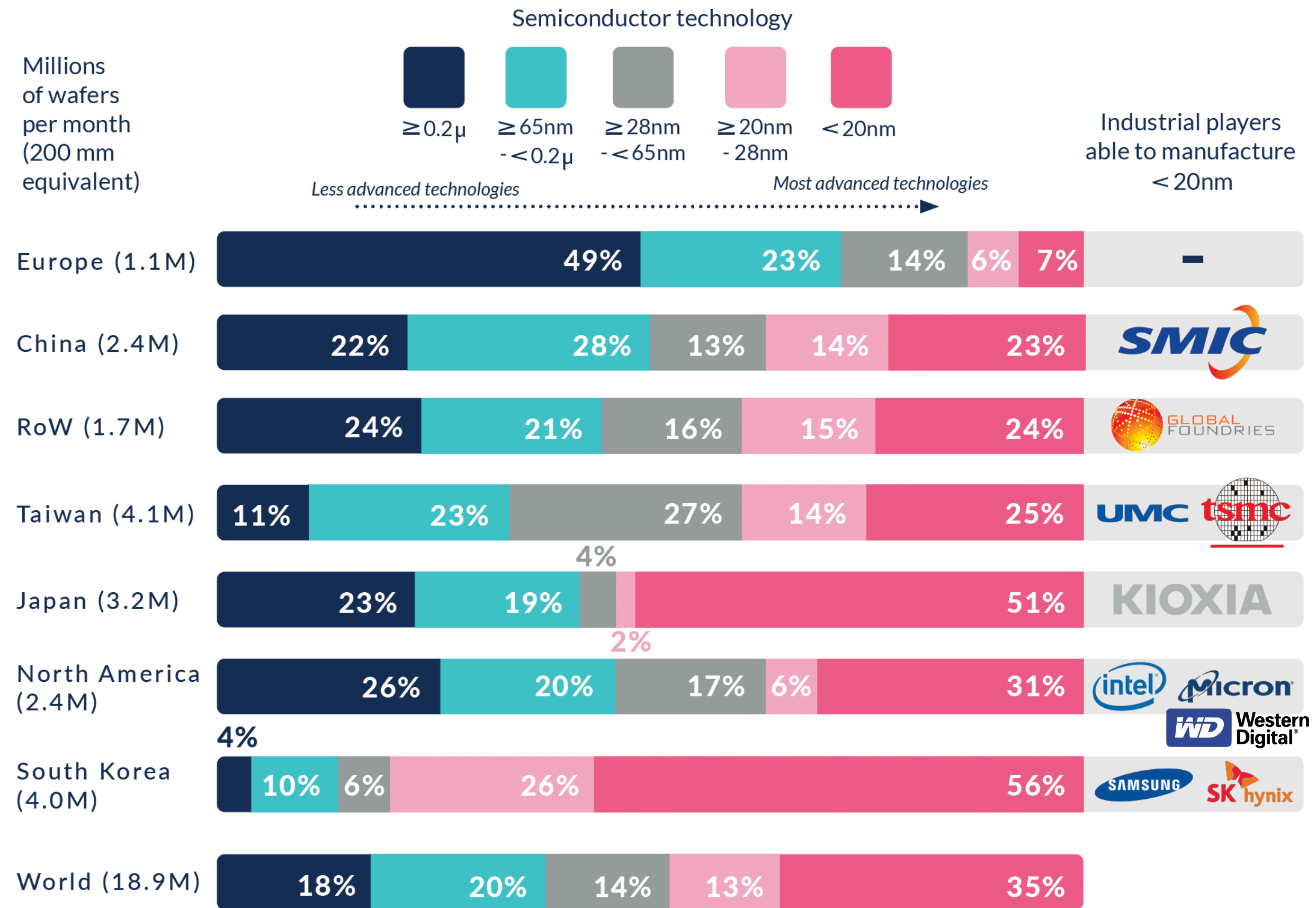
Illustration (opposite diagram)

- No European player able to manufacture below 20 nm.
- Only 7% of the production in Europe below 20 nm.

Actions

- Sponsor investments in state-of-the-art manufacturing capabilities in Europe, requiring highly concentrated investments.
- Ensure the access to such manufacturing capabilities for both large companies, SMEs and Universities to support R&D applied to state-of-the-art semiconductor manufacturing processes.

PRODUCTION CAPACITY OF SEMICONDUCTORS BY TECHNOLOGY



Source: DECISION Etudes & Conseil, IC Insights December 2018

Recommendation 4)

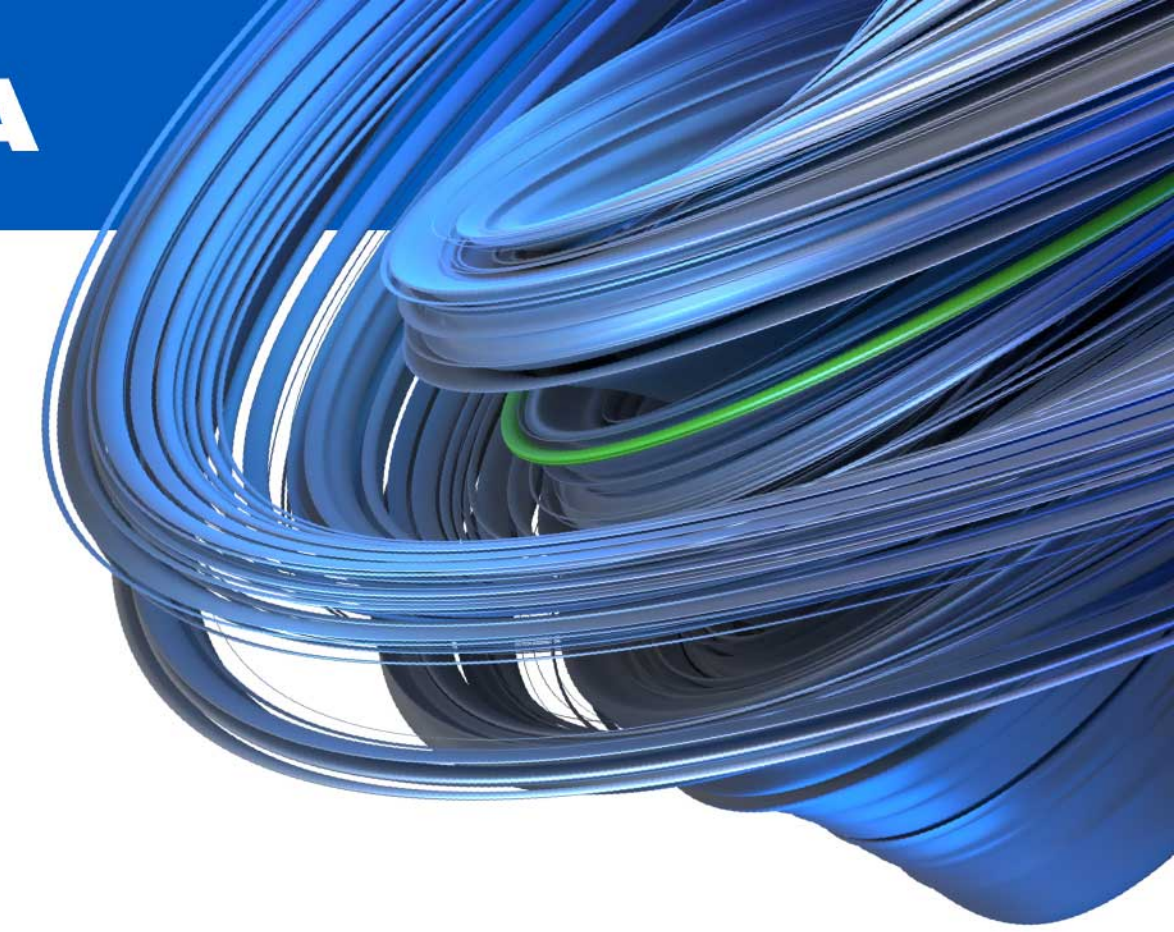
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EU digital compass: Industrial goals by 2030

1. Europe to account for 20% of world production of processors in value (5-10% in 2020).
2. Manufacturing capabilities of processors below 5 nm.

Challenge for METIS and the Pact for Skills?

- Dedicate specific efforts towards manufacturing profiles?
 - Maintenance technicians
 - Process engineers
 - ...
- Dedicate specific efforts to teach basic skills linked to microelectronics manufacturing processes as a common base for all students?



Recommendation 5) Developing Joint degrees in microelectronics

Proposals for joint degrees / curricula for microelectronics

Fields of study	Proposals for joint degrees			
	1	2	3	4
Microelectronics / Electro-engineering / Mechanics / Mechatronics	V	V	V	V
Software / Data science / Informatics	V			
Chemistry / Material science (Polymers, etc.)		V		
Marketing, Sales and Communication			V	
Biology / Natural Science				V

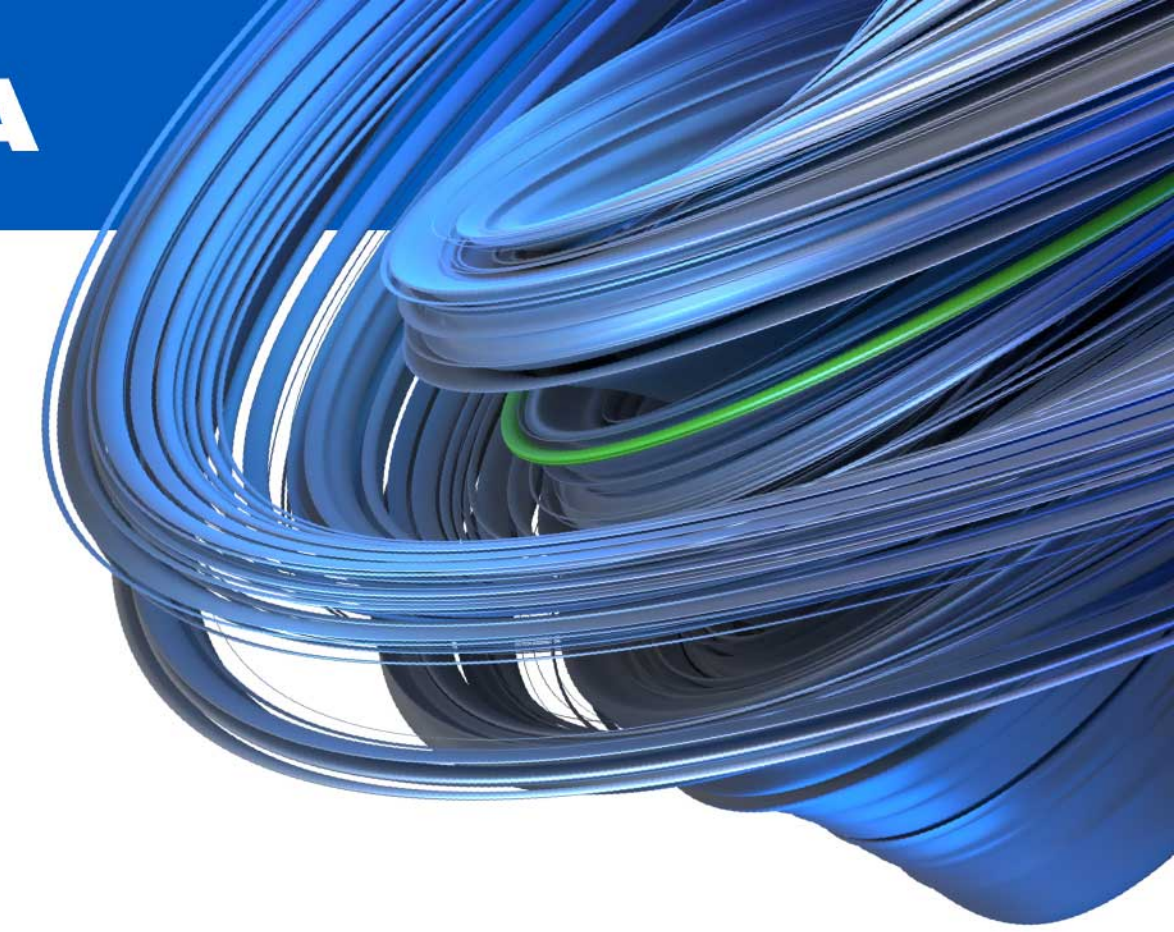
Recommendation 6) Favoring intra and extra-EU mobility

Ease administrative processes

- To hire employees from abroad the EU.
- To facilitate intra-EU workers' mobility.

Enhance the uniformization of degrees and curriculum across the EU

- EQF/NQFs
- ESCO: Proposition of new profiles



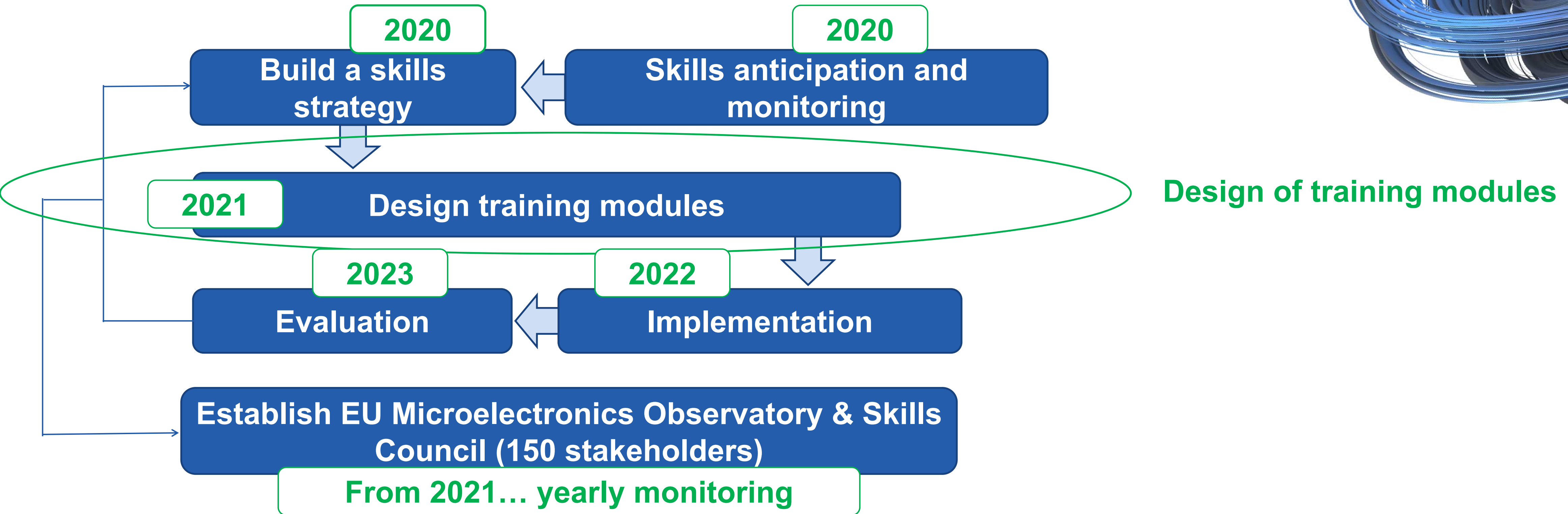
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Update of the METIS Skills Strategy in 2022

- Nurtured by the results of WP3 : Design of training modules.
- Nurtured by the progresses of the Microelectronics Pact for Skills.

Thank You