

MicroElectronics, Training Industry and Skills

# Skills intelligence and skills strategy for the microelectronics sector

## Presentation of key results

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### Link to our website



### Market research consulting - Specialist of the European electronics value chain





- I) Skills monitoring within METIS
- II) Industry needs Microelectronics job profiles & skills
  - A. Job profiles
  - B. Technical skills
  - c. Soft skills
  - D. Key evolutions from 2020 to 2023
  - E. New profiles integrated in ESCO
  - F. Policy recommendations
- III) Next steps









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### Our reports on semiconductor skills needs in the EU

- Report "Skills and Occupational Profiles for Microelectronics" 2021
- METIS Skills Strategy 2021
- Yearly Monitoring Report 2022
- Yearly Monitoring Report 2023

### Link to the reports







### "Skills and Occupational Profiles for Microelectronics"

### A) Anticipate skills and occupational profiles in the EU

Mismatches between offer and demand on the European microelectronics job market

□Most critical skills

- □Most critical job profiles
- Needs in specific sectors: Design, manufacturing process, manufacturing equipment, materials

□Impact of emerging technologies

- I + 30 job profiles identified and described: Associated main skills, emerging skills, educational levels, duration to fill positions, etc.
- B) Proposition of new occupational profiles for microelectronics

□+4 ESCO profiles in microelectronics

 $\Box$ + 25 other profiles that could be added

Public reports: Consult the reports for the detailed results

## "METIS Skills Strategy"

A) Identify trends, challenges and opportunities

Position of Europe in terms of employment
Impact of emerging technologies on the industry
Impact of COVID / shortage/ Chips act / Investments
Diversity in electronics

### B) Skills strategy

Best practice - 10 Initiatives to be benchmarked (HR, policy, etc.)

□Policy recommendations

□Recommendations for training modules





Organisations having participated the METIS Semiconductor Skills Monitoring 2020-2023

### Map - Nationality of stakeholders engaged



- **316** stakeholders from **171** organisations engaged
- Representative for ~145 000 microelectronics jobs across Europe
- ~55% of the European microelectronics workforce
- 23% of respondents were women (More than the average of the sector in Europe)





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### **Questions asked**

- **Demand for profiles**. Indicate the profiles that are the most sought after by European industry since January 2022 (in terms of number of hires).
- Shortage of skilled candidates. Indicate the profiles that are the most difficult to fill for the European industry since January 2022 (greatest difficulty to find skilled candidates).
- $\Rightarrow$  A critical profile = High demand and great shortage.







## From 2020 to 2023:



Most critical job profiles on the European job market



For this question, all the stakeholders were not limited in their choice of answers and could choose between several job profiles. This is why the totals exceed 100%.









## Results & comparison 2023 since 2020

- A new profile in the top 5 of the most critical in 2023:
  - 1. <u>Software engineers</u>: Embedded, Software/Firmware, Machine Learning
  - 2. <u>Design engineers</u>: Especially system & analog design
  - 3. <u>Process engineers</u>
  - 4. Data specialist
  - 5. <u>Maintenance technicians</u>
- The demand and shortage for 4 profiles has significantly raised since 2020:
  - > Data specialist, moving from the 15th position in 2020 to the 4th position in 2023
  - System designers
  - Analog designers
  - Process engineers
- The situation seem to have improved since 2020 for junior design engineers, especially digital designers
- Machine learning engineers emerges as a new profiles, identified as critical by 38% of the stakeholders interrogated in 2023







## Results & comparison 2023 since 2020

- The severe shortage of senior profiles on specific topics continues.
  - 1. Advanced systems architecture designers
  - 2. Systems test engineers
  - 3. Senior analog designer, especially associated with strong programming skills
  - 4. Application engineers. Engineers experts in specific applications fields (automotive...)
  - 5. Senior managers in general
- Another new profile emerges in 2023
  - > Supply chain expert / Logistics specialist



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- Shortage of skills. Indicate the skills that are the most difficult to fill for the European industry since January 2022 (greatest difficulty to find skilled candidates).
- $\Rightarrow$  A critical skill= High demand and great shortage.
- What is the **minimum educational level** for which you require the skill?



## 2020 - 2023 Most critical skills/knowledge on the European job market



For this question, all the stakeholders were not limited in their choice of answers and could choose between several job profiles. This is why the totals exceed 100%.

## Results & comparison 2020-2023

9 key fields of skills confirmed as the most critical across job profiles (stable since 2020):

- 1. <u>System architectures</u>. Knowledge of systems architectures: SoC, SiP, complex ASICs... Ability to design such architectures.
- 2. <u>Data analysis</u>. Increasingly needed by the industry.
- 3. <u>Artificial Intelligence / Machine learning.</u>
- 4. Analog design.
- 5. <u>Knowledge of applications</u> (specificities, linking components, materials, design constraints to apps).
- 6. <u>Quality reliability related skills.</u>
- 7. Security related skills.
- 8. <u>Hardware / software integration, although less brought to the fore in 2023.</u>
- <u>Knowledge of new materials</u>. Especially important for process engineers and material engineers, although this field of skills has been less brought to the fore in 2023 by the stakeholders interrogated.

## 2023: Minimum educational level from which the skill is required

1	Knowledge of systems architectures		20 %	0					80	%	
2	Machine learning / Artificial Intelligence	e	20 %						80	%	
3	Knowledge of new materials		23 %					69 9	% 8	%	
4	Analog design		31	%					69	%	
5	Data analysis	7 %	2	7 %					67	%	
6	Quality / reliability	6 %			44 %	l.		38 %	13	%	
7	Security				50 %				50	%	
8	Software digital skills				50 %				50	%	
9	Knowledge of applications	6 %			47 %	6		35 %	12	%	
10	Hardware / Software integration					67 %			33	%	
		0 %	25	%	50	%	75	%		100	%
		E	QF 4-5		EQF 6 / Ba	chelor	EQF	7 / Maste	r		

Some strong skills in specific fields can only be found in senior profiles with many years of experience:

- Advanced systems architecture design
- Strong analog design skills
- Expertise in specific applications fields (knowledge of applications)





## Key evolutions in 2023

- In 2023 have you observed new skills emerging in microelectronics? (31 answers)
- ➢ 52% Yes
  - 1. <u>Verification</u>. Different from the test, verification plays an increasingly important role so that the classical ratio of "one verification person for one designer" in the past is moving to a 2 or even 3 to one ratio. A number of mid-sized companies are growing in design verification. As for design, the shortage of verification skills is especially important for digital mixed signal and analog mixed signal verification.
  - 2. <u>Design for Manufacturability (DFM)</u>. With the increasing complexity of microelectronic designs, considering manufacturing processes and constraints early in the design phase is crucial. Professionals with knowledge of DFM principles, yield optimization techniques, and an experience in working closely with fabrication and manufacturing teams are valuable for roles such as design engineer or process engineer.
  - 3. <u>Knowledge of the semiconductor value-chain</u>. As the semiconductor industry is increasingly complicated, it becomes increasingly difficult to know how to build the supply chain for a new product and to know how to mitigate risks when new technology is being ramped up.



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## Most critical soft skills on the European job market

- Overall considered as almost 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, agile thinking, business thinking for R&D.

Confirmed by the yearly monitoring report 2022 & 2023



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## Key evolutions from 2020 to 2023





### Exponential rise of investments in manufacturing capacities

- Higher recruitment needs => Higher talent/skills shortage, especially seniors
- Focus on production capacities: process engineers, maintenance technicians, process technicians...
- Semiconductor shortage
  - Design for resilience / Design for availability / Design for Manufacturability
  - More skills needed to handle supply-chain management / logistics
  - Delay in recruitment processes. Leads to delay in business plans progresses and therefore in hires.
- Still 67% of stakeholders experiencing no impact of the EU Chips Act on skills needs in 2023

 $\circ$  Too early

Strong and raising shortage of skills linked to the topic: Edge IoT / Edge Al



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# We have integrated 4 new profiles linked to microelectronics in the ESCO platform

- 1. Microelectronics designer => Focus on developing and designing systems, from the top packaging level down to the integrated circuit level. System-level understanding with analogue and digital circuit knowledge, integrating the technology processes. Overall outlook in microelectronic sensor basics
- 2. Microelectronics smart manufacturing engineer => Microelectronics smart manufacturing engineers design, plan and supervise the manufacturing and assembly of electronic devices and products, such as integrated circuits, automotive electronics or smartphones, in an Industry 4.0 compliant environment.
- **3. Microelectronics materials engineer** => Design, develop and supervise the production of materials that are required for microelectronics and microelectromechanical systems (MEMS), and can apply them in these devices, appliances and products.
- 4. Microelectronics maintenance technician => In charge of preventive and corrective maintenance in semiconductor manufacturing

### Up to 25 additional job profiles identified that could be added in the ESCO platform...



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## Summary - Policy recommendations from 2020 to 2023

- 1. Lifelong learning & increasing the involvement of the microelectronics industry in the education process
- 2. Communication campaigns to improve the image of the sector
- 3. Develop clusters and networks favoring dialog between industry and education representatives
- 4. Favor intra and extra-EU mobility
- 5. Build an EU chip Academy
- 6. Develop joint degrees in microelectronics
- NEW 7. Raise the public funding of universities and VET providers, in order to adapt to the raising industry needs
- NEW 8. Adjust European wages to attract the workforce





# 1) Lifelong learning & involving the microelectronics industry in the education process

### Pushed as the priority since 2020

### Actions:

- 1. Develop internships, apprenticeships, PhDs and graduate training programs co-organized (and co-funded?) by Universities and industrials.
- 2. Teach microelectronics-related topics at early stage of the education system (before EQF 4).
- 3. Generalize the use of experts from the industry as teachers at the University.
- 4. Generalize the organisation of regular presentations of companies at Universities.
- 5. 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.





# 2) Improve the image of microelectronics through communications campaigns

### More brought to the fore in 2023

Goal: Rise the level of interest in microelectronics and attract talents by changing its image.

### Actions:

- Expose the critical aspects in society microelectronics contribute
- Enhance the diversity in the workforce directly to high school students
- Promote and induce top quality students in the critical field of STEM
- Use more communication channels to raise young people in STEM educations for technical jobs, electrical engineering and microelectronics.

### Many stakeholders have another approach:

- Focus on strengthening the microelectronics industry and manufacturing on the European soil.
- A stronger industry will naturally attract more talents without the necessity of costly communication campaigns.







### Goals:

Facilitate the recruitment processes and benefit from synergies with education and research.

### Actions:

Organisation of forums of discussions between the microelectronics industry and Universities & VET representatives to identify synergies and actions at the European level:

- Setting up dedicated groups defining and updating roadmap of skillset needed.
- Mapping training and course from European education provider.
- Open more starting positions for students to secure supply of new professionals in existing clusters

**Microelectronics pact for Skills** 

**Observatory and Skills Council** 



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## 4) Favor intra and extra-EU mobility

Highly pushed since 2022

Shortage of profiles & senior profiles. This is becoming a priority on the short run since 2020 for companies that needs to hire foreign employees

Enhance the uniformization of degrees and curriculum across the EU

- EQF/NQFs
- ESCO: Proposition of new profiles
- Increase the pre-professional international accreditation of the engineering degree and the Professional Development Programs international independent accreditation (ENAEE is strongly focused in this area)

Pre- and post- arrival services for migrant workers

- Bridging training courses, language training
- Logistics support
- Networking support

### Ease administrative procedures & legal framework

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

Lower limits of teleworking from abroad





## 5) Build an EU Chip Academy

Highly pushed in 2022 less brought to the fore in 2023

### Need for an EU online training platform

- Flexible, modular training offers
- Regrouping existing trainings across the EU in a single online platform
- Including microdegrees (upskilling)
- Easing upskilling trainings access to SME

### Postgraduate unified EU offers

- EU collaboration RTO Universities Industry on postgraduates offers.
- Offer summarized in a single online platform.

### Including a skills monitoring and forecasting system

• Monitoring skills and job profiles needs and shortage at the EU level





## 6) Develop Joint degrees in microelectronics

### **Constantly pushed since 2020**

FIELD OF STUDY		PROPOSAL OF JOINT DEGREE							
		2	3	4	5	6			
Microelectronics / Electro engineering / Mechanics / Mechatronics	V	V	V	V	V	V			
Data science / Software / Informatics / Data engineering / Data analysis									
Artificial Intelligence / Machine Learning		V							
Program management / Supply chain management			V						
Marketing / Sales / Communication				V					
Chemistry / Material science (Polymer etc.)					V				
Biology / natural science						V			



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# 7) Raise the public funding of universities and VET providers, to adapt to the raising industry needs.

Raise the public funding of universities and VET providers, in order to adapt to the raising industry needs.

- Several universities, in France, in Germany, etc. indicate that they see the number of microelectronics students stagnating or even declining in the current context.
- Given the already long duration to train new talents to cope with the current shortage (3-10 years), the stagnation or even the decline of new students in several universities could make the shortage last for more than a decade in Europe...
- It seems urgent to ensure a significant rise of the capacities to train new microelectronics students in European universities as soon as possible.







- European wages are below the US average.
- Similarly, European semiconductor wages are often below the wages offered by other industries for similar profiles such as data scientists...
- European semiconductor wages should be adjusted to attract worldwide talents.



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## **DECISION Etudes & Conseil**

First figures on the microelectronics workforce in the EU

Value chain	Workforce in the EU27 in 2022	%
Semiconductors	161 000	53%
Materials & tools	118 000	<b>39</b> %
RTOs	27 000	<b>9</b> %
Microelectronics (total)	306 000	100%

Source: DECISION, Eurostat, company annual reports

**11%** growth of employment in the EU27 in 2022 + 30 000 hires in 2022

Considering the entire electronics value chain (passive components, electronic boards, systems)

2 720 000 employees are located in the EU









## The TOP 25 employers in the EU27 in 2023







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### Main semiconductor clusters in the EU



- This map enables to identify the main European clusters in semiconductor.
- Within ECSA, DECISION will assess on a cluster basis the recruitment needs and the training capacities, to quantify gaps.





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## Thank you for your attention!

For more information,

visit <a href="http://www.metis4skills.eu">http://www.metis4skills.eu</a>

or contact Léo Saint-Martin, Associate Consultant, DECISION Etudes & Conseil (saint-martin@decision.eu.)

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