



The global semiconductor talent shortage

**More than 1 million additional
skilled jobs by 2030**

Introduction

Much publicized semiconductor (semi) shortages have affected a number of critical industries and attracted unprecedented attention and investment from both private and public sectors across research and development, manufacturing, talent development, and more. Two such examples are the recently passed Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act and still pending European Chips Act in Europe. In 2021, the global semiconductor industry had revenues of just over \$550 billion,¹ and this is expected to rise by more than 80% to more than a trillion dollars in 2030.² With an estimated more than 2 million direct employees worldwide in 2021,³ Deloitte predicts that more than 1 million additional skilled workers will be needed by 2030, equating to more than 100,000 annually. For context, there are fewer than 100,000 graduate students enrolled in electrical engineering and computer science in the United States annually.⁴

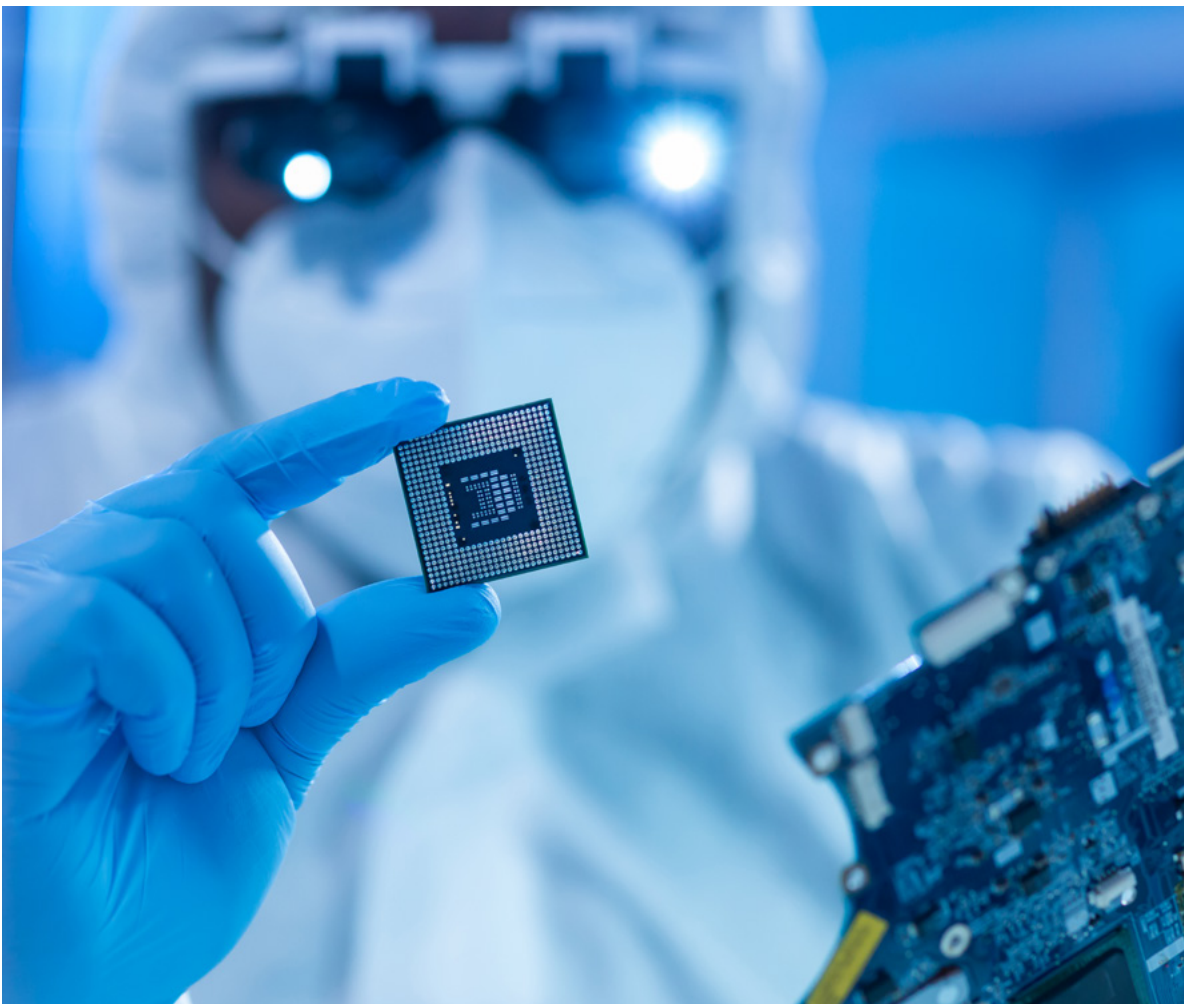
And the competition for semiconductor talent shows signs of getting even tighter. The current global economic environment and ongoing supply chain issues add to the challenges faced by semiconductor companies. However, there are solutions that companies and policymakers can deploy to help, ranging from investment in developing new talent pipelines; better analytics and tools; partnerships with educational and government institutions; an increased focus on diversity, equity, and inclusion (DEI) and environmental, social, and governance (ESG) matters; and a better employee experience overall.



The end of the chip shortage isn't the end of the talent shortage

Yes, demand for some types of chips is down: Semiconductors needed for PCs, smartphones, and crypto-mining are all beginning to decline due to weakness in consumer buying, falling stock markets, and slowing economies. But demand for chips in automotive, factory equipment, and appliances continues to be strong. The forecasts still show expected global 2022 sales of all semiconductors to be up by almost 14%.⁵

More importantly, whether the normally cyclical (this is the sixth cycle since 1990)⁶ chip industry goes up or down by a few points in the next couple years is less important in the face of the longer-term trend of an industry growing by more than 80% by 2030. And there is a corresponding talent boost required to enable, achieve, and support that growth.



Diverse supply chains and labor efficiency

In 2021, the global industry produced about \$275,000 in revenue per worker. But that was possible in part due to the highly clustered nature of chip manufacturing, and the back end, or assembly, testing, and packaging (ATP). About 80% of all chips were made in four countries in East Asia,⁷ and more than 90% of the ATP was in those countries or nearby.

What was a wonderful thing for labor efficiency turned into a nightmare during the recent supply chain crisis, and governments around the world—especially in the United States and Europe—are spending more than \$100 billion to build more manufacturing locally. The United States currently makes about 10% of all chips and aspires to a 30% share by 2030.⁸ The European Union (EU) makes less than 10% and aspires to a 20% share by 2030.⁹ Combined, countries that make about a fifth of all chips today want to make up 50% of the market share by the end of this decade. A less-concentrated chip industry, both in manufacturing

and ATP, will help US and European industries that rely on chips. But labor efficiency will decline as a result, and we will need more people in more locations to make a trillion dollars' worth of chips than in a highly clustered world.

Compounding the problem is the concentration of ATP capabilities. Receiving less press coverage than the fabs that actually manufacture the chips, these back-end capabilities are still a critical and necessary part of the process and about 15% of the global semi workforce.¹⁰ Making more chips in the United States or Europe is a good thing in terms of self-sufficiency ... but if those chips need to be sent to Asia for ATP after manufacture, then sent back for consumption, the supply chains just doubled in length. Of the almost 500 assembly and test facilities worldwide, 65 are in the Americas and only 24 are in Europe, suggesting that if both regions wish to become more fully self-sufficient, they will need to grow the ATP workforce at an even faster rate than the manufacturing workforce.¹¹



The semi talent shortage is already, and will continue to be, global

To reach their goals (in a growing market), the US market share needs to get about five times bigger, and the EU about three times bigger. Meanwhile, the chip industry in Taiwan, China, South Korea, and Japan all continue to expand too. The US chip talent shortage is estimated at 70,000 to 90,000 workers over the next few years.¹² Taiwan's shortage is well over 30,000 as of Q4 2021.¹³ Japan needs 35,000 more semi engineers.¹⁴

South Korea sees another 30,000 over the next decade.¹⁵ China was at a shortage of 300,000 even before the current chip growth and supply chain problems.¹⁶ The European shortfall has not been quantified, but a leading European chipmaker's head of human resources said that "the talent shortage is the biggest challenge to semiconductor industry growth in Europe and globally."¹⁷

"The talent shortage is the biggest challenge to semiconductor industry growth in Europe and globally."

New mix of talent needed

Numerous skills are required to grow the semiconductor ecosystem over the next decade. Globally, we will need tens of thousands of skilled tradespeople to build new plants to increase and localize manufacturing capacity: electricians, pipefitters, welders. Thousands more graduate electrical engineers to design chips and the tools that make the chips. More engineers of various kinds in the fabs themselves, but also operators and technicians ... and if we grow the back end in Europe and the Americas, that equates to even more jobs. Each of these job groups has distinct training and educational needs; however, the number of students in semiconductor-focused programs, for example undergraduates in semiconductor design

and fabrication, has dwindled.¹⁸ Skills are also evolving within these job groups, in part due to automation and increased digitization. A decade ago, a fab needed hardware-oriented skills such as electron microscopy; today they need software experts in programming languages like Python. Digital skills, such as cloud, AI, and analytics, are needed in design and manufacturing more than ever. The chip industry has long partnered with universities and engineering schools. Going forward they need to also work more with local tech schools, vocational schools, community colleges, and other organizations such as the National Science Foundation in the United States.

What can be done?

At a high level, Deloitte believes that the industry needs to do three things:

Unleash the workforce

Organizations should identify, access, and develop (build/buy/borrow) those future skills across the engineering and manufacturing workforce to drive superior performance and value.

Semi companies are not just competing for tech talent against other semi companies. The tech talent shortage spans across the technology, media, and telecommunications (TMT) industry and beyond. Additionally, domestic chip companies are looking for skills in engineering and manufacturing that, for the past 30 years, have been moving predominantly overseas.

Companies need to evaluate the skills they have in relation to their future-state needs and look at innovative means to build and develop their talent pipeline through partnering with educational, industry, and public institutions; leverage skills adjacencies to upskill and reskill their existing talent capabilities; be novel and bold in talent acquisition and alternative talent pool development (e.g., looking across industries); and increase focus on DEI talent recruitment, development, and retention. It's increasingly a challenge to attract diverse workers to this sector, and this merits special consideration for their potentially unique needs; examples may include modified shift schedules, commuter benefits, or paid family leave. These recommendations are all easier said than done, and the real challenge lies in finding innovative ways to entice and build local talent pools in new locations or ecosystems to fuel future industry growth.

Rearchitect work

Organizations also need to identify their future-state capabilities and redesign the way humans and technology interact to deliver services, outcomes, and value for their customers and their organizations—for example, digitalization, artificial intelligence/machine learning (AI/ML).

The industry growth and projections, the changing landscape of required skills through innovation (e.g., digitalization, automation, and AI), increased nationalization of manufacturing, new business models (e.g., solutions, subscription-based revenue models), and increased government initiatives mean that organizations need to be taking a much more in-depth view of their capabilities to meet their organization's long-term needs.

Adapt the workplace

Additionally, organizations should prepare their teams to successfully navigate transformative changes in new or greenfield locations and adopt new technologies, roles, and ways of working. They also need to optimize the environment that maximizes the potential of workers and creates an attractive workplace for employees.

Semiconductor companies are competing with other, more widely recognized TMT brands that have prioritized an appealing workplace culture and effectively marketed their organization as a place people want to work. Additionally, semiconductor companies are lagging other TMT subsectors in their overall focus on DEI. For example, globally, by the end of 2022, large technology companies are expected to have 25% of both technical roles and leadership roles filled by women—with the percentage in leadership roles up by 20% since 2019.¹⁹ Meanwhile, a majority of semiconductor companies surveyed said women in leadership roles (director or above) was less than 1%.²⁰ And while clean water is critical for chip manufacturing, sustainability in the industry is of increasing importance to the potential talent pool. Minimizing the environmental footprint in both clean water usage and energy consumption will also improve overall marketability for recruitment.²¹

Companies need to focus on current and future ways of working, including hybrid working models where possible; adjust rewards and flexibility to accommodate new candidate and employee preferences and expectations; enable increased DEI and sustainability to both retain and attract talent; and better integrate recruitment and marketing to increase brand recognition and attractiveness in recruiting.



The bottom line

The future of work in semi looks different than organizations might have anticipated just two to three years ago, and the volume of talent as well as the skills and capabilities they need to support both near- and long-term objectives and market demand have changed. Organizations need to take the time to understand what the recent supply chain crisis means for their overall organizational design and talent needs.

The ability to identify, recruit, and develop the necessary workforce cannot rely on how companies have operated historically. They need to build new talent pools in new locations, leveraging educational and community partnerships as never before. The speed at which growth is expected as well as the changing skills and capabilities required demand new ways of defining and implementing innovative talent access strategies. Organizations also need to understand the gap between their current capabilities and future requirements to define the talent access strategies that will meet their long-term needs.

The ability to identify, recruit, and develop the necessary workforce cannot rely on how companies have operated historically.

Endnotes

1. Semiconductor Industry Association (SIA), "[Global semiconductor sales, units shipped reach all-time highs in 2021 as industry ramps up production amid shortage](#)," press release, February 14, 2022.
2. Michael Hall, "[ISS 2022: Semiconductor industry market outlook and prospects for reaching \\$1 trillion by 2030](#)," SEMI, May 9, 2022.
3. Deloitte used both top-down (most current reported direct employment by country/region) and bottom-up (number of employees reported by all the large companies) approaches to estimate the 2021 global semiconductor industry direct employment.
4. SIA, "[Electrical engineering and computer science graduate enrollment in U.S. decreases](#)," May 6, 2020.
5. World Semiconductor Trade Statistics (WSTS), "[The World Semiconductor Trade Statistics \(WSTS\) has released its new semiconductor market forecast generated in August 2022](#)," press release, August 22, 2022.
6. See figure 1 in [Five fixes for the semiconductor chip shortage](#) report from Deloitte Insights.
7. See figure 6 in [Five fixes for the semiconductor chip shortage](#) report.
8. Adam Clark and Adam Satariano, "[Intel to invest at least \\$19 billion for new chips plant in Germany](#)," *New York Times*, March 15, 2022.
9. Paul Lauducina, "[Semiconductors: How the U.S. can make up for lost time](#)," *Forbes*, January 29, 2022.
10. Deloitte estimate.
11. SEMI, "[Worldwide semiconductor assembly and test facility database now tracks integrated device manufacturers, 475 facilities](#)," press release, February 23, 2022.
12. *VentureBeat*, "[Report: Critical talent shortage for over 70,000 semiconductor manufacturing jobs](#)," December 9, 2021.
13. Cheng Ting-Fang and Lauly Li, "[Chip talent war: Taiwan faces critical staffing shortage](#)," *Nikkei Asia*, February 18, 2022.
14. *Time*.News, "[Skills shortage threatens Japan's semiconductor industry](#)," June 29, 2022.
15. Man-su Choe, Ji-Eun Jeong, and Ye-Rin Choi, "[Why Korean chipmakers struggle with talent shortages](#)," *Korean Economic Daily*, June 10, 2022.
16. Tracy Qu, "[China's semiconductor talent shortage poses biggest obstacle to Beijing's chip self-sufficiency ambitions. SMIC founder says](#)," *South China Morning Post*, November 18, 2021.
17. Serena Brischetto, "[Pact for skills: X-FAB on opportunities for Europe's semiconductor industry growth](#)," SEMI, May 25, 2022.
18. Stephanie Yang, "[Chip Makers Contend for Talent as Industry Faces Labor Shortage](#)," *Wall Street Journal*, January 2, 2022.
19. Ibid.
20. GSA, [GSA: Women in the semiconductor industry](#), 2020.
21. Deloitte, [2022 semiconductor industry outlook](#), 2022.

About the authors



Karen Weisz
Managing Director

United States

Karen is a leader in Deloitte's Workforce Transformation practice, focusing on the specific needs of technology and semiconductor companies in reimagining talent development and management strategies.

kweisz@deloitte.com



Duncan Stewart
Director of TMT research for Deloitte Canada

Canada

Duncan is the director of TMT research for Deloitte Canada and is a globally recognized expert on the forecasting of consumer and enterprise technology, media, and telecommunications trends.

dunstewart@deloitte.ca



Christie Simons
Partner

United States

Christie leads Deloitte's global semiconductor subsector and is the US TMT Industry Audit & Assurance leader. Serving global technology clients for more than 30 years, she specializes in external audit, IPO, M&A and SOX services as well as leading teams providing consulting, tax and advisory services.

csimons@deloitte.com



Teresa Lewis
Manager

United States

Teresa is a manager in Deloitte's Organization Transformation practice and is the North American Human Capital semiconductor subsector lead.

terlewis@deloitte.com



Brandon Kulik
Principal

United States

Brandon leads Deloitte's semiconductor subsector as a principal, focusing on foundry, fabless, equipment, IDM, and EDA clients.

bkulik@deloitte.com





About the Deloitte Center for Financial Services

The Deloitte Center for Financial Services, which supports the organization's US Financial Services practice, provides insight and research to assist senior-level decision-makers within banks, capital markets firms, investment managers, insurance carriers, and real estate organizations. The center is staffed by a group of professionals with a wide array of in-depth industry experiences, as well as cutting-edge research and analytical skills. Through our research, roundtables, and other forms of engagement, we seek to be a trusted source for relevant, timely, and reliable insights. Read recent publications and learn more about the center on deloitte.com.

About this publication

This publication contains general information only and Deloitte is not, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your business. Before making any decision or taking any action that may affect your business, you should consult a qualified professional adviser.

Deloitte shall not be responsible for any loss sustained by any person who relies on this publication.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States, and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see www.deloitte.com/about to learn more about our global network of member firms.

Copyright © 2022 Deloitte Development LLC. All rights reserved.

Member of Deloitte Touche Tohmatsu Limited