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How the U.S. Can Reshore the Semiconductor Industry

Key points

- With the right approach to talent, the U.S. can achieve a dramatic reshoring of chip manufacturing
- The U.S. has outsourced chip manufacturing over the last two decades, slowly eroding the talent pool and expertise needed
- Tens of thousands of new semiconductor jobs can be created for the U.S. to meet capacity needs for critical applications
- Government funding is available for U.S. states eager to solve this problem; large manufacturers are looking for states that provide the best incentives and infrastructure
- Finding talent to capitalize on this opportunity remains the most critical issue
- Skills are fluid in the semiconductor industry, with some rising and some declining
- Adjacent skills can enable hiring for potential, thereby expanding the pool of people who can fill U.S. semiconductor job needs

How the U.S. Can Reshore the Semiconductor Industry

Through the upskilling and reskilling of talent, and a focus on adjacent skills, the U.S. can achieve a dramatic reshoring of the chip manufacturing sector.

As the nation has outsourced chip manufacturing over the last two decades, the talent pool and necessary expertise has eroded.

But government funding is available to address this challenge, and states are competing for the chance to attract semiconductor business. Large manufacturers are looking for states that provide the best incentives and infrastructure.

What follows is an examination of this challenge and opportunity to reshore the chip-making sector, why it exists, and how it can be solved. This report was produced using data from Eightfold AI's Talent Intelligence Platform, a deep-learning platform powered by the largest global talent dataset. More information can also be found in the supporting slides: "Reshoring Semiconductor Manufacturing."

Essential components and a growing industry

Semiconductors are essential components for many critical and growing industries. The share of semiconductors is 32 percent in the PC/computer industry, which includes tables, laptops, and computers. In the communications industry, which includes phones, switches/routers, cable, and optical network infrastructure, the semiconductor market share is 31 percent.

These industries will continue to grow rapidly over the next five years.

Given the strategic importance of semiconductors, much has been said about the need to reduce dependency on extended supply chains and onshore semiconductor manufacturing. Indeed, a disruption in the availability of these services threatens the global economy and national security. Pending legislation would provide funding to aid in developing new chip fabrication facilities in the U.S. to supply critical applications. However, an Eightfold analysis reveals a critical issue that must be addressed: a substantial skills shortage to fill the positions those plants would require.

The U.S. share of semiconductor manufacturing

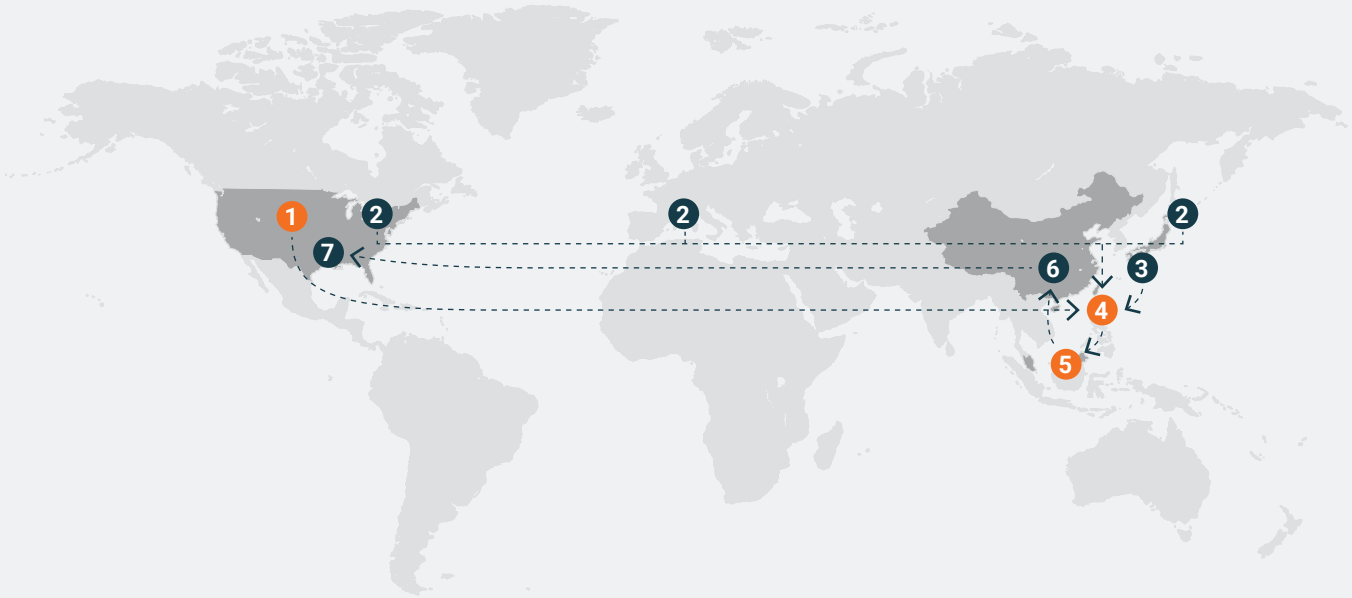
The current supply chain for semiconductors is spread around the globe. A chip could be designed in the U.S., based on customer requirements. Equipment may be manufactured in the U.S., Europe, or Japan. Silicon may be processed and sliced into wafers in Japan. In Taiwan, manufacturers imprint the wafers with patterns.

The wafers could be sliced and packaged into chips in Malaysia. Then, the chips could be sent to assembly facilities in China. The end product could then be sent back to the U.S. for sale.

Southeast Asia has about 75 percent of the current global wafer fabrication capacity; Taiwan, Korea, China, and Japan together have more than 70 percent of the market. The U.S. share has been decreasing, now at just 12 percent of the global capacity, versus its 37 per share in 1990.

The current supply chain of semiconductor-based products is federated, which makes it fragile

Critical stages



1

Design

A firm in the US designs the chip based on customer requirements

2

Equipment Manufacturing

Developed primarily by companies across the US, Europe and Japan

3

Basic Material

Silicon is re-crystallized to form ingots which is then sliced into wafers by manufacturers in Japan

4

Front-End Fabrication

Manufacturers in Taiwan imprint the wafers with patterns per the designs

5

Assembly, Testing and Packaging

Wafers are sliced and packaged into individual chips by firms in Malaysia

6

End-User Product Assembly

The packaged chips are sent to electronic equipment makers' assembly facility in China

7

Commercial-ization

End product is sold in the US market

Source: BCG x SIA Strengthening the Global Semiconductor Value Chain, 2021

The need for a multi-pronged approach

To meet the capacity needs for only the critical semiconductor applications, the U.S. needs to add about 5.5 percent of the global production. This would mean about 18 to 20 fabs, and about 70-90,000 total fabs jobs. Rising to meet this opportunity would require the U.S. to increase its current workforce by about 50 percent.

If the U.S. were to not just handle critical needs but become self-sufficient, almost 20 percent of the global production would need to be added. That would mean 74-80 fabs required and 300,000 total fabs jobs.

The U.S. should first work to meet critical needs, with self-sufficiency later. It should undertake a multi-pronged approach, including:

- Policy interventions such as land subsidies to incent manufacturers and speed up the development and operationalization of fab plants
- Fabrication plants designed and built with the future in mind, not only to become self-reliant and sufficient but also to reinvent those plants
- Talent investments to run the newly built plants

How skills needs are changing

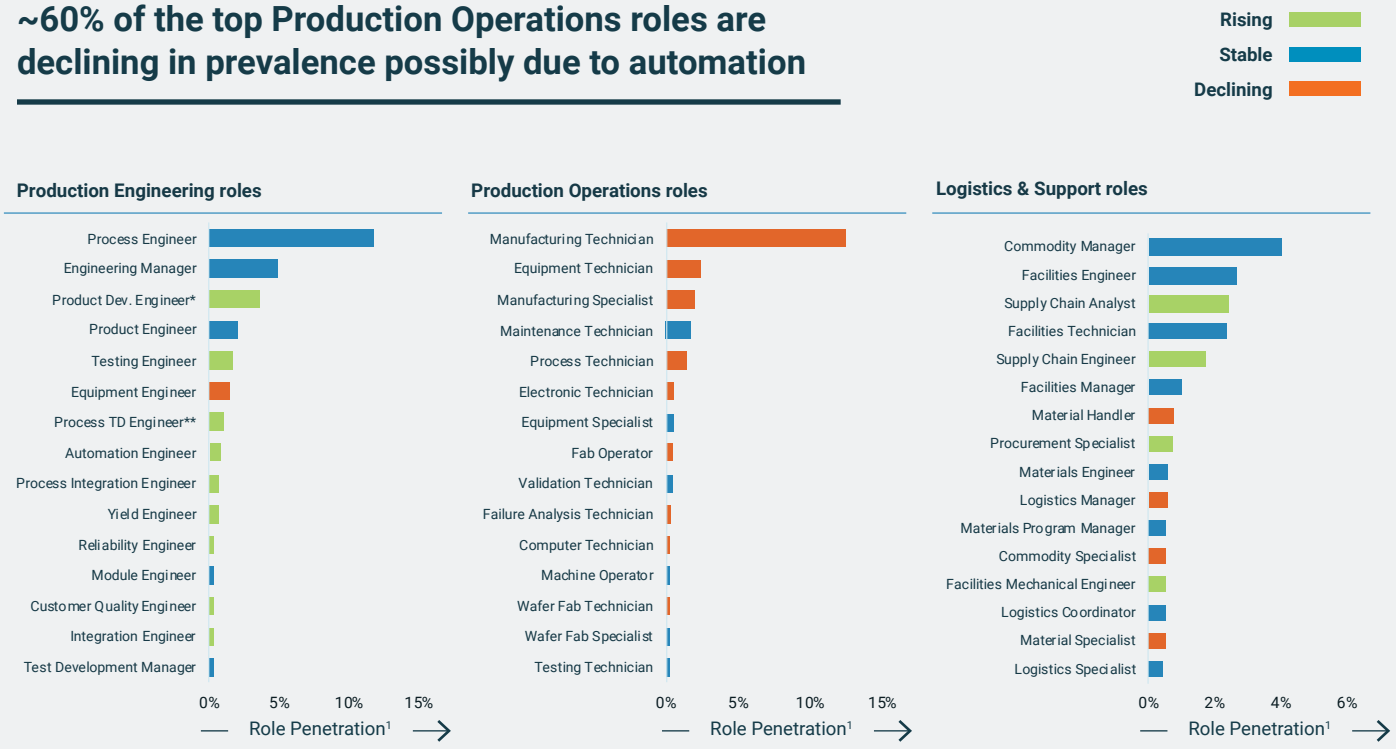
Three major talent groups are needed to run a fabrication plant:

- **Production engineering,** which designs, runs, tests, and upgrades systems and processes. Key roles include Process Engineers, Integration Engineers, Yield Engineers, and Quality Engineers.
- **Logistics and support,** which procures material, maintains facilities, and supports corporate services. Key roles include Procurement Specialist, Category Supply Manager, and Logistics Specialist.
- **Production operations,** which runs, monitors, and troubleshoots production equipment. Key roles include Manufacturing Technician, Equipment Technician, and Manufacturing Supervisor.

Innovative disruptors are increasing the need for new skills and capabilities. The majority of the Production Engineering roles are gaining in prevalence.

Meanwhile, about 60 percent of the top Production Operations roles are declining, likely due to automation. Declining roles include technician roles, such as manufacturing, equipment, and electronic technicians.

~60% of the top Production Operations roles are declining in prevalence possibly due to automation



Source: Eightfold Talent Intelligence Platform
*Product Development Engineer
**Process Technology Development Engineer

1 Role penetration is calculated by dividing the number of employees in a given role (e.g., Process Engineer) by the number of employees in the talent group (e.g., Production Engineering)

Similarly, most of the Production Operations *skills* (not just roles) are declining in prevalence. Troubleshooting skills are decreasing sharply in prevalence. Failure analysis, Statistical Process Control, Lean Manufacturing, Metrology, and Six Sigma are some of the other declining skills.

Even the skill mix of some of the rising and stable roles is changing. Reliability Engineers, for example, are not declining in relevance. But the skills that comprise that role are changing. In 2010, skills such as Scanning Electron Microscopy and ANSYS were among the rising skills not at the top of the relevance list a decade later. In 2020, Python is among the rising skills not as high on the 2010 list.

How to address talent needs

We see two main solutions to overcoming the talent challenges: **1)** Upskilling and reskilling the current workforce, and **2)** Hiring for potential.

Upskilling/reskilling helps bridge the gap between declining and rising skills. Within each set of roles (e.g. Production Engineering), this process begins by identifying declining skills and rising skills. From there, adjacent skills are identified and then used to upskill people with the declining skills and arm them with rising skills.

Consider individuals, for example, with Production Operations roles, who have Lean Manufacturing skills. Such skills are adjacent to Continuous Improvement, which is a strong rising skill in Production Operations. These individuals could be upskilled/reskilled.

Source: Eightfold Talent Intelligence Platform

Upskilling also helps link the **career paths** of declining and rising roles. This begins with identifying the alternative career paths that declining roles can transition into by evaluating the extent of skills adjacencies. Then, we can transition the workforce from these roles into alternate career paths.

Take, for example, Manufacturing Technicians, which is a declining role. These technicians could transition into Reliability Engineer roles, as there is a high degree of skills overlap. Some skills, such as Six Sigma, are prevalent in both the Manufacturing Technician and Reliability Engineer roles. Other skills are related, such as Lean Manufacturing, a skill common in the declining Manufacturing Technician role, and Continuous Improvement, a skill common in the rising Reliability Engineer role.

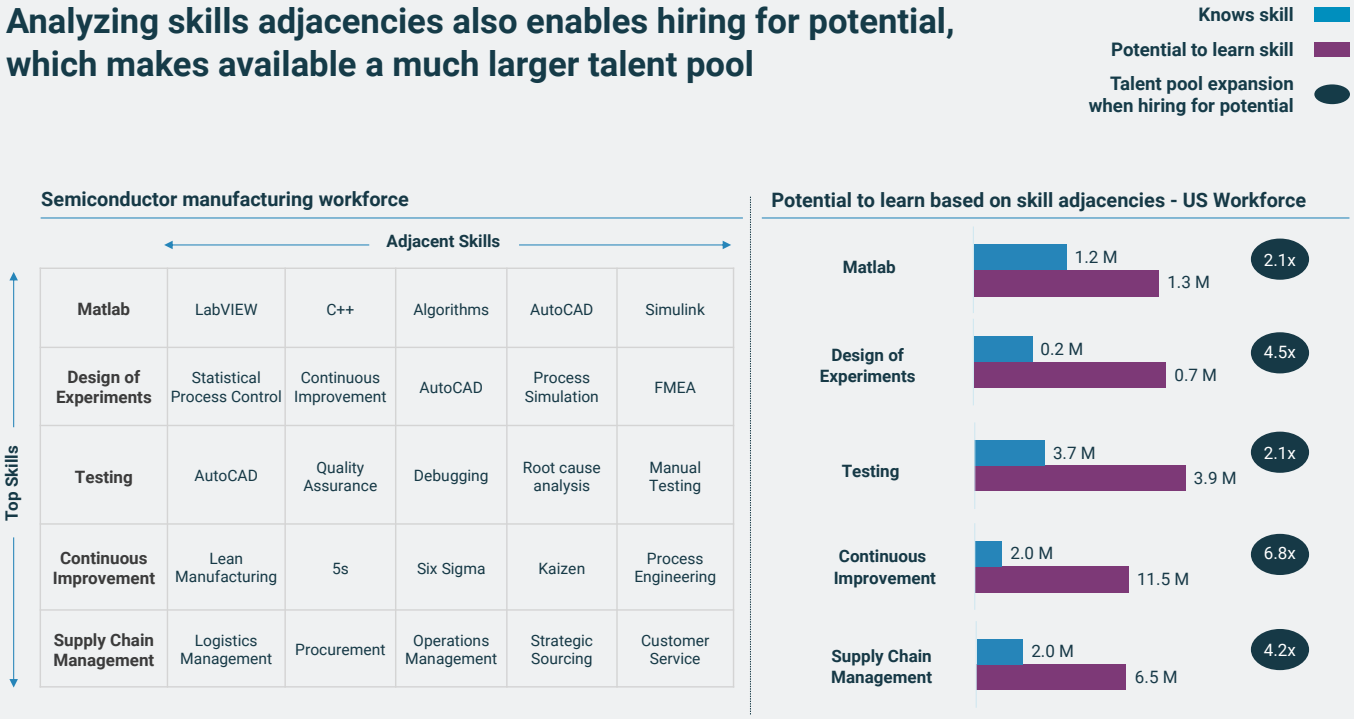
Source: Eightfold Talent Intelligence Platform

1 Reliability centered Maintenance
2 Statistical Process Control

By examining adjacent skills, and seeing how people can be upskilled and reskilled into new but similar roles, we can enable hiring for potential. This results in a much larger talent pool.

There may, for example, be only two million individuals with supply chain management skills, but 6.5 million with the potential to learn such skills. Only 1.2 million may have Matlab skills, but another 1.3 million have the potential to learn the skills.

Analyzing skills adjacencies also enables hiring for potential, which makes available a much larger talent pool



Source: Eightfold Talent Intelligence Platform

A realistic approach

America's semiconductor industry skills shortage may seem insurmountable at first glance. It is not.

We can support policy changes, such as tax credits and other investments, that will help reshore the semiconductor industry, encapsulated in the CHIPS for America Act. But we must not ignore the talent needed to make those investments come to fruition. By considering adjacent skills, we can upskill and reskill individuals with the potential to move from declining roles to rising roles. This can dramatically increase the pool of potential semiconductor talent.

Learn more about how this talent infusion and transformation can be accomplished by reaching out to the team of experts at Eightfold AI.

About the study

More information can be found in the slides “Reshoring Semiconductor Manufacturing.” All major semiconductor manufacturing firms operating in the U.S. were considered in this analysis of the workforce, including but not limited to Intel, Micron Technology, Samsung, Texas Instruments, Global Foundries, and ON Semiconductor.

Key terms in this paper and the “Reshoring” slides are defined as follows:

Role penetration: Percent of employees in a role (out of the total number of employees in a group/cohort)

Skill penetration: Percent of employees with a given skill (out of the total number of employees in a group/cohort)

Relative skill penetration: Skill penetration within a given company minus skill penetration in a market

Skill prevalence (rising/declining/stable): The increase/decrease of individuals with those skills in the workforce: Number of profiles with a given skill / number of profiles with a given skill in the prior year

Prevalence index (Role): Role prevalence relative to the highest point on the chart. A value of 100 represents peak use of role

Adjacent skills: Frequently co-occurring skills within profiles in the global workforce

Adjacent roles: Roles that have high direct and related skill overlap. The higher the overlap of direct and related skills, the higher the adjacency score

About Eightfold AI

Eightfold AI® delivers the Talent Intelligence Platform™, the most effective way for organizations to retain top performers, upskill and reskill the workforce, recruit top talent efficiently, and reach diversity goals. Eightfold AI's deep learning artificial intelligence platform has been issued numerous patents based on its ability to empower enterprises to transform their talent into a competitive advantage. For more information, visit www.eightfold.ai.

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The Eightfold Talent Intelligence Platform™ is a purpose-built, deep-learning artificial intelligence technology that is powered by an ever-refreshing global data set of billions of talent data points and over 1.4M unique skills.

For more information, visit **www.eightfold.ai**