In the AI era, meeting the expectations of systems companies requires more than capacity and process technology leadership. It calls for the breadth, depth, and flexibility only offered by a systems foundry.

Systems Foundries Meet Growing Global AI Demands

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Introduction

Merchant foundry manufacturing is one of the fastest-growing sectors in the semiconductor industry. Its growth is driven by fabless semiconductor companies that design and develop their own products and outsource device production to contract manufacturers; the expansion of demand markets such as mobile, cloud, and AI; and the insatiable requirements for advanced technology. The merchant foundry sector grew over 2.6 times faster than the semiconductor industry from 2020 to 2023, according to IDC.

The merchant foundry business model is one in which a manufacturer produces chips for customers but does not design or produce its own chips. For the past 25 years, its growth has been driven by both the outsourcing of process technology design and the scale of fabless companies. Fabless companies accounted for 78% of revenue reported by merchant foundries, according to IDC. The concentration of fabless companies has always been high. In 2000, they accounted for 85% of all foundry revenue. Clearly, foundries and fabless companies go together in terms of sustainable growth and opportunity in the semiconductor industry.

Integrated device manufacturers (IDMs) — meaning integrated semiconductor manufacturers that own and operate their own fabs and design products — have also played a key role. IDMs enable merchant foundries to leverage a growing supply chain ecosystem, reduce costs in process technology development, and focus on design, software, and differentiating technologies. The cost of building new semiconductor manufacturing fabs continues to increase exponentially as process nodes shrink; equipment, tools, and materials increase in complexity; rare earth materials become harder to source; and design costs grow. Added costs have forced most IDMs to change their business model, making outsourcing to foundries the only long-term alternative.

AT A GLANCE

WHAT'S IMPORTANT

The systems foundry enables a trusted business model that goes beyond traditional wafer and contract manufacturing services by establishing a comprehensive suite of wafers, packaging, IP, chiplets, and software/firmware to enable next-level integration and bring together a full-stack solution for fabless companies, systems vendors, and large cloud service providers at scale.

KEY TAKEAWAY

To succeed in the future, IDC believes foundry buyers will need to seek a systems foundry with a balanced supply chain that incorporates leading process technology and scale. It should also provide other critical systems, software, and advanced packaging requirements of customers vying for opportunities in the AI era.

Governments across every major region — in collaboration with semiconductor suppliers — understand they can no longer be idle when it comes to supply chain disruptions. In today's interconnected demand and supply chains, access to technology is highly correlated to economic prosperity, labor growth, national security, and the long-term competitive position of nations.

Defining the Systems Foundry

The leading manufacturing service suppliers have evolved from offering a unique outsourcing business model to establishing a complex ecosystem of intellectual property (IP) access and optimization, design know-how, prototyping, advanced packaging, and go-to-market services for small- and large-scale systems customers. Customer engagements are more interconnected. Collaboration and risk sharing are more essential given the growing cost of designing and producing chips at the scale required by fabless companies. The successful partnership with this set of customers and merchant foundries has helped revenue increase 15 times over for the foundry manufacturing service market since 1998.

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The foundry industry will continue to grow at the same pace by attracting large investments from the public sector to secure the supply chain (U.S. CHIPS Act, EU Chips Act, and similar legislation in Korea, Japan, and China). The arrival of new entrants in the foundry industry will also drive long-term revenue growth and strategically align toward regional technology sovereignty.

The foundry market's table stakes are well established and include access to a large set of IP; advanced tools, materials, and design; a broad set of process technologies; and flexibility on capacity needs. These table stakes have given existing suppliers a large market advantage over the past decade. However, both the COVID-19 pandemic and supply shocks over the past four years have forced customers to change the requirements once again. Supply chain risk is now one of the most critical pain points moving forward.

Considerations When Selecting a Foundry Partner

Fabless companies, systems vendors, and cloud service providers should be selective in choosing a strategic foundry partner. Organizations should seek one with the following key attributes:

- » An ecosystem and funding initiatives that accelerate collaboration

- » Access to system- and silicon-level IP, developer/engineering teams, and fab and packaging facilities for transparency and a higher level of co-development

- » A willingness to explore different business models and work with suppliers on capacity and technology investment

- » Leadership in process technology and a strong road map for customers to design multiple generations of product

» Possession of fabs and advanced packaging facilities in multiple regional locations to mitigate supply chain risk in today's geopolitical environment

» Investment in other essential supply chain areas including PDKs, EDA tools, design, semiconductor equipment, materials, employee training/incentives, and local communities to commit to employees and meet regulatory/ESG requirements

» Systems level and silicon expertise to support the next-generation design requirements of large strategic customers in AI, high-performance computing (HPC), automotive, and network/edge infrastructure as integration moves from monolithic designs to chiplets and system-on-system integration

Systems Foundry Manufacturing Service Market Outlook

By the end of this decade, the total semiconductor foundry revenue will reach $180 billion, increasing at a compound annual growth rate of 10.2% from 2022 to 2030, according to IDC. The merchant foundry business model will continue to enjoy the strong expansion of key industry segments including AI, high-performance computing, 5G, automotive, and autonomous systems.

Looking toward the next decade, the role of computing and AI will propel autonomy, productivity, and personalization to levels we can only imagine today. The organizations that enable these markets to move forward need a systems foundry partner to help them realize the opportunity.

Foundry customers therefore cannot just focus on process technology and capacity leadership. The journey must begin with close collaboration with the organization and the foundry supplier at a technology, software, and systems level to support complexity, drive differentiation, and enable innovation. Foundry services must be flexible to meet customer requirements and challenges. Processes must be optimized to deliver power, performance, and area requirements for each systems market so that organizations can drive sustainability in energy requirements. Advanced packaging will be a critical part of the solution as chiplets become the next step in delivering integration and performance in AI, HPC, and other key growth markets.

Conclusion

Over the years, the foundry business model has taken advantage of favorable geographies as well as deep and broad local markets with extensive back-end industries. The ongoing and aggressive investments in advanced process technologies are not slowing down. IP optimization, software, and equipment tools coupled with close collaboration and partnership with customers will ensure a sustainable growth path for foundry suppliers and the overall semiconductor industry over the next decade.

Investment can neither focus on manufacturing alone nor create a piecemeal solution that stunts other areas of the value chain. The foundry supplier will be a critical piece of the supply chain so using the criteria outlined previously is essential to measuring success and ensuring that customers can continue to scale and serve their core markets.

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For fabless companies, systems vendors, and cloud SPs, the critical dimension to consider in a systems foundry partner is making sure that it is working closely with the organization to establish a resilient supply chain and minimize geopolitical and trade risk as the world continues to move to regional technology sovereignty.

By the end of the decade, fabless suppliers will surpass non-memory IDMs in revenue. The same holds true for R&D spending, which will help these companies have more influence in the value chain — but only if a company selects the right long-term systems foundry partners.

IDC believes to succeed in the future, organizations will need to seek a systems foundry with a balanced supply chain that incorporates leading-edge process technology and scale while providing other critical systems, software, and advanced packaging requirements of customers vying for opportunities in the AI era.

About the Analyst

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Mario Morales is the group vice president of IDC's Enabling Technologies, Semiconductor, and Storage Group. He is responsible for in-depth analysis, evaluation of emerging markets and trends, forecasting, and research of major semiconductor industry segments such as embedded and intelligent systems, wireless, personal computing, networking and cloud infrastructure, automotive electronics, and AI semiconductors.

MESSAGE FROM THE SPONSOR

Intel Foundry is a systems foundry dedicated to transforming the global semiconductor industry by delivering cutting-edge silicon process and packaging technology leadership for the AI era. With a focus on scalability, AI advancement, and shaping the future, we provide an unparalleled blend of an industry-leading technology, a rich IP portfolio, a world-class design ecosystem, and an operationally resilient global manufacturing supply chain.

As stewards of Moore's Law, we persistently innovate and foster collaboration within an extensive partner ecosystem to advance technologies and enable our customers to design leadership products. Our strategic investments in geographically diverse manufacturing capacities bolster the resilience of the semiconductor supply chain, particularly for advanced products. Leveraging our technological prowess, expansive manufacturing scale, and sustainable supply chain, Intel Foundry empowers the world to deliver essential computing, server, mobile, networking, and automotive systems for the AI era. For further information visit www.intel.com/foundry or follow us on LinkedIn @IntelFoundry.

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