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Is the AI chip boom bypassing Singapore?

The Republic's semiconductor industry does not make cutting-edge chips – but that may not necessarily be a cause for worry

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THE global artificial intelligence (AI) boom is spurring some countries to vie for dominance in making leading-edge microchips – but not Singapore.

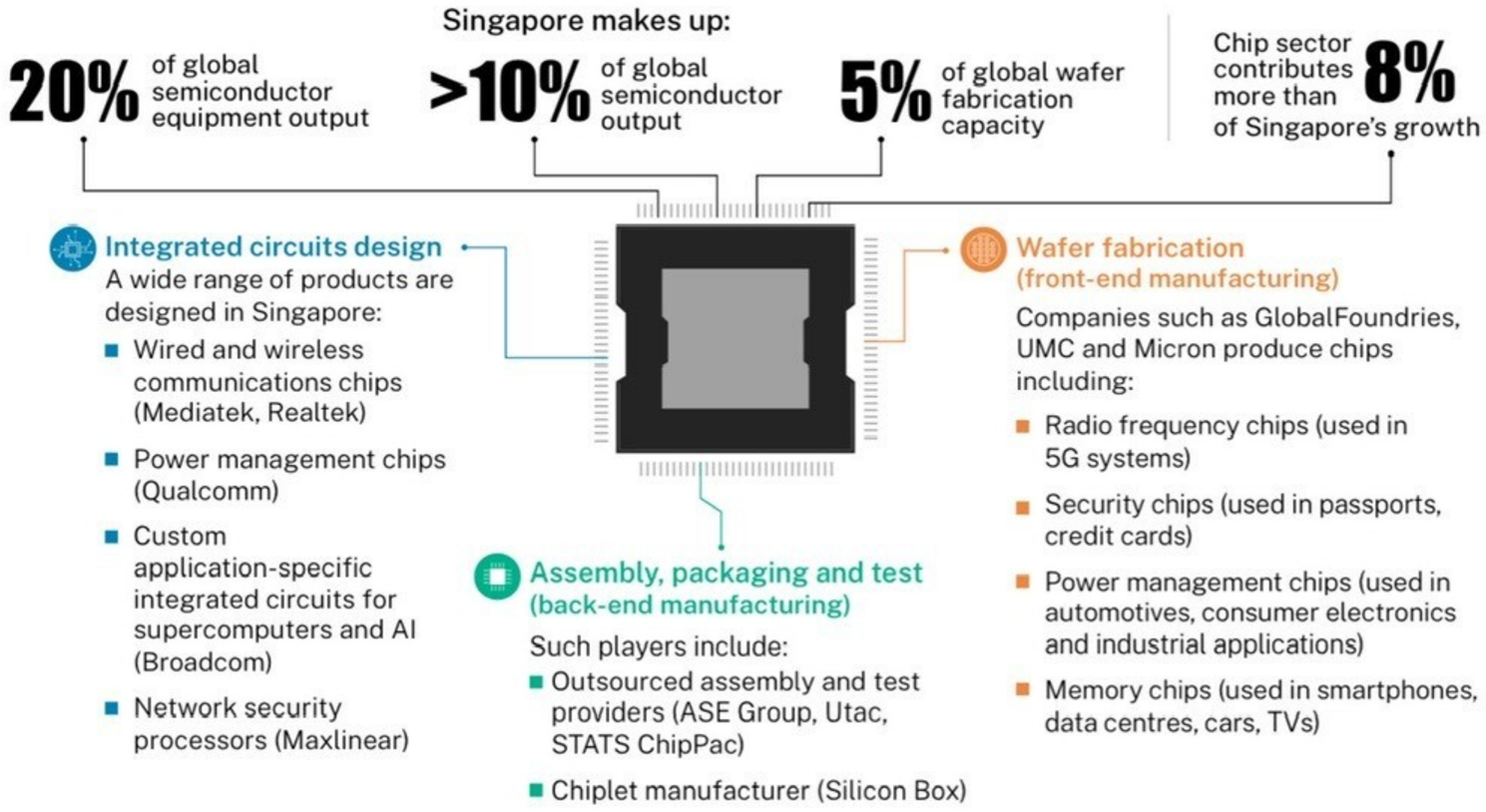
The Republic's focus on "mature-node chips" – used in appliances, cars and industrial equipment – means its semiconductor ecosystem may have limited exposure to the AI boom, said Maybank economist Brian Lee.

Yet industry watchers do not see this as a concern, as the market for mature-node chips is much larger than that for leading-edge ones.

The chips that Singapore makes are for the mass market, said Ang Wee Seng, executive director of the Singapore Semiconductor Industry Association (SSIA).

Singapore's role in the global chip sector

The Republic is a critical global node in semiconductor manufacturing, attracting major players from across the value chain



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No appetite for AI chips

AI chips are made to provide high computing power and responsive speed, said Tilly Zhang, a China technology analyst from Gavekal Research.

In contrast to mature-node chips that use so-called "process node" technology of 28 nanometres (nm) or more, cutting-edge AI chips have process nodes of 7 nm and smaller, and thus require specialised production methods. Current research focuses on developing 2 to 3 nm chips.

"That's something that Singapore will not produce because first and foremost we don't have the EUV (extreme ultraviolet) lithography in our fabs here – none of them have that technology," said Ang, referring to the manufacturing technology for these smaller chips.

Taiwan and South Korea dominate the global AI chip supply as only three companies in the world have the required capability: TSMC, Samsung and Intel.

Cost is a major hurdle. There is only one maker of EUV lithography machines and its products cost US$180 million each, excluding yearly maintenance costs, according to Trendforce.

The high barrier to entry is why most chips optimised for AI are made by Taiwan-headquartered TSMC, which is considered more mature, advanced and reliable than Samsung, said Zhang. She estimates TSMC's market share to be about 90 to 95 per cent.

However, South Korea shines in producing memory chips, including advanced high-bandwidth chips that also require lower process node capabilities and are essential for AI model training.

Singapore, on the other hand, has no advanced chip facilities.

Said Zhang: "If other advanced foundries like TSMC or Samsung consider relocating a part of their capacity to Singapore, it could be possible to establish some domestic advanced chip capacity."

But with intense competition to woo such chipmakers, attracting them would be exorbitant, said watchers.

Maybank's Lee said: "More recently, large developed countries like Japan and the US have been dangling very large subsidies in the tune of billions to attract chip production by heavyweights such as TSMC."

He added: "Singapore cannot compete in this subsidies arms race over the longer term."

Ultimately, companies are the ones making commercial decisions on whether fabs in Singapore should pivot to leading-edge chips, said SSIA's Ang.

Indirect opportunities

In the "very narrow context" of chip manufacturing, Singapore's semiconductor industry may not directly benefit from the AI boom, said Ang.

"But if you look at the ecosystem as a whole, from the design, to the packaging and everything else, I think Singapore plays a bigger role than what we actually expect."

There is also a trickle-down effect of AI demand, he said. AI requires more computing power, more memory space for databases, and faster connectivity speeds for high-volume data transmission.

The chips that make this possible – by powering databases and communication networks – will continue to be mature-node chips, said Lee Bo Han, partner for R&D and incentives advisory at KPMG in Singapore.

> **"Since leading-edge logic chips are hard to manufacture, the technology evolves quickly, and the capital outlays are substantial, it might be worthwhile to focus on other areas of AI-related hardware and software."**
>
> **Frederic Neumann, HSBC's chief Asia economist**

In other words, the market for mature-node chips should have ample opportunities and stable demand in the long run.

"Mature-node (chips are) something that we will have to keep using," he said, citing applications such as factory automation, smart cars, mobile phones and laptops.

HSBC's chief Asia economist Frederic Neumann agreed that AI chips may not be worth pursuing. "Since leading-edge logic chips are hard to manufacture, the technology evolves quickly, and the capital outlays are substantial, it might be worthwhile to focus on other areas of AI-related hardware and software."

He added: "One opportunity lies in further building on Singapore's existing expertise in memory chips, including 3D Nand where it holds a roughly 10 per cent global

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production share." One advantage of mature-node chips is that their wide range of uses means a diversity of clients. Another is that such chips are not affected by the geopolitical tensions surrounding AI-optimised chips.

Said SSIA's Ang: "If you are in the AI leading-edge technology node, I think you'll have to be very clear (that your tech) will not end up in China, (as) there is a lot of concern from countries like the US."

Decades of advantage

Instead of trying to go into leading-edge chips, Singapore can hone its established advantage in traditional chips.

This edge has been in the making since the 1960s and 1970s, with the entry of global semiconductor assembly and test operators, also known as "back-end" players.

Now, front-end multinational corporations such as GlobalFoundries, Micron and STMicroelectronics produce chips that are used in everything from cars to chargers.

As these companies have a strong presence in Singapore, they are more likely to expand their current footprint than build new plants elsewhere, said SSIA's Ang.

New plants must undergo "qualification", or ensuring they meet clients' specifications; expanding an existing plant removes this need and saves time, he noted.

For example, GlobalFoundries took about two years to open the latest expansion of its Fab 7 in Woodlands. In contrast, TSMC's second factory in Arizona was announced in 2022, but may not start production until 2027 or 2028.

Singapore's continued attractiveness can be seen in the new investments that are still being made.

In June, NXP Semiconductors and TSMC-backed Vanguard International Semiconductor Corp announced a US$7.8 billion joint venture for a Singapore plant that will make 40 to 130 nm chips for the automotive, industrial, consumer and mobile market segments.

Losing and winning

Though Singapore retains its front-end advantage, its back-end industry has admittedly shrunk. Many such players have moved to cheaper pastures.

When John Nelson joined assembly and test services provider Utac as group chief executive 12 years ago, the company was already moving some of its more manual and technologically dated operations to Thailand.

But instead of leaving entirely, Utac's Singapore focus has shifted towards research and development. In September 2020, Utac acquired Powertech Technology Singapore to gain its expertise in a process called wafer bumping. Utac then conducted further engineering R&D to integrate Powertech's operations post-acquisition.

Said Nelson: "You can't get comfortable, you have to be looking at new things ... how can we be successful in each of our operations."

Even in the mature-node field, innovation is possible. Local precision manufacturer Jade Micron has seen improvements not just in wafer fabrication, but areas such as testing. For instance, a single testing machine used to test just two chips at a time, but can now test up to 32 chips in parallel.

Attracting talent

Singapore's efforts to maintain its semiconductor edge may be helped by an increasing supply of local talent.

Nanyang Technological University, for instance, has seen rising interest in microelectronics, said SSIA's Ang. Its integrated circuit design course used to have just 25 to 30 graduates each year, but now has about 80. He attributed this to the attention that the industry received during the Covid-19 pandemic, when there was a boom in semiconductor demand.

As Singapore's semiconductor capabilities improve, so do job opportunities. Chip design companies are making higher-end designs here, allowing graduates to move up the value chain.

Such companies include AMD, which acquired high-end chip designer Xilinx in 2022. Together, they have about 1,200 employees in Singapore, including AMD's chief technology office with some 12 to 15 doctorate holders.

While Singapore does not manufacture AI-related chips, local designers of such chips can expect higher pay, said AMD corporate vice-president for Asia-Pacific and Japan embedded business Steven Fong.

"The most lucrative, highest paid (engineers) are in Silicon Valley… but we are moving up very fast to narrow the gap with Silicon Valley because of the talent crunch," he said.

Singapore's openness to global talent is also an important edge, said Fong, since not all the required talent for semiconductor R&D can be found locally.

Overseas talent, in turn, are willing to head here thanks to factors such as the widespread use of English and the country's relative safety, he said.

Semiconductor startup Silicon Box co-founder and chief executive Han Byung Joon noted that Singapore's openness to foreign talent can help it build a stronger local base.

Markets such as South Korea and Taiwan made great progress partly due to an influx of experienced semiconductor talent, he said. In contrast, Japan stopped such talent exchanges about 30 years ago and became more self-sufficient, which led development to slow.

"If you have openness and bring in people who are trained and experienced somewhere else… you will be successful. If you close down the country, then you tend to minimise that opportunity," he said.