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THE VALUE CREATION IN THE SEMICONDUCTOR INDUSTRY IN TAIWAN: THE CASE OF TSMC

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INNOVATION AND VALUE CREATION STRATEGY IN JAPAN

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Summary

The development of Taiwan's industry has gone through agriculture, agricultural product processing industry, traditional industry, information hardware industry, semiconductor, flat panel display, and LED and solar energy industries. During such a development process, along with changes in the market and industrial structure, Taiwan's government and private enterprises have also been constantly adjusting resource allocation, so that the industry's competitive advantage is continuously updated with changes in the external environment, demonstrating the vigorous vitality of Taiwan's industry. And the semiconductor industry has led the development of the world's information and electronics industries for more than 60 years and is also the main driving force behind Taiwan's economic take off and growth. With the evolution of information, communication and industrial technology, and the development of the macro world economy, the global information and communication industry will still be led by the semiconductor industry in the future; at the micro level, Taiwan's economic semiconductor industry will still be a key industry for Taiwan's global competitiveness. In short, the semiconductor industry did dominate the economic development of the world and Taiwan in the past. In the future, it will still be an important industry

related to the development of world science and technology. Therefore, the analysis and judgment of its future development trend will help to grasp the future global technology and economic development. Especially on the case company which will discuss in this content, TSMC. And considering from the several various fields such as competitive advantage, resources, dynamic capabilities of enterprises and etc. Taiwan's innovative "professional wafer foundry" business model has changed the game rules and appearance of the global semiconductor industry, making Taiwan's semiconductor industry a model for the vertical division of labor in the global semiconductor industry to build the value creation. Therefore, the purpose of this content is to explore the development history and success factors of TSMC. In addition, how TSMC did to combine its core capabilities and values with strategic goals, enabling the company to recreate customer value and growth and build the new value creation for the semiconductor industry in Taiwan. And the discussion on the how TSMC made the value creation in the semiconductor industry in Taiwan by their four important core stage to build the basics in the current leading position since they started their business. The status of semiconductors in the global technology industry chain has become more and more important for development, and the upstream and downstream vertically integrated supply chains in this field are dominated by Taiwan related companies, especially TSMC, the leading wafer foundry and the development of the supply chain led by alliance from TSMC and their partner companies. TSMC is still the leader in the semiconductor industry, unfortunately, geopolitical risk is currently the biggest challenge for TSMC. Taiwan occupies a key position in the semiconductor industry, especially TSMC, it also reflects that the world's long-term dependence on Taiwan's semiconductors. Therefore, this content is also attempted to talk about the TSMC's development process from its inception and its core concepts and competitive advantages and how TSMC can be so unique no matter in the semiconductor industry in Taiwan or in the whole world and make it so famous since the global economics troubles which were triggered by the pandemic in recent years.

Table of Content

Introduction

TSMC

- Creating the Foundry business model
- The Vision of the Virtual Fab
- Creating e-foundry services
- Open innovation platform business model

Conclusion

Reference

Introduction

First of all, the development of Taiwan's industry has gone through agriculture, agricultural product processing industry, traditional industry, information hardware industry, semiconductor, flat panel display, and LED and solar energy industries. During such a development process, along with changes in the market and industrial structure, Taiwan's government and private enterprises have also been constantly adjusting resource allocation, so that the industry's competitive advantage is continuously updated with changes in the external environment, demonstrating the vigorous vitality of Taiwan's industry.

And the semiconductor industry has led the development of the world's information and electronics industries for more than 60 years and is also the main driving force behind Taiwan's economic take off and growth. With the evolution of information, communication and industrial technology, and the development of the macro world economy, the global information and communication industry will still be led by the semiconductor industry in the future; at the micro level, Taiwan's economic semiconductor industry will still be a key industry for Taiwan's global competitiveness. In short, the semiconductor industry did dominate the economic development of the world and Taiwan in the past. In the future, it will still be an important industry related to the development of world science and technology. Therefore, the analysis and judgment of its future development trend will help to grasp the future global technology and economic development. Especially on the case company which will discuss in this content, TSMC.

In the traditional competitive advantage analysis, such as the five forces model proposed by Porter (1985), discusses external competitive advantages, mainly in the analysis of industrial structure, the establishment of cost leadership or differentiation of these two competitive advantages. Furthermore, with the concept of value chain, the source of competitive advantage at the internal level of the enterprise is explored, and it cooperates with the external cost leadership or differentiated competitive advantage.

Wernerfelt (1984) put forward the resource-based view. The assumption of the resource-based view is that enterprises have different tangible and intangible resources, which can be transformed into unique capabilities of enterprises. The resources owned by enterprises are different. In the other words, it has heterogeneity, and the heterogeneity of enterprise resources determines the difference in enterprise competitiveness. But the resource-based theory puts too much emphasis on the inside of the enterprise and does not pay enough attention to the changes in the external environment of the enterprise, so the resulting enterprise strategy may not be able to adapt to the drastic changes in the market environment. Drucker (1994) believed that every organization should have a "management theory", without a clear, consistent, and focused theory, it will not be able to grow. But he also stressed that the theory must "evolve with the times" or the company would stagnate. Adapting to the rapidly changing environment poses a key challenge to the development of enterprise capabilities. Often, core capabilities will become core rigidity if they cannot be updated effectively and in real time under changes in the external environment.

Chandler (1962) believed that the growth strategy of the enterprise must have corresponding changes in the business structure of the enterprise and proposed the famous four steps of corporate growth: from horizontal integration, gradually to vertical integration, diversification of related businesses, and diversification of non-related businesses. Chandler (1990) also believed that the development of technology and the expansion of the market are the foundation of enterprise growth. If the way of enterprise growth is divided on the basis of product market, Ansoff matrix (1957) is in HBR (Harvard Business Review), as a method of growing in existing markets and new markets, provides definition for product market strategy as "a joint statement of a product line and corresponding set of missions" Designed to satisfy ", widely used in academia and business circles. There are four growth options for growing an organization in existing or new markets using existing or new products. Each alternative presents different levels of risk to the organization. First of all, market penetration, is to have a regular product in the existing market and examine the market competitiveness through different marketing methods and cost reduction. Second, market development is a method to enter a new market and use the products owned by the company to develop and grow. It is a strategy that can be considered when new product development is difficult. Third, product development, which is a strategy aimed at achieving growth by offering new products to markets already in the market, can be said to be useful when existing markets have highly loyal customers. Finally, diversification, which needs to be the riskiest of the four strategies, and therefore the most innovative, launching entirely new products in entirely new markets.

Looking back at the growth history of successful enterprises in advanced industrial countries in Europe and the United States, all enterprises first obtained market niches by virtue of unique special technologies, and then obtained market niches by virtue of capital markets. Obtain funds, increase investment, expand production scale to expand the market, pursue economies of scale, and gain a leadership position. Then develop related products and enter new fields to fully realize the benefits of scope economy. Then try to expand the market share of new products to further realize another scale economy benefit.

Wernerfelt (1984) first proposed the "resource-based view" (RBV), emphasizing that the "resource positioning" of the enterprise should replace the traditional product view as the thinking direction for formulating enterprise strategies. The assumption of the resource-based view is that enterprises have different tangible and intangible resources, which are immobile and difficult to replicate among enterprises, and the unique resources owned by enterprises can be transformed into competitive advantages of enterprises, in the other words, these unique resources and capabilities are the source of a company's competitive advantage. The resource-based view is to regard enterprises as a collection of resources, and to explain the differences in competitive advantages among enterprises, and to establish long-term competitive advantages through unique resources. Wernerfelt (1984) believed that the main activities of enterprises are to grasp and Create resource advantages, thereby possessing resource positions that other competitors cannot directly or indirectly obtain and propose that enterprises should establish resource position barriers to ensure long-term resource competitive advantages. Rumelt (1985) also believed that through the planning and deployment of resources, enterprises can grasp rare market opportunities, and establish a blocking mechanism in the process of resource deployment to obtain a preemptive advantage, thereby creating profits and maintaining a stable competitive position. Therefore, the resource-based viewpoint has established scholars' in-depth discussion of enterprise resources. Enterprise behavior, including growth, investment, and strategic behavior, can be explained by the resources owned by the enterprise. Without resources, strategic actions cannot be carried out.

Unfortunately, however, Barney (1991) believed that not all enterprise resources have the potential for sustainable competitive advantage and pointed out that only when enterprise resources are valuable, rare, inimitable, heterogeneous, and immovable, can enterprises maintain continuous competition Advantage. Therefore, how an enterprise identifies, plans, and deploys its exclusive and unique resources, this kind of thinking logic from the inside out, has become the main discussion on the source of maintaining competitive advantage from the resource-based perspective. As for the classification of enterprise resources, Grant (1995) divided enterprise resources into three categories, including tangible resources, intangible resources, and human resources. Tangible resources are the easiest to identify, such as physical assets and financial assets are both tangible resources; intangible resources include technology, reputation, and organizational culture, etc.; human resources, employees are also part of organizational resources, including professional skills and knowledge, communication and response capabilities and their motivations.

Spivey and Wolcott (1997) also concluded that the resources required for new product development include four categories: information, infrastructure, time, and money; the infrastructure includes technology portfolio and human resources. Chesbrough (2003) and Gassmann (2004) believed that R&D resources and innovative ideas do not necessarily come from within the enterprise, and enterprises can obtain the required knowledge and technology through outsourcing research, cooperative research, technology transfer, etc. Existing internal resources and technologies, expanding the boundaries and capabilities of the organization through new product development activities. Resource-based theory has a great influence on corporate strategy formulation. When the focus of strategic thinking is only on the vendors often tend to adopt similar strategies when positioning or choosing between leadership and differentiation. However, the resource-based theory emphasizes the uniqueness of individual enterprises and points out that the key to profit is not to compete with other enterprises for the same thing, but to use resource differences that are different from other enterprises to seek different competitive advantages.

The traditional competitiveness theory holds that the market competitiveness of an enterprise is increased by extending the market segment and utilizing the industrial structure. In order to gain a competitive advantage, an enterprise must have the influence of manipulating market dynamics and industrial dynamics, while corporate profits are depending on the amount of its influence. This point of view believes that external market power and industrial structure power have become the main factors that affect enterprises to obtain competitive advantages. However, the competitive environment is changing increasingly fiercely. The advantages generated by external positioning are temporary, and the obstacles of industrial structure may disappear overnight under the rapid changes in technology and market. Therefore, the discussion on the sources of competitive advantages has begun to turn, and the enterprise internal the unique resources and capabilities we have are the source of our competitive advantage. Under the perception that firms are fundamentally heterogeneous, competitive strategy is geared toward encouraging firms to develop resources and capabilities to form competitive advantages.

The resource-based perspective holds that the future development direction of an enterprise, as well as the competitive advantages of individual business units, are determined by the core competitiveness or core resources owned by the entire enterprise, that is, using resources as the logical center of thinking for the company's strategic decision-making. Wernerfelt (1984) believed that the ability and resources of an enterprise are the main source of competitive advantage. The focus of the resource-based view is how to identify, clarify, cultivate, develop, and protect the core or unique resources of the organization. The source of competitive advantage lies in Enterprise internal.

However, when the accumulation of unique resources is overemphasized, it is often easy to fall into the myth and misunderstanding of static views, especially when the external environment changes faster than the time required to accumulate unique resources, and often falls into the danger of rigidity of competitive advantage. Furthermore, resource-based perspectives are difficult to account for the strategic role of timing. Merely owning and accumulating unique resources is not really a kind of competitive advantage. The resource-based theory should be constructed under a dynamic background, that is, the dynamic capabilities of enterprises are the source of competitive advantage. The competitive strategy based on dynamic capability theory is to constantly create new competitive advantages, because in the rapidly changing external industrial environment, all competitive advantages are short-lived.

After viewing from the several various fields such as competitive advantage, resources, dynamic capabilities of enterprises and etc. It is still not easily to figure out that how to build the value creation even with the competitive advantages which owned by the enterprise or the country in the specific industry. Taiwan's innovative "professional wafer foundry" business model has changed the game rules and appearance of the global semiconductor industry, making Taiwan's semiconductor industry a model for the vertical division of labor in the global semiconductor industry. Therefore, the purpose of this content is to explore the development history and success factors of TSMC. In addition, how TSMC did to combine its core capabilities and values with strategic goals, enabling the company to recreate customer value and growth and build the new value creation for the semiconductor industry in Taiwan. This content will discuss about the TSMC's development process from its inception and its core concepts and competitive advantages. TSMC has a trinity of competitive advantages in manufacturing, technology, and partnerships, which have brought great results on its success. Therefore, following content is going to talk about how TSMC can be so unique no matter in the semiconductor industry in Taiwan or in the whole world and make it so famous since the global economics troubles which were triggered by the pandemic in recent years.

TSMC

Taiwan Semiconductor Manufacturing Company Limited, referred to as TSMC, located in Hsinchu, was established in 1987. It is the first company in the world to provide wafer manufacturing services and successfully created the wafer generation Industry (professional wafer manufacturing service), as the founder and leader of professional integrated circuit manufacturing service industry, TSMC provides customers with advanced wafer process technology and high manufacturing efficiency services.

However, in fact, looking back at TSMC when it was first established in 1987, it was still a little-known company. Even many manufacturers in the semiconductor industry are not optimistic about TSMC’s business model, and do not think that the foundry has the possibility of development. Up to now, TSMC has such an industrial scale and has become a pivotal role in the semiconductor industry. Since the launch of the Open Innovation Platform™ service, an IC design ecosystem has been established, allowing customers to find desired services in this system, including Design for Manufacturability (DFM), EDA (Electronic Design Automation), SIP (Silicon Intellectual Property), wafer foundry and packaging and testing services, TSMC leads the open innovation platform to enable itself and partners to create and share greater value.

Therefore, the following content is going to discuss about the four important core stages on the evolution process of TSMC's open management since TSMC started their business that how TSMC could build the new value creation by their business model and strategic vision on the company position to create the innovative business strategies for the competitive advantage. And it will also talk about that the TSMC's development process from its inception and its core concepts and competitive advantages that TSMC has a trinity of competitive advantages in manufacturing, technology, and partnerships, which have brought great results on its success.

Creating the Foundry business model

In 1987, before the emergence of TSMC, basically all semiconductor companies in the world started from designing and manufacturing wafers. After the design was completed, they made the design patterns into photomasks. Before 1987, these semiconductor companies basically existed in the form of IDM (Integrated Device Manufacturer), but the ability to design was actually not enough. In the context of such industry trends and development, if IC design companies entrust products to IDM manufacturers, there will be risks of unstable supply of production capacity, product embezzlement, and product imitation. The founder of TSMC, Zhang Zhongmou believes that the operation of pure wafer foundries This model can provide IC design companies with manufacturing services, which can greatly reduce the capital investment and risk of IC design companies setting up a large number of factories, and more importantly, IC design companies do not have to worry about design technology leaking to IDM manufacturers. The business model of professional wafer foundry is TSMC's first strategy to create expenditures. The purpose is to lock the customer base in IC design companies. If the business model of professional wafer foundry is recognized by manufacturers, it will drive more New IC design companies are established, thereby promoting the growth of the wafer professional foundry market.

TSMC's main business scope is manufacturing, and sales of product design instructions provided by customers integrated circuits and other semiconductor devices. Due to TSMC's founder Zhang Zhongmou's international management experience as the senior vice president of Texas

Instruments Global Semiconductor, TSMC has been gradually moving towards the goal of becoming a world-class company since its establishment. The company adopts the structure of an international company. For example, TSMC's financial system and manufacturing system are transplanted from Philips and its personnel system. Transplanted from Texas Instruments, the general manager seeks international professionals, and insists on professional managers. From the beginning of the business goal, customers will be targeted at international major manufacturers such as Motorola and Intel. After a difficult entrepreneurial period from 1987 to 1990, under the leadership of the TSMC's founder Mr. Zhang Zhongmou, the company continued to improve process technology, quality yield, and delivery time, and finally gradually opened the door to wafer foundry customers. TSMC mainly adopts its own investment to set up factories, and internal growth through derivative methods. In the first half of the 1990s, due to the downturn in the United States and Japan, integrated component companies also did some foundry business, but the unit price was relatively high. As TSMC has gradually improved its quality and delivery time, and is committed to cost control, "low cost" provides products that are relatively "high quality and low price", and the customers it serves are gradually mainly chip design companies. However, the scope of the market at this time is still only concentrated on local IC manufacturers.

The strategies that actively strive for OEM orders for Intel and use this to establish international quality certification in middle school. Intel's orders are equivalent to an international passport, which improves many process shortcomings. And actively looking for cooperation with well-known international semiconductor companies. In the end, we chose to cooperate with Philips, which can take advantage of many of its patents and cross-licensing contracts with other major manufacturers to avoid many patent problems as an important source of technology. In addition to investing in TSMC, Philips also transferred its more advanced process technology. TSMC also sent engineers to Philips' fab to learn related mass production technologies.

The Vision of the Virtual Fab

IC industry in the late 1980s, the transformation of the semiconductor industry led to industrial deconstruction. In the vertical integration model of manufacturers in the past, integrated device manufacturers (IDM) took care of design, manufacturing, packaging, and testing. IDM is like the power of the industry Center, leading the development of the semiconductor industry. In 1987, the innovative business model of TSMC's dedicated foundry emerged, and the vertical integration model was gradually decomposed into a professional vertical division of labor (Vertical Dis-integration) model, which prompted the successive rise of IC design companies and the development of ASIC products , Under such an industrial trend, manufacturers who divide labor are specialized in various tasks, and design, manufacture, packaging and testing are specialized in division of labor, and have their niche points and scale benefits of division of labor.

However, in the 1990s, the semiconductor industry gradually transformed into an application-oriented era of consumer demand. The proportion of global IC applications related to PC products has gradually dropped to less than 50%. The application of communication products and consumer electronics products has gradually risen, and the industry has entered the post-PC era. In addition to the application and demand of semiconductor products, Moore's Law of semiconductor industry and process technology continues to develop. Moore's Law was proposed by Gordon Moore, the founder of Intel. He believed that with the advancement of process technology, the number of transistors that can be accommodated on an IC will double approximately every 18 months, and its performance will also double. As a result, the pace of development and technology roadmap for semiconductors has continued to progress almost in accordance with the vision revealed by Moore's Law. During this period, the process technology has also been continuously improved, from 0.35μm and 0.25μm to the advanced process of 0.18μm. And because consumer products continue to advance in the direction of light, thin, high performance, and low power consumption, and require fast time to market, if we focus on the particularity of chips and ASICs that meet the different needs of customers, it is difficult to quickly change and product life cycle. Launch products in a timely manner under a short market. Therefore, under such a development trend, the product has entered the stage of "integrating" various functional components into an IC from the development of an IC, and the development trend of IC transfer from ASIC to System on Chip (SoC). Such industry trends have promoted the growth of system-on-a-chip technology and enhanced operational efficiency by shortening time-to-market and lowering chip costs. In 1996, the prosperity of the semiconductor industry was optimistic, and TSMC's revenue growth in the field of wafer foundry was greatly improved, and it began to attract many competitors of wafer foundry, except that it entered the wafer foundry industry at the same time as TSMC in the late 1980s. In addition, new competitors include UMC, Israel Tower, SMIC and other new entrants to seize the wafer professional foundry market.

UMC has transformed from an integrated component company to a wafer foundry company since 1996, and TSMC can be said to be a rival. From 1996 to 2001, the wafer duo (referring to TSMC and UMC) launched a series of strategic battles for hegemony. Due to the good prosperity of this period and the advent of the new economic era in the United States, the market growth rate continued to exceed 20%. The expansion of production capacity is the most important goal of this period. After 1998, UMC adopted mergers and acquisitions in order to quickly catch up with TSMC, and TSMC also adopted some defensive mergers in 1999, and the two sides launched a fierce merger competition. The wafer duo vigorously carries out company mergers and acquisitions, and actively compete for production capacity and customer orders, in order to obtain a leading position in the wafer foundry industry market.

TSMC's revenue exceeded US$1 billion for the first time during this period. And TSMC began to transform into a service-oriented enterprise after 1996 and proposed the vision of "Virtual Fab", positioning TSMC as a "virtual wafer factory", the strategic goal is to provide customers with the best service, further strengthen the close relationship with customers, and build a long-term competitive advantage. "Virtual fab" is to make customers feel that it is equivalent to the benefits and convenience of owning their own fab, but it can avoid the large amount of capital and management problems required by customers to set up their own fabs. This positioning is significantly different from the previous professional wafer foundry model, to achieve this strategic goal, the supply chain management (SCM) deployed by customers must be directly and effectively extended to TSMC.

TSMC began to invest in enterprise reengineering, changing the organizational process, and gradually changing the previous production-oriented organization type to a service-oriented organization that allows technical personnel to have marketing skills, so as to increase the barriers to industry entry and to accomplish the vision of the " Virtual Fab". In order to achieve the goal and vision of the "virtual fab", the supply chain management system planned by TSMC can be roughly divided into two parts: one is the front-end system: this is the transaction platform for communicating with customers, through a large number of networks and applications The use of IT tools such as software has made the relationship between TSMC and customers closer. The other one is the back-end system, which is TSMC's own supply chain management. The high performance of the front-end system must be fully supported by the back-end system. These two sides are like two sides of a coin, which are inseparable and indispensable. TSMC's value chain management system focuses heavily on the back-end system, which is TSMC's own supply chain management. Foundry is a customized service, and the output inventory is not the key point. Improving the efficiency of internal operations is the key point, but this includes three conflicting variables: manufacturing cycle, capacity utilization rate, and maximizing revenue and profit. Due to the huge depreciation expenses of the fab, the capacity utilization rate must be maintained at a high level, and the small and varied nature of Foundry customer orders makes manufacturing flexibility the key to maintaining high-capacity utilization rate. In order to increase flexibility, the manufacturing cycle will be increased. And TSMC tried to rationalize and compress the manufacturing cycle, and form a tacit agreement with manufacturers, so that customers can accurately estimate the manufacturing cycle and easily arrange their supply chain.

In the operation of TSMC's back-end system, the total order management system (TOM) is the core. TOM handles order receiving and scheduling, and controls the operation status of all orders, and integrates customer demand with actual production capacity. Cooperate with systematic management. TOM connects upward with the Forecast Planning System (FPS) to understand and arrange customers' possible future orders in advance, which is conducive to the advance planning of production capacity, replenishment of orders under temporary orders, and can measure the accuracy of customers' forecasts It can be used as a reference for future continuous planning. TOM integrates with MES downwards, reasonably matches orders with the fab's process and production capacity, and then integrates with SAP's ERP system downwards. In addition, the product information data base (PIDB) is also connected with TOM, which is a database formed by product classification. The flexibility of TSMC's manufacturing process is fully reflected in the back-end system with TOM as the core. Through FPS, we can effectively grasp the total demand and trend of customers, make the forecast and calculation involved in scheduling more accurate, and accurately expand it into a reasonable collocation of each machine, process, and production capacity in each fab. The process development of Foundry process technology takes more than 6 months, and the delay in equipment adjustment will lead to great depreciation pressure. Therefore, the production model is "goods (orders) according to machines". TSMC Foundry's process flexibility lies in the production process is prepared in advance according to the forecast, instead of adjusting the machine after receiving the order. Since TSMC's process changes must be pre-planned, it relies heavily on its technical marketing capabilities to correctly estimate the technology required by the market and prepare for it in a timely manner. It means that in a changing environment, TSMC must keep abreast of product demand in order to provide the most suitable supply of manufacturing services.

During this period, TSMC actively expanded its production capacity, taking advantage of its competitive advantage of large production capacity, in order to receive large orders from customers in a long-term and stable manner, and provide customers with "long-term stable and large-volume foundry services." In 1997, TSMC established an internal IC design service department (DSD) in accordance with its vision of a "virtual fab", which specializes in the development of basic silicon intellectual property and the establishment of design processes and provides design services for advanced processes. However, since the core of TSMC lies in wafer manufacturing, its internal IC design service department alone cannot meet the needs of the market and different customers. And in this period, due to TSMC’s series of large-scale company mergers and acquisitions, it actively competed for more production capacity and customer orders, and the effect of economies of scale appeared. The entire market covered by TSMC customers. In the process of TSMC's implementation of the virtual fab, TSMC has strengthened communication with customers through various methods, such as via public networks, using FTP (File Transfer Protocol), electronic data exchange (EDI), to communicate design and engineering data with customers. In order to facilitate the smooth exchange of business contacts and relevant information and knowledge, TSMC has launched TSMC-Direct, TSMC-Online and TSMC-Online 2.0. TSMC-Direct is suitable for the direct integration of ERP of large-scale operators, while TSMC-Online 2.0 is accessed online through the Internet, which is applicable to the widest range of customers and has no scale limit. TSMC hopes that through the use of such a large number of IT tools such as the Internet and application software, customers can become an external service window for One Stop Service and provide customized information retrieval services. It is hoped that customers can use TSMC-Online2 .0 can complete the due value activities of the entire business cycle.

Through TSMC's electronic strategy and the realization of the "virtual fab" vision, the supply chain management established by customers can be directly and effectively extended to TSMC, making customers feel that TSMC is their own fab. TSMC deploys related infrastructure to help customers expand and extend the scope of decision-making and control of their supply chain (extended SCM), focusing on the IC manufacturing field, gradually increasing the scope of front-end design service alliances and back-end packaging and testing services. Continuously improve the transparency and timeliness of information, so that customers can control the management of their entire supply chain only through TSMC. In order to accomplish the vision of "virtual fab", TSMC began to require the supplier to know TSMC's actual inventory and introduced continuous replenishment planning (CRP) to automatically replenish TSMC's inventory. The company maintains its own inventory. TSMC will continue to provide the forecast value of the supplier company for 4 to 6 months. The supplier company can see the progress of TSMC's production from the Internet every day, and then adjust its own production plan, and carry out supplier company inventory management (vendor managed inventory, VMI) plan. On the other hand, due to the limited-service capacity of TSMC's design service department, TSMC is trying to combine IC design automation leaders, component databases, semiconductor intellectual property suppliers, and product design execution service providers to carry out strategic alliances for cooperation in IC design services. Therefore, in that year, TSMC united several design companies and IC manufacturers to form an alliance and established the IC Design Center Alliance (DCA). When customers need semiconductor design-related services, customers can use TSMC-Online provided by TSMC. 2.0 The online service is connected to the third-party design service alliance, and customers can easily obtain related semiconductor intellectual property products and services.

Creating e-foundry services

In order to increase the added value of customer service, TSMC provides One Stop Service, and cooperates with front-end and back-end service vendors of the semiconductor industry value chain to increase the depth of service content, to expand the range of customers that can be served. Front-end service providers include intellectual property blocks (IP), component databases

(Library), electronic design automation tools (EDA) and design services, etc. Back-end service providers include packaging, testing and other manufacturers. Foundry's logistics system is a "comprehensive service system" centered on Foundry and surrounded by third parties. e-Foundry is a front-end design service system with customer relationship management as its core. Its vision is to create an integrated service value chain that can shorten the time to profit, time to market, and volume of products for customers. Production time (time to volume) and delivery date (time to delivery) can optimize the business process of cooperation (collaborative business processes) and can improve knowledge management and information technology. Under the concept of "e-Foundry", TSMC has established a set of solutions based on the Internet, including "Relationship Management", "Design Collaboration", and "Engineering Collaboration". Together with "Logistics Collaboration" and other application service systems, it has become the basic structure of TSMC's "Internet professional integrated circuit manufacturing service" (e-foundry). TSMC is based on core manufacturing expertise and uses a virtual integration strategy to integrate front-end design and back-end services in the semiconductor value chain, combining chip design service companies, foundry companies, and packaging and testing Manufacturers and other upstream and downstream companies form a virtual integrated component company (Virtual-IDM). Under the premise of "manufacturability", ensure the close integration of the front and rear processes, and grasp the reliability and stability of the manufacturing quality. The goal is for customers to become the best partner in the global supply chain and collaborative operations, and to respond quickly to customer needs. A more accurate grasp of the delivery date is the key difference in TSMC's professional wafer manufacturing services.

In order to strengthen the relationship with customers, the founder of TSMC, Zhang Zhongmou pointed out that before 2002, TSMC's vision is to become a company with the most advanced technology and the best service orientation in the world, followed by customers and partnerships. But in the second half of 2002 this vision changed to give priority to "win-win partnership". TSMC has also transformed from a part of the industry chain into a community with customers, and this win-win partnership is enough to compete with integrated component companies. The TSMC’s founder Zhang Zhongmou also said that the most important thing about a partnership is the long-term synergy, in the short-term, one party always has to bear some losses. TSMC hopes to establish this kind of benign and lasting cooperative relationship with more customers. In order to practice the "e-foundry" service concept, TSMC invests 1% to 2% of its revenue in e-engineering projects every year. In order to improve customer satisfaction and business performance, an enterprise supply training management system was established in early 2001 to quickly respond to customer needs and master the delivery date. And in 2002, it started to carry out a number of business process reengineering projects, including the process of fulfilling order requirements, customer service and satisfaction processes, technology development to mass production processes, and personnel recruitment and development processes. In addition, applying the supply chain and website, integrating physical and virtual spaces, covering the enterprise interior, supply companies, customers, and complementary companies, and gradually building the entire complete structure of e-foundry. To virtually integrate the network within and between enterprises, including upstream and downstream members, extend the scope of management and services, and achieve the goals of information transparency, real-time information, efficiency, communication, and knowledge sharing through the integration of value network services. And customers can master the management of their own overall supply chain in the business cycle of TSMC.

TSMC has also successfully independently developed and developed a breakthrough immersion lithography technology and has worked closely with optical lithography equipment manufacturers to establish the infrastructure of this technology and has prototype testing machines and mass production machines. This technology has been applied to the most advanced 90nm process technology, successfully verified the feasibility of 193nm wavelength immersion lithography technology in mass production, and successfully produced full-featured 90nm components, which is a pioneer in the semiconductor industry with a very significant breakthrough. The advantage of this technology is that the use of immersion lithography technology can continue the old mass production machine 193nm wavelength exposure machine, so that its resolution can reach 32nm process technology, without relying on the high risk and high unit price of 157nm meter wavelength exposure machine. In other words, TSMC's process technology can be quickly introduced into the next few generations of more advanced process technology levels without the need to replace a large number of process equipment and adjust process parameters and processes.

e-Foundry is a front-end design service system with customer relationship management as the core, and its vision is to create an integrated service value chain. "Relationship management" is to shorten the time to profit for customers by providing customers with a powerful tool that can expand sales, account services, information sharing and track all problems. The solutions include after-sales service management, business intelligence Information sharing management and customer self-service center, etc. By providing the "design cooperation" service of relevant information required in the IC design cycle, it shorten the time to market of customers' products. The share and integrate relevant design information and knowledge with customers, help customers solve design problems, and make TSMC's design service department has a good communication channel with customers, reducing communication costs and time, allowing customers to learn about chip design and layout information before chip release online with TSMC's engineering personnel, or allowing customers to only use the Internet. The overall design process from product design conception to chip verification can be completed. The service content of "Design Cooperation" includes cooperative design layout services, design project management, technical document management, cooperative intellectual property exchange, intellectual property database management and multi-site simultaneous design management, etc. "Engineering cooperation" is to shorten the customer's time to volume by providing cooperative services to manage the life cycle of product production. The life cycle of product production basically includes pre-tape-out, trial mass production, and risk Production and mass production stages, properly manage, share, and integrate wafer manufacturing information and knowledge, so that customers can smoothly improve product yield, and provide real-time measurement data by sharing the yield analysis tool (TSMC-YES) with customers, can shorten the new process development cycle. Other solutions include batch management, CP final testing, production information management, prototyping management, quality, and reliability management, etc. "Logistics cooperation" refers to the sharing of commercial flows and the integration of logistics, through the cooperative services of demand planning, order filling, production control and delivery, to reduce the time to delivery of customers' products and make business contacts can communicate with relevant knowledge smoothly. Solutions include order management, integrated online inventory management, lead time management, demand planning, production allocation management and advanced technology process (ATP) and order promise management. TSMC uses the IT system of the Internet as the e-Foundry external service window, and launched TSMC Direct, which is suitable for the direct integration of enterprise resource planning for large companies, and TSMC-Online 2.0, which provides online services for most customers through the Internet. The two major IT systems provide customized information retrieval services. Therefore, it will aim to cover the three major functions of design, engineering, and logistics, that is, to hope that customers can complete the valuable activities of the entire business cycle through the IT system of the Internet. TSMC manages the entire business cycle to manage the product development process. Each process is related to the process of the semiconductor industry, including the selection of foundry, product design, mask manufacturing, wafer manufacturing order, order process, product execution status report, production and shipment report, test data, quality assurance inspection data, statistical process control data, manufacturing process reliability data, engineering analysis and other functions.

Customers can place orders directly with TSMC through an IT network system called TSMC Direct, and TSMC's computers will automatically confirm and reply to customers. Different resource planning systems can still communicate with each other. On the other hand, as long as they are customers of TSMC, they can use the Internet IT system of TSMC-Online 2.0 to obtain the production status of the company's chips at each stage of the fab after going online and passing the authentication. TSMC's portal website provides each customer with information about the real-time progress of their orders at each process site, and simultaneously completes the business behavior of order tracking, order modification, and even order suspension. Competitors can only give a general pick-up time for the delivery date of the order, while TSMC can provide customers with instant online inquiries. In addition, other solutions under e-Foundry also include: CyberShuttle/Muiti-Project Wafer Services (MPW), which can reduce engineering costs (Non-Recurring Engineering Cost, NRE) by sharing masks and wafers with multiple solutions and speed up development; E-Beam service provides photomask manufacturing and management functions; QuickStart project provides customers with free intellectual property. In order to increase the added value of customer service, TSMC provides a one-stop service. Its entire Foundry logistics system is an Intellectual property, component database, and electronic design automation tool with Foundry as the core and front-end services, design services, and third-party service providers such as packaging and testing of back-end services, and a "comprehensive service system" formed around them. Due to the limited-service capacity provided by the TSMC design service department, when customers need semiconductor design-related services, they can not only download the relevant design process information provided by TSMC through TSMC-Online 2.0, but also connect to it through TSMC-Online 2.0. Third-party design service alliances, including various intellectual property companies, component libraries, electronic automation design tool companies and design service companies. Customers can also download related materials and use related services through TSMC-Online 2.0.

Open innovation platform business model

As the industry has entered a mature stage, the competition among manufacturers is becoming more and more intense. The threshold of the industry's process technology is constantly rising. Due to the shortening of the product life cycle, the cost of research and development has risen more rapidly. The cost pressure formed by expensive research and development technology and manufacturing equipment costs has become a major barrier to entry. Under such industry trends, the business model of traditional IDM factories is no longer applicable to the current industrial environment. Many IDM manufacturers cannot bear such a large construction cost and production capacity. The advantages of owning process technology and fabs are no longer there. Prompting them to gradually shift to a light fab (Fab-lite) or reduce capital investment (Asset-lite) business model, release the front-end manufacturing and back-end packaging and testing capacity, and outsource it to a full-time foundry and packaging and testing factory. Reduce capital investment and reduce the heavy financial burden of advanced process technology development. Under such a trend of industrial development, IDM factories invest heavily in technology research and development and cannot fully guarantee their advantages. All major manufacturers in the industry are rethinking their business models. In order to maintain cost competitiveness and maintain market share, manufacturers form strategic alliances with each other. Flexibly use the professional capabilities of its partners and pool resources to share each other's R&D investment costs and risks. The semiconductor industry continues to evolve following Moore's Law. For a long time, Moore's Law has been like an invisible hand, constantly encouraging the industry to follow advanced manufacturing processes or expand the diameter of silicon wafers. However, changes have also taken place today, with the entry into the nanometer process, the limit of physical characteristics is becoming more and more difficult for the process progress, and the compliance of Moore's law has been gradually questioned by many manufacturers. At this stage of SoC (System on Chip) development, there are still many technical challenges from upstream design to downstream testing. Since SoC integrates multiple components on a single chip, different components may come from different processes, which makes integration difficult. In addition to cost effectiveness is difficult to grasp, the complexity of integrating too many components will also increase. At the same time, the chip will be too large, resulting in a decrease in production yield, and the SoC product development process will be too long to respond to market demand. Therefore, with the development of SoC (System on Chip) in the semiconductor industry, SiP (System in Package) has become another technological trend that complements SoC. SiP also integrates components with multiple functions, but SiP may still contain SoC, and the two are complementary at the technical level. SiP integrates components into a single package by stacking or side by side. This technology must take electrical Therefore, there is a need for a cross-component integrator to assist in the SiP process between upper and lower components to improve product yield. It can be seen that the focus of semiconductor development today has gradually shifted from focusing on the development of process technology to the more important development direction of SoC and SiP system architecture, IC design and product market application, and IC-related technology integration.

During this period, TSMC began to think different business strategies, and started to innovate the business model of the enterprise. In the past, TSMC focused on wafer manufacturing services. Its strategic vision is to become the world's most advanced and largest professional integrated circuit technology and manufacturing service provider, serving customers such as IC design companies and IDM companies, and cooperating with customers to develop new process technologies, emphasizing the three capabilities of process technology leadership, production capacity cost advantage and customer service orientation, in order to provide customers with the greatest overall benefits. However, with the development of the industry, in addition to its original advantages, TSMC must provide more added value to stand firm to strengthen the ability to jointly develop IC design services with more partners. Wafer foundries can no longer simply provide manufacturing services, but must cooperate with upstream chip design customers, and fully cooperate at the beginning of design to help customers shorten chip design time and cost. In view of this, TSMC integrates Electronic Design Automation (EDA), Silicon Intellectual Property (SIP), process technology and process services of itself and third-party manufacturers to launch an "Open Innovation Platform". The platform is built by TSMC for its customers and partners in the design ecosystem. It can bring customers' products to market earlier, improve investment efficiency and reduce waste of resources. It is also built on Silicon Intellectual Property and the basis for designing the ecosystem interface. TSMC hopes to establish an IC design ecosystem, so that customers can find the services they want in this ecosystem, including Design for Manufacturing (DFM), EDA, IP, foundry and packaging and testing at the same time, TSMC also leads the open innovation platform, enabling itself, customers, and ecosystem partners to jointly create the greatest value of the IC ecosystem.

The open business model of TSMC's "Open Innovation Platform" covers the chip design industry, design ecosystem partners, and TSMC's silicon intellectual property, chip design and manufacturability design services, process technology and back-end packaging and testing services, which accelerate the implementation of innovations in an efficient and open manner; one of the important advantages is that it has multiple interoperable design ecosystem interfaces and components jointly developed by TSMC and partners. These components are actively developed by TSMC Initiate or provide support. Through these interfaces and components, the innovation of each link in the supply chain of the entire semiconductor industry can be accelerated more efficiently, and the entire industry can create and share more value. TSMC made organizational adjustments to make it more in line with the goal of technology research and development. The new R&D organization integrates the forward-looking research team, transforms into a technology platform-oriented organizational structure, and expands cooperation with external R&D partners such as major process equipment manufacturers and material suppliers. TSMC separates the technology platform and design services from the R&D department and establishes the Design Technology Platform (DTP) department to develop design services and technology platforms. Through this organizational adjustment, the link between TSMC's R&D capabilities and customer needs will be further strengthened to ensure that technology R&D is oriented towards customer needs. In order to establish an open innovation platform, TSMC has continuously recruited experts in IC design and design services from all over the world in recent years. On the other hand, it has established three design centers in North America, making it easier for TSMC to recruit excellent local design talents. And further strengthen the design service capability of TSMC. The founder of TSMC, Zhang Zhongmou pointed out that TSMC hopes to establish an IC design ecosystem, so that customers can find the services they want in this system, including design for manufacturability, EDA, IP, wafer foundry, packaging, and testing, etc. It also leads the open innovation platform, enabling itself to create and share greater value with customers and ecosystem partners.

During this period, TSMC has established a set of operating models that create company value through intellectual property rights. Therefore, the formulation of intellectual property strategies will fully consider the overall strategy of R&D, marketing, and corporate development. On the one hand, intellectual property rights can protect the company's freedom of operation and avoid the risk of litigation; on the other hand, it can also strengthen competitive advantages and can be used to create corporate profits. TSMC continues to improve the quality of its intellectual property portfolio, reduce maintenance costs, coordinate the company's overall strategy with its intellectual property strategy, and gain value from its intellectual property portfolio. Intellectual wealth is not only the basic element to attract customers and cooperative manufacturers, but also the basis for cooperation between the two parties. TSMC continues to invest and manage its intellectual property portfolio to ensure that the company obtains the maximum benefit from it. In order to provide customers with a more complete and shorter manufacturing process, while reducing chip production costs, to help customers shorten chip design lead time, and to achieve a higher level of precision in TSMC's advanced process technology. TSMC has established the Active Accuracy Assurance (AAA) system mechanism to promote the optimization of chip design, and continuously improve the accuracy of each link in the design and manufacturing value chain. This project is another important key in the "Open Innovation Platform", which can ensure the precision and quality of designing the interface of the ecosystem and its constituent elements.

And the "Unified Design for Manufacturing (UDFM)" architecture can enable chip design customers to improve their production yield, reduce design costs, and speed up product launch and mass production. The UDFM architecture is one of the constituent elements of the "Open Innovation Platform", which is co-operated by TSMC through in-depth and large-scale information collection (Data mining), in cooperation with electronic design automation and other partners in its design ecosystem and provides customers with obtain TSMC's process data in an encrypted manner through a unified framework. The UDFM framework provides a brand-new Design for Manufacturability Kit (DFM Design Kit, DDK), which for the first time encrypts the built-in DFM software with a common application program interface and process related DFM data and modules. Compared with the past, because this architecture provides the same machine tool and process module information as inside the TSMC fab, chip design customers can obtain more and more in-depth TSMC process data, enabling customers to obtain TSMC's accurate DFM process data when designing next-generation chips, the TSMC's accurate DFM process data can be obtained during chip design to fully utilize the advantages provided by TSMC's advanced nanometer process. In addition, the UDFM architecture can handle a considerable amount of DFM data and design complexity, thus shortening the chip design time and accelerating the time to market and mass production. Under the trend of SoC (System on Chip) and SiP (System in Package), the industry has gradually entered the need of virtual integration. Due to the increasing difficulty and complexity of chip design, each IC design is designed from scratch. It is impractical if each piece of SIP (Silicon IP) is designed by itself, the IC design company will have to bear expensive design and development costs. Therefore, it is necessary to provide an "Open Innovation Platform" that integrates the IP of itself and many manufacturers, provides many reusable IP, practical EDA tools, diverse design platforms, and an effective innovation process management system to complement the IC design industry in the part of the design process with insufficient resources or low efficiency ensures first-silicon success, improves the efficiency of R&D resources for customers and greatly shortens the product development schedule.

The "Open Innovation Platform" which led by TSMC, for TSMC's design ecological environment partners who have obtained TSMC's AAA mechanism certification, which means that it can provide chip design customers with a guarantee, reducing reservations in the case of guard band and avoiding over design, the optimized chip design is completed. For chip design customers, the use of electronic design automation (EDA) tools or silicon intellectual property certified by this mechanism of TSMC can greatly increase the chance of successful production of the first chip design, reduce production costs and speed up the time to market. In order to implement the business model of an open innovation platform, TSMC has verified numerous IP and EDA tools and bundled them with its own core technology process. In this platform, TSMC plays the role of intermediary and medium of IP and EDA tools, providing complete IP Cell Library, Reference Flow, DFM, EDA Tool, etc., to help customers quickly find the required IP and EDA tools for Development of IC designs. In the past, IC designers had to independently request IP authorization from major international manufacturers such as IBM and TI. They had to search for available IP everywhere, which was not only expensive but not always applicable, but even faced the problem that it could not be applied to design or import into production. Therefore, through TSMC's "Open Innovation Platform" service business model, TSMC plays the role of an intermediary and integrator. Designers can purchase the required IP according to their own needs, or TSMC and Creative Electronics assist customers in IC development. Design service, in this way, the IPs that have already been verified can be quickly combined in various ways, so that the planning and design of the entire IC can be completed in a short development time and can be quickly introduced into the production stage. In the process of serving customers like this, once customers get used to the operating mode, process technology, and design process of the service system provided by TSMC, customers must meet the specifications and standards of the process formulated by TSMC when designing ICs. Unwilling to spend more time and switching costs to adopt other fab systems, virtually making the services provided by the open innovation platform gradually bundle customers. Although the price per unit wafer provided by TSMC is higher than that of its peers, the reasonable price formed after communicating with customers, because TSMC provides the value of comprehensive IC manufacturing services, makes customers willing Placing an order with TSMC at a higher price has created more revenue for TSMC.

The comprehensive service model jointly created by TSMC, and its partners can be regarded as a virtual vertical integration, or this business model can be regarded as a "virtual integrated device manufacturer" (Virtual IDM). Through the high level of cooperation between TSMC and its partner’s companies, while coordinating and integrating upstream and downstream information and technical specifications, the upstream and IC design manufacturers, IP suppliers, EDA tool manufacturers, and downstream and packaging and testing manufacturers have formed a co-existing partnership. It is possible to quickly manufacture high-quality system-on-chip function ICs. TSMC and its partners introduce Design for Manufacturability (DFM) and Design for Testability (DFT) into customer chip design services and integrate SIP (IP Integration) and planning to design reference flow (Design Reference Flow), Chip layout, providing customers with one-stop shopping, comprehensive and complete IC manufacturing services. The "Open Innovation Platform" led by TSMC, and the comprehensive virtual vertical integration service model created by TSMC and its partners, the added value brought by integration is an integrated open innovation platform. This platform effectively shortens the product development schedule of system operators, IDM manufacturers and IC design operators, and reduce technical thresholds and R&D costs. By shortening the time to market of customer-designed products, reducing manufacturing costs, and accelerating the profit-making stage (Time-to-Money), it can not only create competitive advantages for customers, but it can also gain recognition from more manufacturers and create higher operating value.

In short, TSMC has moved from e-foundry to an open innovation platform. In the past e-foundry services, TSMC and customers cooperated project by project. It is a full-process cooperative service, but the correlation between the projects serving many customers is very small, in the other words, TSMC has many IP Cell libraries and has built many small systems to serve customers, such a large and complex system Under the circumstances, a lot of IP may be wasted and the amount of reuse is relatively small. Therefore, towards an integrated open innovation platform, the IP Cell library is integrated to facilitate the management of IP and the management of the innovation process of IC products. This solves the dilemma that IC design customers have to search for IP everywhere, provides customers with better and more convenient services, and also attracts more new IC design customers willing to join the IC design service ecosystem led by TSMC. According to the rules of the IC ecosystem, more customers are willing to order and manufacture wafers at TSMC and create profits and value with TSMC. Therefore, with the service model of the open innovation platform constructed by TSMC, it is possible to provide customers with a full range of services from design, manufacturing, and delivery. It is a comprehensive service with great advantages and competitiveness, and implements the virtual IDM model, and truly become a "Total Solution Provider" for customers. In addition, more and more IDM manufacturers are willing to join TSMC's open innovation platform and cooperate with TSMC to create value together. For example, TSMC signed an agreement with Intel to cooperate on technology platforms, silicon intellectual property architecture, and system-on-chip solutions. Intel will transplant the Atom™ processor core to TSMC's open innovation technology platform to expand Atom processing Market map of system-on-chip customers. This cooperation will help Intel's customers to use Atom system chips more conveniently and expand the application scope of Atom system chips through TSMC's various silicon intellectual property services, and TSMC can also extend its open innovation technology platform to serve the Intel architecture market segment.

TSMC has mastered the key advanced process technology and key manufacturing capabilities that can attract customers. When customers place orders at TSMC, TSMC's production can provide larger production capacity, higher yield, better quality, and rapid production than its peers. The more important key is that through the open innovation platform, TSMC provides customer-oriented cooperation services from design, manufacturing, to logistics; therefore, under such circumstances, even if TSMC is the first in the industry. Although the price per unit wafer is higher, it can still maintain its market share in the wafer manufacturing service market. Customers are willing to place orders for production at TSMC. TSMC provides one industry-leading advanced process technology, two stable high-quality manufacturing capabilities, and three integrated platform customer services. Therefore, attracting more and more IC design manufacturers (including IC design companies, system manufacturers, and IDM manufacturers), they are more willing to join TSMC's open innovation platform and cooperate with TSMC to jointly create more value. And when IC design manufacturers place more and more orders at TSMC, more and more IP suppliers, IC design service manufacturers, and EDA tool manufacturers are more willing to join the open innovation platform. More and more IP, EDA tools, design process and other resources will attract more customers to join the platform. This creates more profits for TSMC and customers, and more partners and manufacturers in the ecosystem of this platform create and share more profits and values, forming a virtuous circle.

Conclusion

In conclusion, after the discussion on the how TSMC created the value creation in the semiconductor industry in Taiwan by their four important core stage to build the basic in the current leading position since they started their business, the outlook, and challenges in the now and the future seem still much more complicated than in the past. The status of semiconductors in the global technology industry chain has become more and more important for development, and the upstream and downstream vertically integrated supply chains in this field are dominated by Taiwan related companies, especially TSMC, the leading wafer foundry and the development of the supply chain led by alliance from TSMC and their partner companies. The market share of TSMC's advanced manufacturing process is 90%, and the yield rate of advanced manufacturing process is rising quickly, and the production capacity is increasing, which meets the customer's new product mass production requirement within 3 months. Creating the best return on investment for customers is the biggest competitive advantage of TSMC. The biggest challenger, Intel, has signed agreements with 7 of the world's top 10 fabless IC design companies. It is estimated that they should be Qualcomm, Broadcom, Marvell, Cirrus Logic, and other US IC design companies, plus Nvidia. The real key customer order flow is Nvidia and Apple. Nvidia represents Intel's technical capabilities and production capacity, and Apple's orders are one of Intel's ultimate goals to challenge TSMC. Samsung is similar with Intel; they are all both developing into the blue ocean of wafer foundry after the operation of the industry has entered a bottleneck. However, ASML's EUV lithography machine production capacity is limited, resulting in limited expansion of advanced manufacturing capacity. It makes Samsung's development strategy is slightly exaggerated. TSMC is still the leader in the semiconductor industry. Within the past several epic growths, it was determined to expand investment when the global economy collapsed. Fabless IC companies will not go back, because TSMC’s growth strategy with customers has worked, and the quality of chips produced by TSMC is no match. Better, faster delivery, more competitive cost.

However, unfortunately, geopolitical risk is currently the biggest challenge for TSMC. Since the technological war between China and the United States and geopolitical risks have heated up, mastering chips has become the strategy of advanced countries. Taiwan occupies a key position in the semiconductor industry, especially TSMC, which is the supplier of 90% of the world's most advanced chips and has become a global solicitation to set up factories. In addition, the war between Russia and Ukraine has expanded to energy competition. Europe's dependence on Russia's energy has caused the economies of many European countries to suffer greatly. It also reflects that the world's long-term dependence on Taiwan's semiconductors is another potential crisis. As China’s actions against Taiwan become more and more provocative, the crisis of military reunification once heated up, and the global economy may suffer a devastating impact. The White House regards ensuring the supply of semiconductors as an urgent task, and TSMC, which manufactures more than half of the world’s advanced semiconductors, has also become the target of military strategists. In addition, the broken supply chain experienced in 2021 also made the United States remember the lesson. At that time, the shortage of chips cost the US auto industry a recovery of US$230 billion and it is estimated that the largest annual impact of the interruption of supply from Taiwan's fab foundries on the midstream and downstream markets is approximately US$490 billion.

As the United States gradually expands the development of Chinese technology, and the recently introduced Chip Act (CHIPS Act) lures manufacturers to set up factories in the United States, many international brand manufacturers are beginning to worry that Chinese chips may have a chain-breaking crisis, and they have also started to remove the China layout. In this trend of remove China layout, Microsoft and Dell took the lead in firing the first shot. Previously, Microsoft and Dell reported that they had asked the supply chain to sort out the list, detailing which semiconductors in use came from Chinese IC design companies, and asked the supply chain to evaluate the time required for assembly capacity to leave China. With the resurgence of chip wars, major manufacturers have to prepare for the worst. Apple, which has always regarded China as an important production base, has also begun to strengthen the decentralization of supply chain locations in response to the trade war. Apple requires suppliers to actively plan to move assembly to countries such as India and Vietnam, and even plans to use India as a new base for ipads. Vietnam is expected to undertake more manufacturing tasks for Apple's other products, such as AirPods, smart watches and laptops.

But in the past 60 years, the development of semiconductor technology has been like walking in a tunnel. The way forward is clear, which is to shrink the transistor. Now they are approaching the exit of the tunnel. There are more possibilities outside the tunnel, from materials to architecture innovation will make new paths possible and define new destinations. They are no longer limited by tunnels and have unlimited innovation space. In last, it is looking forward to the future, the stage of semiconductors will be bigger, but the challenges will be more arduous.

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