The analysis of whole industrial chain of Samsung Semiconductor

Yueke Qin*

Evergrande Yufu Community, Qilin Street, Yufeng District, Liuzhou City, Guangxi Province, People's Republic of China

*Corresponding author. Email: 15000240122@xs.hnit.edu.cn

Abstract. This article mainly analyses the advantages and disadvantages of the whole industrial chain strategy in the context of the epidemic, and takes Samsung semiconductor industry as an example to demonstrate whether the whole industrial chain strategy is correct, the author's suggestions are also given. First, we will show the impressive sales of Samsung Semiconductor against the situation of epidemic to prove that Samsung has made the right strategic decision in the semiconductor sector and I introduces why Samsung chooses the path of semiconductor industry chain. Second, the whole industrial chain strategy of manufacturing industry is introduced and its advantages and disadvantages are analysed. Third, it studies and analyses Samsung's corporate culture, employee and supplier management, the process of full industrialization of Samsung Semiconductor and the mistakes made by Samsung Semiconductor. Finally, judge whether to support Samsung's whole industrial chain development strategy, and give the author's suggestions. Through the research, it is found that even if there are defects in the strategy of semiconductor industry chain, there are defects in the internal management caused by the expansion of enterprise scale, which is specifically manifested as the neglect of employees' safety conditions. However, the authors believe that even with the drawbacks, it is still the right strategic decision for semiconductor companies. In order to deal with the defects, this article suggests promoting enterprise transparency, introducing social and public opinion supervision into enterprises, and forcing enterprises to actively safeguard the rights and interests of stakeholders.

Keywords: Whole industry chain; Semiconductor; Cancer; Corporate Social Responsibility.

1. Introduction

Semiconductor is a kind of material between conductive and insulator, and it is also the best material for all electronic components. It is made of silicon, arsenic, germanium, gallium and other materials. Semiconductor is opposite to metal conductor, and its conductivity increases with the rise of temperature. Semiconductor is the foundation of the development of electronic information technology and plays an important role in promoting the development of the country and science and technology enterprises. In the context of the pandemic, governments have opted for street, city and country closures in order to reduce the number of novel coronavirus infections, leading to the closure of many businesses, many of which are suppliers to leading enterprises. This makes the advantages of enterprises in the whole industrial chain more prominent, helping enterprises survive and make profits in the pandemic. However, although the predecessors have studied the whole industrial chain of manufacturing industry, they rarely involved the semiconductor industry. With the high threshold of semiconductor manufacturing industry, it is difficult for predecessors to analyse the advantages and disadvantages of semiconductor industry chain. In order to fill the research gap of semiconductor industry chain, this article will study Samsung semiconductor industry chain, find out its advantages and disadvantages, and give whether the author supports Samsung semiconductor development strategy. The discussion of this research topic will be of great significance to developing countries, enterprises and individuals who wish to understand or be involved in the development of the semiconductor industry.
2. Samsung under the pandemic

Since 2019, COVID-19 has spread to almost every corner of the globe, all industries have been affected to varying degrees by the pandemic, and the electronics sector is no exception. Each country has adopted a different and similar strategy; take the Chinese government as an example, in order to cope with the damage caused by novel coronavirus, the Chinese government has taken measures to block all possible channels of virus transmission, including quarantine of residents at home, closure of enterprises, shutdown of factories, and even lockdown of the city [1]. According to Cai and Luo’s research on manufacturing industry, due to the strict logistics control in various countries and regions, transportation becomes difficult, leading to a sharp rise in the analysis of supply chain interruption caused by the transportation difficulties of raw material; Not only that, as COVID-19 continues to mutate and expand its spread, supply and demand and the impact of the declining are already occurring in the automotive and semiconductor industries [2]. However, according to Yonhap News Agency’s report on January 27, 2021, Samsung Electronics released a performance report on the 27th. The company's sale in 2021 was increase of 18.07%, and its revenue will be an increase of 43.45%, setting the Samsung historical record [3]. Samsung’s outstanding performance in the popular background has to attract academic attention.

3. Samsung and Samsung Semiconductor in adversity

Samsung became the world's largest memory chip maker in 1993 and the world's largest semiconductor company in 2017 [4]. Its semiconductor division manufactures a wide range of semiconductor devices, including MOSFET transistors, Semiconductor Memory, Integrated Circuit Chips, Transistors and Semiconductor nodes. It is well known that the production of computers and mobile phones cannot be separated from chips (semiconductors). However, due to the impact of COVID-19 and the trade friction between China and the United States, there began to be a chip shortage around the world in the second half of 2020 [5]. This Samsung have to think about keeping the entire semiconductor industry chain firmly in its own hands instead of relying on foreign suppliers to support; As a result, Samsung acquired a large number of consumable components from global semiconductor suppliers for inventory, while also cooperating with domestic suppliers as much as possible, including expanding the cooperation business with existing Korean suppliers and developing new Korean suppliers [6]. Through the analysis and research of the whole industry chain of Samsung semiconductor, this article shows how the industry chain of Samsung semiconductor helps Samsung to against pandemic.

4. The whole industrial chain of manufacturing industry

Dooley believes that manufacturers and products themselves have a very limited impact on the environment and society, and it is the upstream and downstream industrial chain that can really have an impact on the environment and society [7]. In society, the whole industrial chain refers to the industrial chain system composed of planting, mining, procurement, trade, transportation, design, processing, deep processing, marketing and brand building. In fact, the whole industry enterprises realize these links through internal management, which is simply to replace market competition with internal resource allocation. The business model of the whole industry chain enterprise is being adopted by more and more enterprises. However, to some extent, the business model of the whole industry chain enterprise is against the fair trading principle of the free market. Therefore, the whole industrial chain has both advantages and disadvantages:

4.1 The advantages of the whole industrial chain

First, it is conducive to the integration and distribution of enterprise resources, Concentrate superior resources to develop superior industries. Second, enhance the resilience of enterprises, especially in the context of a pandemic, to bring a relatively stable supply of resources for enterprises.
Third, it is conducive to enterprises to achieve scale efficiency and enhance competitiveness, so as to quickly occupy the market. Fourth, Reduce barriers to the flow of information, whether top-down or bottom-up. Fifth, it is helpful to enhance the visibility and image of the enterprise and strengthen the brand image of the enterprise.

4.2 The disadvantages of the whole industrial chain

First, the development of the whole industrial chain has extremely high requirements for enterprises themselves, which need to continuously invest a large amount of capital. Once the capital chain of a certain business group is in trouble, it is likely to have a great impact on the upstream and downstream business sectors of the enterprise.

Second, it is difficult to coordinate and manage resources of the whole industrial chain. Enterprises in the whole industry chain actually transform free trade in the commodity market into internal trade. Non-whole industry chain enterprises can often choose high-quality and inexpensive products in the free market, while enterprises in the whole industry chain must give priority to their own products, even if the products are inferior and expensive.

Third, it is difficult to coordinate the whole industrial chain. There are two development directions for the whole industrial chain. The first one is complementary, that is, all business segments of the whole industrial chain enterprise develop to produce the same product, which is usually directly managed by the group management, which is difficult to manage. The second type is independent and complementary, that is, all business segments of enterprises in the whole industrial chain not only develop to produce the same product, but also each business segment has a certain right of discourse in the free market and can operate independently, be responsible for profits and losses, but are jointly dominated and coordinated by the same group. Since independent and complementary enterprises of the whole industrial chain can be self-financing and independent operation, it is relatively easy to manage. But also because of self-financing, resulting in the market competitiveness of the enterprise is weak.

5. Samsung Semiconductor and its whole industrial chain process and challenges

5.1 Samsung Corporate Culture

Samsung believes it is its duty to improve people's quality of life and their love for life. As an enterprise, Samsung will continue to enhance technological innovation and product services, so that customers can feel fully satisfied, and promote the development of the common interests of mankind. Therefore, the whole industrial chain of products (semiconductors) will help Samsung make technological breakthroughs.

5.2 Samsung Staff and vendor management

GADALLA believes that Samsung also has something worthy of learning from other companies in terms of employee management, namely, performance-based employee management [8]. Jung believes that Samsung has taken an open and inclusive approach to personnel management. For example, we should respect the creativity and autonomy of employees, remove the institutional obstacles in the process of employee promotion, and establish an open and transparent management system; Jung also believes that Samsung takes performance as the basis for employee compensation and promotion, provides fair competition opportunities to all employees and boldly differentiates employee salary and promotion with performance [9]. It can be concluded that Samsung's competitive employee performance management method provides talent support for the development of the whole industrial chain of Samsung Semiconductor.
6. Samsung Semiconductor industry chain process

In 1970, Japan's GDP was second only to that of the United States, making it the world's second-largest economy. In order to prevent Japan from containing its economic threat to the U.S., the U.S. and Japan signed the Japan-U.S. Semiconductor Safeguard Agreement, which allowed Japan to disclose various intellectual property rights in semiconductors. In addition, the U.S. is fighting the Japanese semiconductor industry by supporting Korean semiconductor companies, including Samsung. By 1996, Samsung had become the world leader in semiconductors and had replaced Japan as the center of the world. The semiconductor industry chain can be roughly divided into four key points: Design, Foundry, Sealing, Testing, Storage and Equipment Samsung will continue to control the four semiconductor production key points and push forward the full industrialization of semiconductors step by step. The changed international environment had brought an opportunity for Samsung Semiconductor's development.

6.1 Design

According to PITTSBURGH, PA, July 07, 2022, Samsung Foundry will use Ansys's electromagnetic (EM) simulation tools to roll out 5G and 6G chip designs with chip, node, and process technology. At the same time, Samsung will use Ansys's design tools to shorten the design cycle for simple chips by two to three weeks and for complex chips by two months [10].

6.2 Foundry

6.2.1. Wafer fabrication

Wafer manufacturing is a complex process that involves embedding electronic components on a wafer circuit. Take the microprocessor as an example, the supply and demand is more than 100 channels. The basic processing steps are usually wafer cleaning, followed by oxidation and deposition processing, and finally repeated steps such as micrograph, etching and ion implantation, to complete the processing and fabrication of circuit on the wafer.

6.2.2. Wafer test

When the wafer is scratched, it becomes an integrated circuit, that is, a grid appears on the surface, and each grid is a Die. Wafers made on a wafer have the same specification, but it is possible to make wafers of different specification levels on the same wafer. Two tasks must be completed in wafer testing. The first is wafer acceptance testing, that is, to detect whether each wafer is qualified by Probe. In order to screen out the unqualified wafers when cutting the wafers, the unqualified wafers must be identified. Second, the electrical characteristics (such as power, etc.) of the chip are detected and grouped, and marked accordingly.

6.2.3. Wafer encapsulation

First, the cut wafer is attached to the Substrate with glue; Secondly, ultra-fine metal wire or conductive resin is used to connect the bonding pad of the chip to the pin of the frame liner, so that the external circuit is connected to the chip and becomes a specific specification of integrated circuit chip (Bin). Finally, the independent chip is encapsulated and protected by plastic shell to avoid the chip component being damaged by external forces. After Plating, they must Post Mold the Cure, Trim, Form and Plating on their Plating.

6.3 Chip testing

The encapsulated chip needs to pass the Burn in Test, including the Initial Test and Final Test, before performing an in-depth Test. The Initial Test is to Test the electrical characteristics (such as speed, frequency, speed, and power consumption) of the encapsulated chip in various environments. After the failure of the chip immediately pick out, with different levels of working chips. The Final Test converts the chip after the Initial Test between levels.
6.4 Finished product storage

The chips that pass the test need to go through the final processing, including laser printing, delivery inspection, finished product packaging, etc. before they are finally allowed to be stored.

6.5 Equipment

The lithography machine, which determines whether a chip can be made successfully, usually accounts for 30 percent of the equipment's total cost. Known as the crown jewel, lithography machines use unique glass and light sources to map the circuit of a chip, which is to project the designed circuit diagrams and transistors onto a silicon chip. At present, 3nm is the limit of EUV lithography. However, Samsung does not have the capability to develop and produce lithography machines at present; Samsung Semiconductor still relies on the support of its lithography suppliers. For example, Processes below 7 nanometres rely on extreme ultraviolet lithography, and ASML is currently the only manufacturer of extreme ultraviolet lithography in the world.

Samsung is pushing ahead with full semiconductor industrialization step by step. According to the report of Nihon Keizai Shimbun Chinese Edition, the business data of Samsung Electronics from April to June 2022 was released on July 28. The operating profit of semiconductor division increased by 44% compared with the same period last year, while the operating revenue of Samsung Group increased by 21% compared with the same period last year. The semiconductor division accounted for more than 70 per cent of operating profit, while net income rose 15 per cent [11]. Such strong profit growth of Samsung Semiconductor cannot be separated from the promotion of the whole industrial chain strategy.

7. The challenge of Samsung's whole industrial chain

The promotion of the whole semiconductor industry chain of Samsung is not very smooth. Besides the fact that the lithography machine depends on suppliers, Samsung also has serious problems in protecting the rights and interests of stakeholders.

According to Yonhap report from News Agency in Seoul on November 23, 2018, Samsung Electronics apologized on November 23, 2018 and paid for the leukemia caused by its semiconductor workers, thus ending the 11-year dispute between the semiconductor workers’ Health and human rights protection Organization and Samsung Electronics [12].

As early as 2017, Yu Mi Huang, who used to work in Samsung Electronics, died of acute myelocytic leukemia. In the same year, many of Yu Mi Huang’s patients also suffered from tumors of different degrees [13]. Park, Choi and Lee followed up on this event and found that Yu Mi Huang’s colleagues developed nine types of cancer; these include leukemia, Malignant Lymphoma, thyroid, ovarian and osteosarcoma [14]. Park, Choi and Lee found that 76% of patients were diagnosed with any form of cancer before the age of 40 and 60% of the patients were employed by Samsung Electronics in semiconductor production before 2000 through investigation of their entry time and age [14]. This led to a huge safety scandal at Samsung. Kim & Park believed that the semiconductor production of Samsung Semiconductor Company should be carried out in the wafer foundry, while the integrated circuit should be processed separately in the clean room of the production line. Employees may be exposed to organic solvents, toxic gases, photosensitive chemicals and other substances harmful to human health during clean room operations [15]. Kim & Park also found that even though there is a Financial Support Compensation (FSC) program to protect the interests of semiconductor workers in South Korea, it is difficult for semiconductor workers to prove that various chronic diseases, rare diseases and even cancers are directly related to their working environment [15]. Most semiconductor workers with rare diseases, including cancer, have been denied state compensation. Samsung, on the other hand, has not provided compensation to its employees, nor has it helped its employees get Financial Support Compensation (FSC) from the state. It can be concluded that Samsung ignored the legal rights of semiconductor workers in the process of integrating the semiconductor industry chain.
8. The suggestion of Samsung semiconductor whole industry chain development

Christopher believes that enterprises need to pay attention to upstream and downstream management; that is, to deal with the relationship between enterprises and customers and suppliers, so as to pay the highest value to the whole industry chain at the lowest cost [16]. Enterprise transparency is one of the most important determinants of enterprise development, especially in the context of social informatization and economic globalization [17]. Enterprises with higher degree of transparency tend to have advantages in free competition. For Samsung, although it has promised to safeguard the interests of all stakeholders in its development, it has not actively released the details. Kundeliene and Leitoniene believe that in the process of corporate transparency, the supervision of society and public opinion will put pressure on companies [18]. For Samsung, the division of labor will become more and more detailed in the process of the whole industrial chain, and the internal management of the enterprise will become more and more challenging. The enterprise often ignores the life safety of employees on the road of profit maximization. Transparent enterprises are always under the supervision of society and public opinion. Stakeholders can find unsafe production behavior or environment and remind enterprises to make rectification in time. At the same time, employees in transparent enterprises are more likely to guarantee their own rights and interests. When the feedback of internal problems fails to produce results, employees choose to accuse to the society, which can often get social attention, South Korean enterprises need bottom-up social supervision so as to better formulate and implement corporate social responsibility [19]. Therefore, Samsung needs to further promote corporate transparency while promoting the whole semiconductor industry chain.

9. Conclusion

Through research, this article finds that the whole industrial chain of Samsung semiconductor industry is the right strategic decision, so the continued implementation of the whole industrial chain policy can continue to bring breakthrough for Samsung in the context of the pandemic. However, the negative impact of the whole industrial chain cannot be ignored, especially in the aspect of production safety, which has a direct impact on the development of Samsung semiconductor. The whole industry chain has disadvantages that cannot be ignored. The reason is that with the promotion of the whole industry chain policy, the scale of enterprises will become larger and larger, and the management will become more and more difficult. This article suggests that enterprises strengthen the transparency of enterprises to realize social supervision, so as to force the health of employees to be guaranteed. The main contribution of this article is to fill the gap in the academic research on the whole industry chain of semiconductor enterprises, and to provide suggestions for the strategic decision-making of semiconductor enterprises in developing countries. The research of this article has some shortcoming, for example, it does not show the financial situation of Samsung Semiconductor over the years after the implementation of the whole industrial chain policy, which makes this article less convincing. In the future research, the author will analyze the financial situation of Samsung's semiconductor business, so as to further study the whole industrial chain of Samsung semiconductor.

Reference


