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Abstract

Samsung Electronics has emerged as the world's largest memory chip maker with a leading position in the DRAM and NAND flash markets. This paper explores and analyzes the key success factors of Samsung in the semiconductor industry using the dynamic capabilities framework. Based on literature review and case studies, the following five dimensions of dynamic capabilities were identified to explain Samsung's successful growth in semiconductors: 1) opportunity recognition and entrepreneurial insight by top management, 2) rapid catch-up through technology acquisition and learning, 3) leapfrogging competitors through product and process innovation 4) product line diversification leveraging existing capabilities and resources, 5) resource release through restructuring during the financial crisis. This study provides insights on the growth strategy of a latecomer firm striving for global leadership and illustrates the importance of dynamic capabilities in creating competitive advantage and sustaining growth.

JEL Codes: L63, M10, N80

Key words: Dynamic capabilities, Samsung, growth strategy, semiconductors

I. Introduction

Samsung Electronics has emerged as a world-class competitor in the semiconductor industry, challenging Intel's global market leadership (See Exhibit 1). Since 1993 it has achieved and maintained the leading market share position in the memory segment, capturing 41 percent of the DRAM market and 32 percent of the NAND flash market in 2010 (See Exhibit 2). According to market research firm IHS iSuppli, Samsung's chip revenues increased 59.1 percent in 2010, as DRAM sales expanded by 75 percent and NAND flash grew by 38.6 percent. In 2010 Samsung's semiconductor division accounted for 24 percent of Samsung Electronics' total revenues and generated 58 percent of its operating profit (See Exhibit 3). According to IHS analyst Dale Ford, "The rise of Samsung is one of the biggest stories of the last decade in the worldwide semiconductor market."

What explains Samsung's successful growth performance in the world semiconductor industry? What are the key drivers of success? Previous research examined Samsung's growth and success from the perspectives of technological learning(L.Kim, 1997), latecomer strategies(Cho, Kim and Rhee, 1998), combinative capabilities (Mathews and Cho, 1999), technological catch-up(Lee and Lim, 2001), first-mover advantage(Shin and Chang, 2006), organizational processes(Chang, 2008) and corporate life cycle(Michell, 2010). This paper provides an additional perspective by applying the dynamic capabilities framework developed in the strategic management literature. According to Teece, Pisano and Shen(1997), the dynamic capabilities framework tries to explain corporate success and failure by analyzing the mechanism of value creation and capture by firms operating in a dynamic environment. Dynamic capability refers to a firm's ability to renew its resource and capability base in response to environmental changes (Eisenhardt and Martin, 2000). Given

the rapidly changing business environment and the need for rapid and flexible response, the dynamic capabilities approach seems to provide a coherent framework for both academic research and managerial prescription.

This paper examines how Samsung was able to achieve rapid growth and sustain its competitive advantage in the semiconductor industry by exercising the various modes of dynamic capabilities. Based on literature review of dynamic capabilities and case studies of Samsung, the following five dimensions of dynamic capabilities were identified and used as conceptual framework to explain Samsung's success in the semiconductor industry.

1) Opportunity recognition and entrepreneurial insights by top management
2) Rapid catch-up through technology acquisition and learning
3) Leapfrogging competitors through product and process innovation
4) Product line diversification leveraging existing capabilities and resources
5) Resource release through restructuring during the financial crisis

This paper provides insights on the growth strategy of a latecomer firm striving for global leadership and illustrates the importance of dynamic capabilities in creating competitive advantage and sustaining growth. It contributes to the literature by identifying the five dimensions of dynamic capabilities, untangling the 'process black box' of dynamic capability theory, and provides a conceptual framework for explaining the success of latecomer firms from Asia.

The paper is organized as follows. Section 2 reviews the literature on dynamic capabilities. Section 3 is a case study of Samsung's growth strategy in the semiconductor industry

organized along the five dimensions of dynamic capabilities. Section 4 provides a summary of key findings and discuss implications

II. Literature Review

The concept of dynamic capabilities emerged in the 1990s in the field of strategic management to analyze the sources of firm success and failure in dynamic business environments. Teece, Pisano and Shuen(1997) define dynamic capabilities as “the ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments”. The dynamic capability approach tries to address the shortcomings of the resource-based view of the firm by emphasizing the dynamic and evolutionary nature of resource development and renewal. Given the rapidly changing nature of technology-intensive industries such as semiconductors, the development and exercise of dynamic capabilities are considered to be critical determinants of enterprise success or failure (Teece, 2007)

An extensive theoretical and empirical literature on dynamic capabilities now exists, but given the diversity of definitions and interpretations of terminologies, the concept remains fuzzy and needs clarification. Eisenhardt and Martin(2000) define dynamic capabilities as a set of specific and identifiable processes such as product development, technology transfer, alliance and acquisition routines that create value for firms. These capabilities are core processes that transform a firm’s resource base by creating, leveraging, integrating and releasing resources. They are not vague abstractions, and share common characteristics across effective firms that can be subjected to empirical testing (Eisenhardt and Martin, 2000).

Winter(2003) define dynamic capabilities as “those that operate to extend, modify or create ordinary capabilities”. Dynamic capabilities are different from ad hoc problem-solving in that they arise from deliberate learning and typically involve long-term investment in specialized resources.

Regarding typologies of dynamic capabilities, Wang and Ahmed(2007) identify three main components of dynamic capabilities. Adaptive capability refers to a firm’s ability to identify and capitalize on emerging business opportunities. Absorptive capability refers to “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal, 1990). Innovative capability refers to a firm’s ability to develop new products, processes and/or geographic markets. Using the extended case method, Danneels(2010) examines how Smith Corona exercised the various modes of dynamic capability including leveraging, accessing, creating, and releasing resources, which provides much insights into the process and operation of dynamic capabilities within a firm.

Empirical research highlights the role senior managers play in the management of various types of dynamic capabilities. Managers’ perception of their business environment and their judgment about the deployment of dynamic capabilities can be critical determinants of performance (Ambrosini and Bowman, 2009). In his study of NCR, Rosenbloom(2000) found that top management leadership played an important role in the evolution of dynamic capabilities and the firm’s cultural transformation. In their study of IBM, Harreld , O’Reilly and Tushman(2007) suggests that senior managers’ possession of two fundamental capabilities-- strategic insight and strategic execution—are at the core of dynamic capabilities at IBM. Teece(2007) finds that firms with strong dynamic capabilities are highly entrepreneurial and suggests a framework for analyzing dynamic capabilities which can be

decomposed into the capacity (1) to identify and shape opportunities and threats, (2) to seize and capture opportunities, and (3) to maintain competitiveness by enhancing and reconfiguring intangible and tangible assets. For each capability, he identifies the microfoundations of dynamic capabilities such as distinctive skills, processes and procedures(Teece, 2007).

Despite the abundance of research on dynamic capabilities, there are still ambiguities in the definition, typologies, determinants and consequences of dynamic capabilities that need to be clarified. Furthermore, most of the empirical research has been conducted in the context of Western firms in developed countries. Some exceptions are Mathews(2002) who examined the case of latecomer firms from the Asia-Pacific region and developed a strategic theory of catch-up based on linkage, resource leverage, and learning. Previous research examined Samsung's successful growth from the perspectives emphasizing the dynamics of technological learning(L.Kim, 1997), latecomer strategies(Cho, Kim and Rhee, 1998), combinative capabilities(Mathews and Cho, 1999), technological catch-up(Lee and Lim, 2001), first-mover advantage(Shin and Chang, 2006), organizational processes(Chang, 2008), and corporate life cycle(Michell, 2010). There is a need to develop a more comprehensive and coherent framework that integrates the existing literature and explain the dynamic growth performance of East Asian firms. This study tries to fill the gap in research by examining how Samsung applied the various dimensions of dynamic capabilities to achieve and sustain competitive advantage in the world semiconductor industry.

III. Case Study of Samsung Electronics

This section examines how Samsung was able to achieve rapid growth and competitive advantage in the semiconductor industry using the dynamic capability framework. Based on literature review of dynamic capabilities and case studies of Samsung, the following five dimensions of dynamic capabilities were identified and used as conceptual framework for the case study: 1) Opportunity recognition and entrepreneurial insight, 2) Technology acquisition and learning, 3) Product and process innovation, 4) Resource and capability leverage, 5) Resource release through restructuring.

The period covered in the case is from 1983 to 2010. Data was collected from publicly available sources such as books, articles, case studies, industry reports, company history, and selective interviews with industry experts.

1. Opportunity Recognition and Entrepreneurial Insight

The ability to recognize and seize emerging business opportunities is an important element of dynamic capabilities (Teece, 2007; Harreld et al. 2007; Wang and Ahmed, 2007). Opportunity creation requires both access to information and entrepreneurial insights(Teece, 2007).

In the case of Samsung, the decision to enter the semiconductor industry was formally announced on February 8, 1983 by Chairman Lee, Byung-Chul. The decision, known as the “Tokyo Declaration”(as it was announced in Tokyo), is considered a turning point in the history of Samsung(Samsung Electronics, 1999). Chairman Lee viewed the semiconductor business as the “rice” of high-tech industries and a strategic platform for upgrading

Samsung's business portfolio. Despite widespread concerns and negative opinions about its likely success, he relentlessly pursued his vision, making bold investment and demonstrating his personal commitment.

How did Chairman Lee recognize the opportunity? Where did he get the insight? Historical data seems to indicate that the decision-making process was more an "emergent" process influenced and shaped by multiple factors over time.

First, government policy to promote the electronics and semiconductor industry was an important factor in Chairman Lee's decision. In December 1980, under the leadership of the Blue House, a task force team was formed to develop a blueprint for Korea's electronics industry. The key highlight of the task force team's recommendation was to promote and upgrade the electronics industry with particular focus on the semiconductor, computer and telecommunication equipment as the top three strategic industries(Electronics Industry, 2009). Even though specific details like products, technologies and financial support were not decided, the report provided a broad direction and guideline for government policy-makers, and had an influence on Chairman Lee's decision to enter the semiconductor industry.

Second, Chairman Lee's broad network and connection in Japan played an important role in identifying new trends and opportunities. Chairman Lee considered Japan as a good role model and frequently visited the country to monitor trends and discuss business opportunities with personal friends and industry experts. He was deeply impressed with how Japan was able to overcome the oil shock and record a huge trade surplus by moving into high value-added, high-technology sectors such as semiconductors, computers, new materials, biotechnology and aerospace. Looking at Japanese companies' success in the world market, he was strongly convinced that a resource-poor country like Korea should focus on brain-intensive, high-tech sectors and catch-up with Japan.

Third, Chairman Lee's third son, Kun-Hee Lee(who is now the Chairman of the Samsung Group) was a strong advocate for the semiconductor business. Kun-Hee Lee was an avid technology fan with an inquisitive mind, benchmarking competitors' products and keeping up with the latest technology trends. While exploring new business opportunities for Samsung, he was attracted to the future growth potential of the semiconductor business, and thought that it was a good fit with the Korean people and Samsung culture, given the high level of skills and discipline needed for success. In 1974, he used his personal money to acquire a 50 percent stake of Korea Semiconductor Company, a struggling IC chip maker and put significant effort to turnaround the company. He arranged company visits for his father with US and Japanese electronics companies to see the business first-hand, and persuaded his father on numerous occasions on the attractiveness of the semiconductor business. Certainly, the father-son relationship and the combined insights of the two people played a critical role in Samsung's entry into semiconductors.

Fourth, to develop a better understanding of the market, Chairman Lee commissioned a task force team to conduct market research and investigate the feasibility of entry. The team worked days and nights collecting industry data from Samsung's overseas branches and conducted interviews with industry experts in academia and research institutes. However, given the lack of sufficient information in Korea, a second task force team was sent to Silicon Valley to develop a more detailed business plan. After much thorough investigation and field work, the team produced a final report recommending entry into the memory segment with major investment in large-scale VLSI production in Korea over the next five years and establishing an overseas R&D center in Silicon Valley to develop new products and run pilot production. There was much debate about which product lines(DRAM, SRAM, EP Rom, Mask Rom) to emphasize, but final decision was made by Chairman Lee to focus on

the DRAM market. Despite the high risk and intense competition in the DRAM market, Chairman Lee thought that Samsung had a better chance of success in this market where it could leverage its traditional strength in low-cost, mass production skills and catch-up with the Japanese. Furthermore, the market had high growth potential given huge PC demand and required large investment but relatively short payback period. Despite heavy losses in the first four years, Chairman Lee committed more than $500 million in production facilities and R&D, laying the foundation for success before he passed away in 1987.

2. Technology Acquisition and Learning

The external acquisition of technology and learning is an important dimension of dynamic capabilities, especially for latecomer firms(Mathews, 2002). Complementary resources and capabilities can be acquired from external sources and combined with internal resources in a dynamic process of organizational learning(Mathews and Cho, 1999). Despite its lack of technological capability in semiconductors, Samsung was able to rapidly develop its capability through external acquisition and assimilation of technologies from multiple sources. Samsung used a variety of channels such as joint ventures, acquisitions, technology licensing, overseas R&D center, equipment suppliers, and part-time consultants to rapidly access and internalize the technologies.

Samsung's experience in mass-production of consumer electronics provided the platform for its entry into semiconductors. In 1968, Samsung established joint ventures with Sanyo and NEC to produce TV, radio, and other basic electronics components. In 1969, 137 newly hired Samsung personnel were sent to Japan for training at Sanyo and NEC. Even though the technology transferred was very rudimentary, Samsung was able to gain valuable experience

and knowledge in the production of basic consumer electronics products.

In 1974, Samsung acquired a 50 percent stake in Korea Semiconductor Company, a struggling venture start-up producing linear IC and transistors. Samsung acquired the failing venture to secure its own supply of IC chips and as a stepping stone for gaining experience in semiconductor manufacturing. In 1978, the company became a wholly-owned subsidiary of Samsung Electronics and successfully developed chips for electronics watches and color TVs. In 1982, the Semiconductor R&D center was established to conduct research on VLSI technology and metal oxide semiconductor(MOS), laying the foundation to assimilate VLSI technology.

To secure DRAM technology, Samsung approached several Japanese companies, but was turned down, as they feared Samsung might emerge as their potential competitor. In 1983, Samsung was able to buy 64K DRAM designs from Micron Technologies, a small US semiconductor company based in Boise, Idaho. A team of eight Samsung engineers was sent to Micron for technology training. In 1983, Samsung successfully developed 64K DRAM using Micron Technologies design, dramatically shortening development time to six months.

In 1983, Samsung established an R&D center in Silicon Valley to monitor the latest technology trends, conduct initial product/process development, recruit new engineers and train the Korean staff. Samsung recruited more than 20 high caliber Korean engineers working in US high-tech companies or academic institutions. They were lured with an attractive compensation package, promotion opportunities, and a sense of mission to serve the nation through technology. Many of them played a critical role in transferring their tacit knowledge and leading the development of each successive generation of new products.

Other modes of technology acquisition were technology transfer from equipment suppliers, “moonlighting” Japanese technical consultants and retired engineers, and participation in

government-sponsored R&D consortium to develop next generation technologies and standards. As such, Samsung pursued “open innovation” to acquire technologies from outside using a variety of channels and combined them with their internal capabilities to rapidly catch-up with competitors.

3. Product and Process Innovation

The development of new products and processes through innovation is at the core of dynamic capabilities. Exhibit 4 shows Samsung’s product development history for each generation of DRAM products. Given the short product life-cycle of each successive DRAM products, speed and timing was critical in the memory business. Samsung used a variety of methods to compress time for new product development and mass production. For example, to prepare for the launch of 64K DRAM, Samsung set an aggressive target of completing construction of its fab within six months, a task that normally takes more than 18 months in the U.S. and Japan. Working 24 hours in a crisis mode and in close collaboration with equipment suppliers, the fab was completed in six months, narrowing the estimated five year gap with Japanese competitors to two years. In developing the 64K DRAM and 256K DRAM, Samsung established two competing product development teams, one in Korea and the other in Silicon Valley. The internal competition and collaboration across global R&D sites created intense pressure to deliver results and to shorten the development time(L. Kim, 1997).

While the 64K DRAM and 256K DRAM were developed with licensed technologies, Samsung intensified its R&D efforts and developed the 1M DRAM with its own design and process technologies. To narrow the gap with Japanese competitors, it prepared the mass

production system in parallel with R&D work and began mass producing the 1M DRAM one year after Japanese firms. A national consortium was formed in 1986 to develop the 4M DRAM in collaboration with LG and Hyundai. Over three years(1986-1989), Samsung registered fifty-six patents related to the 4M DRAM and completed the design only six months after Japan(L. Kim, 1997).

Samsung caught up with the Japanese competitors with the introduction and mass production of 16M DRAM in 1990, and went ahead of them with the development of 64M DRAM in 1992, 256M DRAM in 1994, and 1 Giga DRAM in 1996. Since then, Samsung maintained the dominant position in the memory market, leading at the forefront of next-generation memory chip technology. Samsung's aggressive concurrent development practice is considered a key factor in compressing time-to-market. Technology and product development was planned for two or three generations ahead. For example, when 16M DRAM was in the market, plans were set up for 64M DRAM and 256M DRAM. Tight integration of design and production was achieved through the effective use of cross-functional task force teams. Design and production engineers participated in all phases of the development process, sharing information and resolving problems quickly by carrying out activities simultaneously rather than sequentially(Shin and Chang, 2006). The co-location of R&D and production at a single site in Giheung facilitated close interaction and collaboration, significantly reducing communication and coordination costs(Siegel and Chang, 2009).

Despite the high risk and cyclical nature of the memory business, Samsung made aggressive, sustained investment in R&D and production facilities. Exhibit 4 shows the rising development cost for each generation of DRAM products. Exhibit 5 indicates the rising cost of building a leading edge fab. Samsung invested heavily in economic downturns when other competitors were reducing their investment, and reaped considerable profits when the

industry experienced an upswing in demand. In 1993, for example, Samsung took the risk of investing more than $1 billion in 8-inch diameter wafer processing technology, being the first in the industry to move from 6-inch to 8-inch mass production(Samsung Electronics, 2010). Despite the high risk involved, the decision paid off, resulting in significant market share gain and productivity improvement. Such bold investment in high-uncertainty situation was made possible by the presence of a strong leadership and owner-controlled corporate governance system, which enabled long-term investment horizon and rapid decision-making(Chang and Podolny, 2002).

4. Resource and Capability Leverage

Leveraging resources and capabilities enables a firm to diversify into new product/market domains by sharing its resources and applying them to new uses (Danneels, 2010). In the case of Samsung, resource and capability leverage can be seen in its successful diversification into flash memory and TFT-LCD.

Having achieved market leadership in DRAM, Samsung searched for a new growth engine, and focused on the emerging flash memory market. It set a bold objective of overtaking Toshiba and rejected their joint venture offer, deciding to go-it-alone. In 1994, Samsung succeeded in producing a 16 megabit NAND flash chips at the same time as Toshiba. Through faster increases in bit density and relentless cost and efficiency improvement, it eventually overtook Toshiba in 2002, a position it retained in 2010. Due to the similarity of the technology and production processes, flash memory could be manufactured using DRAM production lines with only small changes in equipment, saving

significantly the cost of building a new flash line(McKern and Tayan, 2009). With the convertibility between DRAM and flash memory lines, production mix could be optimized and capacity adjusted quickly in response to changes in demand. As a result of product diversification, it was positioned as the only provider of a total memory solution(including DRAM, SRAM, NAND flash, NOR flash, and multi-chip packages), which gave it a competitive edge with customers(McKern and Tayan, 2009)

Resource and capability leverage was also evident in the case of Samsung's diversification into TFT-LCD. In 1991, the TFT-LCD business was transferred from Samsung Display Device to the semiconductor division of Samsung Electronics. After spending four years in R&D, mass production began in 1995. In 1998, just three years after it started its TFT-LCD business, Samsung captured the largest market share in the world, introducing new products ahead of Japan. Since then it retained its world leadership position. According to Park, Choung and Min(2008), technological capability accumulated in DRAM and key human resources were transferred to the TFT-LCD business. In particular, R&D capability and funding, operations management and quality control systems, strategic investment decision know-how, and the ability to organize and manage a skilled workforce were all transferred from the semiconductor business to TFT-LCD, resulting in significant synergies (Park, Choung and Min, 2008).

5. Resource Release through Restructuring

Releasing resources by shedding or dropping resources is another mode of exercising dynamic capability(Eisenhardt and Martin, 2000). The restructuring of a firm's set of

resources may involve selling assets, laying off people, outsourcing, and offshoring.

In 1997, Samsung's financial situation deteriorated as a result of the huge decline in the price of memory chips and the onset of the Asian financial crisis. Net profits of the company decreased from $2.8 billion in 1995 to $87 million in 1997. Samsung turned this crisis into an opportunity by restructuring its business operations, streamlining costs and reducing its debt. In the domestic market , 34 non-core businesses were identified and divested to generate cash flow, including the power device division at Bucheon and joint venture equity stakes at Hewlett-Packard Korea and Samsung-GE Medical System. 30 percent of the domestic workforce was laid-off through early retirement and outsourcing(Samsung Electronics, 2010). Several low value-added functions such as logistics, business services, domestic retail distribution and part of the design function were outsourced by selling the company's assets to employees on concession. In the overseas business, 13 money-losing operations including AST, IGT, SMS and the joint venture with Texas-Instrument in Portugal were divested, and 40 percent of the workforce was laid-off. In addition, significant effort was made to streamline overhead and administrative costs, reduce inventory and account receivables, improve productivity through product, process and personnel innovation. As a result of this major restructuring, net profits increased by 254 percent in one year and debt/equity ratio fell from 300 percent in 1997 to 85 percent in 2000. By releasing resources through timely restructuring, Samsung was able to refocus on its core semiconductor business, achieving global market leadership and record profits in subsequent years

IV. Conclusion

This paper has examined how Samsung was able to achieve and sustain global leadership in the semiconductor industry by applying the various modes of dynamic capabilities. The study provides insights on the growth strategy of a latecomer firm striving for global leadership and illustrates the importance of dynamic capabilities in creating competitive advantage and sustaining growth. It contributes to the existing literature on dynamic capabilities by identifying the five dimensions of dynamic capabilities and examining how dynamic capabilities are exercised in the case of an Asian latecomer firm. The following insights can be derived from the Samsung case study:

First, opportunity recognition and entrepreneurial insight is an important dimension of dynamic capability. In the case of Samsung, Chairman Lee, Byung-Chul was able to sense and seize emerging business opportunities in the semiconductor industry by monitoring trends in government policy, benchmarking Japanese companies, listening to the voice of product champions inside the company, and conducting market research and feasibility studies to complement his business insights. Final decision to focus on the DRAM segment was based on the leader's accurate assessment of the strengths and weaknesses of Samsung at that time as well as his insights on market and technology trends.

Second, despite its lack of technological capability in semiconductors, Samsung was able to rapidly catch-up with existing competitors through the acquisition and assimilation of technologies from multiple sources. Samsung used a variety of channels such as joint ventures, acquisitions, technology licensing, overseas R&D center, talent recruiting, equipment suppliers, and part-time consultants to acquire external technologies and combine them with their internal capabilities.

Third, Samsung was able to leapfrog competitors through rapid product and process innovation. It intensified its R&D efforts and compressed time for new product development and mass production through concurrent development. Tight integration of design and production was achieved through collaboration in cross-functional task force teams and the co-location of R&D and production at a single site. Samsung invested heavily in economic downturns and high-uncertainty situation. Such bold and large-scale investment was made possible by the presence of a strong leadership and owner-controlled corporate governance system which enabled long-term investment horizon and rapid decision-making.

Fourth, having achieved market leadership in DRAM, Samsung leveraged its existing resources and capabilities to diversify into new product categories such as flash memory and TFT-LCD. In the flash memory business, it was able to share the DRAM production lines with only small changes in equipment, saving significantly the cost of building a new fab line. In TFT-LCD, it was able to achieve world leadership quickly through bold investment and by transferring technological capabilities, key human resources, and other management skills such as quality control programs and timely investment strategies, from the DRAM business.

Fifth, releasing resources through restructuring is another mode of exercising dynamic capability. Samsung responded to the Asian financial crisis by streamlining costs, selling non-core businesses, laying off employees, outsourcing and moving operations abroad. By releasing resources through timely restructuring, Samsung was able to refocus on its core semiconductor business and achieve record profits.

Finally, the five dimensions of dynamic capability examined in this paper provide insights by opening up and untangling the ‘process black box’ of dynamic capability theory. It contributes to the literature by providing a conceptual framework for explaining the success of latecomer firms from Asia. Further research is needed to integrate the theoretical

literature on dynamic capabilities with empirical cases of emerging market companies.

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Exhibit 1: Top 10 Semiconductor Suppliers in 2010

Rank	Company	Country	Revenue ($billions)	Market Share (%)
1	Intel	USA	40.0	13.2
2	Samsung Electronics	Korea	28.1	9.3
3	Toshiba	Japan	13.1	4.3
4	Texas Instruments	USA	12.9	4.3
5	Renesas Electronics	Japan	11.8	3.9
6	Hynix	Korea	10.6	3.5
7	ST Microelectronics	France/ Italy	10.3	3.4
8	Micron Technology	USA	8.8	2.9
9	Qualcomm	USA	7.2	2.4
10	Elpida Memory	Japan	6.7	2.3

Source: iSuppli Corporation

Exhibit 2: Market Share in Memory Semiconductors (2010, 4th Q)

DRAM

Rank	Company	Market Share (%)
1	Samsung Electronics	41.3
2	Hynix	20.9
3	Elpida	13.4
4	Micron	12.1
5	Nanya	4.3

NAND Flash

Rank	Company	Market Share (%)
1	Samsung Electronics	32.3
2	Toshiba	22.4
3	SanDisk	16.4
4	Micron	12.0
5	Hynix	10.3

Source: Gartner, 2011

Exhibit 3: Samsung Electronics – Selected Financial Information (2010)

(Unit: Trillion Won)

		% of sales
Sales	154.63	100%
Gross Profit	51.96	33.6
R&D Expenses	9.10	5.9
SG&A Expenses	26.24	17.0
Operating Profit	17.30	11.2
Net Profit	16.15	10.4

Segment Information

(Unit: Trillion Won)

Business	Sales	Operating Profit
Semiconductor	37.64	10.11
LCD	29.92	1.99
Telecom	41.20	4.30
Digital Media	57.26	0.49
Total	154.63	17.30

Source: Samsung Electronics

Exhibit 4: Samsung's Product Development History of DRAM

	Year	Development Cost (100 million Won)	Development Time (Months)	Time Gap vs. Japan
64K	1984	7.3	10	4 yrs. behind
256K	1985	11.3	9	3 yrs. behind
1M	1986	235	15	2 yrs. behind
4M	1988	508	20	6 months behind
16M	1989	617	26	Same time
64M	1992	1,200	26	Ahead
256M	1994	1,200	30	Ahead
1G	1996	2,200	29	Ahead

Source: Samsung Electronics 30-year History

Exhibit 5: Cost of Building a Leading-edge Fab

Year	1983	1990	1997	2001	2007
Wafer (inches in diameter)	4	6	8	12	12
Linewidth (microns)	1.200	0.800	0.250	0.130	0.065
Cost (US$ millions)	$200	$400	$1,250	$3,000	$5,000

Source: Adapted from Hurtarte et al. (2007)

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