Business Management and Strategy
ISSN 2157-6068
2010, Vol. 1, No. 1: E3

Quality is Not Strategy, It's just "Surplus Quality": A Review of the Successes and Failures of "Choose and Focus" strategies in the Japanese Semi-Conductor Industry

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Received: July 3, 2010 Accepted: July, 15, 2010 DOI: xx.xxxx/yyy.yyyy.yy

Abstract

Japan was once the leader of the world semiconductor industry. Not long ago, Japan was forced to exit the largest segment of the industry (Dynamic Random Access Memory – DRAM) due to a sustained lack of profitability. In this paper we briefly examine why Japan lost a key position in the industry, where and why Japan remains strong in other segments and why Japan must apply the new rules of corporate governance to gain a competitive edge in the emerging System-On-Chip (SoC) market.

Keywords: Quality Control, Destructive Competition, Product Management, Choose and Focus Strategy, Path Dependence, Japanese Semi-Conductor Industry

Introduction

In describing the success of Japanese corporations, many authors invoke market leaders, such as SONY (Suarez and Lanzolla, 2001; Eisenmann, 2003). However, SONY is probably a poor choice. Porter (1996) argues that the problem with Japanese firms lay not with leaders in innovation like SONY, but rather with the average Japanese firm which was content to duplicate its rivals' plant layouts, manufacturing processes, value chain and market entry approaches. His early criticism of Japanese firms focused primarily on their strategy of quality control, a strategy that forced these firms ultimately to engage in destructive competition. However, even with market leaders, excessive competition can provoke unintended market consequences, particularly if a market is the type where early market entry may lead to occupying the entire market niche (Modis, 1998). As Eisenmann (2003) remarks:

"…The stakes can be enormous when firms race to acquire customers: if winners take most, little is left for losers. In extreme cases, racing can yield disastrous results for all parties. This was true for many industries in which firms pursued learning curve strategies. After cutting prices, these firms found it difficult to gain sustainable cost advantages. Often they were unable to keep their learning proprietary due to technological spillovers: competitors copied their new and improved techniques."

Eisenmann treats this problem in typical economic fashion, describing customer acquisition as a convex curve with characteristics similar to those of classical pollution abatement problems (see figure 1). However, Porter (1996) suggests additional considerations that indicate, in at least a graphical sense, the different elements required for sustainable advantage (see figure 2).

Eisenmann is not insensitive to Porter's analysis, and his approach is to catalogue the standard requirements for competitive advantage as factors that increase customer acquisition cost. He sees the main pitfall of the customer race, or the race for first mover advantage to arise from attempts to broaden a company's products beyond the core demand characteristics of the bundle of goods and services most likely to appeal to its customers. Understanding the structure of these bundles is not prima facie difficult. In figure 2 we have developed a simplified chart designed to express the tradeoffs between price and quality that Porter explores more fully in his cost-focus matrix. Porter's more complex underlying argument however, is that, for a firm's competitive strategy to succeed in the long run, it must achieve above-average profitability. In order to do this, the firm requires a more complex competitive strategy, based on a more nuanced set of tradeoffs between cost and focus.

Porter also argues, familiarly and quite reasonably, that focusing solely on increasing operational efficiency has the industry-wide result of pushing out the production frontier, thus improving corporate performance in every dimension of the firm except profitability (Porter, 1996) as shown in figure 3 below.

Goal and Methodology

Our first goal is to determine fundamental causes for over-quality problems, as well as reasons for the lower competitive advantage, experienced in the Japanese semi-conductor industry. As a result, we may be able to revise current arguments about competitive advantage in international business based on quality control. The emphasis on quality control was a major competitive advantage during the post-war Japanese miracle, helping Japan to become a world economic power. However, Japanese companies must now examine how to maintain a competitive advantage in order to deal with continual changes in international markets. Our second goal is to develop a transitional process of locked-in competitive advantage, based on a path-dependence argument. We hope this paper will be a basis for future field studies on this issue. Our research for this paper relies exclusively on intensive literature reviews of existing empirical and theoretical articles. This is because there is a lack of various empirical studies, no doubt due to the newness of this issue in international business. Additionally, this paper will be used as a basis for future empirical research by the authors. We hope this paper provides a strong theoretical framework that generates fundamental questions for future study in this area.

Japanese Firm Strategy in the Semi-Conductor Industry

Most analyses of Japanese firm strategy in the semi-conductor industry have focused on traditional market dynamics rather than the more technical aspects of semi-conductor manufacturing. Following the analysis of Yunogami (2006), we would argue that such an approach produces a misleading picture of the industry. This in turn has led to unnecessary investment in non-productive innovation and performance capabilities, and ultimately forced Japanese firms to exit the DRAM market, where once they were the unchallenged industry leader. Yunogami's fundamental hypothesis, which is highly consonant with Porter's critique of the "shop floor layout imitation strategy," is simply that, in conjunction with inherently historical group behavior, Japanese firms produce semi-conductors with "surplus quality".

This position is consistent with the general point of this paper that quality improvements, no matter how consistent, do not constitute a business model or a business strategy. A major disadvantage of this surplus quality is that it invokes additional costs at all three levels of the silicon wafer manufacturing process: elementary process technology, integration process technology and mass production quality (see figure 4). The imposition of these additional costs has made Japanese manufacturers unable to compete with Korean and Taiwanese rivals as well as rival production schemes such as semi-conductor foundries. Semi-conductor foundries, of which 60% are located in Taiwan, account for one-fourth of all semi-conductor production (Shimizu, 2006). These semi-conductor foundries are implementing new models of product development such as "fabless production," in which the manufacturer handles the innovation and design elements of production and outsources the actual fabrication.

Path Dependence and "Surplus Quality" in Japanese Semi-Conductor Manufacturing

When Japan entered the semi-conductor industry in the 1970's the primary market was mainframe computers and the primary problem was quality. As Yunogami explains:

…pursuit of the utmost in elementary process technology and high quality DRAM led to the formation of the technological culture during the late 1970s and through the 1980s at the Japanese semiconductor manufacturers. This technological culture was also the driving force behind the competitive strength of the Japanese semiconductor manufacturers. It made perfect business sense and it was now common that the users requested high quality DRAM. As the result, the constant drive to extend the limits in elementary process technology producing higher quality DRAM was not questioned and eventually became the norm.

The problem with this approach is that it became difficult to change the attitude of design engineers and production facilities designers, even though the market for end use profoundly changed. Attitudinal change among these designers was further dissuaded by the proprietary nature of most semi-conductor manufacturing processes. A few simple examples of this problem relate to the length of the product life-cycle. As the market has evolved from main-frame computers to personal computers and servers (Yoshioka, 2004), the product life-cycle has shrank on a steady basis. Even within the personal computing market, Intel's 8086 micro-processor chip had a product life-cycle of nearly five years. The 80286 had a product life-cycle close to three years. The 80386's aborted product life-cycle lasted only about one of its estimated two to two and a half years because of early replacement by the 80486 and the change from hardware driven architectures to software driven architectures. DRAM chips and other semi-conductor products followed a similar pattern, although the elements which changed were somewhat different. Additionally, DRAM chips may have been initially easier to incorporate in the previously mentioned three-step manufacturing process, being less dependent upon software changes and more nearly a function of manufacturing process technologies.

However, Japanese semi-conductor firms largely missed the paradigmatic nature of this shift. One of Yunogami's best examples of "excess quality" has to do with the engineered lifespan of the product. In this case, a quality consistent with Porter's criticism that imitative firms, in this case, firms which are deeply locked into "sticky investment" (Aoki, 2001), are improving performance on every dimension except profitability. The particular case discussed by Yunogami has to do with the performance lifespan of Japanese semi-conductors. While mainframes could be expected to remain in use for a decade (many third-world countries' banking systems still run on mainframes which are over twenty years old), the bulk of the recent computing market has consisted of small computers and devices that have a product life cycle of two to five years. Continuing to over-engineer semi-conductor products so that they last for ten years in products only intended to last a short fraction of that time imposes significant costs on Japanese semi-conductor manufacturers as compared to their "lower-tech" Taiwanese and Korean competitors. As Yunogami explains from his interviews with semi-conductor engineering personnel:

A Japanese engineer proudly commented on his company's mass-production factory overseas saying, "Only our factory can guarantee the quality of DRAM for over ten years." (Interview G). It should be noted that it is a sign of a high level of mass-production technology to produce DRAM at a mass-production factory overseas with a 10-year warranty. However, if the main user for DRAM is PCs, it is a sign of excessive quality. There is no need to produce DRAM with such a quality that it merits a 10-year warranty for personal computers.

Other issues haunt the Japanese semi-conductor industry, also. One problem is, the greater the initial quality and complexities of the manufacturing process, the lower the initial yield from new facilities. However, yield is often the modern driver of value in semi-conductor manufacturing. Yunogami argues that the emphasis of Japan's other Asian competitors is to raise the yield at start-up. However, Japanese firms still follow the historical pattern of attempting to raise both yield and quality at startup. In a market that no longer demands these attributes from the product, this is a profitability disaster. Again, a typical example of problems that arise from this approach is the Japanese focus on new technologies. Yunogami's interviewees indicated that Japanese firms routinely want to incorporate new technology whenever they build a new plant, but that other Asian semi-conductor manufacturers will only add new technology if it leads to a rise in the yield. The Japanese emphasis on new technology and technological excellence (where it is not demanded by the customer) pushes Japanese production out towards the right hand side of the curve in Figure 1, and actually destroys rather than creates value. This is a near-perfect example of why "quality is not strategy". Yunogami summarizes this for us in figure 5 arguing that, instead of thinking about quality only along the single dimension of improved performance, the right approach to technology in the semi-conductor industry is to attain a market-driven balance in the use of technology for product improvement with the use of technology for the reduction of cost.

Choose and Focus – A Different Approach

In her 2008 book, "Choose and Focus: Japanese Business Strategies for the 21st Century", Ulrike Schaede argues that Japan's economic recovery was largely driven by a combination of corporate reorganization and specialization. She reports a general movement to smaller, more efficient boards for large corporations. In fact, 75% of firms have undergone reorganization with many moving away from the large holding company model to spin-offs of firms engaged in more specific activities or groups of activities (Schaede, 2008).

Whether or not Japan will re-enter the chip market as a technology leader is unknown. The stated industry intent is to enter with new, next-generation, SoC (nanotechnology level, "system on chip", high intellectual property content) devices. This entry will depend largely on the ability of the industry to restructure, develop an enhanced sensitivity to market demand and the continuously changing nature of applications, the ability of firms to reorganize along the lines Schaede both describes and prescribes for competitive success. The Development Bank of Japan suggested four dimensions along which SoC manufacturers must improve if they are to obtain a competitive advantage in this new market (Shimizu, 2006): (Note 1)

(1)Refocus their operations on design and marketing
(2)Participate actively in global alliances
(3)Rebuild their relationships with final set product departments
(4)Overhaul corporate management, organizational control and personnel evaluation

All of these recommendations are consistent with the pattern of reorganization that Schaede observes for more competitive firms in the 2002-2006 period. These are also the same reforms that she and others consistently recommend for developing new competitive strategies for Japanese firms.

Japanese Semi-conductor Packaging Materials Firms

Not all Japanese firms in the semi-conductor manufacturing business followed the path of "excess quality" and production for use beyond the product life cycle. In particular, Japanese firms in the packaging segment of the global semi conductor industry continue to dominate this aspect of the industry, most likely because they do not suffer from the hysteresis associated with the DRAM market. In particular, Vardaman (2010) cites the following firms as industry leaders:

This industry, while small by comparison with the DRAM segment, still represented a $15.8 billion packaging market in 2009 (approximately 8% of the overall industry). This occurred at a time when the overall semi-conductor industry was shrinking, and is expected to suffer a 16.8% decline in 2009, following a 4.4% decline in 2008.(Note 2)

Most interestingly, while SoC is the difficult future of the industry, Japanese firms have captured a steady "bread and butter" segment of the industry, precisely when increased investment in DRAM technology would likely have been a disaster. Unlike, the 2001 DRAM crisis, which was driven by excess inventories, the current crisis is one of overproduction. According to Gartner's December 26, 2009 report "The DRAM market is so bad that suppliers must either significantly scale back supply, or the weaker players will be forced into mergers or bankruptcy." In this context, Japan's early exit from the DRAM market may actually prove to be in its long-term interests, despite "projected" better returns for 2010 and 2011.

Conclusion

Once the leader in the world's DRAM industry, Japan destroyed its own profitability by directing "excess quality" and excess investment of both tangible and intangible resources in directions that were no longer consonant with market structure. In the aftermath of the Japanese DRAM collapse, two kinds of markets offer substantial opportunity. One is "bread and butter" technology accessory and adjunct products and services, which by their very nature demand that suppliers remain in close touch with the market and are able to adjust their production specifications to market demands. This type of industry is exemplified by the semi-conductor packaging industry.

The other emerging opportunity for Japanese industry to regain its world leadership position in semi-conductors is the nascent SoC industry. In this context, because of the need for joint ventures, sharing of intellectual properties and managing, leasing and licensing core competencies rather than owning them in their entirety, the new kinds of corporate structure discussed by Schaede et. al. may provide an appropriate corporate governance platform for allowing a healthy SoC industry to develop in Japan. If that industry can focus its quality and technology where it is most needed, rather than using it in an imitative or habitual fashion, Japan may once again emerge as a market leader.

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Glossary

DRAM: Dynamic Random Access Memory

SoC: System-On-Chip

NPV: Newt Present Value

Note 1. The Report (Report 57, 2006) argues, "it is difficult for a company to design and develop an SoC on its own because of the huge volume of IP integrated on one chip. Since the decision on "what to make" is a major factor of differentiation, success depends not only on process technologies but also on skills in designing, developing and marketing.

Note 2. A back to back annual shrinkage experienced for the first time in history.

Business Management and Strategy
ISSN 2157-6068
2010, Vol. 1, No. 1: E3

Appendices

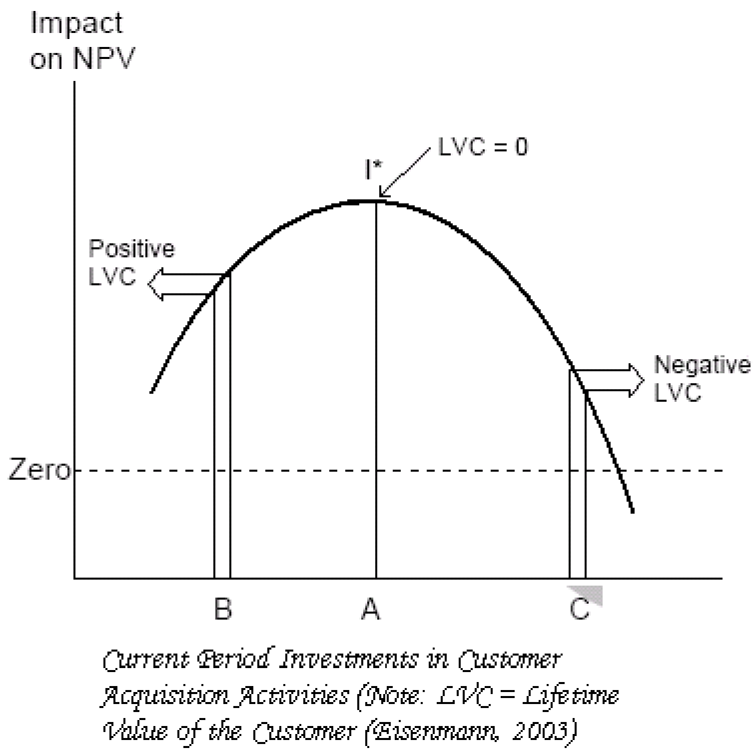

Figure 1. NPV Impact of Investments in Customer Acquisition

FOCUS \ COST	Hi	Lo
Hi	**Niche Products**	**Extraordinary Returns** **The MICRO$OFT position**
Lo	**Bankruptcy** **No Sustainable Advantage**	**Mass Market Products**

Figure 2. The Simplified Cost-Focus Matrix

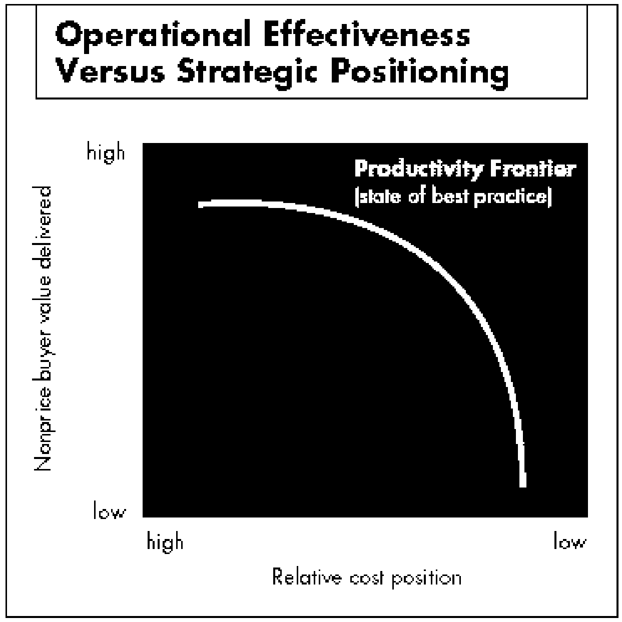

Figure 3. Destructive Competition and the Productivity Frontier (Porter, 1996)

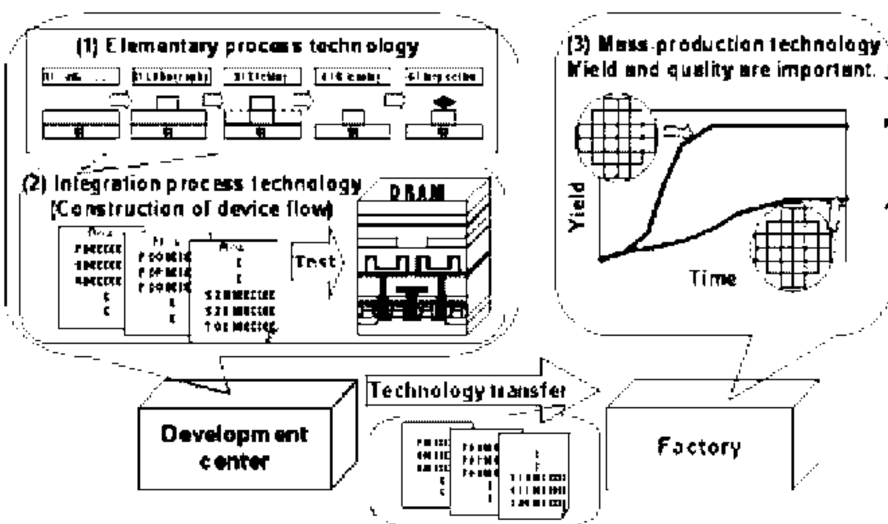

Figure 4. The Three Stages of Semi-Conductor Development (Yunogami, 2006)

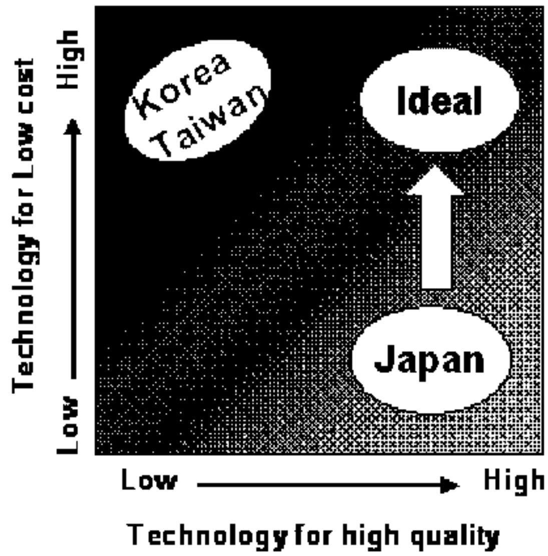

Figure 5. Two Axes for the Comparison of Semi-Conductor Technology (Yunogami, 2006)

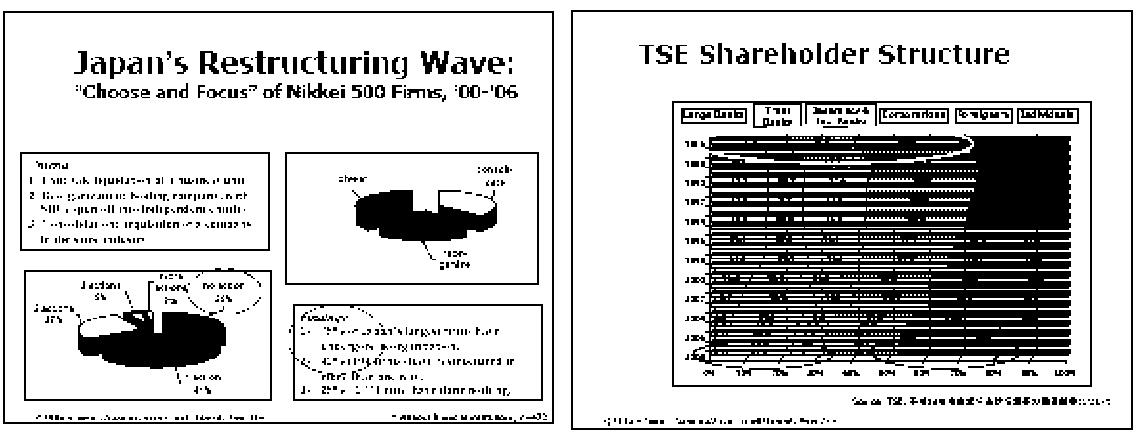

Figure 6. Nikkei Firm Reorganization (Schaede, 2008)

Business Management and Strategy
ISSN 2157-6068
2010, Vol. 1, No. 1: E3

Top Suppliers in Each Segment (Headquarter region)

Organic Substrates	Bonding Wire	Leadframes	Mold Compounds	Die Attach
Ibiden (Japan)	Tanaka (Japan)	Sumitomo Metal Mining (Japan)	Sumitomo Bakelite (Japan)	Henkel (Germany)
Shinko (Japan)	Heraeus (Germany)	Mitsui High-Tec (Japan)	Hitachi Chemical (Japan)	Hitachi Chemical (Japan)
Nanya PCB (Taiwan)	Sumitomo Metal Mining (Japan)	Hitachi Cable (Japan)	Nitto Denko (Japan)	Lintec (Japan)
	Nippon Micrometal (Japan)	Shinko (Japan)	Kyocera Chemical (Japan)	Sumitomo Bakelite (Japan)

Figure 7. Semi-Conductor Packaging Industry Leaders by Segment

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