STRATEGIC ANALYSIS OF A SOFTWARE DIVISION IN A FABLESS SEMICONDUCTOR COMPANY

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ABSTRACT

SemiCo is a fabless semiconductor company that recently began developing products for the consumer and home networking markets. Customers of SemiCo in these markets require the development of more than just a silicon chip; they also need software, firmware and hardware. SemiCo is faced with a new set of challenges, including new customers, stiff competition based on product price, strategic fit issues, and required new skills.

This paper analyses these challenges and provides recommendations by giving an overview of the company and its new software department, followed by an in-depth analysis of the industry and competitors, then an analysis of SemiCo's strategy is given. Further analysis is done on the company, including financial and cultural issues along with a view of how SemiCo creates value within the organization. The paper concludes with an identification of strategic issues found in the analysis, along with recommendations and an implementation plan.

DEDICATION

To Jennifer who has supported me so much and to my parents who have taught me that I can do anything I put my mind to.

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GLOSSARY

ASIC	An Application Specific Integrated Circuit (ASIC) is a silicon chip designed for one customer for the sole purpose of being used in only one application or piece of equipment.
ASSP	An Application Specific Standard Product (ASSP) is a silicon chip designed to meet industry standards such that multiple customers can use it in multiple applications or pieces of equipment.
Fabless	A semiconductor company is called fabless when it does not own its own fabrication facilities for producing silicon wafers and chips.
IC	An Integrated Circuit (IC) is the collection of electrical circuits to form a silicon chip that performs any number of functions
MIPS ®	Millions of Instructions Per Second (MIPS) is a measurement of the processing speed of a processor. MIPS is also a type of processor that uses a specific instruction set common in lower cost, embedded systems. "MIPS" is a registered trademark of MIPS Technologies.
ODM	An Original Design Manufacturer (ODM) is a company that specializes in manufacturing equipment in high volumes for sale to mass markets through a third party.
OEM	An Original Equipment Manufacturer (OEM) is a company that specializes in owning relationships with distribution companies to get products to end consumers. An OEM also typically has a brand name that conveys a perceived level of quality to its customers.
SOC	A System-on-a-Chip (SOC) is a single integrated circuit that combines the functionality of multiple chips into a single chip, usually to reduce costs.
VoIP	Voice-over-IP (VoIP) is the technology used to transmit regular telephone traffic over the Internet instead of through a regular telephone line.

1 INTRODUCTION

The semiconductor industry has historically been very cyclical, experiencing periods of rapid growth and innovation followed by periods of retraction and lower R&D investments. The long product development cycles and high cost of R&D make companies in this industry reliant on capital to continuously innovate. The market crash of 2000 affected the semiconductor industry by making it harder for companies to gain access to sources of capital. As a result, the semiconductor industry has been slowly recovering since 2000 when year-over-year sales growth reached a peak of over 60%, but subsequently fell to almost negative 50% growth. Growth levels have been slowly recovering since then (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 43).

There has been a large shift in how the industry operates since the market crash. Prior to the crash, it was common for large original equipment manufacturers (OEMs) to do most of its own design and development of silicon chips required for its systems. The relative ease of access to capital made companies operate in a manner that may not have been the most efficient. With the drying up of capital markets, companies had to conserve cash and look at development processes more closely to ensure scarce resources were being applied efficiently. This primarily meant cutting costs and one way of doing this was to outsource more pieces of silicon chip development to smaller companies.

The way in which OEMs developed products prior to 2000 was to do as much development of the system in-house as its resources would allow. This was done to protect intellectual property (IP) and to build proprietary systems that could be differentiated against competitive products in the market place. Developing products in this manner was very expensive and required OEMs to have large design teams on staff dedicated to specific product programs. The internal semiconductor design teams were focused on developing what is called application specific integrated circuits (ASICs). These are chips designed for one purpose and usually not used in more than one product.

After 2000, OEMs began to look at how chips could be designed for better reuse in multiple products and how to outsource chip development for less critical components that did not require a lot of IP. Manufacturers turned to semiconductor companies that had expertise in developing application specific standard products (ASSPs). These are chips designed for a

specific purpose, but use industry standards such that the chips can be sold to multiple customers. A company developing ASSPs amortizes its R&D costs across multiple customers buying the same chip, therefore achieving economies of scale.

The OEM buys multiple chips from multiple semiconductor companies and designs a system around all of the components. The system consists of more than just silicon chips on a board; all of the chips have to communicate with each other and present an interface to the environment that the system is working in. This is accomplished through development of software that resides on the chip, called firmware. The firmware adds the most value to the chip because it allows an OEM to differentiate its products. For this reason, firmware has historically been developed by the OEMs.

OEMs are continuing to look for other ways to reduce development costs. One way is to continue to outsource more product development functions, such as the software components. If an OEM can outsource or acquire the software, it can reduce its time to market and produce a product at a much lower cost. Currently in the industry there is a shift towards pushing the software development costs back on the semiconductor firms for lower-end products where time to market and lowest cost are critical success factors, such as consumer products (AMCC, 2005, p. 3-4). In many cases today, an OEM in consumer markets will not deal with a semiconductor company unless it has a complete off-the-shelf solution that is ready for the OEM to essentially put its name on and begin marketing immediately.

Developing software is an area where semiconductor companies that specialize in ASSP development, have an opportunity to grow and expand into new markets. Semiconductor companies typically do not have a lot of software development expertise, but if a company wants to prepare to capture some of this business, software must become a core competence. SemiCo is one such company that has realized this and has recently committed resources to a new software division to specialize in developing products targeted at these end markets.

The purpose of this paper is to do a strategic analysis of SemiCo's new software division and make recommendations on strategic options for how the company should move forward in this area. An investigation will be done on how the semiconductor industry has evolved. This is followed by identifying key success factors for semiconductor companies. Next, a comparison will be done of SemiCo's software division strategy with strategies of similar companies in the industry. Then, an internal analysis will be done of SemiCo's corporate strategy and how the new

software division's strategy aligns with that of the overall company. The information gathered through this research will be used to make recommendations to SemiCo's senior management on the strategies to employ for its software division.

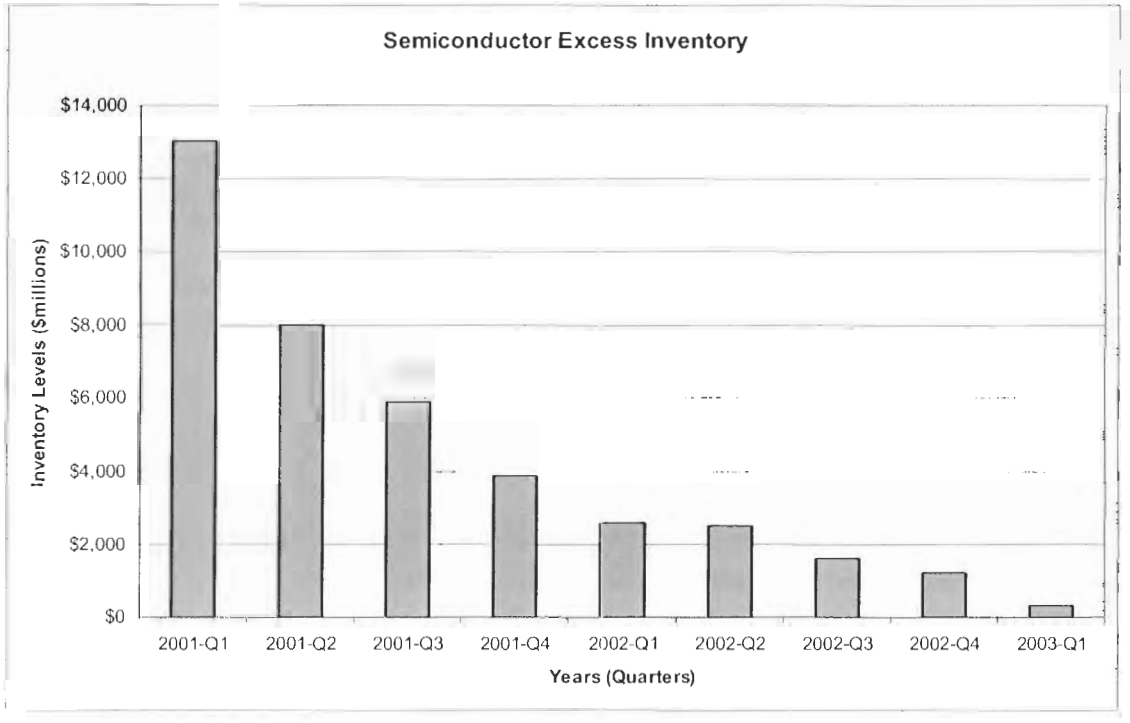
1.1 Overview of the Firm

SemiCo is a fabless semiconductor company, which means it does not own any manufacturing facilities. Instead, SemiCo focuses its resources on research and development of semiconductor chips and manufacturing is outsourced to contract manufacturers in Asia. This structure enables SemiCo to be very flexible through the ups and downs of the semiconductor industry's cycles. When the industry is retracting, SemiCo can scale back manufacturing to match slowing customer demand without incurring overhead costs of maintaining manufacturing facilities. When the industry is rapidly growing, SemiCo competes with other fabless semiconductor companies for manufacturing capacity; therefore it is important for SemiCo to maintain good relationships with its suppliers. SemiCo was one of the early adopters of the fabless model and as a result has had long term relationships with contract manufacturers such as Taiwan Semiconductor Manufacturing Company (TSMC).

SemiCo got its start designing silicon chips for telecommunications equipment manufacturers, such as Cisco, Lucent and Nortel. SemiCo has expertise in taking complex design specifications from customers or industry standards organizations and designing silicon chips from them. SemiCo primarily designs ASSPs, but sometimes a customer may request SemiCo to design an ASIC just for them. In this case, the customer would sponsor that development program.

After the technology market crash in 2000, the telecom industry was hit hard with many companies going bankrupt. This resulted in a lot of used telephone and networking equipment being available on the market, which in turn forced telecom equipment manufacturers to slow shipments of new products. SemiCo was affected by this because its customers were not buying chips, resulting in massive amounts of inventory in the system which took over two years to flow through (see Figure 1-1). SemiCo was forced to look to new end markets and opportunities to grow while waiting for the inventory problem to correct itself.

Figure 1-1 Semiconductor Industry Excess Inventories (2001 to 2003)



Source: Author; adapted from Sheppard & Farrell (2002) and Farrell (2003)

SemiCo has evolved since 2000 by diversifying its product portfolio to include product lines other than telecom and communications chips. New product areas include MIPS based microprocessors for high-end printers, chips for enterprise storage products, and most recently, chips with complete systems for consumer electronics aimed at home network users. Each of these product areas continue to experience revenue growth, yet over 68% of SemiCo's revenues still come from chips used in telecom equipment[1].

SemiCo differentiates its products from those of competitors by charging a premium price while providing a superior quality product combined with excellent customer service. SemiCo has been successful in this strategy with traditional telecom chips, achieving gross profit margins from 60% to 80% (see Table 1-1). The company has been successful at doing this by keeping operating costs down and charging competitive prices.

[1] Source: Internal SemiCo document: Q1-2005 Financial Results Employee Presentation

Table 1-1 Fiscal 2004 Corporate Revenues and Profit Margins for SemiCo's Competitors

Company	Revenues ($K)	Gross Profit ($K)	Profit Margin
Broadcom	$2,400,610	$1,207,316	50%
Marvell	$1,224,580	$642,823	52%
PMC-Sierra	$297,383	$209,841	71%
2Wire	$107,438*	N/A	N/A
AMCC	$131,177	$73,576	56%
Vitesse	$218,775	$140,055	64%
Agere	$1,912,000	$866,000	45%
SemiCo	**$545,572**	**$384,970**	**71%**

Source: Author; adapted from data in 2004 corporate annual financial reports (2005)
**Source: Inc.com (2005)*

The structure of SemiCo is built around each product area, with communications chips under the Communications Product Division (CPD), MIPS processors under the Microprocessor Division (MPD), and the enterprise storage products in the Enterprise Storage Division (ESD). The newly formed home network consumer electronics development group is currently within the Software Solutions Group (SSG), which is located within the CPD division due to some overlap in product areas.

Each of SemiCo's business units operates autonomously, requiring little coordination between divisions. This model works because each division sells products for different end markets, with very little overlap in the product development efforts. This may change for the new SSG products, however, because its products require development efforts from resources within multiple divisions. For example, a product being developed may include a chip (or multiple chips) that include functions of a MIPS processor, a storage communications chip and a telecom chip; therefore requiring expertise from all three divisions.

Although the product divisions operate autonomously, decisions around which products to develop and where to apply scarce resources are made centrally. In fact, the CEO maintains complete decision making authority for product planning decisions. The decision for proceeding with a new product is done using return on investment (ROI) metrics. SemiCo has internal hurdle rates that must be achieved, and most often a product will not be developed if a business case does not show that it would meet or exceed that hurdle rate. Product planning decisions are made on a quarterly basis, consisting of presentation of the business case and ROI to the executive team for approval. If a product is approved, appropriate resources are applied to that project. The SSG group was formed through this process by recognizing the potential for entering new markets and deciding to assign appropriate resources to set up the department.

1.2 Overview of the Business Unit

The Software and Solutions Group is a new department for SemiCo. Started in late 2004, SSG's mandate is to identify new market opportunities for new and existing chips that are targeted at applications in the home network. The evolution of the home network with services such as voice-over-IP (VoIP) are gaining a lot of attention because growth is expected to be strong even though economies around the world have slowed in recent years (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 233 & 290-331). Another factor in the growth of home networking is the 30% per year growth of broadband Internet access in developing countries such as China and India[2].

An average home network today consists of a broadband Internet connection, a broadband modem connected to a home gateway (which may include a firewall and routing capabilities), plus multiple computers or devices connected to the router. The future for home networking is expected to provide all home services through the Internet via the home network. Services such as telephone and television will be available over an Internet connection and therefore available anywhere in the home over its network. The SSG department at SemiCo is targeting products that will service these end consumer markets with products known as triple-play products. Triple-Play products are those that encompass three services in one product, typically voice, data and video traffic, available through a single connection.

SemiCo recognized that home networking is a growth industry with the potential for millions of units in sales. This combined with SemiCo's desire to benefit from the growth expected from Asian markets brought about the desire to create a new department. The challenge was deciding how to enter the triple-play space without simply using a follower type strategy and only differentiating products based on price. The choice was to examine the market and identify opportunities that meshed well with SemiCo's existing areas of expertise.

Prior to SSG formally being created, SemiCo had begun targeting development efforts in the home network and Asian markets. These products did not fit well into any existing product division, and as a result did not get the internal support and resources required to successfully take the products to market. This was when the decision was made to create a new department

[2] Source: According to internal documents from SemiCo, as of late 2004 the worldwide broadband market has over 100 million users. It is growing at over 30% per year, which is driven primarily by Asia. This is in comparison to only 25% growth rates for North America.

with dedicated resources tasked with developing products for new markets not traditionally explored by SemiCo.

SSG has started development of products for a number of different areas and has future plans to develop products in others. Table 1-2 shows the main product categories and various products that are in development, or soon to begin development once resources are available.

Table 1-2 List of current and planned products for SSG (Italics are currently in development.)

Home Network Products	Small Office Home Office	Enterprise Products
Voice over IP ATA	*Thin client*	*Thin client*
Voice over IP Gateway	*Network Attached Storage*	
Voice over IP+DSL Gateway		
Voice over IP Handsets		
Voice-over-IP PBX		
Network Attached Storage		
Digital Set-top box		
Digital Video Recorder		

Source: Author, adapted from internal documents

SSG is responsible for creating complete systems that an equipment manufacturer can turn into a ready to ship product very quickly. Manufacturers in these new areas for SemiCo are mostly concerned with time to market and keeping costs down. These equipment manufacturers may wish to make some modifications to the product in order to differentiate from competitors because SemiCo could sell the same product to multiple customers. This may be the case with some customers, but not for all. For example, SemiCo presented its Home Network Attached Storage (NAS) product to a potential customer who liked it so much they agreed to buy it. All that this customer did to market the product as their own was to change the colour of the case, add their logo to the box and modify the logo within the system's software. This gave the customer a solution to get to market rapidly with very little investment.

In order to create an entire system or solution product, SemiCo must develop a chip, a board for the chip to sit on, firmware to run the chips, an operating system and software to run and manage the device. All these areas, except chip development, require new skills for SemiCo. These are skills that will quickly need to become a core competence in order to achieve a competitive advantage.

The structure of SSG includes each of the development areas required to create its products. A firmware team writes the proprietary software required to operate the chips. An

operating system team is responsible for creating an embedded operating system using technologies such as Linux and VxWorks. Chip development is done by SemiCo's existing chip development divisions. Sometimes existing SemiCo chips can be used in new products, therefore not requiring additional development resources. Due to resource and cost constraints, other development functions of the software layer and board hardware are outsourced to companies in India.

The structure of SSG within SemiCo as a whole is within the CPD division, but it is being treated almost like a start-up organization. SSG is funded with capital from SemiCo's ongoing operations and is using internal resources where possible. To foster this start-up mentality, SSG is given freedom to operate in any manner that it sees fit. This has allowed some product development efforts to circumvent some of the formal procedures that SemiCo has in place in cases where its traditional processes would slow down the development cycle enough to risk missing critical time to market targets.

Growth within SSG has been very rapid with a staff of approximately 40 people as of the middle of 2005. Plans are in place to double the size of the department before the end of 2005 in order to meet the demand of resources to develop new products that are in the pipeline. To date, this growth has been somewhat reactive to needs as they arise, but future growth will need to be more purpose driven with an overall strategy in place. Before a strategy can be implemented, strategic issues need to be identified.

1.3 Strategic Issues and Problem Statement

The Software and Solutions Group has developed its current strategy to address immediate needs. The strategy must now evolve to become a future looking one that will address the needs of the growing organization. This paper will analyze SSG's departmental strategy in detail in a future section, but some of the key strategic issues that will be discussed are highlighted here.

The first strategic issue is how decisions around product development at SemiCo are made on the basis of ROI analysis and internal hurdle rates that must be met before a project is approved. One of the challenges with this method is that historical ROIs achieved by SemiCo may not reflect current or future market capabilities. As a result, product development for areas that may have lower than expected margins but high sales volumes may be overlooked using the basic ROI hurdle rates. This is a challenge that the SSG group faces when proposing new product

areas to explore. There must be an understanding at SemiCo of the different dynamics of SSG's end markets, when compared with the company's traditional semiconductor markets, before making product development decisions. Development of chips for SSG related products could have multiple applications, rather than just one single application which is common of SemiCo's traditional chip products. This makes it difficult to calculate the full ROI of a development effort if all end market opportunities are not known when a product is being developed. It is very likely that during the development of a system, the SSG team will identify new uses for the product that were not known when the business case and ROI calculation were done.

New product applications could add incremental revenue with minimal development effort. Currently there are no processes in place to allow for the recognition of new product innovation during the development phase, because most new product idea generation is done by marketing. In order for SSG to be successful it needs to foster innovation, and SemiCo's executives need to understand that they cannot evaluate software product development opportunities the same as chip development.

SemiCo's executive team has high expectations of what the SSG group can deliver. They are very excited about products such as triple-play. The question is whether or not SSG will deliver big enough returns to meet the high expectations of the executives. SemiCo has a history of cancelling programs or departments that are not able to meet the expected ROI; therefore, there is a chance that SSG could be cancelled before it fully matures.

A second strategic issue is that SSG's product development may require coordination of resources across all of SemiCo's product development divisions (CPD, MPD, and ESD). For example, the HomeNAS product has a MIPS processor from MPD and a SATA controller from ESD. SemiCo does not currently have an organization structure that enables matrix style project management. Each product division operates autonomously, which makes the work of SSG more challenging when resources are required from multiple divisions that are all resource constrained. In order to manage this matrix organization structure, SemiCo will need people with strong project management skills that it does not currently have. Projects have historically been run on their own with a project management team in place for each individual product, but for SSG products there are multiple components (firmware, software, chip, operating system and hardware) that all need to come together in the end to form a complete system. Currently each of these components is being developed independently, including some outsourced development,

with little coordination across the project teams. Management of these cross functional project teams will need to become a core competence for SemiCo.

The third issue is a lack of understanding of software development processes because the product development methodology of SSG related products is different than that of SemiCo's traditional chip products. Chip products are developed using standard development methods that are understood at all levels within SemiCo. Terminology is used to describe certain phases of development and the definition of these terms are known across the organization. When a chip product is developed and released to production, it typically comes back and is ready to start selling to customers without any further development required, as any modifications to the chip at this phase are very costly. With software development there is a different methodology that is not yet understood at many levels within SemiCo. Software development often requires multiple releases and revisions before a final customer-ready product is released. Software may be released in various phases of completion before a production release is done. Modifications of software after a release are relatively inexpensive to make, in comparison to chip development. The challenge for SSG is that the development flow of software is not understood by the majority of SemiCo's employees and there is not a common understanding of the definitions of various releases. Ensuring that all employees are educated in software development processes will become an issue for SSG.

Managing the release of various versions of silicon chips has not been a problem for SemiCo because the number of products and product variations has been relatively small. The issue with software development is that releases can be continuous throughout the life of a product. SemiCo will need to have release management expertise available to manage what releases are going to which customers so that future updates can be sent to the customers as needed. In the software world, a single product may have hundreds of revisions and iterations, whereas in SemiCo's traditional business a chip may only have a couple.

The fourth issue is that the marketing methodology is also different for software versus chip products. SemiCo's current marketing expertise is selling semiconductor chips to OEMs that have long product lifecycles with relatively high gross margins in the range of 60% to 80% (SemiCo, 2005, p. 16). Consumer market products, on the other hand, operate on much shorter product lifecycles, with dramatically lower profit margins, 25% to 40% (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 50), but much higher sales volumes. In these markets time to market

and low cost are critical success factors. Understanding these differences will be a challenge for SemiCo's marketing resources.

The fifth issue is that the customers SSG is targeting products to are different than SemiCo's traditional customer base. SemiCo's telecom, storage and microprocessor product lines are typically sold directly to an OEM that will integrate the chip into its solution. SemiCo works with the customer through their development phase to ensure a smooth development process with the chip. By doing this, SemiCo has a feedback mechanism whereby the company can learn from the customer what future additions may be beneficial to improve the product. Instead, SSG's products are sold to original design manufacturers (ODMs) that in turn sell the same product to multiple OEMs. In this model, SemiCo will have almost no contact with the end customer that is buying its product, so the customer feedback component is lost. SemiCo also does not yet have relationships with the ODMs which it is trying to sell to, so the company must start fresh and build all new relationships with this new style of customer. The issue is that SSG is starting out without connections at the major ODMs and the group will be missing some of the critical customer feedback about the products due to a different relationship between the ODM and the OEM.

SemiCo is currently known for its strong customer support. This is a primary differentiator for the company and its products over its competition. The resources required to support a chip development customer is manageable, but at this time it is unknown what the resource requirements will be for managing a support organization of software products. With SemiCo selling to ODMs instead of the end customer that will be selling the product, it is possible that SemiCo will lose the communication with the users of its products and therefore not be able to effectively support them. SSG does not currently have a strategy for how it will support its customers and what level of support or warranty it will provide for products.

The planned growth of SSG is to double the size of the department by the end of 2005 to meet demand for product development. Hiring staff fast enough is a challenge for SSG because the job market has been improving and there are fewer talented people available than there were after the industry-wide layoffs of 2000. Attracting and retaining talent will become a critical success factor for SSG.

The problem statement for this paper is to look at all of the strategic issues identified here and investigate them in further detail. The paper will identify which are the best short term

strategic goals and which are the best long term by making some recommendations based on the analysis.

1.4 Methodology

This paper is intended to provide recommendations to senior management at SemiCo on possible strategies that could be implemented for the Software and Solutions Group. The topic of this paper has been approved by SemiCo's management and it is intended to provide an unbiased view of SSG's role within the overall organization.

The materials used in this paper were from confidential internal documents from SemiCo, interviews conducted with SemiCo employees, interviews with external parties, and some additional external resources. Academic references are also used to provide a frame of reference for the analysis of the information collected.

This paper consists of eight chapters covering an introduction, industry analysis, external analysis of competitors, internal company analysis, evaluation of strategic options available, recommendations and conclusions. Chapter 2 will provide an analysis of the fabless semiconductor industry, its competitors, customers and suppliers. Chapter 3 will give an analysis of other semiconductor firms that have software divisions and are competing in the same markets as SemiCo. Chapter 4 will contain an internal analysis of SemiCo's corporate strategy and the strategy of the SSG group. An analysis of these strategies will be done to show the level of strategic fit between the two. Chapter 5 has a review of the strategic issues based on the internal and external research. Chapter 6 takes all of the options and makes specific recommendations for SemiCo. An implementation plan for these recommendations is provided in Chapter 7. Finally, Chapter 8 provides a summary and conclusion for the paper.

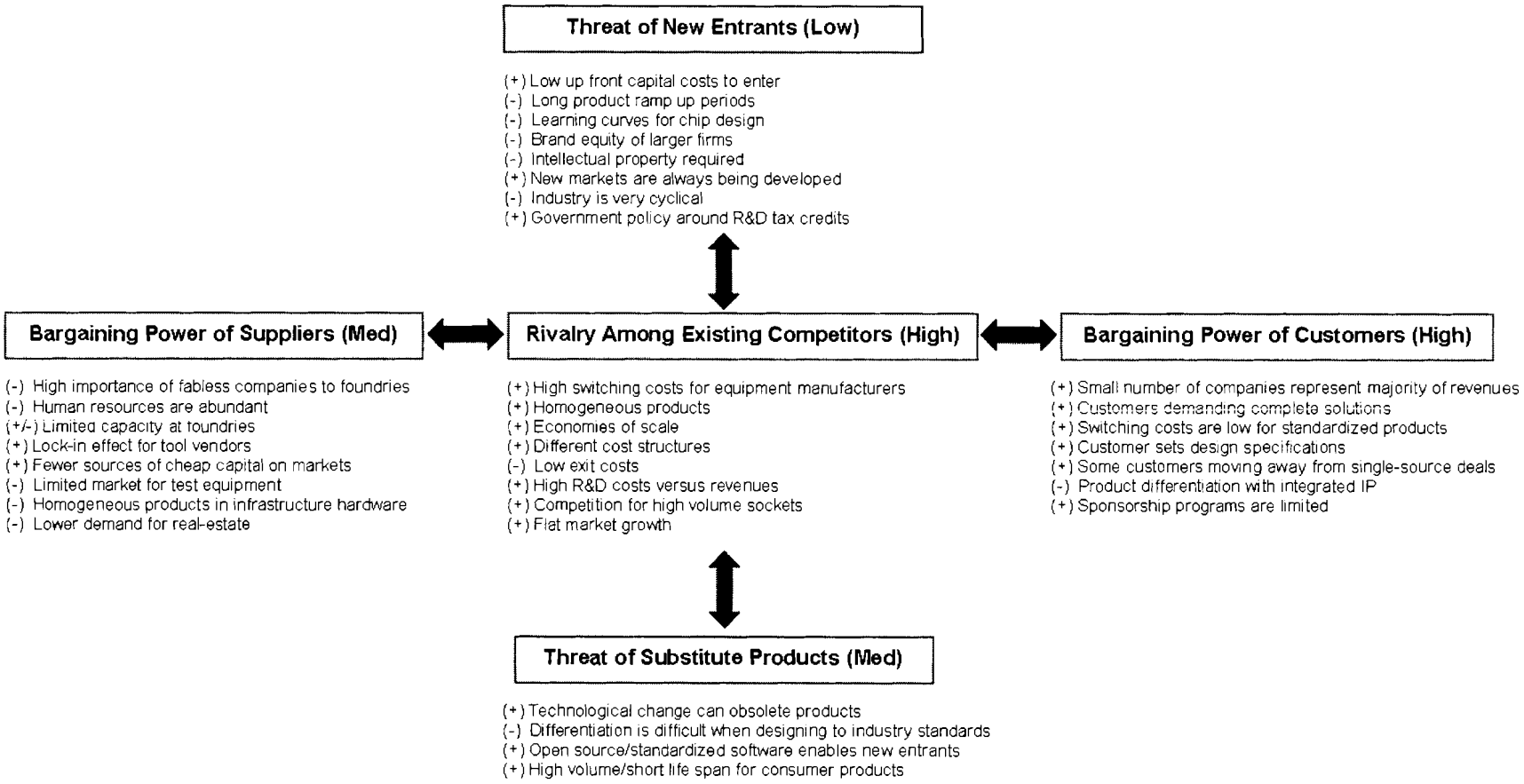
2 INDUSTRY ANALYSIS

This chapter provides an industry analysis of the fabless semiconductor industry that SemiCo operates in. The semiconductor industry is very diverse and covers many different products, but the scope of this chapter will be limited to fabless companies that compete in similar product areas as SemiCo. SemiCo operates as a fabless company and competes in multiple product areas with other fabless companies such as Broadcom, Marvell, PMC-Sierra, 2Wire, AMCC, Vitesse, and Agere.

The semiconductor industry contains many companies that are classified into one of four main manufacturing strategies; Integrated Device Manufacturers (IDM), Fabless, Foundry and Hybrid (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 28). An IDM is a fully integrated manufacturer that designs semiconductors and owns its own manufacturing facilities to produce the chips. Fabless semiconductor companies also design semiconductor chips, but the companies do not own or operate manufacturing facilities. Instead, all of the fabrication for a fabless company is outsourced to foundries for manufacturing of the silicon chips. Foundries do not design any of the chips produced on contract. A foundry company is one that solely owns manufacturing facilities that are contracted out to companies wishing to produce semiconductor chips. The final type of company is a hybrid of the other three types. For example, a company could be partially integrated, but still require outsourcing of some manufacturing functions during peak demand periods; or vice versa, a company could contract out almost all of its manufacturing.

The purpose of this chapter is to focus on the portion of the semiconductor industry that follows the fabless model. An analysis will be done using Michael Porter's Competitive Forces Model (1979) as a basis to assess the attractiveness of the industry and to identify key success factors.

Figure 2-1 Michael Porter's Five Forces Diagram for the Fabless Semiconductor Industry



Legend:

(+) = Increases the threat, bargaining power or rivalry
(-) = Decreases the threat, bargaining power or rivalry

Source: Author; adapted from Porter (1979)

2.1 Threat of New Entrants

The threat of new entrants in the fabless semiconductor industry is relatively low. The industry is one that is relatively easy for a new company to enter because there is very little capital required to get into the business. Although, there is some minimal software and infrastructure required to design the chip. All that a company requires to get started is a product idea and the electrical engineering expertise to design the product. During the technology industry downturn in the year 2000, there were many electrical engineers that were laid off. If these engineers have an idea that they think would make a viable product, they may decide to start their own semiconductor company to develop the product.

The bigger expense comes to a new entrant when getting its product manufactured and into a form that can be sold to customers. The process whereby a chip goes from design to manufacturing involves a number of steps to make the product production ready. These steps include, but are not limited to, design, simulation, masking[3], verification, design revisions, customer prototyping, and finally ramping to production volumes. This entire process to ramp a product to production can take anywhere from six months to two years, depending on the complexity of the chip design. While producing chips costs millions of dollars, a company can choose to wait until it has a potential customer before sending the chips to production. However, the new entrant may have additional fixed cost obligations that it must meet during this period. All of the phases prior to shipping production volumes of a product can require a lot of capital to sustain the business before any revenue is received.

The design and simulation phases are done internally prior to sending a chip to a foundry. By attempting to simulate the chip's behaviour in software before creating the first silicon chip, a company can potentially save millions of dollars by not having to revise the design once a chip is received back from the foundry. Once a company is satisfied with the chip's behaviour, the design must be converted to a mask that can then be used by a foundry to print the chips onto a silicon wafer. The mask can be created in house, but more than likely this is contracted out due to the cost involved. After the mask is created, it is sent to a contract manufacturer that will produce a small run of the chips to be sent back to the company for testing. This initial run may produce only a handful of chips or hundreds, depending on the amount required for further

[3] The process of masking involves taking a design of a chip and creating a "mask" to be used in the chip production process on the silicon wafer. This mask is used to burn the electrical pathways on the silicon in order to create the circuits required for a functioning chip.

testing. The cost of this initial run can be anywhere from a couple hundred thousand dollars to a few million dollars, depending on factors such as the type of chip being produced[4] and the number of chips in the run. The company then tests these chips against the original design, and if there are modifications required, the whole process must be repeated, incurring the same costs again.

This cost can be somewhat prohibitive to a new entrant, especially when it can take up to two years before receiving any revenue. The next phase, once the product meets the design specifications, is to sell prototypes of the chip to prospective customers. The revenue generated at this phase is minimal due to the extremely low volume of chips that are sold. The customer then performs their own tests on the chip before deciding whether to design it into their equipment. This process is usually done simultaneously with multiple customers.

Once a customer selects a chip to be designed into their equipment, the semiconductor company calls this a design win[5]. The equipment manufacturer will typically then order a small volume of chips to be used in their equipment development and design phases, but once again the revenues generated for the semiconductor company at this stage are relatively small. It may take another one to two years for the equipment manufacturer to complete product development and ramp up to any significant order volume of the chips from the semiconductor company.

These long periods for revenue ramp up can be a barrier to entry for a company with all of its resources poured into one chip. A small company can spend anywhere from two to four years to get its product to market and shipping at volumes high enough to fund the company's further research and development efforts. As well, the cost of developing newer chips is dramatically increasing as technology continues to push new boundaries. These two factors make it very difficult for a new entrant to grow to a size that the company would become a threat.

Designing a semiconductor chip takes a lot of electrical engineering expertise. There are significant learning curves involved that give an experienced company a competitive advantage over new entrants. As a company's design practices mature it will create standards and

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[4] Different technology used in a chip's design requires different techniques for production. Older techniques are less expensive, but result in a much larger, less powerful and less efficient chip that is produced. The newer the technique, the more expensive it is due to the manufacturing processes required.

[5] A design win is when a semiconductor company wins approval from an equipment manufacturer stating that they intend to use that chip in the design of their product. Typically at this stage the customer states their expected purchase volumes and then pricing is negotiated. However, this is not a guarantee of future revenue because equipment manufacturers may change their designs or find that the chip doesn't meet their needs and select a different chip from a competitor in the future.

knowledge sharing mechanisms that allow for new employees to learn from their co-workers faster. The end-to-end processes continuously improve with each new chip that a company designs; therefore, reducing its design costs and development time. New companies without this experience will not be as competitive.

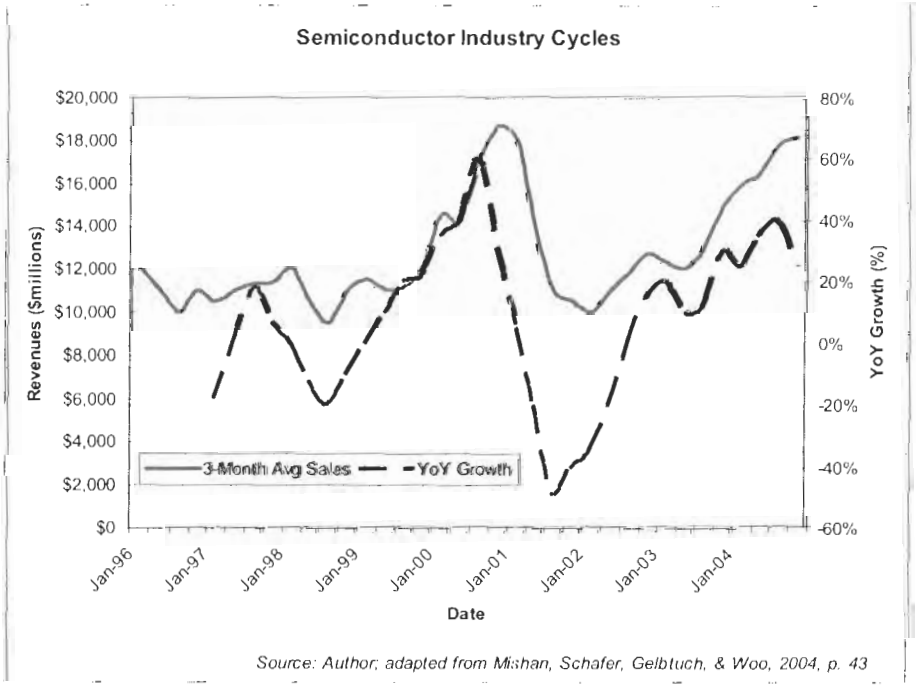
Another deterrent to new entrants relates to the amount of brand equity that the larger semiconductor companies have accrued by being in the industry for a number of years. During the late 1990s, equipment manufacturers were buying chips from many different semiconductor companies, including many newcomers that only had a one chip product portfolio. After the technology industry downturn started in 2000, many of these newcomers went bankrupt because the capital markets dried up when investors pulled their money out of high-tech companies. This resulted in delays for equipment manufacturers of getting products out because equipment had to be redesigned around a new chip from a different company. Equipment manufacturers now tend to lean towards buying chips from companies that have a product track record and more than one chip on the market. Although this is another barrier to new entrants gaining traction, there are some low-cost equipment manufacturers that are willing to take risks in selecting a chip from a smaller company in order to gain a cost competitive edge if the chips are cheaper.

The fabless semiconductor industry is evolving from developing individual chips that can interoperate to providing complete solutions on a single chip for end customers. This is called system-on-a-chip (SOC). The main driver behind this is the fact that the largest part of cost of goods sold is manufacturing the chips on a silicon wafer. If a company can combine multiple functions into a single chip, it will be able to charge more per unit, but at the same time cut its costs and those of its customers. What enables a company to do this is its collection of intellectual property (IP) and patents. A company that has been in the industry for a number of years has likely collected massive amounts of IP (either by acquiring it or developing it internally). Rather than designing a single purpose chip, a semiconductor company can now combine multiple functions from its collection of IP and put it onto a single chip. These economies of scope provide a barrier to entry for smaller companies because these competitors will not have the IP required to integrate into a single chip. To combat this, the new entrants would have to either acquire or license the IP from another company, or risk developing a single purpose chip that a customer may not want due to higher costs. As time goes on, it becomes more difficult for companies to enter existing markets because incumbents that have patented IP will enforce those patents to protect the investments by suing any company that is infringing on its IP.

There are many new product markets being created, such as the recent growth in the areas of voice over IP (VoIP) and wireless technologies. New entrants can present a threat if they are more nimble and able to develop a product for the new growth markets before the larger companies can react. This would allow the new entrants to get a foothold on the market and obtain a first mover advantage. These companies could then leverage this growth into further research and development for other new products and to build brand equity.

The semiconductor industry has been very cyclical throughout its history, as shown in Figure 2-2. There are four distinct phases: the downturn, the recovery, the expansion and the peak (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 42). If a new fabless semiconductor company were to enter the market during either the downturn or the recovery phases, there would be a risk that the company wouldn't stay in business long enough to get its product to market. Judging when these phases are going to occur is almost impossible, even for the industry experts; therefore the cycles may be a deterrent for new entrants.

Figure 2-2 The Semiconductor Industry's Cycles (1996 to 2005)



Source: Author; adapted from Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 43

Governments in most countries around the world want to encourage technological development within their country. To support this, many countries, such as Canada and the US, offer tax credits for research and development done within their borders. There are also start-up

grants available for new companies starting out. These advantages may encourage investors and companies to enter into the semiconductor industry to compete with incumbents. Although, the research and development tax credits are not exclusive to new entrants, larger companies can also take advantage of them.

Overall, the threat of new entrants in the fabless semiconductor industry is relatively low. There are only a few factors that may make new entrants a threat to any incumbents, but the majority of the factors act as barriers to entry. These barriers can act to deter new entrants and therefore, help to solidify the strategic strength of existing players in the market.

2.2 Rivalry Among Existing Competitors

The fabless semiconductor industry has a number of competitors operating in the market. Rivalry amongst these competitors is quite high.

The biggest component that leads to rivalry amongst fabless semiconductor companies is during the design win phase. Semiconductor companies will do almost anything to win a design with an equipment manufacturer because once the manufacturer designs its equipment around a specific chip, the switching costs can be very high to redesign around another chip vendor's product. Some high end equipment designs can provide a revenue stream for the chip companies for up to five or ten years; these two factors combine to create a very rivalrous industry during the design win phase.

Many chip products are becoming homogeneous as a result of industry standards. This leads to additional rivalry in the industry, causing companies to attempt to integrate more intellectual property into chip designs to differentiate its products. A trend in the industry that is occurring is to have fewer chips in equipment designs by integrating more IP onto a single chip to help reduce the total bill of materials (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 237-238). This is called system-on-a-chip (SOC). The current state of the industry is such that fabless semiconductor companies are trying to acquire as much valuable IP as possible to create highly integrated SOCs. This too is creating rivalry in the industry to acquire or partner with companies that have the most valuable IP.

Larger fabless semiconductor companies have advantages over smaller ones due to some economies of scale. Companies that have large teams of engineers working on multiple program can amortize design costs over many different chip development programs. For example, if a low

margin chip is strategic to the future of a company, its design costs can be balanced by the company against higher margin products in other areas.

Rivalry is also increased by different cost structures present at different companies in the industry. Some fabless companies have much higher cost structures than others, such as spending a higher percentage of revenues on research and development. These companies suffer more than others during low parts of the industry cycle because the higher cost structure drains cash reserves. During peak cycle times these companies can compete because higher demand leads to less pricing pressure, resulting in higher margins (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 44).

The exit costs in the fabless industry are extremely low. A fabless company usually has very little infrastructure that cannot be easily liquidated and almost no asset specificity issues. A company can exit this industry by simply selling off its intellectual property rights and liquidating any infrastructure assets. This can create rivalry, especially in down cycles because companies that are closer to bankruptcy may be willing to cut prices to a point that will negatively affect the industry if other companies are forced to follow.

Moore's Law was defined by the founder of Intel, Gordon Moore, who said, "the number of transistors on a chip doubles every 18-24 months" (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 20). The result has been ever more complex chips operating at much higher performance levels. Over the last 30 years, the semiconductor industry has followed this law. As a result, rivalry has existed amongst semiconductor companies to constantly invest high percentages of revenues into research and development in order to stay on top of the performance curve in relation to competitors. The problem is that the cost of designing ever more complex chips is increasing at a significant rate. This is causing a prisoner's dilemma because faster chips may not be needed by the industry or the end consumers. If all companies believe that at least one competitor will design a faster chip, then all companies will do so even if the industry will be better off by not investing in the faster chip until a later date when the technology is needed.

Another factor in rivalry in this industry is that equipment manufacturers are outsourcing more chip designs to semiconductor companies with standard products. Equipment manufacturers are changing strategies to build more standardized equipment using fewer unique chips and reusing components in multiple end products. This allows the equipment manufacturers to reduce costs, but as a result there is more rivalry in the semiconductor industry

with companies fighting for the limited outsource deals and fewer standardized sockets[6]. These deals can be lucrative for a fabless company, but there is some risk involved if an equipment manufacturer decides to cancel a program before the semiconductor company has recovered its chip design costs. Although there are fewer sockets available, each may result in higher volumes than previously would have been the case. These key design wins could lead to years of revenue for a chip company, so competition is often fierce for these high volume sockets.

The fabless semiconductor industry has had a few years of almost no growth in its typical markets. This has resulted in many companies attempting to diversify products into newer areas that are growing, such as consumer electronics. The consumer electronics space is expected to be one of the faster growing semiconductor markets (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 39) compared with areas such as telecommunications, which has seen flat growth. Many traditional telecommunications semiconductor companies are entering into consumer electronics for this reason. The result has been greater competition and rivalry among competitors.

The fabless semiconductor industry is one with high rivalry amongst competitors. The industry is becoming more competitive with more companies fighting for less business and areas for growth. Many of these semiconductor companies and investors have become used to growth rates of 20% to 50% or more year-over-year, but recently these growth rates have been in some cases negative or single digit (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 37). Those semiconductor companies that are striving to achieve historical growth rates are faced with intense rivalry in every market, thus making the historical growth rates nearly impossible to achieve in the near future.

2.3 Bargaining Power of Customers

This section talks about how much power customers in the fabless semiconductor industry have over the fabless companies. It will be shown that customers have significant power in this industry.

Customers that represent more than 10% of any given semiconductor company's revenues can exert significant power over the company. The reason for this is that the customer segments of the industry are quite fragmented, which results in fabless companies having many

[6] A socket is a location for a chip to plug into on an electronics board in a piece of electronic equipment. The term socket is used to describe the equipment design that a chip is being developed for by a semiconductor company, or multiple companies competing for the same socket.

customers and only a small handful which represent over 10% of revenues. Another factor for this phenomenon is that any given fabless semiconductor company may only have one chip out of many in a customer's piece of equipment. This can also create a powerful position for a customer because they are not dependent on only one chip supplier.

The market is also changing such that customers are demanding complete solutions from the fabless semiconductor companies rather than single point solution chips. This change has come as a result of equipment manufacturers trying to reduce costs. OEMs are doing less design work and instead buying useable solutions from companies such as the fabless semiconductors. By doing this, customers are exerting more pressure on the fabless companies because if a semiconductor company doesn't have a complete solution product, it may lose business to a competitor that does. This has forced many semiconductor companies to find strategic partners to produce a solution with or to acquire IP that can be incorporated into a solution. Customers are pushing more development costs onto the fabless companies by using their power in the industry.

Application specific standardized products (ASSPs) are chips that can be substituted with relative ease from one company's chip to another. The reason is that these chips are designed for a specific application but are designed to meet industry standards; therefore an equipment manufacturer can switch between one vendor's chips and another with minimal additional design costs. As a result, equipment manufacturers will typically choose an ASSP chip based on its relative price to power or performance ratios. This allows customers to exert some power over the chip makers knowing that the manufacturer can select another vendor's product without the typical switching costs. It also enables the customer to use this power to not pay high premiums for standard products that are differentiated slightly from the competition with the addition of enhancements. If the customer does not perceive value in the enhancements, then they are not likely to purchase the higher priced, differentiated product if a cheaper, standard product is available. This is proving as a challenge to companies that rely on a differentiation product strategy to achieve higher profits.

Equipment manufacturers also exert power over the semiconductor companies due to the design specifications required for a given chip. When a customer sets out to design a new piece of equipment, they will create strict design specifications that must be met by all of the components in that piece of equipment. In order to win the design, a chip manufacturer must meet those exacting specifications just to be considered. At times, the customer can set specifications that are extremely precise even though they may know that no chip on the market

can meet them. This may force a semiconductor company to design a new chip or make revisions to an existing chip in order to win the socket. Often this is done at the chip company's expense with no commitment from the equipment manufacturer that the chip will be designed into the product. The power that customers use in these situations can often be quite high, and there have been instances where an equipment project is cancelled during the design phase; thereby leaving the chip company with no revenue for its efforts.

Customers are also exerting their power for large volume deals whereby they may wish to source standardized chips from multiple semiconductor companies. This allows the customer to have a dual-source for chips to reduce risk of supply problems. This also allows them to exert more pricing pressure by pitting one company's price against another. In this case, the equipment manufacturer would then agree to buy a minimum amount of chips from one company and the rest from another for the life of the equipment product.

Fabless companies can retain some power with customers by integrating specialized IP into the products that will differentiate these chips from the competition. This may allow the chip manufacturer to extract higher rents from customers if the company can show the value of the IP; thus giving some power to the fabless company if it is the only company with such a product.

Another move in the industry, in an effort for equipment manufacturers to reduce costs, is to sponsor chip design programs at a fabless company. This is typically done when an equipment maker does not have the resources to design a new chip for a product or the company wants to reduce development costs and risk. By partially sponsoring a fabless company to develop a new chip, the customer commits to buying the chip if the equipment product gets deployed. The equipment manufacturer will typically also license the product to the fabless company to enable it to sell the same chip to other equipment manufacturers. This allows the semiconductor company to recoup some development costs without directly passing on the full costs to the equipment company. The problem is that there are not a lot of sponsorship programs being provided. Although the programs can be quite lucrative for the fabless semiconductor companies, the equipment manufacturer knows this and therefore has a lot of power in negotiating the deal. Sometimes the sponsorship program may involve developing a chip that has no market other than for the program sponsor, but if the fabless company does not do its due diligence, then it may end up losing money on the deal. Another problem that exists is that sometimes an equipment manufacturer cancels its equipment program before launch, which adversely affects the fabless company. The equipment manufacturer holds all of the power in these deals.

The overall power situation for customers in the fabless semiconductor industry is in favour of the customers. Fabless companies have very little power and influence over customers except in a few key areas.

2.4 Threat of Substitutes

In the technology industry there a moderate threat that a new technological innovation will make obsolete or become a substitute for current technology that is being developed. This section will review some of the factors involved in the overall threat to the industry regarding substitute products.

New semiconductor technology is always being developed by start-ups and existing companies in an attempt to create the next big innovation that will take over the market. There is always a threat that current products a semiconductor company is working on will no longer be useful, which is why companies must continuously innovate. Sometimes this innovation comes in the form of revitalizing a current product that a company is already selling. This could be to reduce the size and power consumption of the chip, increase its performance or reduce production costs. It may be necessary for a company to develop a strategy whereby it is making its own products obsolete, but this will allow the company to stay ahead of the curve and block out substitute products.

Many of the products in the semiconductor industry are built around industry standards that exist for specific product areas. This standardization enables products from multiple vendors to interoperate. The threat that comes from this, however, is that any newcomer can create a similar product that adheres to the standards that can then be used as a substitute. The same standards also make it more difficult for products to be differentiated from each other. If products meet the industry standards and perform according to those standards, there are only a few characteristics that a company can alter to differentiate a product from those of its competitors. Chips can be differentiated based on price, power or performance, but a customer may not be willing to pay a premium for a differentiated product if they only need one that meets industry specifications as well as their own design requirements for a low cost. This can cause a challenge for companies that adopt a differentiation strategy for products in order to extract higher rents. As the industry is moving towards using standardized products more frequently, it is becoming more difficult for differentiators to retain the value for the additional investment required to differentiate a product.

The high-tech market crash in 2000 caused a number of equipment manufacturers to re-evaluate their business models. In the 1990's, many of the large equipment companies (such as Cisco, Nortel and Lucent) had in house design teams that would design entire products, including many of the chips that were required. The chips designed by these companies are called application specific integrated circuit (ASIC) because the chips are often designed for one specific application and cannot be reused in another product. After 2000, these same companies realized that this business model did not provide a competitive advantage. Instead, the equipment manufacturers started outsourcing ASIC chip development or buying ASSPs from fabless companies that may be able to amortize development costs across multiple customers wanting the same chip. This change in the industry has brought some power back to the fabless semiconductor companies; however the chips still must meet design specifications that are set by the equipment manufacturers.

One example of this highly competitive market is in the microprocessor space. A microprocessor is a chip that can be programmed to perform any number of functions. There are a number of microprocessor types; for example, Intel's x86, MIPS based processors, and IBM's PowerPC. Although each of these products has its own advantages and disadvantages, each is almost entirely substitutable for the other due to the open source and industry standard software written for these chips. For example, a PowerPC chip can be used for the same application that a MIPS processor can, although the design of each is completely different. A customer may choose one chip over the other depending on their price, performance or power requirements for their application.

One segment of the semiconductor market that accounts for 22% of the overall revenues is the consumer space (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 39). This segment operates very differently than the other segments in that it primarily follows a cost based strategy and operates on a very short product lifecycle, as short as 3 to 6 months compared with 5 to 10 years for segments like communications equipment. As a result of this shorter product lifespan, a semiconductor company's products can be very quickly substituted by one from its competitors. There are high volumes in this segment, but if a semiconductor company cannot adapt fast enough to its market segment, then its products may be replaced.

The overall threat of substitutes in the fabless semiconductor market is medium. The primary threat is from new technology innovation that could be used to displace an entire product segment from the market.

2.5 Bargaining Power of Suppliers

The fabless semiconductor industry has many suppliers, some of which have some power over the industry and others that do not. This section describes those suppliers and how they exert their power.

During times of high demand for silicon and semiconductor production, foundries can be the main bottleneck in the manufacturing process. Many fabless companies work with foundries all over the world, but the majority of foundries are in Asia, which has 67% of the fabrication capacity (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 32). The construction of new fabrication facilities can take a number of years to complete, so foundry capacity (supply) can lag if demand increases rapidly. The lack of capacity during these peak times causes the foundries to raise prices, which then in turn causes the fabless semiconductor companies to pass on the increased costs to customers. It is during these peak times that the foundries have more power over the fabless companies; however, due to the cyclical nature of the industry there are also times when demand significantly drops and there is excess capacity in the foundries. During that most recent cycle from 1996 to 2004, foundry capacity utilization went from about 75% up to full capacity and back down to 75% (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 45). In these down periods, the fabless companies can exert more pricing pressure on the foundries because of idle production capacity that needs to be filled.

Skilled engineers are a major component of the semiconductor industry. Without enough electrical engineers to design the chips, companies are not able to develop new innovative solutions to keep up with or stay ahead of the competition. During the high-tech boom of the 1990's there was a shortage of skilled engineers; however since the bust in 2000 there has been an excess capacity of engineers on the job market due to the massive layoffs that took place. This is still the case today, but it is slowly changing. As a result of the excess supply of resources, semiconductor companies have more power over engineers in determining compensation packages and other incentives.

Semiconductor companies require specialized software to design chips. The software tool vendors for the semiconductor industry develop products to assist in the design and test of these chips. When a fabless company selects a tool vendor, the switching costs can be high to select a new package because it would involve retraining its engineers on the new software. This would negatively impact productivity; therefore, the software vendors have a lock-in effect once becoming the incumbent vendor. As well, the fabless company must pay annual license

maintenance fees to use the tools, which provides a steady stream of revenue for the tool vendor. Fabless companies have little bargaining power with the tool vendors because without the tools, chips cannot be designed.

Since the technology industry bust in 2000 the capital investment markets have been less likely to invest in high-tech companies. This has made it difficult for companies that are cash starved because of the ongoing capital required to develop chips. Currently the capital markets are still the biggest source of funding for fabless companies, but any company that has had to raise capital in recent years has done so at the high cost of diluting its share base due to deflated stock prices. This has lead to a more powerful position for the capital markets over semiconductor companies.

The equipment required for testing chips after being produced is very specialized and expensive for a fabless company. The test equipment market is quite fragmented with Advantest, Agilent and Teradyne making up the majority of the market share with between 19% and 31% share each in 2003 followed by many smaller vendors (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 45). Due to the fact that there are a number of vendors in this market and the products are targeted at very narrow niche markets, it is difficult for the test equipment manufacturers to have much power over the fabless companies.

Fabless companies also require a lot of computing power to develop and simulate its chip designs. The industry trend is moving towards using open source Linux based computers to perform these compute functions. This is an attempt to reduce capital and depreciation costs of purchasing computers for the engineers to use. Open source Linux and PC based servers are homogeneous products and are available from multiple vendors, compared with the expensive proprietary systems that were available previously. This allows the semiconductor companies to exert a lot of pricing pressure on the infrastructure server hardware vendors.

The final primary supplier to the fabless semiconductor industry is real-estate property owners. The majority of semiconductor companies are clustered in similar areas such as Silicon Valley in California and Kanata in Ontario where there is a large supply of engineering resources. Since the high-tech crash in 2000 there have been many companies that went bankrupt or downsized and as a result there has been a lot of vacant commercial real-estate. This has put the semiconductor companies into a powerful position when negotiating rental contracts for office

space. In many cases, semiconductor companies have been able to renegotiate contracts in recent years to gain additional office space at no additional cost.

All of these factors contribute towards a low to medium strength rating for bargaining power of suppliers in the fabless semiconductor industry. The changing industry has shifted the power in recent years, but some of the major suppliers still have a strong power position and therefore the overall power rating is at the medium level.

2.6 Industry Assessment

Based on the analysis in the previous subsections, there are some key findings and statements that can be made about the fabless semiconductor industry. This section will summarize those findings and assess the state of the industry.

The semiconductor industry is one that is very cyclical and has periods of rapid growth along with innovation followed by a retraction and lower spending (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 43-49). This cyclicity can make it difficult for some companies that are low on capital because developing semiconductors can be capital intensive due to the long product development lifecycles. A typical chip can take a year or more to develop followed by another several years before the chip company will see significant revenues for the chip (SemiCo, 2005, p. 19).

Capital has been a key requirement for successful semiconductor companies, especially since the industry crash in 2000 (Fuscaldo, 2002, p. B.5.E). Since this time, it has been difficult for high tech companies to obtain sources of capital because the markets have not favoured investing in technology companies. This has made it difficult for companies that were short on cash to begin with and as a result there have been many semiconductor companies that have gone bankrupt since 2000; therefore, companies that have strong balance sheets are better able to weather the ups and downs of the semiconductor industry (Fuscaldo, 2002, p. B.5.E).

The industry is slowly recovering since 2000, but growth levels have not yet returned to those of the 1990s (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 37). This slowing growth has forced companies in the industry to look at other ways to obtain a competitive advantage. One way that equipment manufacturers have done this is to reduce costs through outsourcing development of some chips to fabless companies. Fabless companies have a natural cost advantage due to not owning any chip manufacturing facilities. Another way has been to move

away from using ASICs to using more ASSPs, again to reduce costs. The main focus in the industry as a whole has been towards cost reductions (Ojo, 2002, p. 3) to remain competitive, but there is a possibility that the short term result of this will be less innovative products in the near future due to the reduced spending on research and development.

The change towards cost based strategies by the equipment manufacturers has benefited fabless companies that can design and produce chips for the OEM more cheaply than the competition. Another cost optimization strategy that fabless companies have begun employing is to design SOCs that incorporate multiple functions into a single chip. SOCs integrate functionality from multiple chips in a piece of equipment down to a single chip which can be sold at a higher unit price, but at a lower overall cost to the equipment manufacturer. This move has benefited companies that have access to a wide variety of IP that is necessary to design an SOC.

In recent years, the semiconductor industry has become extremely competitive due to fewer high volume sockets and a move towards standardized products by equipment manufacturers as these companies try to minimize costs. Equipment manufacturers have a lot of bargaining power and are applying pricing pressure to semiconductor companies. This is why it is important for fabless companies to adopt a new lower cost structure to compete (Morgan, 2003, p. 17) and have access to enough capital to weather potentially long industry down cycles. During the boom period, capital was abundant, which enabled many companies to get away with not focusing on lowering costs, but since the crash companies have been forced to focus on cost to remain competitive (Alessandri & Bettis, 2003, p. 32). The fabless semiconductor industry is therefore not very attractive for new entrants, but it can still be attractive to the stronger companies that are able to maintain a position and wait for the recovery to take place.

2.7 Key Success Factors

Analyzing the factors affecting the fabless semiconductor industry above helps to shed light on what strategic factors may be involved. This analysis helps to identify some key success factors for semiconductor companies.

Of all the key success factors in today's highly competitive semiconductor industry, the number one factor is having a low cost structure. According to Yun-Hee Kim, "suppliers' cost structure will be the key factor in staying ahead" (Kim, 2005, p. B.3). A company that can maintain a low cost position will be able to defend itself in industries that have customers with high bargaining power and lots of rivalry amongst competitors, such as the semiconductor

industry (Porter, 1998, p. 35-36). The ability to have a cost advantage over competition when competing over industry standard ASSP sockets can often make the difference, all other things being equal. An equipment manufacturer will look at how a chip performs in relation to its price and power usage when compared with a competitor's product. If two similar products perform relatively the same, the design win will often go to the lower priced chip.

The second most important key success factor is the ability for a semiconductor company to access vast amounts of intellectual property that will enable it to design highly integrated SOCs. In the years since 2000, OEMs have been working strategically with component manufacturers (Baljko, 2002, p. 3) to drive down component prices. One way this is being done is to drive higher levels of system integration into a single chip to reduce the bill of materials, which is important to the cost conscious OEMs (Souza, 2001, p. 4). Having SOCs in its portfolio will give one semiconductor company a competitive advantage over another that may have a similar product requiring two chips to perform the same function as the single SOC. To create these chips requires access to a lot of IP which can be obtained internally by investing in R&D or externally through partnerships or acquisitions.

In order to acquire IP, a semiconductor company can develop it internally by funding research and development projects. The company can also acquire the IP externally by purchasing it from a third party or finding a strategic partner that is willing to do a revenue sharing, or similar, model. Internal R&D and acquiring IP from a third party require a source of capital to fund the acquisitions. As a result, access to capital is the third most important key success factor for the semiconductor industry. Capital also forms another important function of enabling a company to fund operations during down cycles of the semiconductor industry. Equipment manufacturers may look at a company's available capital as a differentiator when contemplating doing business with two semiconductor companies. The equipment manufacturer may choose to use a chip from a company that has a solid balance sheet because it can be more certain that the company will be around long enough to supply the chip for the life of the equipment.

The protection of investments in intellectual property is the final key success factor in the fabless semiconductor industry. After companies invest heavily to develop or acquire IP, the companies must protect those investments through the application and enforcement of patents. Patent protection can act as a barrier to entry for any potential competitor that may wish to enter an existing market. The enforcement of these patents is equally important to provide a credible

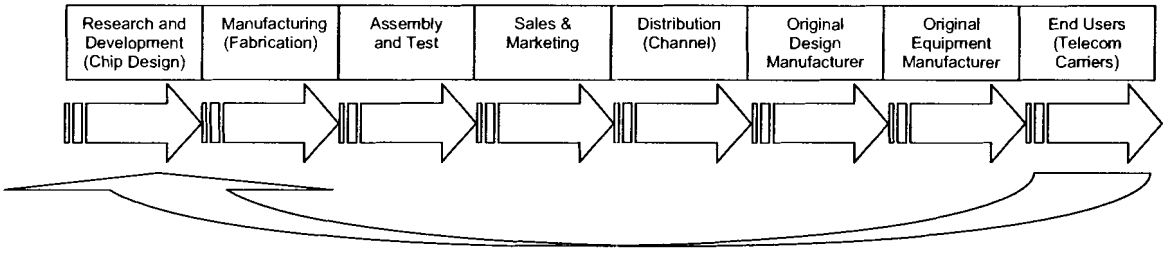
threat to any company that attempts to infringe on an existing patent. Companies need to protect IP the same as any other investment to ensure that shareholders can retain the value and achieve a positive return.

A fabless semiconductor company that can measure and achieve best in class levels for each of the four key success factors outlined above is likely to achieve a competitive advantage. This competitive advantage can then be used to achieve market dominance and slowly erode the competition's market share.

2.8 Industry Value Chain

The semiconductor industry is comprised of multiple components from research and development to the end users of the products containing silicon chips. This is depicted in the industry value chain diagram in Figure 2-3. This section will describe the value chain and briefly discuss the role that SemiCo plays in adding value to the overall industry.

Figure 2-3 Fabless Semiconductor Industry Value Chain



Source: Author; adapted from Bukszar (2005)

The beginning of any silicon chip starts with R&D. A semiconductor company will identify a need in the market that can be filled with a new chip design (or redesign of existing chips to reduce production costs). Once a need is first determined, the semiconductor company sets out to design the chip in the most effective manner to meet the best combination of price, performance and power consumption. All three of these factors are important to the end consumer of the silicon chips, so it is important for the chip to be designed with them in mind from the beginning.

Once a chip has been designed, it is sent to manufacturing facilities where the chips are fabricated onto silicon wafers. In the case of fabless semiconductor companies this is completely

outsourced to contract manufacturers. The fabrication of silicon wafers is done by companies that specialize in this function; therefore, these companies add value to the industry by keeping plants operating efficiently and being able to invest in next generation chip manufacturing technology.

The next step in the industry value chain is when a wafer completes the manufacturing process at the foundry. A silicon wafer contains multiple chips that must be separated into individual chips. Then the core of the chip is assembled into a housing that allows electrical connections to travel from the chip to an electronics board. This assembly is sometimes done in conjunction with the wafer manufacturer, but there are also companies that specialize in chip assembly. Once the core is assembled into its housing, each chip must be individually tested for quality control to ensure that it works. The chips must meet strict quality standards before being shipped to customers. The quality assurance testing portion of the assembly is sometimes done by the assembly houses with specialized test programs provided by the semiconductor company; however, most often it is done by the semiconductor company. Further testing of a chip's functionality is done by a semiconductor company in simulated real-world applications of the chip. This creates a feedback loop to the design engineers during this portion of the testing phase which allows making improvements in future revisions of the chips.

A completed chip is ready for implementation into equipment designs once it has been tested and validated. The next step is to sell the chip to potential customers, which is the role of a company's sales and marketing arms. The process of selling a chip involves working closely with equipment manufacturers (OEMs) and equipment design companies (ODMs) to understand what equipment these companies are designing or planning to design in the future. This is usually done through years of building relationships with the OEMs and ODMs such that the companies are willing to share confidential information about future products with the semiconductor company. Once a potential sales opportunity is identified, the sales and marketing groups will put engineers at both companies in touch with each other to work through design specifications to see if there is a fit for the company's chip. The ODM and OEM may be considering chips from multiple vendors for a given piece of equipment, making this phase of the development critical to winning a design.

The next step in the chain is to get the chips distributed to the equipment manufacturers once manufacturing of the equipment in production quantities begins. The distribution of chips can either be done directly by the semiconductor company or through distribution channels.

Fabless companies will typically use a combination of both distribution models depending on the circumstances and the relationship with the equipment manufacturer.

As mentioned above, the design of equipment can be either done by ODMs or OEMs. Some equipment is designed and manufactured entirely by an OEM, but there are times when an OEM acquires a completed product from an ODM. This enables the OEM to have a time to market advantage by not requiring time spent on development. It also helps OEMs reduce research and development costs by not having internal resources tied up with designing all equipment. This model is becoming more popular in consumer equipment markets where time to market and lower cost are critical factors (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 290-331). A semiconductor company will work with an ODM in the same manner as with an OEM to get chips designed into a new piece of equipment. Engineers from both companies will work together to make the design process more smooth for the ODM.

The OEM is the final link in the chain before a completed piece of electronics equipment is shipped to the end consumer. An OEM will design its equipment (or purchase a design from an ODM) using multiple silicon chips to produce a working solution. The product is then identified with the OEM's brand for end user recognition of the product's perceived quality. The OEM will mass produce the product and use its distribution channels to get the product on store shelves where it can be accessible to the end user. The most value that an OEM adds in the industry is its mass distribution capabilities and relationships with stores and end user distributors. ODMs do not currently have this capability due to a specialization in designing equipment rather than distribution.

The end user of an OEM's equipment can be any individual person or company, such as a telecom equipment manufacturer. The end user is not usually concerned about the individual silicon chips that go into designing a product that they need to use, but the way that they use the equipment can often influence the design of future silicon chips. The OEMs use their relationship with end users to understand how to improve on their equipment, which will in turn require different or modified chips in future products. This feedback loop goes all the way back to the research and development portion of the value chain to start the process all over again and continue the innovation process.

SemiCo's involvement in the fabless semiconductor industry is primarily limited to research and development, internal chip testing, and sales and marketing. For any given chip that

SemiCo develops, the company does the majority of its own R&D. However, some projects are partially outsourced if the IP is not strategically important to SemiCo. The manufacture of SemiCo's chips is 100% outsourced to contract manufacturers in Asia. Once a chip is produced, the assembly is outsourced to third parties, but the majority of the chip's testing is done by SemiCo itself. During peak periods when SemiCo does not have the capacity to test all of its chips, this function may be partially outsourced to companies that specialize in testing. SemiCo does most of its own sales and marketing with internal resources. These groups have formed relationships with the many equipment manufacturers in order to understand what the requirements are for current and future products. Distribution of SemiCo's chips is partially done through semiconductor distribution networks. For larger customers that order in volume, chips are distributed directly from SemiCo to the customers.

SemiCo does not participate in all functions of the industry value chain, but instead it focuses on those areas that its expertise enables it to add the most value. The value that SemiCo can add in the areas of R&D, product test, and sales and marketing is through continuous product innovation to help equipment manufacturers meet the changing requirements of end users and being able to sell the OEMs and ODMs on the idea of using its chips. SemiCo closes the feedback loop through the integration of the end user feedback into future chips to improve next generation equipment. If SemiCo were to be involved in all areas of the industry value chain, it would require more resources and the company would not add the most value by exploiting its competencies. As a result, SemiCo has chosen to focus on those areas that it feels it can best serve itself, the industry and its shareholders.

3 EXTERNAL ANALYSIS

This chapter takes a look at the external environment that SemiCo operates in. An analysis of some of SemiCo's competitors was done to provide insight and context for the analysis and recommendations that will be given for SemiCo. Each competitor's business model, its goals, financial situation and potential retaliation strategies will be examined.

3.1 2Wire, Inc.

> A pioneer in broadband networking, 2Wire is dedicated to developing integrated solutions to deliver broadband service and content throughout the home or small office. Built upon the company's core expertise and continued innovation in software and hardware, 2Wire products enable home and small business users to fully leverage the benefits of broadband. In addition, 2Wire solutions offer service providers with a flexible platform to deliver and manage feature-rich Internet, telephony, entertainment, and other enhanced broadband application services.
>
> *(Source: 2Wire, 2005a)*

2Wire is privately held, and as a result information about the company is sparse. 2Wire was started in 1998 and has raised a total of $196 million in private equity investments since that time (2Wire, 2005a). The company has grown from revenues in 2000 of around $3 million (Taylor, 2004) to $107 million in 2003 (Inc.com, 2005). As a result of this massive growth, 2Wire was ranked 26th in the Inc. 500 Company list of the fastest growing private companies (Inc.com, 2005).

The company began with the vision of enabling the delivery of the full benefits that broadband Internet access can provide (2Wire, 2005a). 2Wire's products are primarily focussed on the home network and providing service providers a managed gateway solution for a complete entertainment solution in the home (2Wire, 2005a). The company's product strategy drives at the heart of triple play (2Wire, 2005e) with products for the home that will provide a gateway to unlimited possibilities on the home network. This strategy has lead to significant partnerships and joint ventures with communications companies, such as SBC Communications and SaskTel (2Wire, 2005f).

The management team and board of directors at 2Wire come from backgrounds that benefit the company's strategy. Specifically, the company's founder and CEO, Brian Hinman, has experience as co-founder of the successful companies PictureTel Corporation and Polycom, Inc. (2Wire, 2005a). Hinman's success has garnered him the prestigious award of Ernst & Young's 2005 Entrepreneur Of The Year (2Wire, 2005d). 2Wire's VP of engineering, Pasquale Romano, comes from Polycom, Inc. where he held senior positions in product development (2Wire, 2005b). Michael Crumlin, 2Wire's VP of North American sales comes from a background that gives him a strong understanding of the communications industry (2Wire, 2005b). A management team with applicable experience and background such as this should help 2Wire achieve success in its target markets.

Speculating on how strong 2Wire is for future growth can be done by looking at its potential available cash. The company has raised $196 million (2Wire, 2005a), but it has spent some of this to fund development. Even if the company had not spent any of this capital and was entirely funded by cash flows, it would currently have almost $200 million in cash, which is low compared to its competitors. Therefore, if 2Wire is expected to continue to grow it will need access to more capital to fund this growth. One possible way to do this would be for 2Wire to become a public company. According to Inc.com, 85 of the top 500 (17%) private companies intend to go public at some point, so it is possible that 2Wire is one of these companies (2Wire, 2005c).

2Wire's likely retaliation strategies at this point are unclear. Many of the companies that 2Wire competes against have more funding so 2Wire could not survive a long price war if it tried to retaliate with pricing pressure. The company is more likely, therefore, to differentiate the company and its products in the market to attract customers. In order to differentiate, 2Wire will need to invest heavily into research and development, which requires significant capital. As a result, it is less likely that 2Wire will attempt to retaliate with newcomers into its market, instead it may try to partner with companies that have a core competence in R&D or access to capital, such as SemiCo, to better differentiate its products.

3.2 Agere Systems

> [Agere Systems] design, develop, manufacture and sell integrated circuit solutions for applications such as high-density storage, mobile wireless communications and enterprise and telecommunications networks. These solutions form the building blocks for a broad range of computing and communications applications. Some of [its] solutions include related software

> and reference designs. Our customers include manufacturers of hard disk drives, mobile phones, high-speed communications systems and personal computers.
>
> *(Source: Agere, 2005, p. 1)*

Agere sees itself as a company that has strong expertise in systems and solutions development as well as software (Agere, 2005, p. 3). The company uses this expertise to develop chips and software products for many areas, including home networking products such as telephone and video products (Agere, 2005, p. 3).

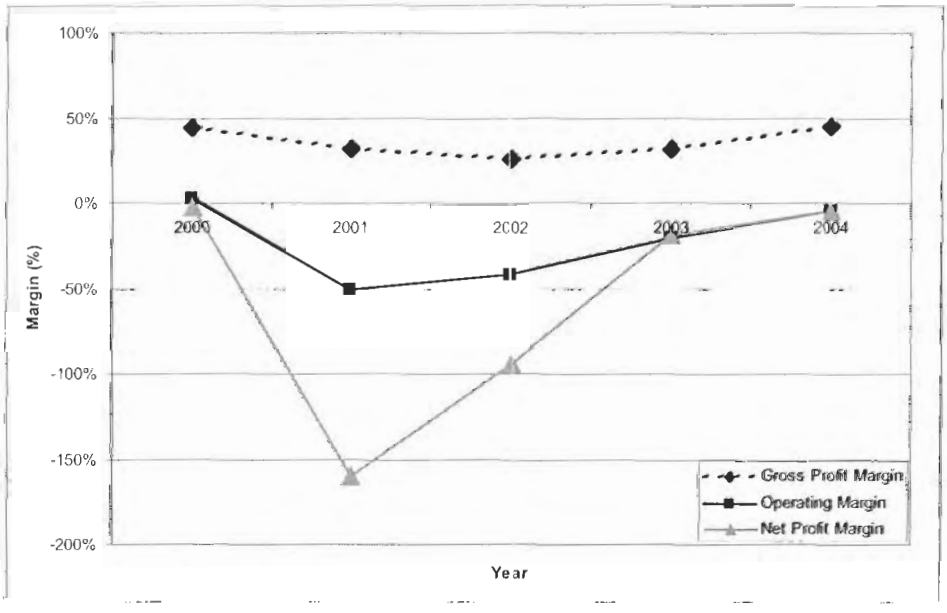
Agere believes that two important factors of competition in its industry are price and time to market, but the company also believe that some of its competitors have an advantage in these two areas (Agere, 2005, p. 6). If Agere believes these are primary factors in being competitive, then it is likely that the company could alter its strategy to achieve a low cost competitive advantage. Agere is, however, at a disadvantage for trying to be a low cost provider because almost 10% of its employees are unionized (Agere, 2005, p. 8), which means its labour costs will be more difficult to minimize compared with competitors that may be able to outsource certain parts of the business to contain costs.

Another cost disadvantage versus its fabless counterparts is that Agere owns and operates four of its own silicon manufacturing facilities (Agere, 2005, p. 5). This could be advantageous during a growth phase of the semiconductor industry when supply of manufacturing capacity is scarce, but it could impact financial performance significantly during down cycles when the plants sit partially idle. Agere views these internal manufacturing facilities as a competitive advantage because it enables the company to have a guaranteed supply of wafers when needed, despite the high costs of running the facilities (Agere, 2005, p. 5). However, the company does plan to slow investment in new manufacturing facilities to meet changing technology needs due to the high cost of building these plants; instead, the company is using contract manufacturers and foundries for the newer technologies (Agere, 2005, p. 5). Agere also is a joint partner in a silicon manufacturing facility with the foundry company Chartered Semiconductor (Agere, 2005, p. 5). One of the terms of this joint venture requires Agere to purchase 51% of the facility's silicon wafer capacity; otherwise the company is obligated to cover the fixed costs associated with the unused capacity (Agere, 2005, p. 5). Agere's investments and obligations in these manufacturing facilities act as a large exit barrier.

Agere also has a financial burden from its investment in manufacturing and office space. As of December 2004 the company had 39% of its facilities that were not being used, of which 70% of the total space is owned directly by Agere and the remaining 30% was from lease agreements for anywhere up to 12 years (Agere, 2005, p. 8-9). This investment in excess facilities can cause a drain on Agere's cash and could also act as an exit barrier.

Since 2001 Agere has realized a need to reduce its cost structure, and has implemented cost savings measures such as reducing headcount, consolidation of operations, reduction of owned manufacturing facilities, and exiting or selling non-core businesses (Agere, 2005, p. 12). These efforts have helped to reduce Agere's fixed costs and as a result the gap between its net profit, gross profit and operating margins has been reduced since 2002 (see Figure 3-1). In 2004, the restructuring efforts had a significant impact on gross margins, increasing them 13.8% from the year before (Agere, 2005, p. 18). Agere's targeted gross margins are 45% to 50% with an operating margin of 15%, but the company predicts that margins will decrease in 2005 versus 2004 (Agere, 2005, p. 13). These are signs that Agere is experiencing challenging times with trying to be competitive in a market that rewards those companies that are cost leaders.

Figure 3-1 Agere's Gross Profit Margin versus Operating Margin (2000 to 2004)



Source: Author; adapted from data in Agere, 2005, 2003, 2001)

One risk that Agere faces is its high concentration of revenues from a small number of companies. Agere gets about 65% of its revenues from only 10 customers (Agere, 2005, p. 24), so it is likely for Agere to fight aggressively with any competitor trying to take business by penetrating these 10 companies.

Agere's likely retaliation strategy is to reduce prices, even if it means to sell products at a loss. This is because Agere has manufacturing facilities that it needs to keep busy, so even selling chips at a loss provides revenue to contribute to covering some of its fixed costs for maintaining those facilities. Agere believes that price is a main factor in competition for its markets, so it is very likely that this will be a lever the company would use to compete.

3.3 Applied Micro Circuits Corporation

> [AMCC] design, develop and market technolog products for the communications and storage equipment markets. [Its] products are essential for the transport, processing, switching, routing and storage of information worldwide. [It utilizes] a combination of design expertise couple with system-level knowledge and multiple technologies to offer integrated circuit, or IC, products, as well as printed circuit board assemblies or PCBAs, for these markets. [It generates] revenues in the communications market primarily through sales of ... IC products to communications equipment manufacturers ... In the storage market [the company generates] revenues primarily through the sale of [its] host bus adaptor boards, or HBAs, to original equipment manufacturers.
>
> *(Source: AMCC, 2005, p. 1)*

AMCC has a very strong balance sheet, with a current ratio of over 13.5 (AMCC, 2005, p. F-3). The company has almost no current or long term liabilities, which means it uses its cash to fund operations. AMCC has over $850 million in cash and equivalents (AMCC, 2005, p. F-3), which at its current burn rate of between $35 and $45 million per year (AMCC, 2005, p. F-5) will last the company about 19 to 24 years. The reason for AMCC's strong balance sheet is that the company benefited from the stock market bubble by issuing over $4 billion in common stock during 2001 (AMCC, 2005, p. 19) just before the market crash. The influx of cash has helped to sustain AMCC's strong balance sheet position, but profits have been running at a loss since 2000 (AMCC, 2005, p. 19).

AMCC plans to use its strong balance sheet position to continue to grow its product lines and expand into new markets through strategic acquisitions (AMCC, 2005, p. 2). Acquisitions are a "key element" of AMCC's strategy to develop complementary products (AMCC, 2005, p.

5). A product area that is complementary to AMCC's existing products is home networking because these products require storage and communications elements. This product area may also be attractive to AMCC in the future due to the growth expected from this market and AMCC's target criteria for acquisitions include markets that will experience high growth (AMCC, 2005, p. 2).

One of the largest acquisitions for AMCC was the purchase of IBM's 400 series line of PowerPC microprocessors for about $228 million (AMCC, 2005, p. 5). These processors are used in many products that reside in the home networking space, including wireless access points, network hubs and switches, Internet access and gaming devices (AMCC, 2005, p. 8). AMCC intends to grow revenues for these processors and one way of doing this is to expand into the growing consumer and home networking product areas.

Price and integration are two of the factors that AMCC believes contribute to competition in its markets (AMCC, 2005, p. 11). This belief will likely lead AMCC to drive towards higher levels of integration on its chips to try to become a cost leader.

During the fiscal years from 2002 to 2004, AMCC spent a significant portion of revenues on research and development. The company spent 85%, 130% and 101% of revenues on R&D for 2004, 2003, and 2002 respectively. These figures are significantly higher than AMCC's peers, which spend between 20% and 50% of revenues on R&D (see Table 4-2). This could be a sign of a company that is unsure of what product areas are going to succeed in the market, and one that spends in many areas with the hopes of a big payoff in a small number of them. This shotgun type approach can be costly if the company does not have the cash to sustain it, but in AMCC's case it has enough cash in the bank to support this strategy for the short term.

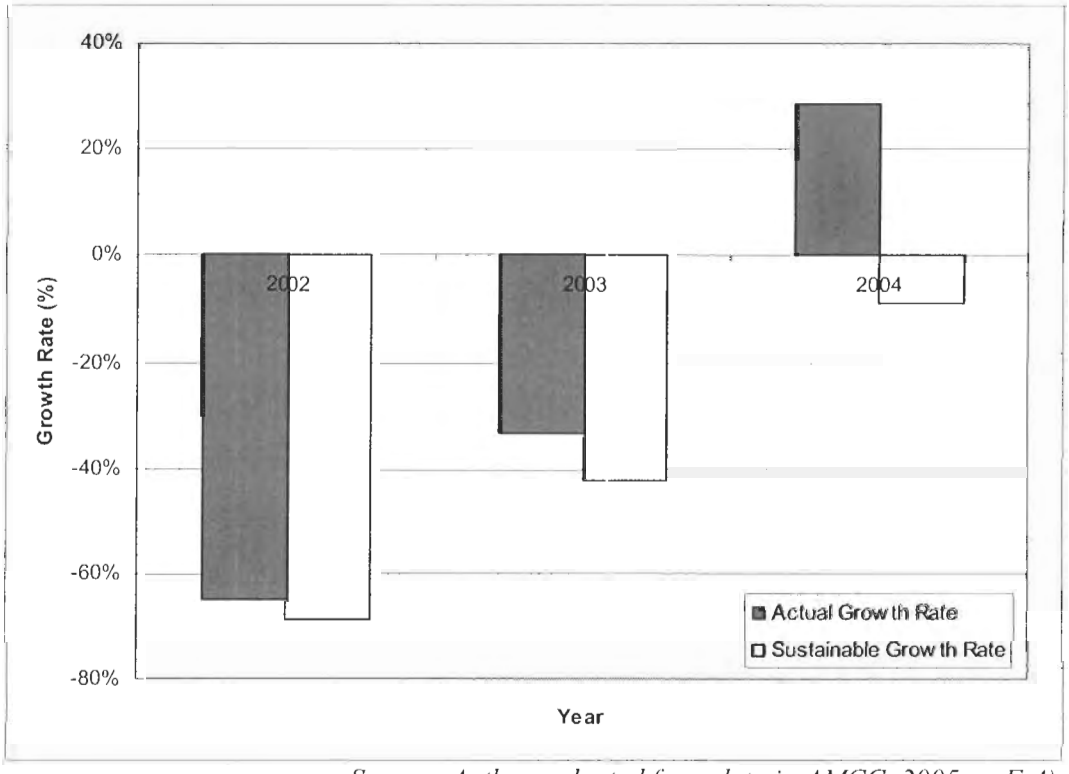
The strength of AMCC's cash position can be a credible threat to its competitors that are not in a similar position. For example, AMCC could threaten to retaliate against existing or potential competitors by lowering its prices to at or below cost as a scare tactic. This strategy would likely be short lived, but it could be enough to stave off competitors. There is no evidence that AMCC has or will use this strategy, but it is a potential retaliation strategy that it could employ in the highly competitive consumer space; especially since the company views price as a major competitive factor.

As of the company's 2004 annual report, AMCC was fighting at least 9 lawsuits that could have a material impact on its financial situation (AMCC, 2005, p. 15-17). If these lawsuits

are not resolved in favour of AMCC, there could be a significant drain on its financial position. This could impact the company's ability to grow and expand into new markets or raise capital in the future.

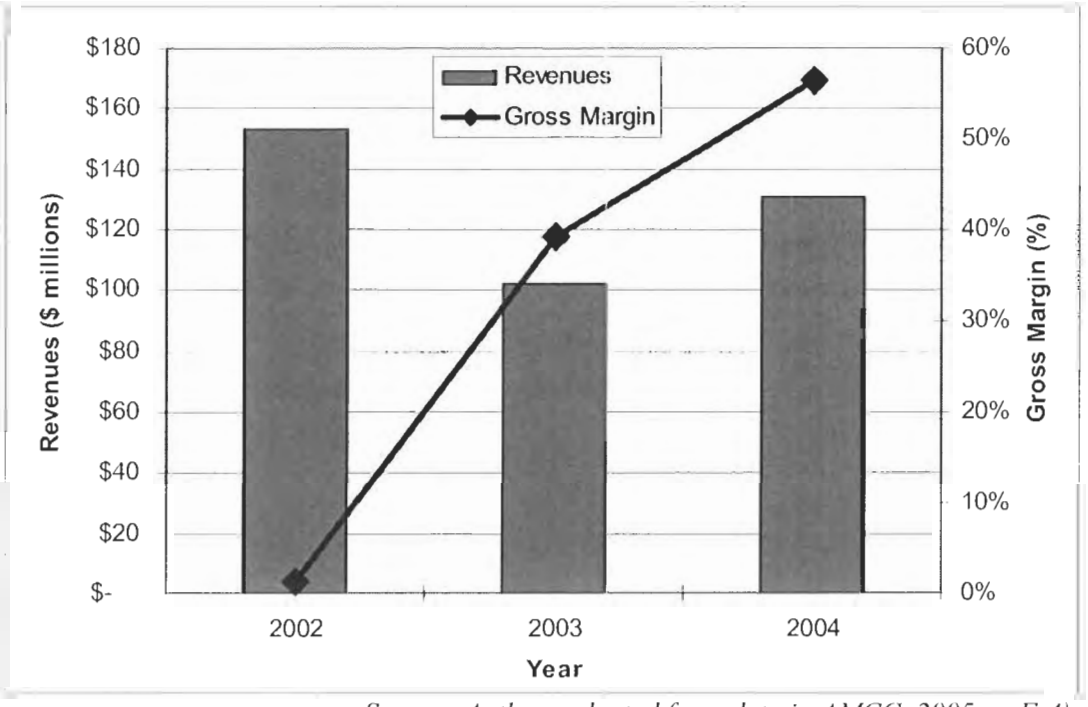
AMCC's revenues only started to recover in 2004 with modest growth, but the company has managed to improve its gross margins significantly over the same period (see Figure 3-2 and Figure 3-3). The company has, however, had growth rates that have exceeded a sustainable rate based on its available resources. It appears that AMCC is funding its growth with the use of available cash rather than strong fundamentals. As a result, AMCC is a potential threat for irrational competitive behaviour, but it is not as strongly positioned for the future as its peers.

Figure 3-2 AMCC's Actual and Sustainable Growth Rates (2002 to 2004)



Source: Author; adapted from data in AMCC, 2005, p. F-4)

Figure 3-3 AMCC's Revenues and Gross Margins (2002 to 2004)



Source: Author; adapted from data in AMCC, 2005, p. F-4)

3.4 Broadcom Corporation

Broadcom Corporation is a global leader in wired and wireless broadband communications semiconductors. [Its] products enable the convergence of high-speed data, high definition video, voice and audio at home, in the office and on the go. Broadcom provides manufacturers of computing and networking equipment, digital entertainment and broadband access products, and mobile devices with the industry's broadest portfolio of state-of-the-art system-on-a-chip and software solutions.

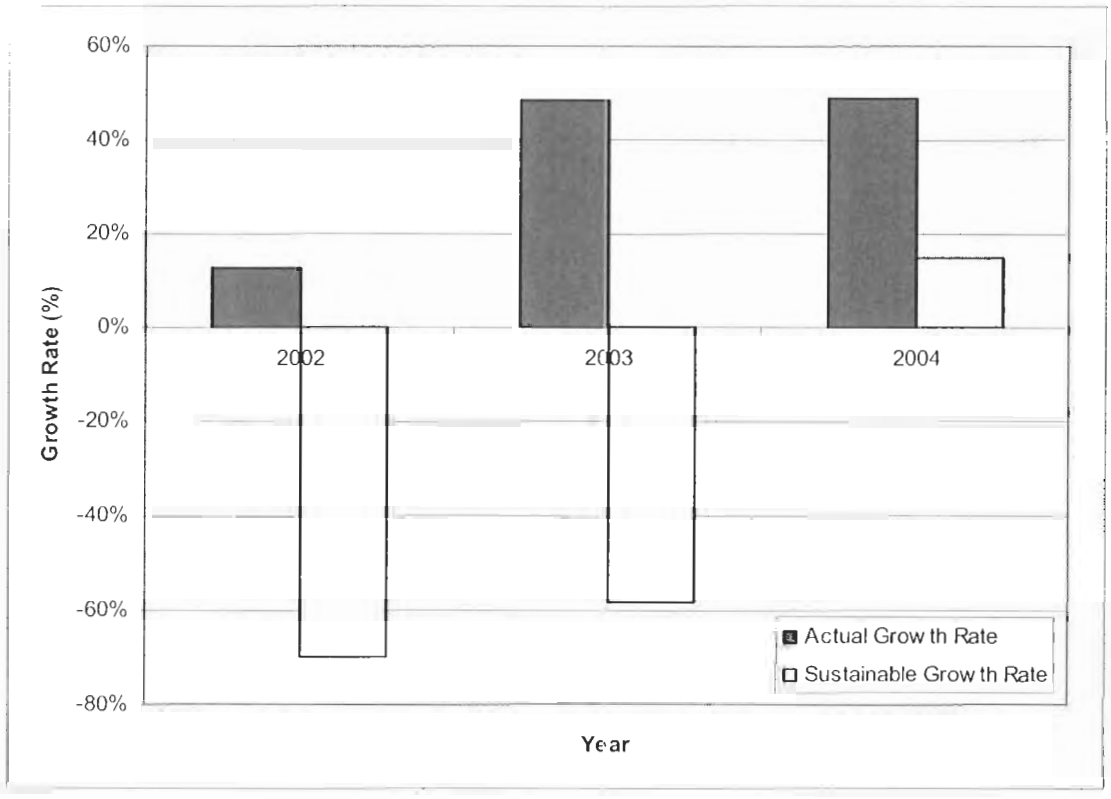
[The company's] diverse product portfolio addresses every major broadband communications market and includes solutions for digital cable, satellite and Internet Protocol set-top boxes; high definition television (HDTV); cable and digital subscriber line (DSL) modems and residential gateways; high-speed transmission and switching for local, metropolitan, wide area and storage networking; home and wireless networking; cellular and terrestrial wireless communications; Voice over Internet Protocol (VoIP) gateway and telephony systems; broadband network and security processors; and SystemI/O™ server solutions.

(Source: Broadcom, 2005, p. i)

Broadcom is one of the world's largest fabless semiconductor companies (Broadcom, 2005, p. i) and it is a fierce competitor in the home networking space. The company develops products such as set-top boxes, voice over IP, cable modems, digital subscriber line, broadband processors and wireless networking, which are all targeted at the home network (Broadcom, 2005, p. 1). Since 2004 Broadcom has been acquiring some companies that have products which could be targeted at the home network. For example, in 2004 Broadcom acquired Sand Video, which develops video compression technology, and in 2001 Broadcom acquired VisionTech, a developer of MPEG-2 audio and video compression technology (Broadcom, 2005, p. F-18). Broadcom is focused on achieving higher levels of integration with its products (Broadcom, 2005, p. 14). The reason for integration is to drive down costs for its customers by integrating more functionality onto a single chip. The company achieves this by investing 21% of revenues into research and development with 2,282 R&D employees, or 68% of the total (Broadcom, 2005, p. 19). It is apparent the Broadcom's objectives are targeted at continued product innovation and increasing the presence of its silicon chips in home networking products.

As of December 31, 2004 Broadcom had over $1 billion in working capital; an increase of almost $600 million from the year before. Much of this increase was due to cash from operations and the issuing of common stock through employee stock programs (Broadcom, 2005, p. 46). The company's strong capital position will enable Broadcom to grow and fund future research and development. Although this is the case, since at least 2002 Broadcom has been growing above a rate that is sustainable by its resources (see Figure 3-4).

Figure 3-4 Broadcom's Actual and Sustainable Growth Rates (2002 to 2004)



Source: Author; adapted from data in Broadcom, 2005, p. 22)

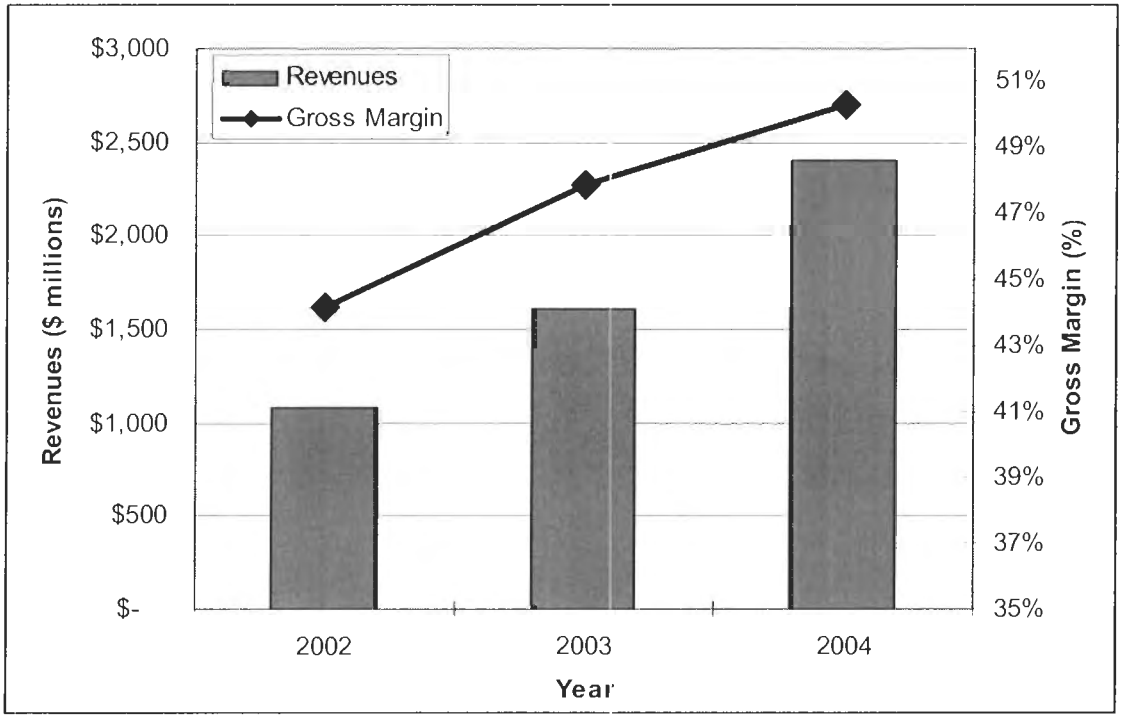
In December, 2004 Broadcom entered into a $183 million lease agreement for new office space that runs through to 2017 (Broadcom, 2005, p. 48). This could act as an exit barrier for Broadcom if it needs to downsize staff due to changing market conditions.

Broadcom's primary sources of capital are cash from operations and issuance of common stock (Broadcom, 2005, p. 46). Over 51% of its revenue for the last three years has come from only 5 customers (Broadcom, 2005, p. 54). These two factors represent a risk to Broadcom because if it loses any of its top 5 accounts, the company's cash from operations may decline, forcing it to issue more stock to fund future growth. To avoid this, Broadcom is likely to retaliate against any competitor trying to take business from its top 5 customers.

Broadcom's retaliatory response to entrants in the home networking space could be to drive down prices to at or below its costs as a threat. The company could realistically do this because of the over $1.1 billion in cash and short term securities (Broadcom, 2005, p. F-2). This would likely only be a short term strategy for Broadcom because the company is not a low cost

producer, which can be seen by the fact that its margins are not as strong as some of the other fabless semiconductor companies. Broadcom's gross margins for 2002 through 2004 have increased, along with revenues, from 44% to 50% (see Figure 3-5) which is consistent with the industry average of 40% to 50% (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 50). Broadcom's margins are, however, not as strong as some of its competitors like PMC-Sierra, Vitesse and SemiCo which have gross margins in the 60% to 75% range.

Figure 3-5 Broadcom's Revenues and Gross Margins (2002 to 2004)



Source: Author; adapted from Broadcom, 2005, p. F-3)

In recent years, Broadcom has lost significant market share in a few areas, specifically in its ServerWorks division, which developed a chipset for enterprise servers. Broadcom has experienced increased competition in the market for ServerWorks products and as a result it has lost designs to competitor's products (Broadcom, 2005, p. 36). The company has reflected this in its financial statements by taking a charge of over $319 million for impairment of goodwill (Broadcom, 2005, p. 43). According to Broadcom, the ServerWorks business represented a "significant portion" of total revenues and the company does not expect to be able to make up the loss of revenue in the short term (Broadcom, 2005, p. 53). The way that Broadcom responded to this loss was to diversify the ServerWorks products away from Intel only processors and work

with other processor vendors, such as Advanced Micro Devices (Broadcom, 2005, p. 8). This could cause issues for Broadcom in the form of reduced market capitalization as investors withdraw, which could impact Broadcom's future abilities to raise capital.

3.5 PMC-Sierra, Inc.

> PMC-Sierra, Inc. designs, develops, markets and supports high-speed broadband communications and storage semiconductors and MIPS-powered microprocessors for service provider, enterprise, storage, and wireless networking equipment. [PMC has] more than 230 different semiconductor devices that are sold to leading equipment manufacturers, who in turn supply their equipment principally to communications network service providers and enterprises. [PMC provides] superior semiconductor solutions for [its] customers by leveraging [its] intellectual property, design expertise and systems knowledge across a broad range of applications.
>
> *(Source: PMC-Sierra, 2005, p. 2)*

PMC-Sierra sees that industry and markets it operates in are changing such that communications service providers are seeking new ways to increase revenues by transitioning infrastructure to be more data centric and transferring information digitally (PMC-Sierra, 2005, p. 3). This change is allowing the service providers to look to new applications such as voice over IP, video on demand and advanced wireless services (PMC-Sierra, 2005, p. 3), all of which will require home networking products to deliver the services. PMC develops products to help enable the change in the communications industry and is developing new products to enable the new applications that service providers are seeking (PMC-Sierra, 2005, p. 6-7).

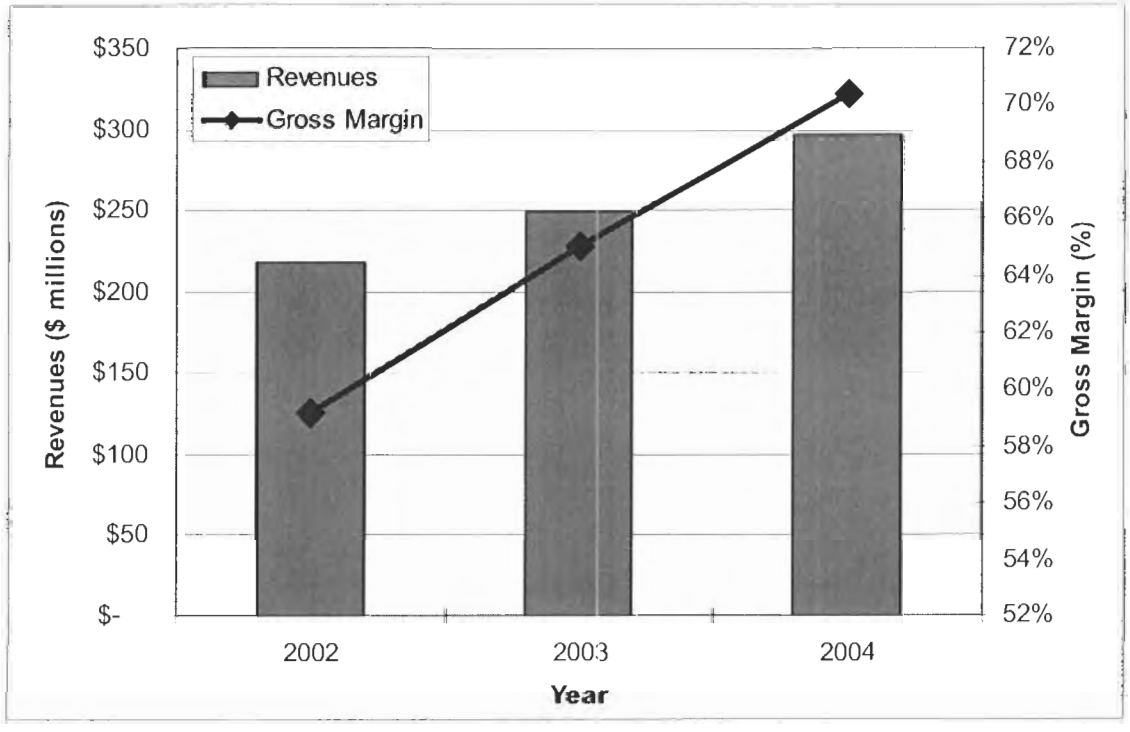
From 2000 to 2004, PMC-Sierra's spending on research and development ranged from 26% to 63% of revenues, with an average of 48% (PMC-Sierra, 2005, p. 16). This is on the high end when compared with PMC's peers, which range from 20% to 50% (see Table 4-2). PMC has over 63% of its employees working in R&D (PMC-Sierra, 2005, p. 13), which shows that it has a significant focus on development of new products that will produce future revenues.

PMC-Sierra believes that while price is a factor in competition, it is significant only to the extent that customers will choose a product if it is priced competitively (PMC-Sierra, 2005, p. 11). This means that PMC believes it can price its products slightly higher than a competitor and if PMC can demonstrate value for the additional amount. This admission in PMC-Sierra's 2004 annual report shows that it is not attempting to be a low cost producer, but instead it focuses on the other competitive factors such as time to market, quality, power and functionality

requirements (PMC-Sierra, 2005, p. 11-12). PMC does admit that OEM customers are becoming more price conscious and warns that its profit margins may be affected in the future if aggressive price competition takes place (PMC-Sierra, 2005, p. 11).

As of December 31, 2004, PMC-Sierra did not have any significant debt and the company had over $400 million in cash and investments (PMC-Sierra, 2005, p. 16) that could be used to fund future growth. PMC has experienced modest revenue growth over the last three years. During the same period, the company's gross profit margins have also been increasing (see Figure 3-6) and are healthy compared with its peers.

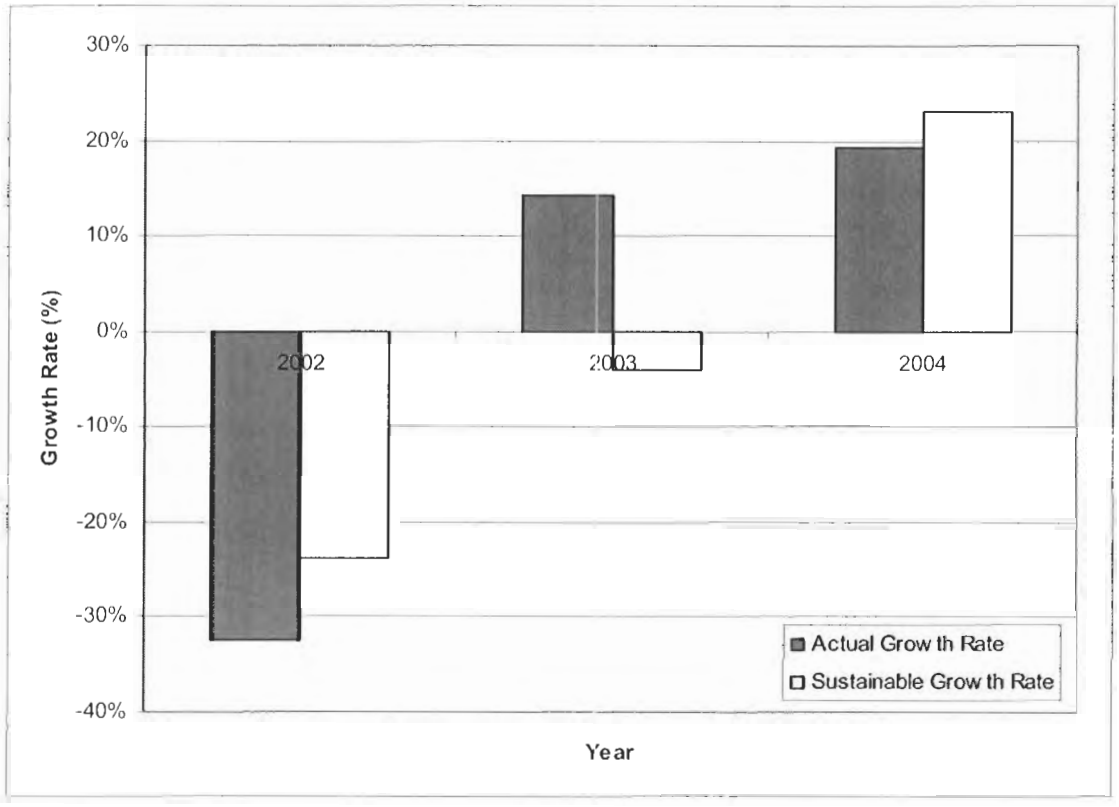
Figure 3-6 PMC-Sierra's Revenues and Gross Margins (2002 to 2004)



(Source: Author; adapted from data in PMC-Sierra, 2005, p. 16)

Over the last two years, PMC-Sierra's revenues have grown by between 10 and 20% per year. In 2004, revenue growth was about 19%, but based on the company's available resources, it could have sustained a higher growth rate of about 23% (see Figure 3-7). This means that PMC-Sierra has the resources available to grow further in the future, which could be a threat to its competitors and potential new entrants that may not have access to the same resources.

Figure 3-7 PMC-Sierra's Actual and Sustainable Growth Rates (2002 to 2004)



(Source: Author; adapted from data in PMC-Sierra, 2005, p. 16)

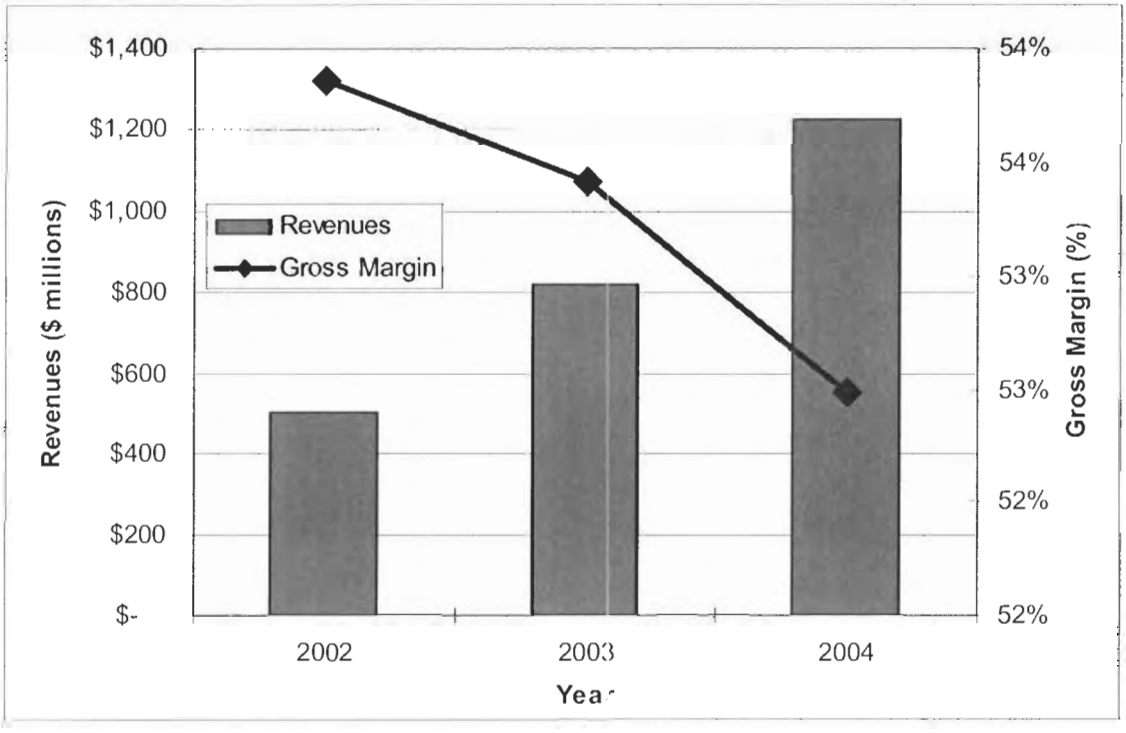
3.6 Marvell Technology Group

> [Marvell is] a leading global semiconductor provider of high-performance analog, mixed-signal, digital signal processing and embedded microprocessor integrated circuits. [Its] diverse product portfolio includes switching, transceiver, wireless, PC connectivity, gateways, communications controller, storage and power management solutions that serve diverse applications used in business enterprise, consumer electronics and emerging markets. [Its] core technologies were initially focused on the storage market, where [they] provide high-performance products to storage companies. [The company] subsequently applied [its] technology to the high-speed, or broadband, communications market, where [it provides] industry-leading physical layer transceivers, switched Ethernet and wireless solutions, which provide the interface between communications systems and data transmission media, to manufacturers of high-speed networking and wireless equipment. [The company has] also targeted [its] wireless technology for a variety of emerging consumer electronic devices to enable applications such as wireless connectivity, ad-hoc gaming, streaming audio or video and voice over Internet applications.

(Source: Marvell, 2005, p. 3)

Marvell is a company that appears to be having some difficulties and is going through some changes. Since 2002, Marvell has managed to increase its revenues, but at the same time its gross margins have been decreasing (see Figure 3-8). Possible hypotheses for the cause of this are that it could be an indication of a change in the company's product mix or it could mean rising production costs coupled with pricing pressure from customers and the competition.

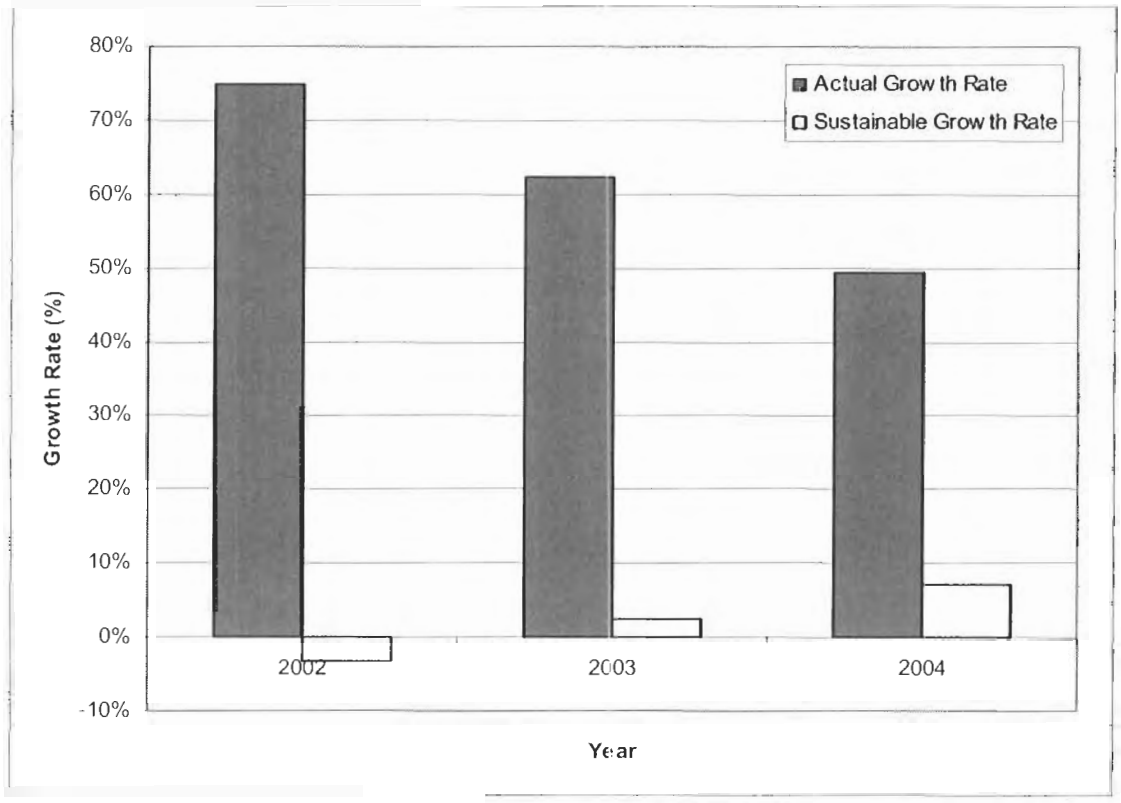
Figure 3-8 Marvell's Revenues and Gross Margins (2002 to 2004)



(Source: Author; adapted from data in Marvell, 2005, p. 30)

Marvell has seen significant revenue growth in the last few years, 75% in 2002 (Marvell, 2005, p. 30), but the company is outgrowing its resources which means that it will not be able to sustain these growth rates indefinitely (see Figure 3-9). Although growing at a rate that significantly exceeds one sustainable by available resources, Marvell has managed to more than double its cash and working capital positions from 2002 (Marvell, 2005, p. 30). The company has done this partially by increasing its short term liabilities by almost 20% and issuing more common stock (Marvell, 2005, p. 73). The company, however, does acknowledge that its growth has put a strain on resources and could harm the company if it is unable to manage the growth effectively in the future (Marvell, 2005, p. 60-61).

Figure 3-9 Marvell's Actual and Sustainable Growth Rates (2002 to 2004)



(Source: Author; adapted from data in Marvell, 2005, p. 30)

Marvell's products are targeted at high volume markets, of which the company believes cost, performance and features are some of the critical success factors (Marvell, 2005, p. 7). This shows that the company will try to focus its efforts on lowering costs to remain competitive, but at the same time it will invest in the development of differentiated products. In fact, Marvell states that it has been able to gain a cost advantage by lowering manufacturing costs (Marvell, 2005, p. 9). Marvell has also implemented the fabless semiconductor business model (Marvell, 2005, p. 12) and the company outsources most of its assembly and test functions to further reduce costs (Marvell, 2005, p. 23). The company appears to have a strong focus on reducing costs, possibly in an attempt to be a low cost producer. Some of the cost management strategies that the company employs include "design changes that lower the cost of manufacturing, assembly and testing, by entering into long-term, strategic arrangements with ... foundry partners to secure wafer capacity at reduced prices, by negotiating reduced charges from ... foundries as ... volumes increase and by successfully managing ... manufacturing, assembly and testing

relationships" (Marvell, 2005, p. 26). This focus on cost containment by Marvell could act as a potential threat to its competitors if the company is successful at becoming a cost leader.

Since Marvell is a company that does focus on containing costs, it could be an indication that it wishes to be a cost leader. This could act to its benefit as a potential strategy if the company wishes to retaliate against potential competitors entering its markets. If Marvell is in fact a low cost producer, then it could lower its prices to a point that would have a negative impact on competitors that try to match the prices. Since Marvell believes that it is a low cost producer (Marvell, 2005, p. 9) this is the likely retaliation strategy that the company would employ to ward off competition.

3.7 Vitesse Semiconductor

> [Vitesse is] a leading supplier of high-performance integrated circuits ("ICs") principally targeted at systems manufacturers in the communications and storage industries. Within the communications industry, [its] products address the enterprise, metro and core segments of the communications network, where they enable data to be transmitted at high speeds and to be processed and switched under a variety of protocols. In the storage industry, [its] products enable storage devices to be networked efficiently. [Its] customers include leading communications and storage original equipment manufacturers ("OEMs").
>
> *(Source: Vitesse, 2005, p. 1)*

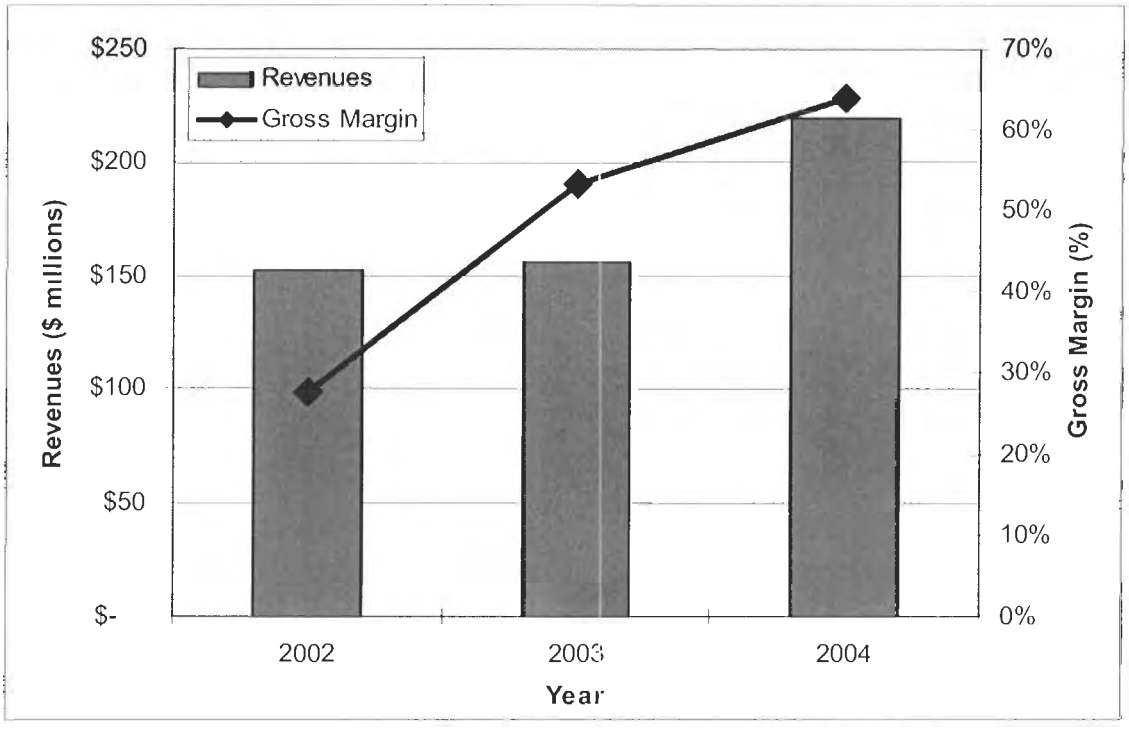
Vitesse is a company that has just finished repositioning itself in the market to be able to go after high growth areas and markets where it can potentially grab share with a technological change (Vitesse, 2005, p. i). This strategy requires a lot of investment, so a low cost strategy is not what Vitesse is aiming for.

Since 2001, Vitesse has been focused on restructuring itself and lowering costs. As part of this restructuring, the company closed its wafer fabrication facility (Vitesse, 2005, p. 2) and began to outsource almost all of its manufacturing. The company still has a single manufacturing facility that may be closed in the future (Vitesse, 2005, p. 7), which would make Vitesse a fabless semiconductor company. This one remaining fabrication facility could act as an exit barrier for Vitesse if it is unable to keep the facility running at capacity and there are no buyers interested in acquiring it.

The company currently focuses, and plans to continue focusing, its sales efforts on a small number of customers, some of which are competitors (Vitesse, 2005, p. 11). This is a risk

to Vitesse and its future earnings because a change in sentiment with one of these customers could have a major impact on Vitesse's revenues. Since 2002, Vitesse has managed to increase its revenues and more than double its gross margins (see Figure 3-10). The significant growth in gross margins is due primarily to the closure of its manufacturing facility (Vitesse, 2005, p. 27). Despite its growth, Vitesse has experienced significant financial losses since 2001 and has decreased its shareholders equity by almost 75% ir that same period (Vitesse, 2005, p. 20).

Figure 3-10 Vitesse's Revenues an d Gross Margins (2002 to 2004)



(Source: Author; adapted from data in Vitesse, 2005, p. 20)

Vitesse has $90 million of convertible long term debt, which is financed at a low rate of only 1.5% (Vitesse, 2005, p. 25). The servicing of this debt is not likely to act as an exit barrier or adversely affect the financial position of Vitesse because of the low interest rate. With $183 million in cash and cash equivalents at the end of fiscal 2004, a decline of 22% from the year prior (Vitesse, 2005, p. 32), Vitesse has less cash and cash equivalents when compared to its competitors. This could affect the company's ability to grow and invest in new areas in the future.

Due to its fewer resources, Vitesse does not appear to have a lot of options to retaliate against a competitor. The investment required to keep the remaining fabrication facility up to date with technology could become a drain on Vitesse and reduce its abilities to grow; however, this facility could act as an exit barrier that forces Vitesse to make retaliatory decisions that its competitors would not expect. Vitesse does not view itself as a cost leader, so it is unlikely the company would retaliate with price cuts. The company also does not have a lot of cash to retaliate by investing in lots of new technology that would beat its competition. Therefore, Vitesse does not have a lot of retaliation options and would likely lose out to a competitor with more resources entering into its markets.

4 INTERNAL ANALYSIS

This section takes an internal look at SemiCo's operations and strategy. An analysis was done at the corporate level and the business unit level strategy, showing how it fits with the company's strengths. This will be followed by a more in-depth review of the strategic issues facing SemiCo's business unit.

4.1 Corporate Strategy

Michael Porter (1998) identifies three generic competitive strategies that exist, cost leadership (low cost), differentiation, and focus. A low cost strategy is defined by Porter as one in which a company attempts to achieve a competitive advantage by producing its products at a lower cost than the competition (Porter, 1998, p. 35). This can be done in many ways, including scale efficiencies, cost controls, and low R&D. Porter defines a differentiation strategy as a competitive advantage achieved through differentiating a company or product from the competition by creating superior quality products, excellent service, or brand image to create something that is perceived as unique (Porter, 1998, p. 37). A focus strategy can be a low cost or differentiation strategy that is targeted at a specific niche market.

To be successful at a differentiation strategy, Michael Porter (1998) outlined some common characteristics of companies using this generic strategy (see Table 4-1).

Table 4-1 Michael Porter's Requirements for a Differentiation Strategy

Commonly Required Skills and Resources	Common Organizational Requirements
• Strong marketing abilities • Product engineering • Creative flair • Strong capability in basic research • Corporate reputation for quality or technological leadership • Long tradition in the industry or unique combination of skills drawn from other businesses • Strong cooperation from channels	• Strong coordination among functions in R&D, product development, and marketing • Subjective measurement and incentives instead of quantitative measures • Amenities to attract highly skilled labour, scientists, or creative people

Source: adapted from Michael Porter (1998, p. 41)

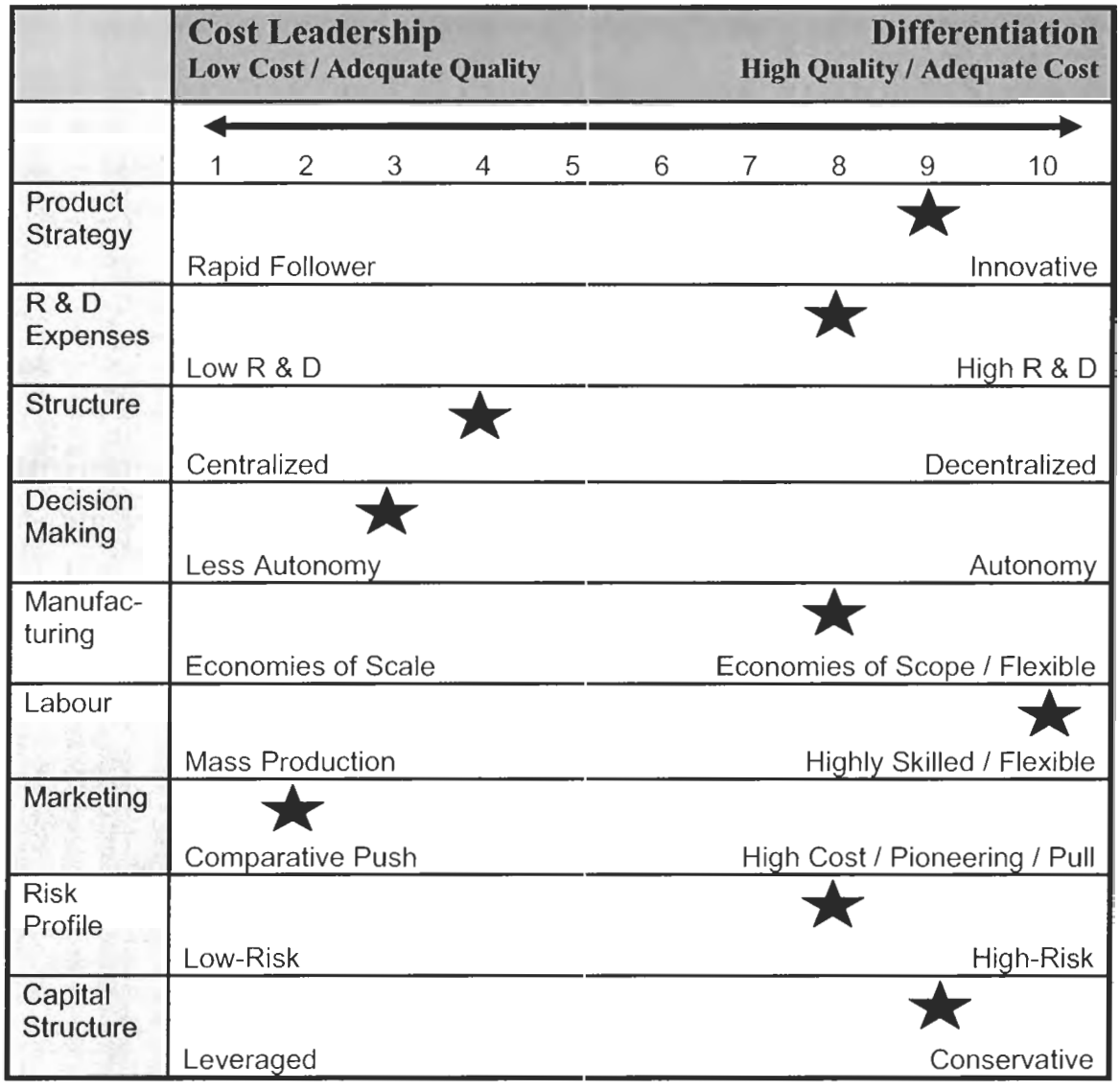
The strongest attributes from Porter's model that SemiCo has are its research and product engineering, marketing abilities, reputation for quality and leading technology. SemiCo invests heavily in R&D to develop innovative new technology and the company is known in the industry for providing high quality products with strong support for its customers. These attributes have contributed to SemiCo successfully defending its differentiation strategy in the market place. The one area that SemiCo needs to improve is the coordination between R&D, product development and marketing departments. SemiCo is very strong at communication within the various product divisions, but historically it has not been as strong at coordinating these functions across divisions. This is because each division operates autonomously with its own R&D, product development and marketing functions; therefore very little cross divisional coordination was required with the traditional semiconductor product lines. This is changing because customers are demanding more integrated systems and chips that may require intellectual property from each product division, therefore requiring more cross-coordination.

SemiCo's overall corporate strategy follows Porter's differentiation model in that the company has built a strong reputation in the industry by having high quality products and service, which have in turn contributed to a strong brand image. SemiCo also differentiates its semiconductor products in the marketplace by combining intellectual property into a chip that a competitor may not be able to as a result of patent protection.

4.1.1 Strategic Fit of Corporate Strategy

By mapping a company's strategic fit, one can build a relative scale to measure where a company is operating in relation to either a low cost of differentiation strategy. This helps to identify possible areas for improvement within an organization in order to align it to its overall corporate strategy. Figure 4-1 shows the nine criteria that are used to measure strategic fit and the relationship of SemiCo's corporate strategy to those criteria. For each item, a star is placed on a scale from one to ten to represent the relative position that the corporate strategy is in relation to a low cost strategy or a differentiation strategy. A further discussion of these points and what they mean to strategic fit follows.

Figure 4-1 Strategic Fit Diagram for SemiCo's Corporate Strategy



Source: Author; adapted from Bukszar (2005)

4.1.1.1 Product Strategy

SemiCo's product strategy is heavily weighted towards the differentiated products. In order to remain competitive in the semiconductor industry, SemiCo must continuously innovate to keep its products in touch with what the customers need. Technology is always changing, so the strategy that SemiCo employs is to try to remain one step ahead of its competition, or at least on par with its innovations. If SemiCo did not have a differentiation strategy based on innovation, the competition would create chips that have better performance and are lower cost in order to take business away from SemiCo.

The service and support that SemiCo provides its customers is one way in which it differentiates its products from the competition. According to an internal presentation summarizing the results of a survey of 548 industry professionals in 2001, SemiCo ranked 15-20% higher than its competitors in the area of field support for customers. Having a reputation for superior customer support is part of SemiCo's product strategy. Each product is developed with service in mind to ensure that when the chip is produced, there will be support resources in place and ready to assist customers that are designing with SemiCo's chips.

4.1.1.2 R&D Expenses

Relative to its competition, SemiCo invests a large portion of its revenues into R&D, which is consistent with a differentiation strategy. As can be seen in Table 4-2, SemiCo invests over 40% of revenues in R&D and the company is one of the top spenders when compared to its competitors. By investing into R&D, SemiCo is able to continuously innovate to create new products that can be differentiated from the competition.

Table 4-2 Research and Development Expenses for SemiCo and its Competitors

Company	Revenues	R&D Expenses	R&D % of Revenue
Broadcom	$2,400,610	$495,075	21%
Marvell	$1,224,580	$263,261	21%
PMC-Sierra	$297,383	$120,492	41%
2Wire	$107,438*	N/A	N/A
AMCC	$131,177	$112,594	86%
Vitesse	$218,775	$108,533	50%
Agere	$1,912,000	$496,000	26%
SemiCo	**$545,572**	**$221,052**	**41%**

Source: Author; adapted from 2004 annual corporate financial reports (2005)
**Source: Inc.com (2005)*

4.1.1.3 Structure

SemiCo's structure is counter to a differentiation strategy. Companies that have a differentiation strategy will typically have a decentralized corporate structure, but in the case of Semico, the structure is quite centralized. The company has a corporate headquarters where most of the senior executives are located. This location houses more than 50% of the company's worldwide staff and almost all of the corporate overhead functions, such as finance, information technology, and purchasing. In the years since the crash of 2000, there has been an effort within SemiCo to centralize more functions to achieve greater scale efficiencies. For example, at the

beginning of 2005, SemiCo decided to close down a department for testing chips in its Santa Clara office and move it to the corporate headquarters where similar functions were already being performed. Having a centralized structure is more common for a low cost strategy, so SemiCo is currently in conflict with its corporate strategy in this area.

4.1.1.4 Decision Making

Decision making at SemiCo, like corporate structure, is in conflict with the company's differentiation strategy. Much of the key decisions are made centrally by the executive team at the corporate headquarters with very little autonomy being given to the individual leaders within the organization. For example, all decisions around product planning and project prioritization are made by the executives at regular meetings. Senior management meets four times per year to discuss products currently in the pipeline and new opportunities that have been identified. New product ideas are presented by the marketing groups and product enhancements requested by customers are presented by the development groups. This meeting is where all key decisions are made around which products will be allocated a portion of SemiCo's limited resources or cancelled if the product is no longer viable. SemiCo does not have a process in place to make many decisions around product prioritization outside of these quarterly meetings due to the lack of autonomy given to the product teams.

Another example of autonomous decision making is how SemiCo approves capital spending at a monthly executive meeting. Any capital over than $1000 that needs to be spent must first be approved at this monthly business review meeting. Even once an expense is approved, the signing authority limits within the structure are very tight such that many purchase orders must be signed by a vice president before being sent to a vendor. This type of decision making structure is more common with a low cost strategy where management needs to keep a tight control on spending and does not want to push simple decision making down to the lower levels of management.

4.1.1.5 Manufacturing

Although SemiCo's manufacturing is all outsourced, the resulting economies of scope are in line with the differentiation product strategy. SemiCo benefits from scope economies simply through its collection of intellectual property and ability to integrate somewhat related pieces of IP together to make a cheaper solution. The manufacturing process for chips using the same process technology and relatively similar chip complexity is approximately the same across any

chip; therefore, SemiCo can achieve scope economies by producing chips with more functionality. This is a good fit with the company's differentiation strategy.

4.1.1.6 Labour

The labour at SemiCo fits very well with the differentiation strategy. SemiCo's employee base consists primarily of knowledge workers, specifically electrical engineers. The advantage to SemiCo with this labour force, in terms of the corporate strategy, is that they are highly skilled, very flexible and can be located anywhere in the world to develop products. Although SemiCo is a company based in the United States, many of its product design facilities are located in Canada where the labour force is less expensive. This flexibility in location of labour gives SemiCo a fair amount of ability to open design centres where it is most advantageous to do so. For example, the recent trend in corporate America of moving knowledge worker jobs offshore to reduce costs is a possibility for SemiCo. Design centres can be set up anywhere that there is a talent pool of engineers. This highly skilled, flexible labour force lends itself well to a differentiation strategy because SemiCo can pull from a vast body of knowledge to develop products that are different and better than those of the competition.

4.1.1.7 Marketing

The marketing functions of SemiCo are a closer fit to the low cost strategy end of the spectrum because a push strategy is used to sell its products. SemiCo must market its products to potential customers by making them aware of the products through direct selling during a customer's design phase. When a customer designs a product that requires chips from a vendor, such as SemiCo, it is up to SemiCo to be aware of these opportunities and work closely with the customer to convince them that their chip will work best for the customer's solution. SemiCo's marketing groups are responsible for finding companies making equipment that could have a need for SemiCo's chips. It is rare for a customer to come to SemiCo and ask for a specific chip for their product that SemiCo already has. When this happens it is usually because the customer already has a relationship with SemiCo and is aware of the company's products, rather than through the efforts of pull marketing. Comparative push marketing strategies are mostly common with low cost strategy organizations, so this is in conflict with the differentiation strategy at SemiCo.

4.1.1.8 Risk Profile

SemiCo's risk profile fits with the corporate differentiation strategy because the company does take risks when attempting to grow into new markets. To continuously innovate and develop new products, SemiCo must take on some risk by trying to identify where a given market is going and then develop products to match that market's needs. In the early stages of technology development when there are few standards in place, it can be quite risky for a company like SemiCo to develop a chip to an unknown standard. To mitigate this risk, SemiCo tries to be involved in the development of industry standards, but there is still risk involved. This fits well with a differentiation strategy because if SemiCo is trying to develop new products ahead of the competition, it must take risks to maintain a competitive advantage and potentially obtain a first mover advantage.

4.1.1.9 Capital Structure

The capital structure at SemiCo is relatively conservative. As of 2005, SemiCo has no debt and it has over $750 million in cash and investments (SemiCo, 2005b). This cash is used as a reserve for funding operations during down cycles of the semiconductor industry, and during growth cycles SemiCo uses the cash to invest in new opportunities or acquisitions. Due to the cyclical nature of the semiconductor industry, SemiCo must be conservative with its capital in case there is a prolonged down period such as the period between 2000 and 2003 when inventory levels were substantially high (see Figure 1-1). A conservative capital structure fits well with a SemiCo's differentiation strategy.

4.1.2 Summary of Corporate Strategic Fit

The generic strategy that SemiCo employs is one of differentiation, which involves selling a high quality product at an adequate cost. As can be seen in Figure 4-1, most of the individual elements of the corporate strategy align well with this differentiation strategy. The specific areas that do not align are corporate structure, level of autonomy and marketing. The way SemiCo operates in these areas fit more closely with a low cost strategy. This could cause an internal conflict for SemiCo due to a lack of alignment with the corporate strategy.

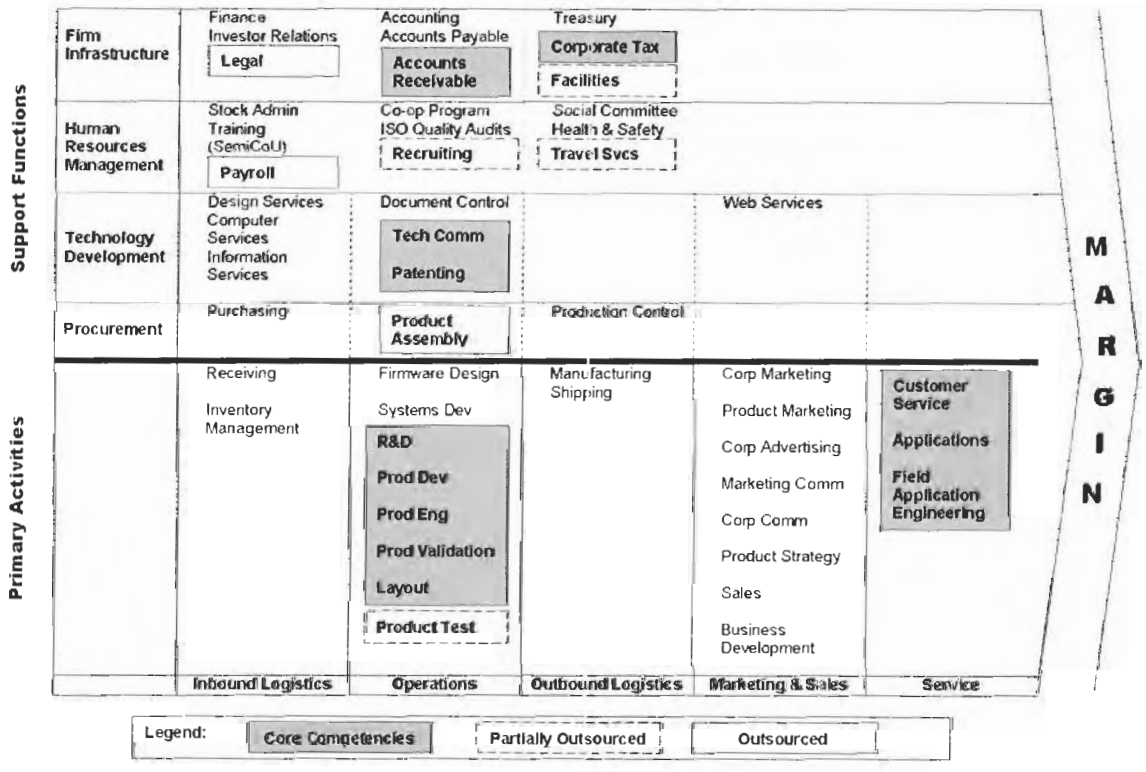
Changes in the semiconductor industry that are happening could also cause problems for the future of SemiCo's differentiation strategy. As the industry moves towards using standardized products it will be more difficult for semiconductor companies to differentiate chips

in the market. This may lead SemiCo to change its strategy over time to adopt more qualities of a low cost strategy, as is already the case with the company's structure, autonomy and marketing.

4.2 Firm Level Value Chain

The firm level value chain for SemiCo is shown in Figure 4-2. This diagram depicts all of the major functions within the company and uses different shaded boxes to highlight SemiCo's core competencies and activities that are fully or partially outsourced to show how SemiCo creates value.

Figure 4-2 SemiCo's Firm Level Value Chain



Source: Author; adapted from Porter (1985)

4.2.1 Primary Activities

SemiCo's primary activities consist of all functions within the organization from creating new products to servicing end customers. This section will describe each of those primary activities.

4.2.1.1 Inbound Logistics

There are two main functions in the inbound logistics portion of SemiCo's value chain. The receiving department is responsible for ensuring that products are delivered to the intended internal department upon arrival. The receiving department is also in charge of managing the physical inventory of SemiCo's chips, once the chips have been tested (which happens later in the value chain). At any one time SemiCo has millions of dollars in inventory either waiting to be sold to customers, or ready to be shipped when a distributor or customer needs it.

The receiving function is also tied into the support function provided by the purchasing department. When an item is received from a vendor it must be cross referenced with a purchase order (PO) number to ensure the item can be tracked internally with this corresponding unique identifier. Therefore, all purchases must first be approved and then processed by the purchasing department. This ensures that when SemiCo receives an item, it can be asset tagged (if required) and delivered to the correct owner.

Inventory management is more involved than just managing the physical inventory in a secured room for protection. This function requires complex forecasting of customer requirements and management of inventory in the distribution channel. Since the technology market crash in 2000, customers and distributors have been reluctant to hold too much inventory on hand of raw materials (chips in particular) in case demand changes rapidly. The complexity of inventory management comes in trying to retain the optimum levels for each type of chip that SemiCo sells based on ever changing customer demands. SemiCo's customers will order smaller quantities of chips as needed and put more of the burden on SemiCo to manage its inventory levels. SemiCo also does not want to manage too much physical inventory, so the company informs customers that they have to wait six to twelve weeks for delivery of chips (the time that it takes to produce a tested chip). Maintaining inventory at optimum levels is complex because it involves having enough chips on hand to meet urgent orders for high priority customers while at the same time minimizing risk of having too much inventory that could lose its value while in storage.

4.2.1.2 Operations

The operations function in the value chain is the heart of SemiCo's business and contains many of its core competencies. In operations, SemiCo produces most of its outputs in the form of new chip development and tested chips to be sent to customers.

The primary function is research and development, one of SemiCo's core competencies. The company has always been an R&D company and must continue to be good at it to keep up with new technology and maintain a competitive advantage. SemiCo's R&D function includes researching upcoming changes in technology and developing products to meet these new requirements. Once the research and development phase proves the feasibility of an idea, it is usually handed off to a product development team that manages the development from inception to production release. There is some overlap between R&D and product development, but the R&D groups are mostly focussed on future products, whereas product development is responsible for current products that are in the pipeline.

One of SemiCo's core strengths is its ability to develop complex silicon chips from complex design specifications (spec). The product development teams will typically get a design spec document from the R&D groups, which is either a customer specific design or an industry standard design spec. Once they receive the design document, designing of the silicon chip can start. Design may involve many electrical engineers working independently on individual blocks[7] within the chip. The engineers will design the chip to meet exacting specifications stated in the design document. There are many factors that the engineer must consider, such as electrical interference within the device, power consumption, and time delays for the electrical current to traverse the chip's many pathways.

The product engineering (PE) group is responsible for taking a chip design and simulating its performance in real world scenarios. This group is involved early on in the design cycle, but typically their role does not take affect until later when the chips are nearly completed. Once a chip's design is known, the PE group will build test scenarios for the chip using complex testing hardware and software. Some of these simulations can be done without a physical chip available from the foundry, but many of the final tests cannot be performed until a chip is back from manufacturing. The PE group performs a critical function within SemiCo and that is also why it is one of the company's core competencies. The reason this group is involved in chip development from an early stage is to reduce the need to redesign chips once back from the foundry. Since this can be a very expensive process, early testing is very important. The PE group is also responsible for selecting materials and production processes for each chip. There are multiple ways that a chip can be produced, each having its own pros and cons. The PE group will help a design team to select a method and materials based on cost and performance

[7] A chip is segmented into multiple independent working units, called blocks, that are interconnected at a later point in the design cycle called layout

requirements of the end product. For example, the selection of the package that a chip's core resides in can have a significant affect on the chip's performance under different temperature and power scenarios. This is because each package type uses different materials that react differently under various conditions, but the cost of each package varies. Therefore, it is important for this group to consider the end application requirements when selecting the package and weigh the cost savings of different packages against the product's intended use and environment.

The product validation and verification (PV) group is involved at an even later phase of the development lifecycle than PE. This group is responsible for writing tests to verify that a chip, or any product that SemiCo produces, does not have any software or hardware bugs that would prevent it from operating as designed. The PV group will test a chip to ensure that it functionally operates without any problems. If there are bugs, they must be fixed by a doing a redesign. The PV group is another core competency of SemiCo and it is the group responsible for maintaining the high quality standards that customers have come to expect. The PV group is involved with the product development so that they can identify what functions of the product will eventually need to be tested, but they are unable to test all functionality until the product is produced for the first time. They do have the ability to simulate the chips prior to receiving physical devices back from the foundry, but there are many limitations of the simulation technology that can prevent full testing in real-time.

The product testing function is outsourced. This work is different than that of what the PE and PV groups do during the development phase. Instead, product testing performs quality assurance testing to ensure that every chip (or system) works before being shipped to a customer. This process is in place to identify any flaws that may have occurred during the manufacturing process. They do not test chip functionality since this has already been done by the PV group when the chip was in development. In the case of silicon chips, SemiCo ships most of its chips from the foundries in Taiwan to SemiCo's headquarters. It is in Taiwan that the company tests many of its chips prior to being sent to customers. In recent years, SemiCo has outsourced some of the product testing functions to third parties. Some of the foundries have vertically integrated to include chip testing as a service offering. Outsourcing of this function is a good idea for SemiCo because the cost of maintaining test equipment for changing chip technologies can be expensive. Product testing is a necessary function that can be performed by any company specializing in chip testing; therefore, it does not provide SemiCo a competitive advantage if the company was to do its own testing. SemiCo will still need to be involved in developing the test

programs to determine whether a chip passes or fails, but the physical act of testing each chip can easily be repeated and handed off to a third party thereafter.

Chips are designed by multiple engineers at the same time by splitting the chip into individual units, called blocks, which can be independently designed and tested. The different engineers don't need to know about the functionality in other blocks, but in the end all of the blocks must be able to work together on a single chip. The work of pulling all of the blocks together is done by a layout engineer. The job of layout is to merge each block design together by connecting them electronically in the design. To do this, the layout engineer must know specific requirements of the design specification that state what timing the chip must meet. Timing is the physical time it takes an electrical current to get from point A to point B on a chip. The design of the chip relies on the current reaching certain points within a given time period. The job of layout is to simulate the delay for a current to travel through all possible pathways on the chip. It is acceptable for a current to arrive earlier than expected, but it cannot arrive late; therefore, SemiCo's layout engineers create complex software models that will help to identify potential timing delays in the design. Once problems are identified, the layout engineer can optimize the location of electrical pathways to ensure the delays are corrected. This must be done prior to sending the design to the foundry, otherwise if a chip comes back with delay issues, it must be fixed post production, which is costly. The earlier a design flaw can be identified, the more it will save the company. This is why layout is critical to SemiCo and it is also why this function is one of the company's core competencies.

Systems development is a new function that SemiCo is undertaking within SSG. It entails building a complete system that a customer can simply take and brand as their own to sell to consumers. Historically, OEMs would design and develop systems using chips from multiple manufacturers. OEMs have found that hardware design in the low end consumer market is quite expensive relative to the low margins that these products provide. Instead, OEMs are now asking semiconductor companies to develop complete systems that can be sold to multiple OEMs with minor modifications; thereby reducing the OEM's development costs. SemiCo's recent entry into the systems development market is meant to address the needs of these equipment manufacturers. This will develop new markets for SemiCo's chips and build systems with many SemiCo chips to drive higher sales volumes. Systems development is not currently a core competence of SemiCo, but it is a function that can add substantial value to the customer. Therefore, to drive revenues up through increased value, expertise in systems development is needed at SemiCo.

Another function in SemiCo's operations activities is firmware design. Firmware is software that runs on top of a silicon chip and helps drive the chip's functionality. This function is, however, not one of SemiCo's core competencies. SemiCo does firmware design because it is a necessary part of a chip, but SemiCo has not built extensive expertise in this area. Firmware can be written to perform multiple functions on the same chip. For example, a single processor can have firmware to enable a telephone call to take place different firmware that will allow the processing of data traffic. SemiCo is a company that specializes in hardware design, not software. However, without firmware, many of SemiCo's chips would not be as valuable to end customers that would otherwise have to write their own firmware; therefore, SemiCo adds value by developing the firmware. If SemiCo provides a system without the firmware, the customer would need to develop it themselves with added cost and increased time in getting a product to market. Therefore, the more that SemiCo can help customers reduce development costs and time to market, the more value the company is creating. As SemiCo begins to do more systems development activities, the firmware will become more critical intellectual property for SemiCo to own because a system's software relies on firmware to operate. The systems being sold will be more valuable to the end customer the more complete the systems are.

There are a few support functions on the value chain that are directly related to the operations functions at SemiCo. Product assembly, technical communications, patent/IP management and document control all directly support operations. These functions will be discussed in further detail later, but it is important to note here that they directly relate to operations. Product assembly, for example, involves assembling chips into a final physical state when received from the foundry. A foundry manufactures a chip's core on a silicon wafer, but the core must be mounted on a device that will allow connection of the core to a circuit board. Technical communications is responsible for ensuring that end user and internal documentation for any chip meets SemiCo's strict standards. Patent management ensures that any intellectual property in SemiCo's chip designs is protected by existing or new patents. Document control acts as a repository for all IP and design documentation, maintaining all versions of documents to meet ISO quality standards.

4.2.1.3 Outbound Logistics

SemiCo performs two outbound logistics functions: manufacturing and shipping. The shipping function is the other half of the receiving department, but it is involved primarily in shipping inventory to customers and distributors. Since the shipping/receiving department

manages the physical inventory of chips, they can also manage the shipping of this inventory as an additional duty. Shipping also works in conjunction with all departments for shipping of internal and external mail.

The manufacturing portion of outbound logistics is responsible for maintaining relationships with foundries and other manufacturers that SemiCo uses for producing its products. The manufacturing department manages all scheduling and logistics for building, testing and shipping products to customers once an order has been placed. Having good relationships with foundries allows this group to schedule rush orders when necessary if a customer requires an order to be expedited. SemiCo deals with up to three foundries; TSMC, Chartered, and UMC. Combined, these companies held 69% of the semiconductor foundry market share in 2003 (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 30). Minimizing the number of foundries has allowed SemiCo to maintain a closer relationship with each one.

Manufacturing is also responsible for understanding what parts are available for sourcing from multiple electronics distributors. When a system is being developed, for example, manufacturing can help to source available components that meet design and cost specifications.

The outbound logistics functions are directly related to one support function called production control. Production control works closely with manufacturing to assist with production and materials planning when ordering chips from outsourced manufacturers. Production control is responsible for managing the orders to ensure chips are produced on time to meet customer schedules.

4.2.1.4 Marketing and Sales

SemiCo has invested heavily in marketing and sales functions. This is because the market is extremely competitive and SemiCo needs to generate awareness for its products by using a push strategy. The marketing functions are divided into many different areas. Although, there may appear to be some overlap between the various marketing departments, each serves and independent function.

First, corporate marketing is a department that is responsible for SemiCo's image in the marketplace. This group does this by building relationships with customers and working with them to ensure their satisfaction. This is one reason why the customer service function is

structured under the corporate marketing department. The department also sets strategy for all customer facing material, such as advertisements and press releases.

Next, a marketing communications (Marcom) department works closely with corporate marketing for external communications material. Marcom extends the corporate marketing function further by coordinating tradeshows, media events and web seminars. These web seminars are online sessions that teach customers about SemiCo's products. Marcom coordinates the web seminars with the support group called web services.

The corporate advertising department is related to both corporate marketing and Marcom. This department is responsible for coordinating the advertising functions and getting advertising material in front of potential customers.

The fourth marketing group is product marketing, which operates independently of the other marketing functions. This department is responsible for managing a product from inception through to end-of-life. The product marketing team is comprised of electrical engineers that have an understanding of various product markets and customers. They use their knowledge of these markets to predict future revenues and propose product changes. Product marketing operates at a strategic level, ensuring that SemiCo receives a return on its R&D investment for each product. The group does this by identifying target customers for the products and classifying those customers into Tier 1 through 3, with Tier 1 being customers that represent the largest revenue opportunity. Since marketing has limited resources, they will typically only target Tier 1 or 2 customers. A product will typically have a single product marketing manager. This person is often the one who originally developed the business case for developing the product.

While the fifth group, product strategy, is somewhat related to product marketing, it is involved at a much earlier stage in a product's lifecycle. The product strategy group both creates the strategy for entering new product markets, and evolves the strategy for existing products. The product strategy and product marketing groups form the backbone of the team that manages a product through its life from a marketing standpoint. For example, the product strategy group first identifies an opportunity and does a feasibility analysis to determine the viability of an opportunity. If the product development is kicked off, it is handed over to product marketing which forms half of the product management team (PMT) that manages the development process. The other key half of the PMT is the technical product development management that oversees the technical portion of the project. This forms the link between the engineering and marketing

groups. The PMT forms a matrix structure that operates for the life of a given product development cycle until the product is released to production. At that point, product marketing still remains involved in managing the product and developing marketing strategies through the product's life as a production product for SemiCo.

The corporate communications group is responsible for ensuring a consistent message internally and externally for any communication. Most recently, corporate communications became responsible for all internal employee communications related to product announcements and other marketing information for a consistent message internally. This ensures that employees will then give a consistent message externally when talking to customers and their peers.

The sales department represents the sales force in the field working with customers to generate sales. SemiCo has a global sales force in all major centres where there are OEMs developing products that use semiconductor chips. The sales group's focus is to understand customer product plans and identify any potential opportunities where SemiCo's chips may be used. They do this by developing relationships with the engineering groups at OEMs and working with them on a regular basis to understand what products they are developing. The sales group then works with the customer to develop design specifications that SemiCo's chips must meet, followed by a formal process to win the design. This process involves many phases where SemiCo is often competing against other chip vendors that have similar products. Typically a sale is won or lost based on a product's features and price and how well these factors fit the equipment design requirements. In some cases, the sales department works to identify opportunities for new chip development in the case where a chip is needed by an OEM, but one doesn't exist in the market to meet its needs. In these cases, the sales department would develop a business case to prove whether the opportunity is viable. This analysis also looks at other market opportunities for the chip because SemiCo doesn't typically design a chip that has a single customer due to the risk of not recouping the development costs.

Business development is the final marketing and sales function that exists. This group has some overlap with the product strategy group in that they are responsible for understanding the technology landscape and identifying new market opportunities. SemiCo got its start in the telecommunications chip industry, but over the years it has entered new markets in enterprise storage and microprocessors. The business development group was responsible for identifying these market opportunities and building a business case to enter them. SemiCo usually enters a new market by acquiring or developing IP that business development has indicated is required.

While none of the marketing functions form part of SemiCo's core competencies, this does not mean that SemiCo can outsource any of its marketing. Some of the marketing functions, such as product marketing, product strategy and business development are involved with intellectual property for SemiCo's products. Outsourcing these functions would be a risk to the company. Also, corporate marketing works too closely with customers, which is important enough not to outsource. Areas that could be partially outsourced are the marketing communications and advertising functions. There are companies that specialize in advertising and product promotion, so this is not an area that SemiCo needs to be good at to be successful.

4.2.1.5 Service

The final primary activity in SemiCo's value chain is service, which is an area that SemiCo excels in. Customer service is a core competence at SemiCo because the company feels that customers must have an excellent experience whenever dealing with SemiCo. SemiCo is known in the industry for having some of the best customer service functions, not only after a customer buys a product, but also prior to the sale. The biggest reason for this reputation is SemiCo's large team of field applications engineers (FAEs) whose role is to work with customers and the sales department to help customers develop their products using SemiCo's chips. The field engineers work closely with customers to help them understand the technical reasons for buying SemiCo's products. Once a customer purchases a product, the FAEs work directly with them to resolve any design issues relating to SemiCo's chips.

The FAEs also work with the applications department which operates in a similar fashion. Applications engineers work at the various SemiCo offices to understand SemiCo's chips while in development. Their role is to develop sample applications of the products in action so that customers can see demonstrations of the chip's capabilities before they commit to buying. Applications engineers will also work with customers that are having issues implementing SemiCo chips into their designs. This may involve building a sample system that mimics the customer's implementation of the chip to resolve any issues. The applications group also works on customer facing documentation. This documentation is a large part of SemiCo's excellent customer service reputation. The documentation that SemiCo provides customers is extremely detailed and it helps them to design their product. The applications group is a core competence within SemiCo. Without this group, the customer experience would be significantly different.

The customer service group is responsible for non-technical customer issues. This group is involved in functions such as product pricing, order entry and billing issues. Any technical issues are dealt with directly by the applications groups.

4.2.2 Support Functions

This section discusses support functions within SemiCo's organization that directly or indirectly support the primary functions. Some of these activities are core competencies; others are not and therefore may be candidates for outsourcing.

4.2.2.1 Firm Infrastructure

There are many functions within SemiCo's infrastructure support activities, but none of them relate directly to one of the primary functions. The purpose of these infrastructure activities is to provide a base set of services that support all primary activities.

The finance functions operate as a service to manage all financial related items. The controller ensures that SemiCo follows reporting guidelines set out by the Securities and Exchange Commission for publicly traded companies. The finance department is also responsible for ensuring proper corporate governance controls are in place to abide by the Sarbanes Oxley act in the US.

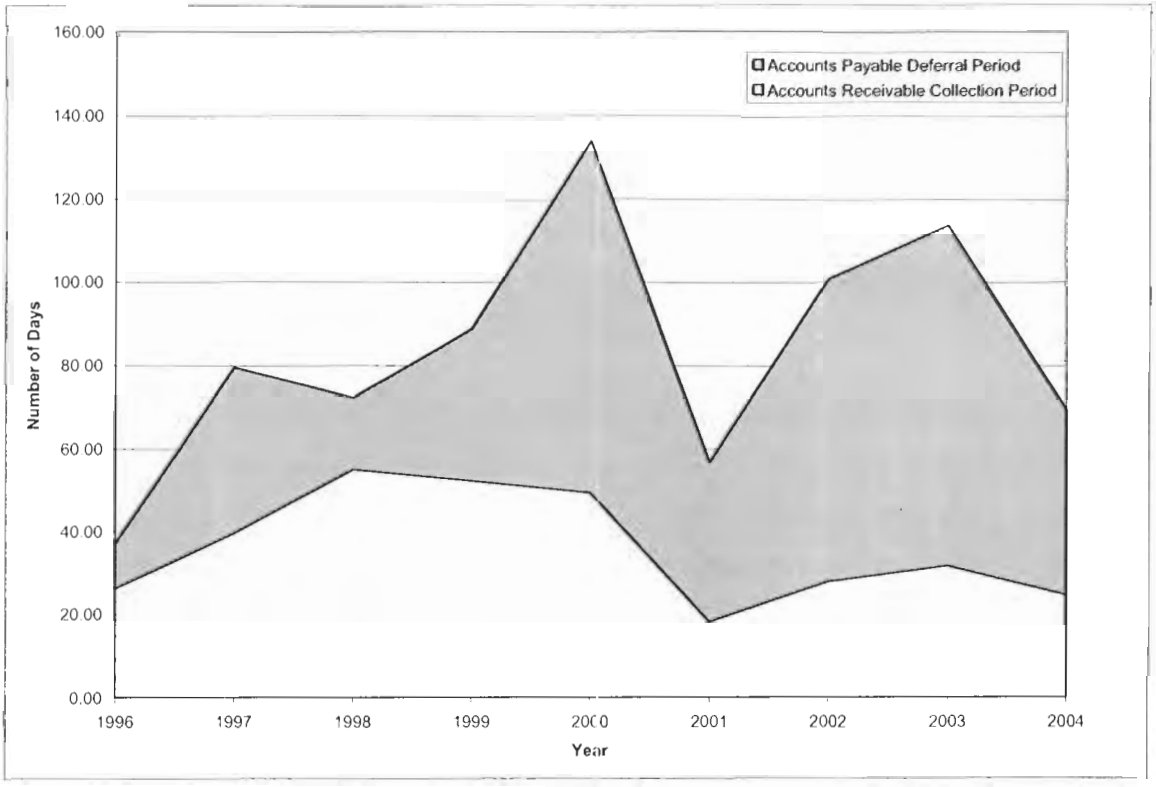
The accounting, accounts payable and accounts receivable functions are all related to the finance function; however, they are separate because finance is primarily responsible for reporting to investors. The accounting group is responsible for accounting records and maintaining the general ledger for financial reporting. Accounts payable manages the payments to vendors. Accounts receivable is in charge of collecting from customers in a timely fashion. The reason accounts receivable is a core competence is because SemiCo has one of the best collection rates in the industry (see Table 4-3). On average, SemiCo collects its receivables in less than 30 days, whereas the industry average is around 50 to 60 days (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 52). By having such a strong accounts receivable department, SemiCo is able to manage its cash flow better than some of its competitors. Couple this with the ability of SemiCo to delay paying its creditors for 70 to 130 days (see Figure 4-3) and it becomes a competitive advantage that SemiCo can leverage to achieve other forms of financing and capital to fund further growth.

Table 4-3 Receivables Collection Periods for SemiCo and its Competitors (2003 to 2004)

Company	2004 Receivables Collection Period	2003 Receivables Collection Period
Broadcom	31 days	50 days
Marvell	60 days	61 days
PMC-Sierra	24 days	32 days
2Wire	N/A	N/A
AMCC	65 days	20 days
Vitesse	61 days	82 days
Agere	54 days	53 days
SemiCo	**24 days**	**32 days**

Source: Author; adapted from 2004 annual corporate financial reports (2005)

Figure 4-3 SemiCo's Cash Flow Management



Source: Author; adapted from SemiCo (2005,2004,2003,2002,2001,2000,1999,1998)

Corporate tax is another finance related function that is a core competence. This is because SemiCo has been aggressive and successful at obtaining R&D tax credits in Canada and the US. SemiCo has obtained millions of dollars of additional tax credits for previous years by

taking advantage of historical tax breaks that may have been overlooked. SemiCo has a team of three corporate tax specialists who ensure that SemiCo pays the minimum in taxes.

Legal is a support function that is required for any company, especially one that depends on intellectual property. As important as this function is, SemiCo does not require a permanent attorney on staff; therefore, this function is entirely outsourced and only used as needed.

Investor relations manage all communication to and from investors. This group is responsible for understanding the financial markets and how SemiCo is perceived. They report financial results to investors on a quarterly basis, and they also manage all investor related press releases. Press releases for product announcements are handled by the corporate communications department.

Facilities management is partially outsourced to a third party company that specializes in managing corporate offices. SemiCo has some employees that manage the physical buildings and leases, but the majority of this function is performed by the third party. SemiCo has strong relationships with all of its landlords and as a result has been able to negotiate some successful lease agreements. In the past, however, SemiCo paid some penalties for early withdrawal from some of its leases due to excess capacity after massive layoffs.

The treasury department is responsible for managing SemiCo's cash and non-cash investments. Until recently, SemiCo had a limited amount of debt that was financed by a one-time convertible debt offering. This debt was recently retired, a decision that was undertaken by the treasury department. The group compared the interest rate being paid on the debt to the interest being received on the cash and realized that the debt should be paid off with the company's cash.

4.2.2.2 Human Resources Management

SemiCo performs many functions relating to its HR management. All of these functions, except payroll, are done internally. Payroll is outsourced to a company that specializes in doing large company payroll. This is an ideal candidate for outsourcing because SemiCo does not need to be an expert at payroll activities to achieve a competitive advantage.

The stock administration group takes care of all employee stock option and share purchase plans. These programs require management by the stock administration group to ensure employees are treated equally and SemiCo's equity is not diluted by too many stock options

being granted. They are also responsible for understanding regulatory changes in the industry, such as the recent changes in the US relating to how companies expense stock options.

The SemiCo University (SemiCoU) was created to foster employee training. SemiCoU offers many free courses online for all employees, and it sponsors external training initiatives that employees may want to take on their own. SemiCoU also updates employee training on a regular basis and manages mandatory training courses that all employees must take every year.

The co-op education program is one that SemiCo sponsors with universities. Each semester, SemiCo hires dozens of co-op students to work in all areas of the company. The students that are hired from across North America are looking to gain work experience and SemiCo will often hire these students fulltime once they have graduated, thus requiring less training for the new hire since they are already familiar with SemiCo's processes. The HR department manages the co-op program by building relationships with the universities and assisting with the recruiting process.

Recruiting is a function that the HR department coordinates. In the years leading up to 2000, SemiCo was growing its employee base by around 50% or higher per year (see Table 4-4). To do this successfully, the company needed to develop hiring practices and methods of finding qualified candidates quickly. One of the methods was to open SemiCo offices in various locations where there is a talent pool of electrical engineers. Another method was to assist people with immigration into Canada or the US from other countries. HR manages its recruiting process through external job websites and other media.

Table 4-4 SemiCo's Employee Growth (1997 to 2004)

Year	Total Employees	Year over Year Growth	R&D	Sales & Marketing
2004	1,745	2%	1,101	306
2003	1,706	-15%	1,070	268
2002	2,016	-4%	1,246	372
2001	2,093	-34%	1,304	365
2000	3,166	162%	1,987	449
1999	1,211	52%	690	202
1998	798	46%	468	150
1997	545	N/A	250	125

Source: Author; adapted from data acquired in SemiCo annual reports (2005,2004,2003,2002,2001,2000,1999,1998)

The ISO quality management and auditing function is responsible for ensuring that SemiCo follows the ISO 9001 guidelines for quality. SemiCo is an ISO certified organization and therefore must meet ongoing best practices guidelines set out by the organization. To ensure that all lines of business adhere to the guidelines, SemiCo conducts audits every six-months of various quality processes and documentation throughout the organization.

SemiCo has a social committee that organizes employee events and fun activities to improve morale. The company sponsors some of these events, but the majority are self funded by the committee. Low employee morale has been a problem in recent years, so the social committee was brought back in an attempt to remedy the situation.

There is a health and safety committee that maintains a safe work environment for all employees. The committee is responsible for things such as ergonomic desks, proper lighting, and ensuring some employees are trained in first aid.

The travel services group assists employees with making work related travel arrangements. They will arrange for flights, hotels and car rentals through third party travel agents. This group is responsible for ensuring cost effective travel by negotiating contracts with various suppliers.

4.2.2.3 Technology Development

SemiCo is a high tech company and therefore has many technology management functions. The design services group, for example, is solely responsible for ensuring that technology is in place to assist with the design flow process. They purchase all infrastructure computer hardware and software licenses, such as computer aided design (CAD) tools used by

engineers for designing chips. This is a critical role for SemiCo because they must keep up with changing technology and always be able to provide the best design environment to maximize productivity. If the design tools are a bottleneck for an engineer, it is at a cost to SemiCo.

Computer services (CS) works with the design services group, but computer services provides non-engineering design infrastructure and support. CS provides all networking and PC support, including a helpdesk, to keep the network running optimally for all employees.

Information services (IS) provides application development and support expertise to SemiCo. The IS group develops some custom in house applications for other support groups, such as finance and HR. They also support third party applications that are not managed by either CS or design services.

Technical communications is a core competency for SemiCo. They are responsible for managing all documentation for internal and customer use. SemiCo is known in the industry for having some of the best product documentation, so the company needs a good documentation group to maintain the high standards.

Patent and intellectual property management is also a core competence for SemiCo. This is critically important for a company like SemiCo that relies on its intellectual property. In order to protect its investment in R&D, SemiCo must manage and defend its patents. SemiCo has hundreds of patents and continues to create more. Employees are rewarded financially for each patent that they create, so it is in the best interest of the employee and the company to increase their number of patents.

Document control is somewhat related to the technical communications group, except they are responsible for maintaining documentation repositories to meet ISO requirements. All documentation is retained in a repository and protected with necessary permissions to ensure that no intellectual property is taken from the documents without proper authority. This document repository is also important for sharing of knowledge within the company so that IP can be reused from one product to another.

The final group in technology development is web services. This group is responsible for the management of SemiCo's internal and external web presence. Web services works closely with the various marketing groups to create a website that matches marketing material and they promote products through web seminars. The web services group manages an extranet that is

customized for each customer. The extranet hosts customized information and in some cases intellectual property being shared between SemiCo and the customer.

4.2.2.4 Procurement

There are three main activities in the procurement section of SemiCo's value chain. Each of these functions directly relate to one of the primary activities on the lower half of the value chain diagram.

The purchasing group is responsible for generating purchase orders for all approved purchases. The flow of purchase approvals is documented and appropriate sign-off from various management levels must be received before a PO is sent to a vendor. This strict level of approvals ensures that all purchases are vetted by a manager or executive, depending on the amount of the purchase request. Once a PO is generated, the purchasing department deals with vendors to get best pricing and tracks the order until it is received.

The product assembly function is entirely outsourced for chip manufacturing. When a chip is received from the foundry it does not contain all necessary parts to connect it to a circuit board. The process of completing chip assembly is done by third party companies and in some cases by the foundries.

Production control is the final procurement activity. This group works with manufacturing to provide options for different materials that can be used in the manufacturing process. They are also responsible for scheduling the fabrication of chip orders with the foundries in order to meet customer schedules.

4.2.3 Core Competencies

SemiCo has many core competencies that were identified in its value chain. A core competency should enable a firm to achieve a sustainable competitive advantage by developing its abilities in a given area beyond the level of its competitors (Aaker, 2001, p. 141).

Of its core competencies, the ones of most importance to SemiCo are its capabilities in:

1. Research and development,
2. Product development,
3. Product validation,
4. Patenting, and
5. Applications.

This is because these are all in areas that will enable SemiCo to continue to develop new products and keep up with the competition with the objective of achieving a competitive advantage. R&D and product development will enable further product innovation to protect against the threat of product substitutes. Product validation will ensure a quality product is delivered to customers to keep them coming back for future products and to help differentiate SemiCo from other companies. Patenting will help to provide an entry barrier by protecting SemiCo's R&D investments from other market entrants. Applications will help to ensure customers are satisfied with their interactions with SemiCo and its products to create a successful partnership, which is important because of the high level of bargaining power that customers have in the semiconductor industry.

SemiCo's recent entry into the systems and solutions development markets may require the addition of new core competencies in order to achieve a sustainable competitive advantage in these markets. Specifically, expertise in systems development and firmware design are required, but SemiCo does not currently have a core competence in either of these areas.

4.3 Culture

The culture at SemiCo is one that is geared around shared values that foster innovation. The company was founded by electrical engineers who had a passion for developing new technology and this has become a part of the corporate culture. SemiCo spends over 40% of its revenues on research and development to encourage new product innovation (see Table 4-2). This type of culture is focused on product differentiation through technological innovation. It is not a low cost culture that has processes in place to reduce costs to achieve a competitive advantage.

The company drives innovation by rewarding employees for new development. One program pays $5,000 to any employee who files and receives a patent for new technology. Employees benefit from improved company performance through the use of stock option and stock purchase programs. SemiCo also has a history of promoting engineers who have developed the most innovative technology. All of these programs are in place to reinforce the innovative culture at SemiCo.

The company celebrates its successes and recognizes employees that have achieved something for themselves or the company. SemiCo has rituals that have been repeated through the company's history, such as the celebration of employee promotions. The tradition is for the

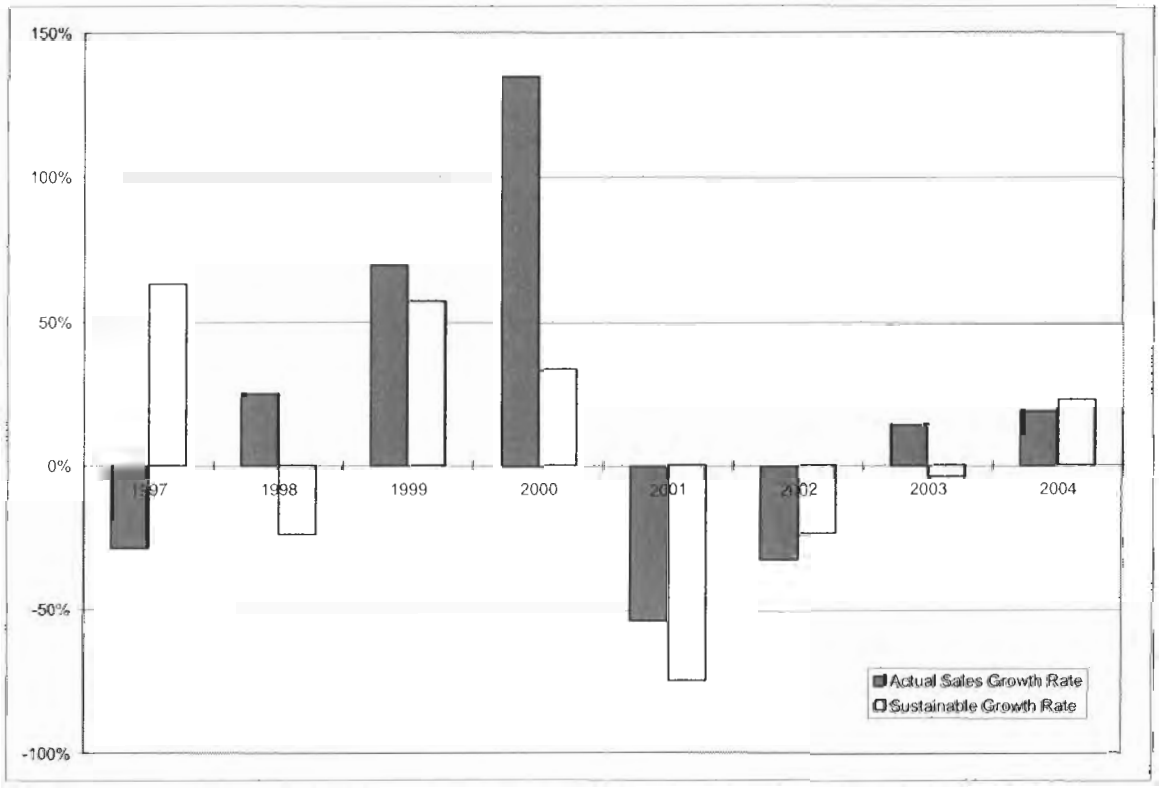
person who got promoted to pay for and take out all interested employees for beer and wings. This is a tradition that has been enjoyed and encouraged from the executive team on down.

The SemiCo culture focuses on product innovation and rewarding successful development. Less emphasis is placed on people management skills and more on technical abilities when considering management candidates. The culture has not historically been focused on low cost strategies, but rather high levels of investment into research and development to innovate.

4.4 Financial Analysis

SemiCo, like many of its peers in the semiconductor industry, has had a slow recovery in revenue levels and profitability since the 2000 technology crash. Figure 4-4 shows the return to revenue growth starting in 2003 for SemiCo after two years of revenue decline that followed the massive run up prior to and during 2000. The figure also shows what SemiCo's sustainable growth rates were during the same periods, and what growth rate the company could have continued to grow at based on the resources it had available to it. Based on this analysis, it is apparent that for five out of the eight years from 1997 to 2004, SemiCo was growing faster than its resources could sustain. A company that grows faster than its sustainable growth rate can run into financial problems, even profitable companies (Higgins, 2004, p. 119). As a company grows beyond its available resources, it will need to use more financial leverage to fund its operations, but growing too rapidly in this fashion can cause the company to reach its debt capacity (Higgins, 2004, p. 119).

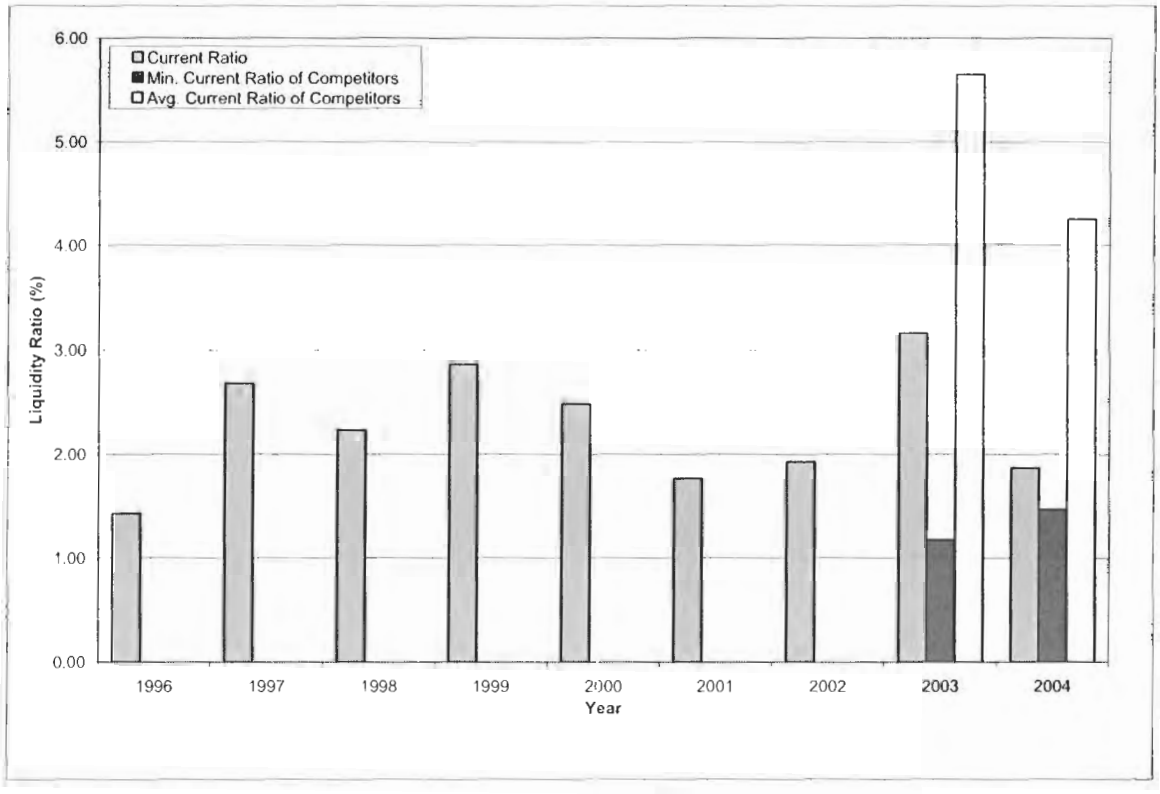
Figure 4-4 SemiCo's Actual Versus Sustainable Growth Rates (1997 to 2004)



Source: Author; adapted from data in SemiCo (2005,2004,2003,2002,2001,2000,1999,1998)

The problem of high uncontrolled growth can also manifest itself in having relatively low liquidity (current assets to current liabilities) because the company uses its creditors as a form of financing operations. In most countries a liquidity ratio of 1.1 is considered average (Higgins, 2004, p. 68); SemiCo has averaged above 2.2 from 1996 to 2004 (see Figure 4-5), which is considered relatively healthy based on the world average. However, when compared with its peers, SemiCo is relatively illiquid. Figure 4-5 shows the average and lowest liquidity measures of SemiCo's competitors for the most recent two years. SemiCo is only slightly higher than the lowest company's, and it is significantly lower than the average. The company with the highest liquidity is AMCC, which was at 21 in 2003 (AMCC, 2005, p. F-3). Since a company's liquidity can impact its ability to grow, a look at SemiCo compared to its competitors reveals that the company's future growth may be hampered more than its peers. This could be a threat to SemiCo if it begins to grow too rapidly, beyond its sustainable growth rate, and becomes too highly leveraged as a result.

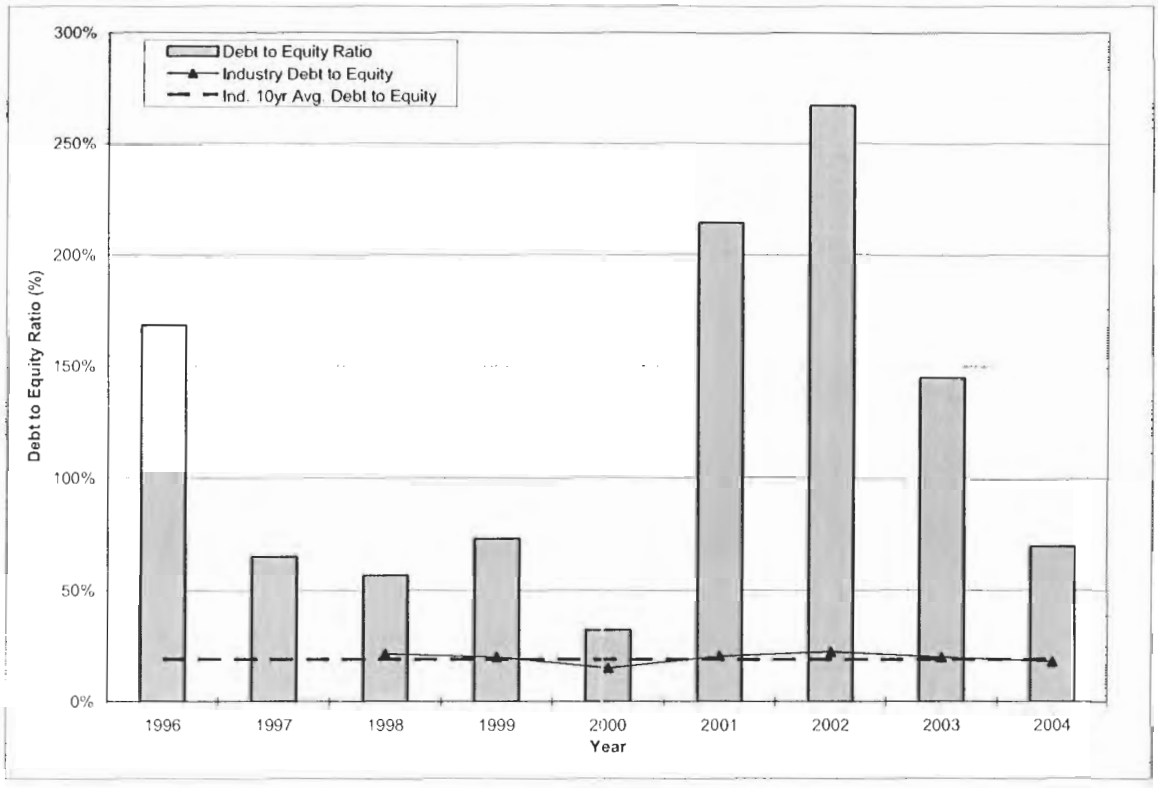
Figure 4-5 SemiCo's Liquidity versus Liquidity of Competitors (1997 to 2004)



Source: Author; adapted from data in SemiCo (2005,2004,2003,2002,2001,2000,1999,1998), Agere (2005), AMCC (2005),Broadcom (2005),Marvell (2005), PMC-Sierra (2005), Vitesse (2005)

SemiCo's use of financial leverage can be seen by analyzing the company's debt to equity ratios compared to the industry. Figure 4-6 depicts SemiCo's debt to equity ratios, which are significantly higher than the industry average of around 20% (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 56). In recent years the debt has been abnormally high due to accrued restructuring costs and some long term debt that was retired in early 2005. As of the end of the first quarter of 2005, SemiCo has been able to reduce its debt to equity ratio to 45% (SemiCo, 2005b), but this is still more than double the industry average. This is due to many companies in the industry issuing lots of common stock during the late 1990s, thus diluting the share base of these companies, but increasing shareholder's equity. AMCC is a perfect example of this because in 2001 just prior to the stock market crash, AMCC issued over $4 billion in common stock (AMCC, 2005, p. 19), which is also a factor in AMCC's relatively high liquidity.

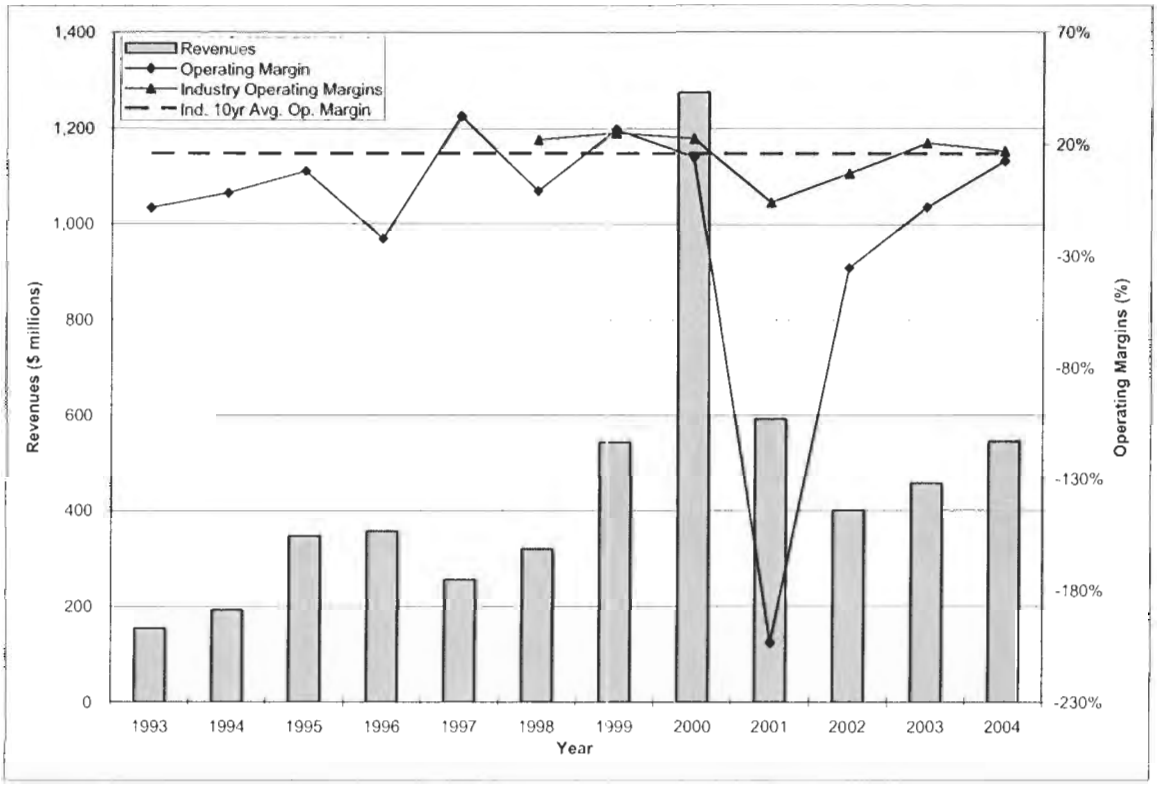
Figure 4-6 SemiCo's Debt to Equity Ratio Versus the Industry (1996 to 2004)



Source: Author; adapted from data in SemiCo (2005,2004,2003,2002,2001,2000,1999,1998) and (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 51)

SemiCo internally measures itself against what it calls "model profitability," with a target of approximately 20% operating profit margin. The average operating margin for the semiconductor industry over the last 10 years has also been around 20% (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 51), so this appears to be a healthy target. Figure 4-7 shows SemiCo's revenues and operating margins over the last twelve years. Of these periods, only four have achieved the industry average, or model profitability levels. The most recent period in 2004 was one of those years, and if SemiCo is able to continue the upward trend in operating profitability that started in 2002, the company should be poised for strong profitability in the future. However, there is evidence that stability in these high operating margins is wavering, as can be seen by the first quarter 2005 financial performance when SemiCo experienced a significant drop of over 15%, from the period a year earlier, to only 1.8% operating margin (SemiCo, 2005b). This is lower than the company's model profitability target and could be a sign of the company having a high cost structure for the changing market that is experiencing shrinking margins.

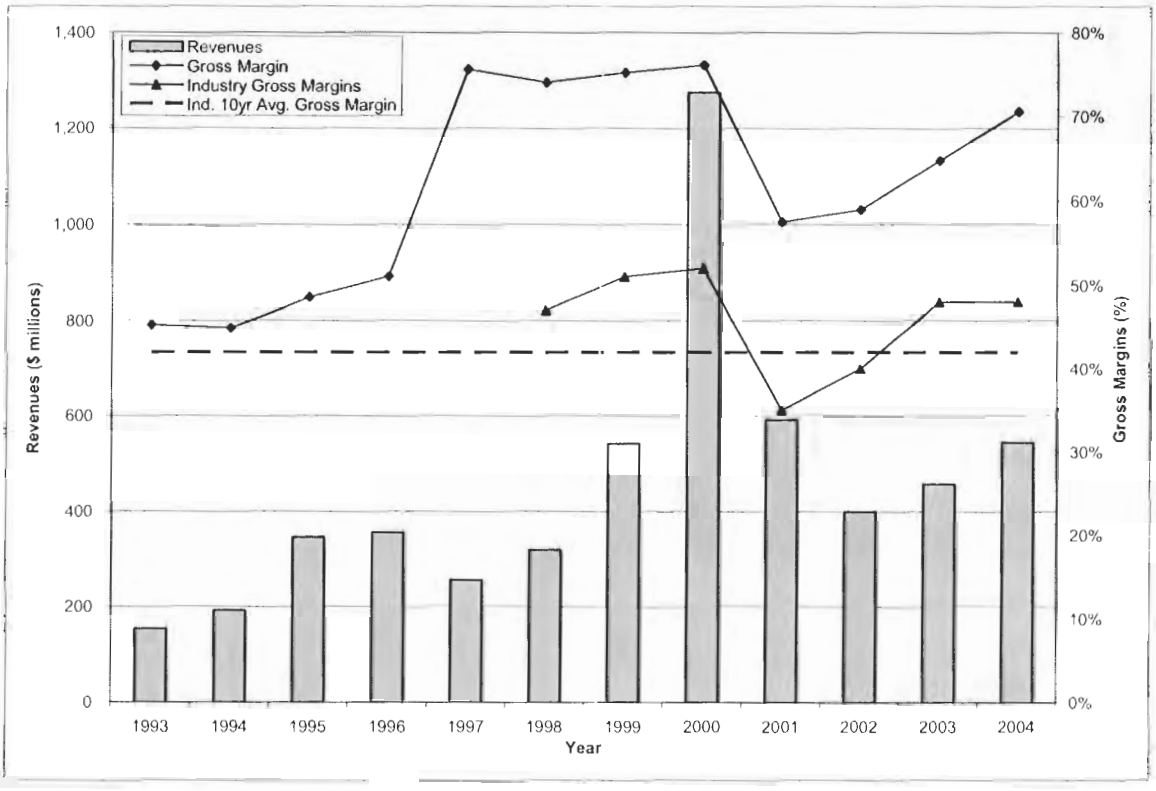
Figure 4-7 SemiCo's Operating Profit Margin versus the Industry (1993 to 2004)



Source: Author; adapted from data in SemiCo (2005,2004,2003,2002,2001,2000,1999,1998) and (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 51)

For much of the company's history, SemiCo has enjoyed some of the industry's highest gross profit margins, primarily due to its use of the fabless business model (see Figure 4-8). SemiCo's gross margins have been returning to its historically high levels, which will also continue to help the company return to model profitability and prepare it for future growth.

Figure 4-8 SemiCo's Gross Profit Margin versus the Industry (1993 to 2004)



Source: Author; adapted from data in SemiCo (2005,2004,2003,2002,2001,2000,1999,1998) and (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 51)

Overall, SemiCo has recovered well since the 2000 crash. As of the end of 2004, the company has nearly returned to its pre-2000 revenue levels, which will prepare SemiCo for continued profitability into the future and provide the resources required to grow. As the company grows, SemiCo will need to monitor its financial leverage situation to ensure there is enough cash to sustain operations through the growth. Using its short term debt facilities will not enable long term growth for SemiCo, so the company may need to consider future issuance of common stock to increase its ability to grow faster.

There is evidence that SemiCo's future profitability may be of concern given its current cost structure. The industry is experiencing downward pressure on margins as equipment manufacturers move towards using industry standard products. SemiCo has experienced this first hand with the drop in its operating margins in the first quarter of 2005 (SemiCo, 2005b). As a result, in the long run SemiCo may need to become more cost conscious in order to achieve and maintain its model profitability targets. This highlights the need for change at SemiCo, and the

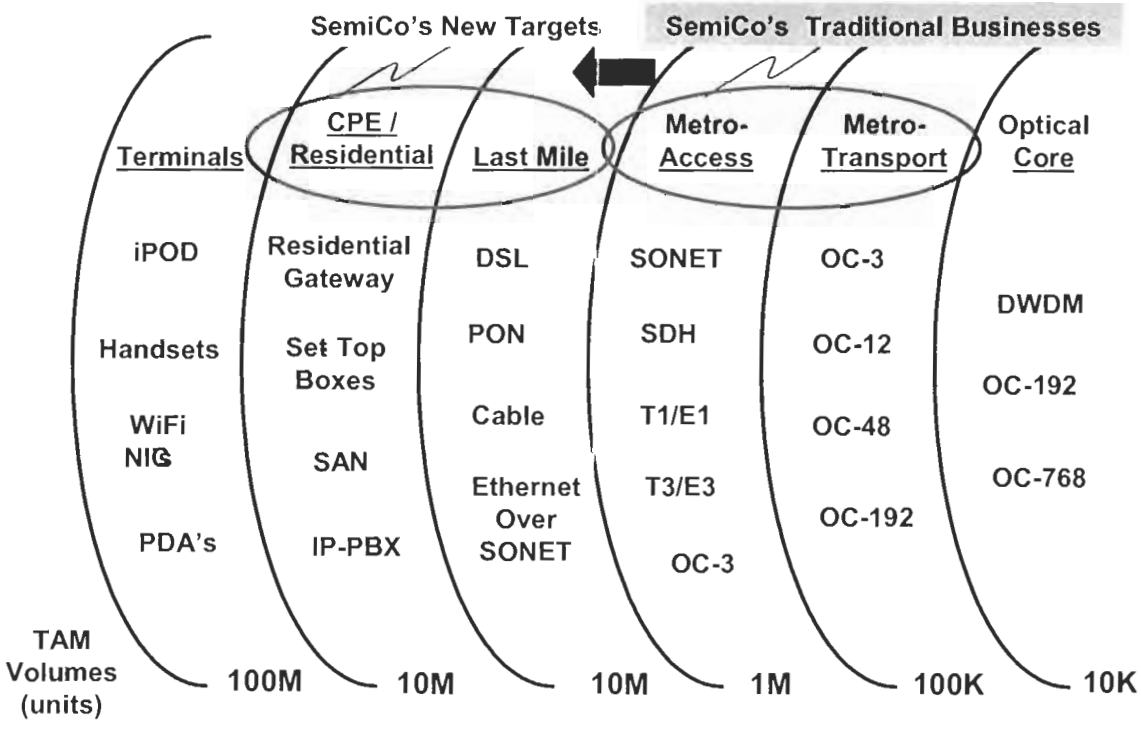
development of a new business unit with a different strategy may help to bring about the required change at the company level.

4.5 Software Business Unit Strategy

This next section discusses the strategic fit at the business unit level, specifically SemiCo's Software and Solutions Group (SSG). The mandate of SSG is to target products for the evolving home network. A home network today is much different from what it is expected to be in the coming years. Today a typical home network consists of a connection to the Internet, a modem to convert the connection to standard protocols that devices on the home network can understand, and one or more computers connected to that Internet connection. The future of the home network is expected to include many new devices in the home that will be wired to the Internet, including the television, the home entertainment system, telephone services and even large appliances (see Figure 4-10).

The reason SemiCo has entered this new market is that the company sees a much larger market opportunity for selling its chip products for these uses, as well as the opportunity to generate revenues from value added products, such as software, in combination with the chips. As can be seen in Figure 4-9, when compared to SemiCo's traditional markets, the number of potential unit sales in the new residential and home networking markets is over ten times the size of SemiCo's traditional markets.

Figure 4-9 Total Available Market (TAM) Sizes for SemiCo's Traditional and Targeted Markets



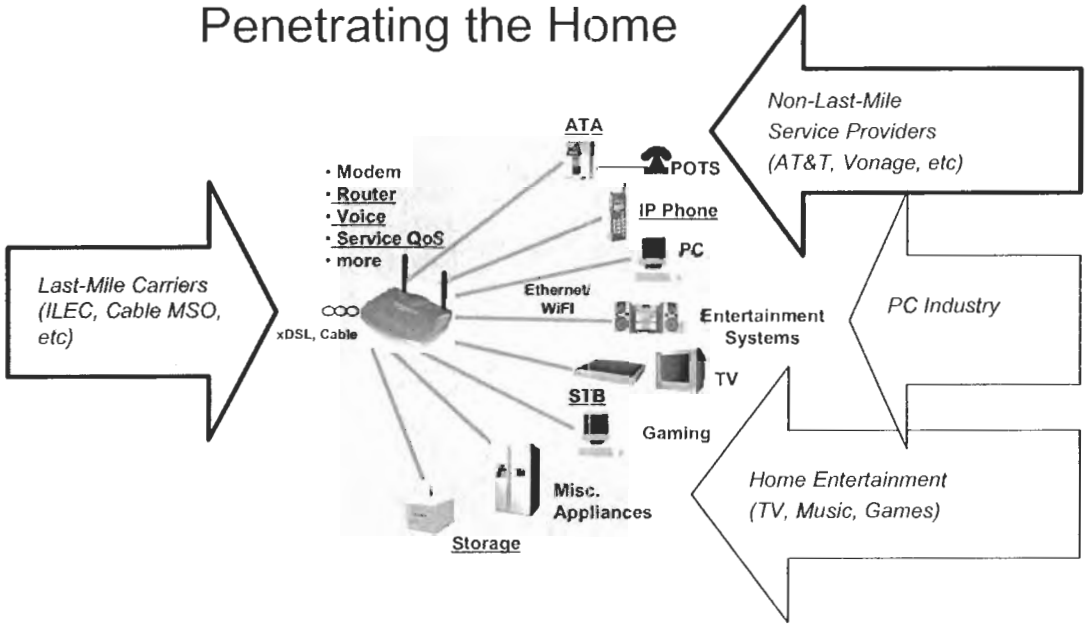
Source: internal SemiCo documents with permission (2005)

Figure 4-10, taken from internal SemiCo documents, shows the company's view of how the home network will some day look. The diagram is taken from the perspective of telecommunications companies and how they will be "penetrating the home" through various means. Some companies will be providing Internet services to the home (last-mile carriers), some replacement telephone services (non-last mile service providers), and others will be developing electronic equipment that will operate on the home network to enable communication between multiple devices. SemiCo has historically specialized in telecommunications semiconductors for service provider equipment, so it is a natural progression for the company to move up the telecommunications value chain to develop products closer to the end user. The new strategy that SemiCo is employing with SSG is to develop products for the non-last mile service provider market.

The areas that SemiCo currently believes it can successfully target with its expertise in communications equipment are underlined on the diagram in Figure 4-10. These are areas that encompass products for voice over Internet protocol (VoIP), storage devices for the home or

small offices, and media centre devices. SemiCo is planning to leverage its expertise in telecommunications, storage products and microprocessors to gain a competitive advantage in these new strategic markets.

Figure 4-10 SemiCo's View of the Home Network



Source: internal SemiCo documents with permission (2005)

In order to maintain revenue growth, SemiCo has decided to target the consumer and home networking products to capitalize on the growth expected from these markets. Many of the products in areas such as VoIP or set top box (STB) have target markets on the order of multi-million units (internal SemiCo documents, 2005). Since the tech market crash of 2000, growth in capital spending for the telecommunications industry has dropped by almost one third and is expected to remain relatively flat through 2007 (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 208-211). This has resulted in slower growth for the telecom semiconductor industry. According to internal documents, 68% of SemiCo's revenues in the first quarter of 2005 came from selling chips to the telecom industry, affecting company growth. SemiCo annual reports dating back to 1994 show that revenue growth has fallen from a high of 135% year over year in the late 1990s, to less than negative 50% and low double digit growth in recent years (SemiCo, 2005, 2003, 1999, 1998). Internal SemiCo documents estimate that by 2007 the total sellable available market

for home networking products that SemiCo's chips can be sold into will exceed $500 million. In SemiCo's 2004 annual report the company states that expanding business in advanced consumer markets is a key objective (SemiCo, 2005, p. 5). SemiCo's strategy is to do this through the development of a new internal department using new and existing resources.

4.5.1 Method for New Market Entry

Michael Porter (1998) outlines how companies should identify potential target markets to enter through internal development. Porter has identified industries that are prime targets for internal entry, which is summarized in Table 4-5. This section will compare SemiCo's internal entry strategy to Porter's categories.

Table 4-5 Michael Porter's Prime Target Industries for Internal Entry by a Firm

Prime Target Industries for Internal Entry
• The industry is in disequilibrium
• Slow or ineffectual retaliation from incumbents may be expected
• The firm has lower entry costs than other firms
• The firm has a distinctive ability to influence the industry structure
• There will be positive effects on a firm's existing businesses

Source: adapted from Michael Porter (1998, p. 344)

First, the home networking products industry can be viewed as an emerging industry based on Michael Porter's definition, which says "emerging industries are newly formed or re-formed industries that have been created by technological innovations ... [or] emergence of new consumer needs ... that elevate a new product or service to the level of a potentially viable business opportunity." (Porter, 1998, p. 215) Porter goes on to say that new or emerging industries are typically not in equilibrium because of a lack of well established competitive structures. Based on this information, the home networking industry might make a prime target for internal entry for SemiCo since it meets the criteria of being in disequilibrium.

Second, retaliation from incumbents in the home networking products market can be expected to be low because the market is new. Any incumbents that exist are not yet well entrenched with customers. There is also the potential for disruptive technology to displace any existing products in the market. Due to the low risk of retaliation, the home networking industry still appears to be a good candidate for internal development, based on Porter's analysis.

Third, the argument that SemiCo may have lower entry costs than other firms in the home networking industry may not be valid. The expertise that SemiCo already has in chip development may give the company some cost advantage to develop specialized chips for home networking products; however, the company will have to develop new core competencies in areas of software, hardware and firmware development that any potential competitors may already have. This point goes against Porter's lower entry costs criteria for prime target industries for internal entry.

Fourth, SemiCo may have some ability to influence industry structure by implementing various mobility barriers, such as using proprietary technology or achieving cost advantages through high levels of system-on-a-chip (SOC) integration. SemiCo is developing extensive expertise in the area of SOC development, described as the process of integrating the functionality into a single chip that was once done by multiple chips; therefore, reducing costs. The use of proprietary technology may also be an option for SemiCo through the use of its many patents to block entrants from developing competing products. The proprietary technology could then be used to develop a disruptive technology that may change the industry structure. These reasons in favour of SemiCo having some ability to influence the industry structure also support the plan for internal development of a new department within SemiCo.

Finally, the strongest reason for SemiCo to enter into the home networking industry is because it is expected to have a positive effect on its existing semiconductor business. SemiCo already has a solid reputation in the semiconductor industry, so it can leverage that reputation for selling more of its chips into new markets for the home networking industry. By designing complete system products for this market, rather than only silicon chips, SemiCo stands to benefit by increasing sales of chips and obtaining additional revenues through the sale of the systems products.

Based on this analysis using Michael Porter's (1998) criteria for identifying target industries for internal entry, the conclusion is that SemiCo made the right decision to develop the new skills needed internally.

4.5.2 New Skills Required

The new skills that SemiCo will need in order to execute on the systems development front are software, firmware and hardware development. Chip development is also required for these solutions, but SemiCo already has this expertise readily available.

Hardware development involves the design of an integrated circuit board that the silicon chip(s) are soldered onto in order to communicate with each other electronically. SemiCo has limited experience developing hardware for production released systems, but the company has done board development to test its many chips. The skills required to design hardware are readily available from many companies and retaining these skills internally within SemiCo does not add any significant value to the company.

Firmware is the software written to manipulate the functionality of the silicon chip to perform the required functions of the device. SemiCo has had limited firmware development experience, especially for products in the home networking market, but this is a critical skill required to be successful. The added value of any system solution is in the firmware, so it is imperative that SemiCo retain these skills internally to add value and protect its competitive advantage.

Software for the systems solutions will provide the front end functionality and coordination of the system's various functions. These are skills that SemiCo does not have available internally. In some cases, the software that is sold with a system can be add value and give SemiCo a competitive advantage, but the expertise required to develop such complex software may not be easily obtained by SemiCo.

SemiCo has realized that developing these skills will not happen immediately. For this reason, the first generation of products being developed are not aggressive in design because the intention is to use these new products to enable SemiCo to learn through the development process. The learning curve effects involved in developing these systems will likely be significant. The initial systems that are being developed will likely take longer and require many more resources than future products because employees are learning as the products are developed. Throughout this learning process, SemiCo will start to develop best practices and find out the best method for producing systems solution products for the home networking market. If SemiCo is able to develop these skills better than the competition, these learning curve effects may be leveraged to provide SemiCo with a low cost competitive advantage.

4.5.3 Strategy Selection

Since SemiCo has decided to develop the skills for solutions development internally, the company needs to decide what strategy to employ. According to Michael Porter (1998), there are multiple entry options for entering into a new business or industry (see Table 4-6).

Table 4-6 Michael Porter's Generic Concepts for Entry into a New Business

Generic Concepts for Entry into a New Business
• Reduce product costs • Buy in with a low price • Offer a superior product • Discover a new niche • Introduce a marketing innovation • Use piggybacked distribution

Source: adapted from Michael Porter (1998, p. 349)

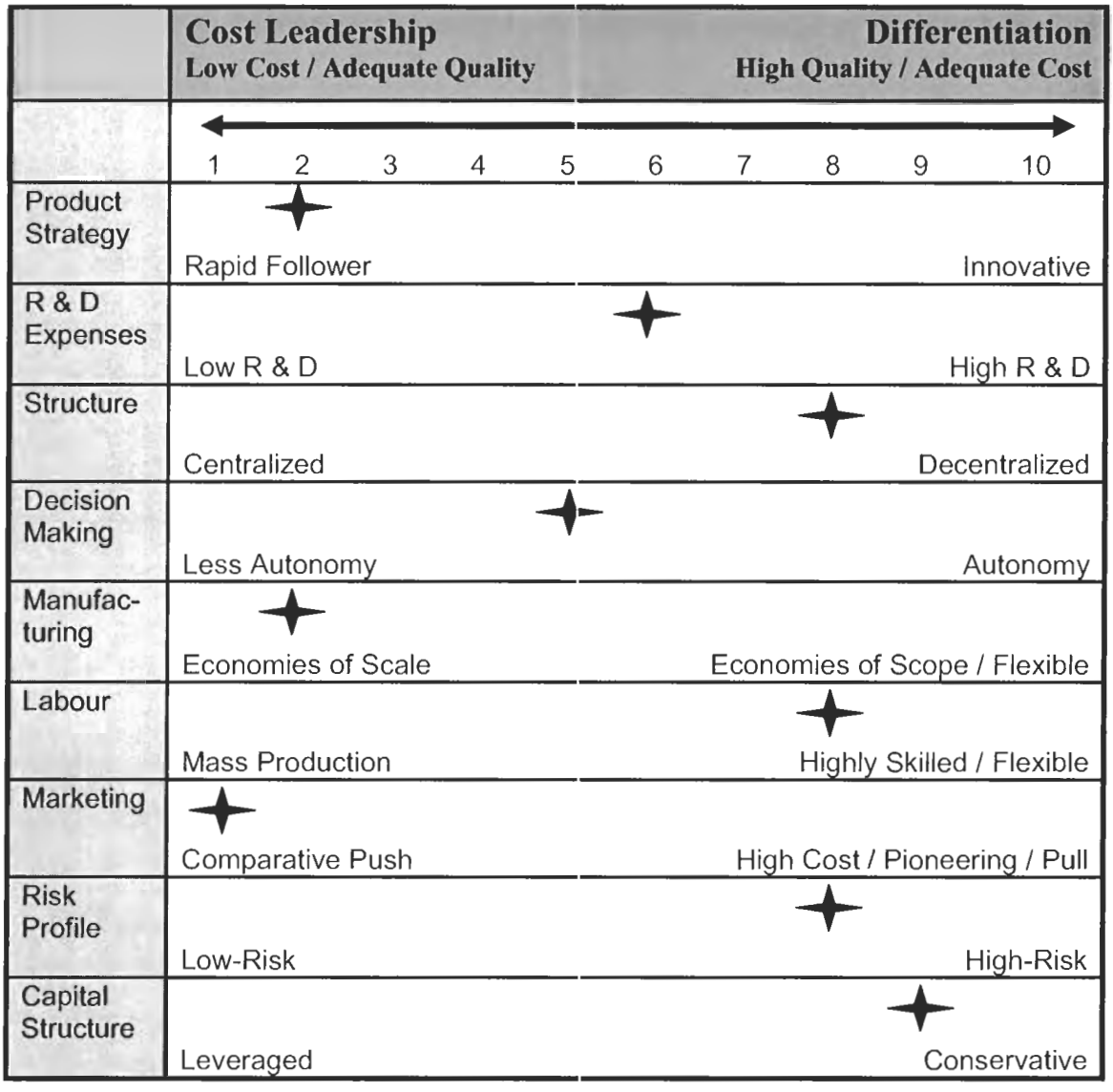
Of the six concepts for entry, the only one that SemiCo is pursuing is to reduce product costs. The consumer products market is increasingly competitive with cost and time to market being the main concerns of customers for SemiCo's systems products (Mishan, Schafer, Gelbtuch, & Woo, 2004, p. 290). Since SemiCo's customers in this market will be concerned about price first, and performance or functionality second, the company must adopt a cost based strategy. The only problem with this approach is that a cost based strategy for only the systems and solutions group is in contrast to the overall corporate differentiation strategy. This is likely to cause some strategic fit issues for SemiCo.

4.5.4 Strategic Fit of the Business Unit's Strategy

The strategy for the Software and Solutions Group at SemiCo must be a cost based one due to the market realities involved. Potential customers for SSG's products are extremely cost conscious and are primarily concerned with two things, the cost of the system and time to market. If a customer can get their product to market slightly faster than their competition, they stand to benefit greatly from a first mover advantage. Although, if a second mover enters the market and wants to take market share away from an incumbent, they will typically compete on price before product features because consumers are mostly price sensitive. In the home networking space, SemiCo is definitely a second mover because there are multiple incumbents that have existing products on the market.

This next section will show any issues relating to SSG's current strategy and how it may or may not fit the cost based strategy required to be competitive in this industry. Figure 4-11 shows a representation of where SSG's strategy fits on a scale of one to ten in relation to the nine strategic fit criteria for either a cost based or differentiation strategy. These issues will then be used to find areas for improvement in the strategy.

Figure 4-1 Strategic Fit Diagram for SemiCo's SSG Business Unit Strategy



Source: Author; adapted from Bukszar (2005)

4.5.4.1 Product Strategy

The product strategy for SSG is that of a rapid follower; which is consistent with a low cost strategy. For many of its early products, SSG was not defining new markets or new products, but rather looking at existing products that were on the market and identifying areas where SemiCo's chips could have an application. This is particularly true for the VoIP products which were designed by SemiCo as new market entrants 12 to 18 months after competitors already had products on the market. In the consumer products market, technology and consumer

tastes can change rapidly after as little as one year. SemiCo was hoping it could get an advantage over incumbent products and displace some of the competition strictly based on cost.

4.5.4.2 R&D Expenses

Research and development expenses for SSG are relatively high, but still lower in relation to the overall SemiCo R&D costs. Reducing R&D costs is consistent with SSG's low cost strategy. Efforts have been made to develop products in SSG more cheaply than standard SemiCo products, but there is still a significant expense involved. Some of these efforts involve outsourcing much of the development to offshore design centres in India and Asia.

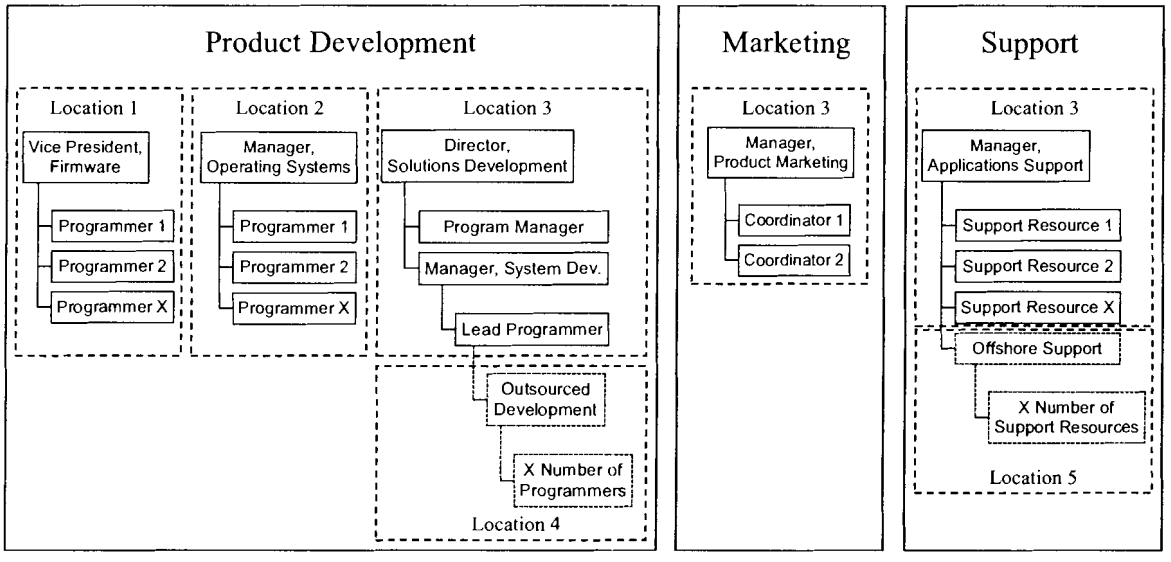
4.5.4.3 Structure

SSG's structure is highly decentralized, which is more consistent with a differentiation product strategy. The SSG department is spread between multiple design centres on multiple continents. This structure can possibly increase the costs of development, compared with a centralized model, by requiring more management overhead to manage the disparate teams. This is already evident in the organization structure compared with the structure of SemiCo's traditional business units. SSG has a structure in place that has more management personnel on a given product than a standard chip development project at SemiCo. A product development project in SSG today is typically managed by a team of managers, each supporting software, firmware, hardware, operating system, and chip development. This team of managers is led by another layer of management, the Program Management role, which is in place to manage the project managers and to ensure efficient inter-group coordination. This structure does not exist in any other product development team within SemiCo.

Figure 4-12 depicts the current organization structure for a typical product team within SSG. The picture shows that a product group can be spread across as many as five physical locations, which can cause communications issues and integration problems. There are also multiple independent groups (silos) operating on different pieces of a given product. These components must be integrated at some point to produce the final product, so communication across the silos during the development phase is crucial. Each of the silos has its own manager to coordinate the development efforts of each team, but a further level of management is also required to ensure the work done in each group is aligned. The role of managing this is currently done by the Program Manager, who acts as an information medium to direct the project and ensure the free flow of information between the firmware, operating systems, solutions

development, marketing and support groups. The location of the Program Manager within the organization structure, under the solutions development team, can make this role challenging. Another issue with the current structure is that each silo has its own mandate and may have a different agenda than what could be best for the entire product group. This can create political issues when various teams grapple for control at different phases of the project. This decentralized structure within SSG is not aligned well with a cost based strategy and currently has a number of inefficiencies that can result in miscommunication and added project costs.

Figure 4-12 Current Organization Structure for an SSG Product Team



Source: Author

4.5.4.4 Decision Making

Relative to the rest of SemiCo, the decision making within SSG provides more autonomy to the individuals, which is not consistent with a low cost strategy. Decision making over product planning decisions are still centralized and managed at the corporate level, but there is a lot more flexibility given to the SSG group. The main reason for this is that the product cycles for SSG's target markets are much shorter than the traditional SemiCo target markets. In order for SSG to be more nimble and adjust strategy quickly to changing market conditions, the department may not be able to wait for a quarterly product planning session to decide to start a new product. If this was done, the window of opportunity may have already passed, so much more autonomy is given to the management team within SSG to determine strategy on an as needed basis. Having a higher level of autonomy is not out of the realm of a low cost strategy for SSG, but it may prove

difficult to manage as the business unit grows to a larger size and the difference in levels of autonomy between SSG and the rest of SemiCo clash. However, giving SSG higher levels of autonomy in the beginning may allow it to grow more easily and develop its own processes, rather than being tied to the corporate decision making structure. It would be too difficult for SSG to create a plan and structure that will work for the group right from the beginning because there are too many unknowns. Therefore, granting autonomy in decision making is likely to encourage the free flow of ideas and information as the group grows. Having too much autonomy may, however, cause inefficiencies to creep in, so it will be important for SemiCo to manage this properly and not lose any cost advantages as a result.

4.5.4.5 Manufacturing

The SSG group's manufacturing capabilities, although outsourced, achieve some economies of scale due to their ability to sell products to many customers and potentially for multiple applications. This is consistent with SSG's low cost strategy. The way in which to achieve economies of scale in manufacturing high volume systems is to have tight controls on the bill of materials going into the system. SemiCo does not currently have this expertise. In order for SemiCo to achieve a competitive advantage in manufacturing, the company must be able to help its customers reach a certain level of economies of scale that are difficult to replicate by the competition. Without this, SSG's low cost strategy will be easily replicated and the company will be at risk of losing any advantage to a company that can achieve greater economies.

4.5.4.6 Labour

The employees involved in designing products for SSG are highly skilled, which is similar to SemiCo's chip design teams. The designing of systems and solutions does not fit well with a mass production model because highly skilled electrical engineers are required to design the equipment. One way that SemiCo can achieve a competitive advantage in this area is in knowledge sharing and building products from a common platform. If SSG is able to create a framework from which all of its products will be designed, it should be able to achieve a competitive advantage. The framework will allow SSG to design products more quickly and at a lower design cost because the group will be able to reuse existing components. By doing this, the skill of labour required will migrate somewhat towards the mass production side of the spectrum, which is more closely aligned with a low cost strategy.

4.5.4.7 Marketing

The marketing function for SSG is very well aligned with a low cost strategy because it requires SemiCo to push its products and sell them to ODMs based on comparative qualities with competitors' products. SemiCo has another challenge that requires it to use a push strategy: the company has never sold products to these customers before. SemiCo has not built a name for itself in the industry as a systems *and* solutions provider, so it must make customers aware of its products by forming new relationships. SemiCo is also challenged in that it is known as a semiconductor company, not a systems company. As an example, some customers and competitors have been surprised to see SemiCo participating in trade shows relating to home networking systems products. This is a hurdle that SemiCo will have to overcome by using a push marketing strategy, which is consistent with the company's overall marketing strategy.

4.5.4.8 Risk Profile

The risk profile of SSG is the same on the whole as the overall company because the two share the same senior management team that makes the decisions regarding how much risk to take on. The nature of the high tech business requires taking risks and investing in new technology that may or may not pay off in the end. It may be argued that the risk profile for SSG is somewhat higher than SemiCo's corporate risk profile since it is involved in entering a brand new market, but it is the author's opinion that SSG has a similar profile to the company because decisions about evaluating risks and what new areas to invest involve SemiCo's senior management. Having a higher risk profile is more identified with a differentiation strategy than a low cost strategy so this may cause some strategic conflict in the future. Although, the risk profile of SemiCo's competition in the systems and solutions markets should be very similar due to the nature of the risk of the high tech industry; therefore, SemiCo will not lose its competitive advantage very easily to a lower risk company.

4.5.4.9 Capital Structure

The capital structure of SSG, like risk profile, is also the same as SemiCo's because SSG is funded entirely by the company. Part of the reason is because SSG is being funded by SemiCo's capital structure. The investments into the new systems and solutions product markets does not require SemiCo to take on a more leveraged capital structure because the company has a strong balance sheet to fund future development. Although a conservative capital structure is more common with a differentiation product strategy, it should benefit SSG in its low cost

strategy to some extent. By funding SSG with SemiCo's capital the company can avoid the costs of financial leverage and potentially achieve a competitive advantage over a more highly leveraged firm. Having access to capital will allow SSG to invest in multiple areas for development, but the higher cost of these development projects may come at the expense of not being able to have low cost products. To counter this and to preserve capital, SSG will need to be strategic in what research and development projects it invests SemiCo's capital into.

4.6 Strategic Fit of SSG within SemiCo

There are some potential conflict areas for SemiCo due to differences between the overall corporate differentiation strategy and the newly formed SSG department's low cost strategy. This section will review the areas where there is a lack of fit for SSG's strategy within the corporate strategy of SemiCo.

The first area where there is a lack of strategic fit is in the product strategies. SemiCo's corporate product strategy is to be a product innovator and differentiate its products based on features. SSG's products on the other hand fit a rapid follower model whereby SSG finds areas to use SemiCo's chips or expertise to develop similar products to those already on the market. The issue arises because SemiCo's marketing and sales employees are trained to be innovative and develop brand new products for the market, not to mimic the competition's products. Being a rapid follower requires a different set of skills than SemiCo employees traditionally have. SSG must develop new abilities that will allow it to identify market niches that are not being addressed by competitors. SemiCo's employees do not currently have these skills.

The second most critical area where the fit of SSG does not align with the corporate strategy of SemiCo is the structure of the organization. SemiCo has a highly centralized structure, which is more closely aligned with a low cost strategy. Interestingly enough, SSG has a completely opposite structure that is much more decentralized. As a result, SSG requires more management functions in place, compared to SemiCo's traditional structure, to ensure communication and systems are in place to coordinate product development across many sites located around the world. Having different structures between the two organizations may be a source for conflict. Senior management may view the extra levels of management required for SSG as additional overhead that is not necessary. This would be true if the structure was more centralized, but the extra management is required because of the decentralized structure. This may also cause conflict with SSG's low cost strategy because having a more decentralized

structure will add to the costs of the research and development teams due to the additional management resources required. To date, SSG has overcome this by reducing development costs through outsourcing to India, but this is an easily replicated strategy by a competitor.

The third and final area where SSG's strategy does not align with SemiCo's overall strategy is in manufacturing. This may cause internal issues between SemiCo and SSG due to the differences in thought process when thinking about how to manufacture a system. Although manufacturing is outsourced in all areas of SemiCo's business, the manufacturing for silicon chips benefits from economies of scope, while manufacturing for systems and solutions benefit from economies of scale. The process of building a system involves pulling together many individual components that interoperate with each other. Deciding what components are used to design the entire system can have a large impact on the final cost of a system, especially since the volumes are much greater for SSG's products than SemiCo's chips. For example, an equipment manufacturer that is building products in millions of quantities will choose to work with a semiconductor company that can save it pennies on the cost of its product because that would translate into thousands or millions of dollars in extra gross profit when produced in volume. SemiCo has not invested in skills for developing mass quantity production systems, so when SSG is designing systems it may make a decision that can dramatically add to the cost of the end product. In the low cost strategy that SSG is employing, the ability to minimize the bill of materials for any given system will be critical. SemiCo may not realize the value of developing these skills since it is not as much of an issue for the traditional chip business.

This section outlined some of the major issues of strategic fit that face SSG within SemiCo. The two sides of the business have entirely different strategies, because the end markets are very different from each other. These issues will now be looked at in terms of the overall strategic issues for SSG.

5 STRATEGIC ISSUES

The purpose of this paper has been to identify strategic issues facing SemiCo and its entry into the software and solutions business with the new SSG business unit. This section outlines each of the key strategic issues in order from most to least important. These issues will be used to identify strategic recommendations in the following chapter.

5.1 High Cost Structure in Low Cost Market

The Software and Solutions Group at SemiCo is creating products to enter a market that requires the use of a low cost strategy due to the low margins available in the end products. Although it has been shown that a low cost strategy is in conflict with SemiCo's overall differentiation strategy, the only way SemiCo can be competitive in this specific market is to use a low cost strategy.

According to Michael Porter (1998), a low cost strategy is important in industries where both competitive rivalry and the power of customers are high (Porter, 1998, p. 36). In an industry where rivalry is high companies will compete to the point where profits are nullified, but a company that has a lower cost structure will still remain profitable while its competitors lose money. Similarly when customers have high bargaining power a customer will only be able to negotiate prices down to the level of the second most efficient competitor; therefore still affording profits to the lower cost company (Porter, 1998, p. 36). The semiconductor industry has customers with a lot of power as well as strong competitive rivalry; therefore, a low cost strategy is one of the key success factors in this industry.

Michael Porter (1998) has identified a list of requirements for implementing a successful low cost strategy (see Table 5-1). These requirements will be used to provide a basis for analysis of the strategic issues facing SSG.

Table 5-1 Michael Porter's Requirements for a Low Cost Strategy

Commonly Required Skills and Resources	Common Organizational Requirements
• Sustained capital investment and access to capital • Process engineering skills • Intense supervision of labour • Products designed for ease in manufacture • Low-cost distribution system	• Tight cost control • Frequent, detailed control reports • Structured organization and responsibilities • Incentives based on meeting strict quantitative targets

Source: adapted from Michael Porter (1998, p. 40)

In order for a company to achieve a defendable cost advantage in an industry, it must reach a high market share relative to the competition, design products that are easier to manufacture, spread development costs across a broad array of related products, and/or reach high volumes of sales by targeting all of the potential customer groups (Porter, 1998, p. 36). To achieve this may require a large initial capital investment, aggressive pricing and early losses in order to build market share (Porter, 1998, p. 36).

While SemiCo's SSG unit does have a sustained source of capital available through the cash reserves of SemiCo and its ongoing operations, the company does not currently meet any of Porter's other requirements for a low cost strategy, which could cause strategic issues. Specifically SemiCo does not have tight cost controls, detailed control reports, a structured organization in SSG, and the company does not have expertise designing products for ease of manufacture.

The current cost structure in SSG is not very tightly controlled because it is in a growth mode, and any required expenses are usually approved. SemiCo does have a very tight leash on expenses for other areas of the organization, but due to the growth nature of SSG, approvals are being expedited. For example, demand for talent in SSG is substantial and as a result there have been approvals for many new hires in the department at the expense of hiring requirements in the rest of the company. According to internal SemiCo documents, SSG is expected to double its headcount between January and December 2005.

The costs of this growth are not being closely tracked, which could lead to a department that grows beyond its requirements before it is recognized. This could jeopardize the low cost strategy that SSG needs to implement if too much inefficiency creeps into the system as the group is growing so rapidly.

According to Porter (1998), related to tight cost controls is a need for detailed control reporting. However, SSG does not currently have any detailed reporting process in place for monitoring progress or controlling costs. A monthly meeting is held company wide for the reporting of product development status, which SSG participates in, but this meeting is relatively informal in its approach. It is used more as a forum to ensure that resources are being allocated to the right programs as opposed to a tight control on project costs and schedule delays. The intention behind this informality is to foster innovation through the development process; however, for a low cost strategy to be successful there must be controls in place along the way to ensure that a project is not exceeding its original business case and return on investment projections.

The culture at SemiCo is one that rewards a differentiation strategy, not a low cost approach. According to Aaker (2001), to be successful with a low cost strategy the company must have a cost-oriented culture. "Top management, rewards, systems, structure, and culture must all stress cost reduction" (Aaker, 2001, p. 179). SemiCo does not currently have this in place, nor does SSG.

5.2 Challenges Entering a New Market

The new markets that SemiCo is entering with SSG's products are entirely different than its traditional business. This causes problems for sales and marketing because they rely on their business contacts to develop new customer relationships and identify business opportunities. The current sales and marketing staff do not have many contacts at the ODMs they are targeting, so they must start from scratch and build a reputation. To date, it has been challenging for SemiCo to obtain contacts at many of the potential customers.

Another challenge has been to identify which customers to target because sales and marketing do not understand the market well enough to classify customers as they can in the traditional chip markets. SemiCo typically breaks customers into Tier 1 through 3 customers, with Tier 1 customers being the ones with the greatest revenue potential and Tier 3 the least. Historically, SemiCo has tried to focus only on Tier 1 and 2 customers, but with the unknown consumer market the sales team could be inadvertently spending time to win a customer that turns out to only be a Tier 3 or lower. The risk with this is that the revenue potential from a Tier 3 customer won't match the sales and support costs required to win the design. Michael Porter says

that a company adopting a low cost strategy must avoid marginal customers (Porter, 1998, p. 35). If SemiCo can't classify its customers, it will not be able to avoid the marginal accounts.

Support is another issue that SSG faces. SemiCo does not have a lot of support expertise in house to support software. If the company can't classify its new customers into Tier 1 through 3, it will not be able to effectively support the customers that could represent the largest revenue opportunities. With the limited resources SemiCo has to support software it will need a way to classify customers and pass that on to the support organization so that it can spend the appropriate amount of time supporting each customer group.

Support for software requires a different skill set than managing chip customers because software requires the management of multiple product releases, customer notification of bug fixes for each version, and possibly the implementation of for-fee support services. SemiCo does not have the infrastructure in place for this level of support. Resources are not being applied to implement the support resources at the same rate as the growth of SSG.

SemiCo's marketing organization has a very good understanding of how to sell chips and manage the chip development process. The group does not, however, understand the software development process very well and as a result may over or under sell an opportunity. When managing customer engagements, marketing needs to be able to communicate delivery dates and manage the expectations of the customer, but in order to do this they also need to understand how the development is proceeding. With its lack of understanding of the software development process, marketing is still learning.

5.3 Organizational Structure

A low cost strategy demands a structured organization with clearly defined responsibilities, as shown in Table 5-1. SSG currently has a decentralized structure which does not fit with what would be best for a low cost strategy. On any given project, SSG has development teams spread between up to four and five locations, including outsourced development in India (see Figure 4-12). Even though these teams are working on components for the same end product, they are split into independent working units developing pieces that must come together in the end to form the final product. This structure mirrors the chip development team structure at SemiCo where blocks on a chip can be developed by independent groups and easily integrated at the end, but software development requires more coordination throughout development. Outsourcing to India makes sense from a cost savings perspective, but can not be

done at the same time as having a decentralized internal development team. This model can be easily replicated by a competitor, and likely improved upon. There are also inefficiencies in this model because of a potential lack of communication between development teams. The decentralized structure has caused the department to have more management structure in place relative to the rest of SemiCo's product development groups. For example, due to the multiple teams in each location, there is a new role required to manage the coordination of activities between each of the development teams. This new role does not exist elsewhere at SemiCo, although it is required for SSG due to the distribution of development teams. The addition of more layers of management will add to the development costs and make it more challenging to achieve a cost advantage over the competition.

SemiCo has a lack of coordination between its various R&D divisions for shared product development and marketing efforts. Each of the three product divisions operate autonomously to manage the different product lines. The growth of SSG may change this, however, because some of the systems that are being planned could require chips from one division and marketing expertise from another. This could cause an issue based on the current structure at SemiCo if each autonomous division has its own marketing groups and communication across divisions is limited. In order for SSG to sell its systems products, the team may need to understand how the chips from another division are being marketed by the division responsible for that chip. With SemiCo's current structure, this cross divisional coordination can be challenging. As a result, the current divisional structure is not the most efficient setup to benefit SSG.

5.4 Missing Required Competencies

SemiCo does not have any core competencies in the areas that are required for systems and solutions development, such as software, firmware and hardware. Software development is being outsourced to contractors in India, primarily for cost savings reasons. For any system, the software is considered a value add part of the solution, so with well developed software, SemiCo should be able to charge more for its products. Firmware is similar to software in that it adds value to the solution for customers. A customer for SSG's products will likely not buy a chip without the firmware because of the added development costs for them to do their own firmware, but SemiCo must determine if it can charge extra for it. Internal SemiCo documents show that many competitors, such as Broadcom, are offering firmware (and in some cases software) free of charge because the company wants to drive chip revenues. The problem with this situation is that if one company is bundling firmware and software for free, then all companies will be forced to

do the same. In order for SemiCo to become a strong competitor in the home networking products space it will need to develop core competencies in software, hardware and firmware development practices because these can help SemiCo increase its perceived value.

5.5 Achieving Economies of Scale

Developing products for ease of manufacture is a way of achieving economies of scale that can provide a cost advantage. SemiCo does not manufacture the products that SSG sells, instead the company sells the design to a customer that will manufacture it for an OEM. If a customer can achieve greater economies of scale with a SemiCo product's design versus that of a competitor, they are more likely to select the SSG product due to its lower cost. In order for SemiCo to pass on these manufacturing economies to the customer, it must first design a product with manufacturing in mind. SemiCo has expertise across the company in designing and manufacturing single chips economically, but there is a lack of skills inside the organization for designing low cost systems that include a chip and multiple additional components. The selection of one wrong component during a system's board design can make the difference between achieving manufacturing efficiencies and not. These are skills that SemiCo will need to develop to achieve a cost advantage.

5.6 Lack of Strategic Fit

The product development cycles for SSG's targeted products are much different than the traditional silicon chip cycle. The development of a chip can take six months to two years before a chip ramps to production volumes with customers, whereas the consumer market products can ramp up within six months from the start of a product's design. However, SemiCo's standard product development processes and strategic planning do not mesh well with these shorter cycles. The time for SemiCo to turn around a decision about whether to develop a new product or not may take three months under the current processes, but this may cause a market opportunity to be missed. SSG needs to be able to react to quickly changing market conditions and respond to an opportunity as soon as it is identified.

Time to market may be hard to reduce because of a lack of strategic fit between the overall company's differentiation strategy and SSG's low cost strategy. Conflict may come from the lack of fit in areas of corporate structure, level of autonomy in decision making and manufacturing functions. The corporate structure is centralized, while SSG maintains a

decentralized structure. As SSG grows, the company may try to impose its centralized structure on the business unit, which will affect the way SSG operates in a positive fashion because it will pull it closer to what is required for a cost based strategy. However, this may cause conflict for those employees within SSG that are used to the current structure. The same is true for the level of autonomy in decision making. SemiCo tries to give employees less autonomy in decision making than SSG does currently which, if the company imposes its methodology on SSG, will pull the group in the direction of a low cost strategy. The lack of skills in manufacturing for economies of scale may also become a strategic fit problem because of the differences in skills between the company and SSG. These fit issues are not likely to threaten the success of SSG's strategy, but they are areas that should be considered.

5.7 Financial Metrics

SemiCo's current product planning process is based on a return on investment (ROI) metric for program selection. Programs are evaluated based ROI projections meeting a company wide benchmark level based on historical returns for other products. The risk with this method for SSG products is that its ROI may be different than SemiCo's traditional products because a systems product could evolve into new products with very little additional R&D investment. The return on an SSG product may be more challenging to predict because through the development stage it may be found that the product can have multiple customer applications with minor changes. These derivative products produced by SSG could yield greater returns for the initial product. This is called a "shadow option;" the knowledge of the new product alternatives would not have been gained by SemiCo if the initial product had not been developed (Bukszar, 2005, p. 68). In the world of software and solutions development there is a potential for many shadow options because of the creativity required in the development process.

5.8 Product Strategy

The current product strategy that SSG is implementing is that of a rapid follower, which is consistent with a low cost strategy. Longer term, there are plans to develop products that are more innovative; therefore, requiring more R&D spending. The risk is that any new products that SemiCo develops will be easily copied by another company that is using a rapid follower strategy. The drawback is that the additional revenue gained from having a first mover advantage to gain market share may not compensate for the added R&D costs to be innovative.

5.9 Growing Pains

Flat revenue growth in SemiCo's traditional markets has driven the company to look to new markets to increase revenues. The targeting of home network markets by SemiCo with SSG's products is a result of this change in focus. However, growth in the new markets may not meet the high revenue expectations of the company and its investors. SemiCo is trying to achieve its historical growth levels of over 50% revenue growth per year, but based on its current financial situation a sustainable level is only in the 15% to 20% per year range (see Figure 4-4).

The plan to double the size of SSG by the end of 2005 is creating challenges for recruiting. SemiCo's human resources (HR) department has been well trained to hire electrical engineers, but it does not have skills to recruit software engineers. This is creating a challenge for the hiring managers in SSG because HR is not equipped to add value as the group normally would for screening resumes and building relationships with universities to hire new graduates for software development. Instead, the burden is being put on the hiring managers to review the resumes for each job and perform the interviews. The effect of this is that SSG's managers are spending a lot of their time on recruiting rather than managing the department.

SemiCo has a number of strategic issues that require attention. While it will not be possible to correct all of them at once, a long term structured approach towards improving them will benefit SSG.

6 RECOMMENDATIONS

6.1 Revisiting the Problem Statement

The problem statement for this paper was to look at all of the strategic issues identified for SemiCo and SSG and to investigate them in further detail. This section will identify which are the best short term strategic goals and which are the best for longer term consideration to address the identified strategic issues.

6.2 Low Cost Strategy

The biggest issue facing SemiCo and the SSG business unit is trying to be competitive with a corporate structure and culture that is not positioned to be a cost leader in an industry that is focused on cost reductions. In order to remain competitive, SemiCo will need to adopt some strict cost controls because a differentiation strategy will not succeed over the long run in this market.

To begin with, SSG needs to adopt tighter cost controls. When a product development initiative seeks approval and development funding at SemiCo, a business case is first created. The decision to go ahead with a project is based on whether it meets a minimum ROI by comparing the estimated development and manufacturing costs against potential revenues. Then development begins and the business case is rarely revisited during to see if the project is going to meet its ROI projections. In order to contain development costs for SSG's products, this needs to be done differently. Each SSG project must have development reviews at regular intervals throughout the project to assess the progress according to the project plan, conduct analysis of planned versus actual development costs and to adjust identified revenue opportunities based on changing market conditions since the business case was produced. The more frequently that this is done, the more likely SemiCo is to prevent a product from becoming unprofitable once it hits the market. If a project is not going to meet its expected ROI then a decision can be made of whether to proceed for the sake of market share, alter the plan, seek additional customers for the product, or to cancel the project.

Depending on the size and duration of a project, it is recommended that a comparison to the original plan is done at least twice during a project (at the mid-point and the end). For larger

projects that last up to a year or longer, this review should be conducted at least four times, at each quarter of the project's progress. This review should consist of an update from marketing reflecting changes in customer plans and potential revenue opportunities. Furthermore, the development team should present the progress of development to the original plan and identify variances for project schedule and budget. An updated budget should also be presented to show the expected schedule and budget to get the product to market. This information can then be used to revise the ROI, revenues, development costs and other metrics so that a determination can be made whether the product is still viable to proceed with development.

The culture within SSG needs to be changed from the culture of the overall company such that driving cost savings is expected from employees at all levels. If the SSG culture continues to follow differentiation model, then SSG will not be able to become a cost leader in its product end markets. The culture needs to be altered from the top down within SSG without drastically affecting the culture of SemiCo. This should be done by implementing incentives or bonuses based on the cost savings individuals can bring about. The best way to implement these incentives without affecting the bottom line is to reward employees with stock options based on their contribution to lowering costs. These rewards must be above and beyond the regular incentives that employees get to ensure that employees make a connection between their cost reduction efforts and the reward. Employees should also be rewarded publicly for their efforts to encourage others to also cut costs.

Being cost conscious must become a core part of every SemiCo employee's mindset, especially those in SSG, and a regular review of costs must be done to ensure that the company can achieve a sustainable competitive advantage in these new markets.

6.3 New Market Education

The challenge for SemiCo entering a new market is that its existing employee base is not educated in how they need to operate differently. The differences between the semiconductor market and the software/systems markets are significant. Customers, product development processes and product life-cycles are different, and the products are aimed at a different end user. The variations between the traditional market and the new markets are large enough that employees need to learn a new way of doing business.

The customer base for software and systems products is almost completely different than that of SemiCo's traditional customer base because ODMs manufacture these products instead of

the OEMs the company normally deals with. This requires forging new relationships with companies that SemiCo has never dealt with in the past. To overcome this, SemiCo would benefit from hiring some experienced sales and marketing senior managers from companies that already sell similar products into the ODMs and OEMs that SSG is targeting. These new managers will bring with them a wealth of knowledge of the industry, an understanding of who the Tier 1 and Tier 2 customers are, and they will have personal contacts at these key customers. This experience can be leveraged to get SSG's products into the market faster because it will advance SemiCo further down the learning curve related to entering the new markets. This will get SSG operating at a more efficient level much faster than if done through organic growth internally by learning from mistakes along the way.

Education of software and systems development processes needs to be a priority for all employees involved in SSG projects. At a higher level, SemiCoU should work with SSG to develop at least one course that is designed to educate the entire SemiCo employee population on how software is developed and how it varies from silicon development. This would be similar to the existing chip development education required for all employees that teaches them enough to understand the basics so they are able to interact better with other groups when they inevitably need to work on projects together. By doing this, SSG will ensure that all employees involved in its projects, from development to marketing to support, will be able to speak a common language and understand the differences of developing software compared with chips.

6.4 Structural Changes

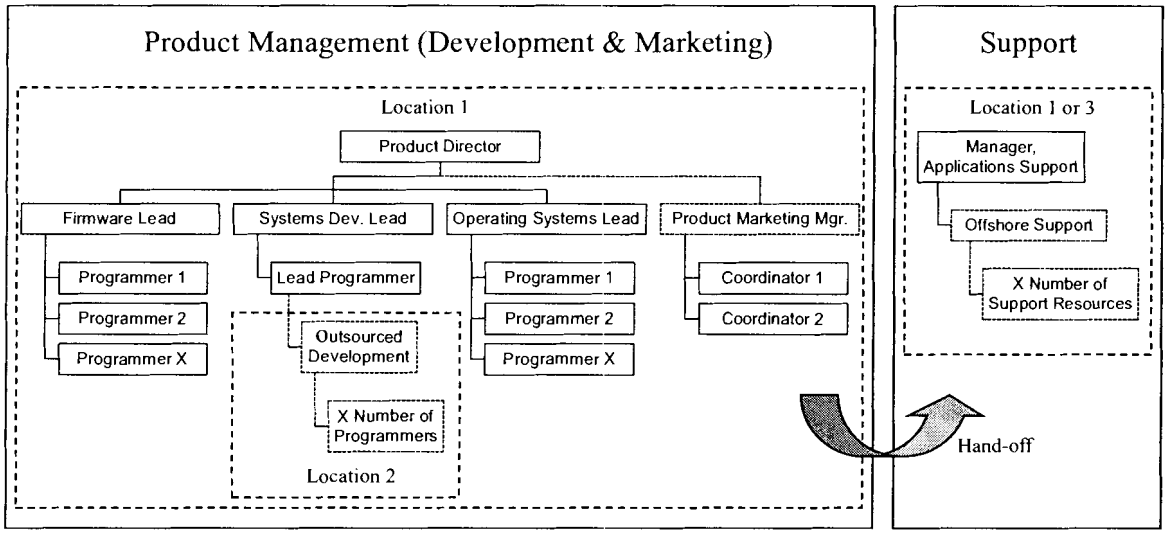
The lack of cross-divisional coordination required by SSG today does not scale well. Each product division within SemiCo has its own marketing and development groups that operate autonomously. Since SSG's products can potentially require components from each of the company's divisions, the SSG department should become a division on its own that will develop its own products and have its own marketing groups. This will remove the reliance on other divisions that may not understand the end markets that SSG operates in. Products developed by SSG today are sold using marketing resources that come from multiple divisions within SemiCo. This creates a lack of continuity and sharing of customer information within marketing. Support for software and solution products also requires a different skill set than is required to support chip customers. Separating out support will be a benefit because specialized software resources could be acquired to better serve the customers. The new division could also have its own development groups that design chips specifically for SSG products, rather than relying on an

existing or future chip development from another division that may have its own objectives. The differences between SemiCo's traditional markets and those of SSG are significant enough to warrant the separation of SSG into its own autonomous division.

The decentralized structure of SSG goes against the ideal structure for a cost based strategy, which should be more centralized to ensure there are proper controls in place to minimize costs. Software development requires a great deal of collaboration between the groups developing code that must integrate together seamlessly to form a complete solution. The teams that are working on SSG's products need to be more closely aligned or they must be able to work in closer proximity to each other. The existing teams developing some of SSG's products are spread out across multiple locations with only teleconference meetings and email keeping them connected. If these teams were located in the same physical facility it would enable better collaboration between all of the individuals involved. One benefit of this is that when the pieces need to come together, they will be more likely to fit with fewer issues. Another benefit is that less management will be required to coordinate all of the dispersed teams since they can be centrally managed from one location. The final benefit of having teams located together is that it allows for tighter management of costs because everything can be monitored more closely.

A recommended organization structure that will enable greater centralization, collocation of product teams, fewer physical locations of staff and better cost management of a project is pictured in Figure 6-1. First, this structure reduces the number of physical locations by almost one half (depending if the support group is located offshore for cost savings reasons) when compared to the current structure (see Figure 4-12). Second, the new Product Director role will give total control and centralization of the management functions for the entire product through its lifecycle. The Product Director will be responsible for a product from writing the business case, through design and development, and marketing of the product to customers (through the dotted-line relationship of marketing reporting to the Product Director). This person is ultimately responsible for the success or failure of a product. Third, the recommended structure removes the silos that existed previously, except for the support functions. A hand-off from the product management group to the support group will occur during the later phases of the development cycle. This is when the support group will be responsible for any customer issues and marketing will remain involved to manage the sales efforts. The recommended reorganization will go a long way to achieve a more centralized structure that can help with implementing a cost based strategy for SSG.

Figure 6-1 Recommended Organization Structure for an SSG Product Team



Source: Author

Another challenge of fitting the SSG organization into SemiCo's existing corporate strategy is around the different product lifecycles for SSG's products compared to chip products. SemiCo's processes and procedures are geared towards development cycles that can last four times longer than SSG's product cycles. Therefore, waiting for a product planning meeting at SemiCo that occurs every six months could cause SSG to miss a product window of opportunity. Due to the shorter product cycles, SSG needs to have its own product planning and other sessions that give it the flexibility to react more quickly to changing market conditions. This will enable SSG to get approval for development sooner in order to capitalize on an opportunity and potentially gain a first mover advantage.

6.5 Increased Competencies

If SemiCo is committed to developing software and solutions then it must develop skills in these areas that will enable it to be as good or better at this development than its competitors. To achieve this, SemiCo must build core competencies in software, firmware and systems design. The challenge for SemiCo is that it cannot develop these competencies overnight. Even if the company were to hire industry experts to gain a critical mass of employees with the required skills, the new employees would take time to integrate into SemiCo. Developing the skills with existing employees by retraining them would take even longer, so the only option for SemiCo to gain competencies in these areas would be to acquire the expertise or find a strategic partner.

The other alternative is for SemiCo to use its cash and stock to acquire companies that have significant software and systems development core competencies. By acquiring a sizable company with this expertise, SemiCo could itself become a software development company overnight. The challenges would be how to successfully integrate the two cultures and how to ensure the strengths of both companies are not diluted after the acquisition. For this reason, strategic partnerships are likely the best short term solution for SemiCo to gain the required expertise in software development.

6.6 Increased Economies of Scale

The products that SSG is developing will eventually be manufactured in volume by the ODMs that sell to multiple OEMs targeting large end markets. Thus, the challenge for SSG is to understand how to optimize manufacturing of its products for mass production. The volumes for SSG's products will be magnitudes higher than those of SemiCo's traditional chips. As a result, there is a new skill that SSG employees will need to develop, which is how to design products to optimize cost reductions during manufacturing. If SSG's customers are manufacturing ten million units of a given product, saving ten cents on a design can amount to a one million dollar cost savings to the manufacturer. Decisions that are made in the design phase have a direct impact on the end customer's costs. SSG needs to have employees that understand the system manufacturing process very well so that they can help product designers ensure that they are optimizing their designs for cost. These are not skills that SemiCo currently has, so the company should find and hire people that have this experience by head hunting from companies like ODMs that have employees who have experience with manufacturing high volume electronics products.

6.7 Product Strategy

SSG's current rapid follower product strategy is well suited to a low cost strategy. Thus, SSG's plans to invest in product innovation to be a market leader rather than a follower can be dangerous for the company because investment in unproven markets may not pay off; as shown by AMCC's shotgun approach to R&D (see Section 3.3). Instead of investing this money in unproven markets, SSG should invest in product innovation of existing products on the market where it can reduce costs, such as VoIP. By retaining this rapid follower strategy, SSG will be able to identify markets that have proven growth potential and learn from the mistakes of other companies. SSG can then step in and develop a cost reduced version of an existing product to win market share away from incumbents. Since these new consumer markets are extremely cost

conscious, a rapid follower strategy with sustained investment in R&D for cost reductions will pay off with less risk than entering unproven markets. This is a strong strategy that has been proven to work numerous times with companies like Texas Instruments and Du Pont (Porter, 1998, p. 36).

6.8 Enabling Growth

The growth planned for SSG is substantial and the expectations of SemiCo's executives and shareholders are also high. In order to meet these expectations and to grow successfully, SSG needs to be able to identify talent and hire people very quickly. SemiCo's existing HR department does not have skills in identifying software development candidates, but this is a skill that the group will need to acquire. SemiCo should hire at least one person who specializes in recruiting software and systems developers. This person should come with the necessary contacts in the industry and the skills to identify talented individuals and head hunt them from key companies around the world. To grow SSG successfully, SemiCo needs to have the right human resources processes and skills to enable this growth.

7 IMPLEMENTATION PLAN

This implementation plan outlines the actions that should be taken to apply the recommendations made in this paper. The implementation plan follows a timeline that identifies when certain recommendations should be done, what resources will be required for each step and how success will be measured. The timeline is broken into three month periods, or quarters, to allow flexibility in scheduling tasks and prioritizing the implementation based on available resources.

7.1 First Quarter

7.1.1 Reorganization

During the first quarter of the implementation, one of the first things that should be done is to reorganize the SSG group into the recommended structure (see Figure 6-1). The initial reorganization will not be able to take advantage of the recommendation to reduce physical locations of staff due to employee relocation issues, so instead it should focus on building the hierarchy. To implement this change will require significant buy-in from all parties involved. Without their buy-in the reorganization is bound to fail because of a lack of support. In order to overcome this issue, the department's vice president (VP) should kick off the process by announcing that the structure is being analyzed and changes will be made. The VP should appoint someone to be in charge of communicating the reasons for change and getting feedback on the proposal before mandating anything. This person could eventually become the Product Director since they will have formed the necessary relationships during the reorganization phase. Once agreement is reached on the need for change and on the new structure, then the VP will need to make a formal announcement to the department explaining the reorganization. This entire process will likely take about four to six weeks.

Measures of success: A new structure is implemented within no more than eight weeks. Visible improvements in communication and coordination amongst the various parties should become apparent within two months after the completion of the reorganization.

Resources required: One person to be appointed as the communication liaison that will ensure buy-in from the required teams. No capital expenses are required.

7.2 Second Quarter

7.2.1 Cost Controls

During the second quarter of the implementation, cost controls and detailed control reporting should be implemented once the reorganization has been completed. The Product Director will be responsible for implementing these controls by setting up regular project review meetings. At these meetings a review will be done to ensure that a project is on schedule, on budget and that it will meet or exceed the business case ROI. The first step will be to identify what should be measured and reported at these meetings and the frequency at which the meetings should occur. Input from marketing and each of the product development teams should be gathered to understand what is being collected and what gaps exist. One to two projects should be selected as a pilot test to work out any problems with the process, to figure out the best format for the meetings and to ensure that the necessary data to make decisions is being collected. This phase should begin immediately in the second quarter and run for a period of about three months with modifications to the process as required.

Measures of success: By the end of the second quarter, one pilot project will have gone through at least one project review meeting. The results of this meeting should be able to recommend (or not) continuing development of the product and present the updated business case metrics to senior management.

Resources required: The Product Director, plus representatives from marketing and product development, will need to be available to discuss an action plan. No capital expenses are required.

7.2.2 Cost Based Incentives

To create a cost based culture within SSG, the mindset of employees will need to change to think about all possible ways to reduce costs in everything that they do. One way to do this is to provide employees financial incentives to reduce costs, such as providing stock options. This will encourage employees to achieve the required behaviour. In order to devise a new incentive plan, SSG's senior managers will need to work with human resources to identify the most equitable fashion in which to implement the plan without adversely affecting employees in other divisions. An initial proposal for the plan will have to be presented to SemiCo's board of directors for approval because of the involvement of stock options. Once the details have been

worked out, specific metrics will need to be established to assign a value to each type of cost savings measure that an employee achieves. As an example, if an employee finds a new way to develop or refine an existing product that will reduce its costs by $100,000 in volume for a customer, then this employee could be given $1,000 in stock options. The incentive has to be perceived as a high enough value that employees will want to participate in the program. It could take four to six months to implement a fair and equitable incentive program.

Measures of success: By the end of the fourth quarter, an incentive program will be rolled out to all affected employees. Employees get excited about the program and begin achieving cost savings within two months after the program kicks off. Communication and training, if required, will be conducted along with the rollout.

Resources required: Time involvement from SSG's managers and human resources to develop the plan, as well as time from SemiCo's executives and board of directors to approve it. Sufficient stock options will need to be available in the existing stock option grant programs that SemiCo has in place.

7.2.3 Education

During the second quarter, the institution of a software development education program for all SSG employees should also begin, followed by a higher level program aimed at the entire SemiCo population. The VP of SSG and the department's top managers should work with the training department at SemiCo to develop these courses. The initial focus should be on identifying what to teach each existing and future SSG employees. The training department can help to design the course and collect the course content once the managers have determined what material they want included. The course can be designed in an online format where employees can take it at their leisure within a six month period from when it is assigned to them. The focus of the training should be on some main topics including, the software development lifecycle, release management, the selling of software, supporting software, how to think about low cost instead of product differentiation, how to operate in a low cost market, and the requirements for a low cost culture at all levels. This initial SSG training program will take about three months to develop and implement.

The second training program aimed at all employees at SemiCo should be a much lighter version of the SSG program. To develop this program, the training department and SSG managers will need to meet to identify the topics and material to cover. This training program

should address topics including, reasons SemiCo needs to develop software, how software development differs from developing chips, how software and chip teams should operate together to benefit the company. The second course will take an additional three to six months after the completion of the SSG targeted course.

Measures of success: Within one year, the culture of SemiCo should be visibly supportive of software development and everyone should be able to identify what value software can add to SemiCo's products.

Resources required: One dedicated person from the training department for up to nine months will be needed to design the courses. Time from the managers of SSG will also be required to provide guidance on the course content. If a person is not available from existing staff in the training department, a contractor will need to be hired at a cost estimated to be about $72,000 (nine months at $50 per hour).

7.3 Third Quarter

7.3.1 Expanding Competencies

The process of looking for acquisition targets or strategic partnerships is one that should be a continuous, ongoing process for SemiCo and SSG. Partnering has already been underway within SSG, but starting in the third quarter a team should be setup to look for acquisition targets that can help build SSG's core competencies in software, firmware, and marketing to the consumer and home networking markets. This team should be comprised of the department's top managers and some senior managers from other divisions within SemiCo. The more people involved that have contacts in the industry, the more likely potential targets will be found sooner. The acquisition team could meet monthly to review potential targets and discuss opportunities. Looking for potential candidates should be a task that all of SSG's managers take on themselves as an ongoing task by using their contacts in the industry.

Also during this quarter, SSG should build competencies in designing and selling products for manufacturing high volumes for the consumer market. This can be done by looking at either hiring experienced people from manufacturing companies, or through a strategic partnership with an ODM or manufacturer that can work with SSG on its products. This phase should take no more than one year to complete because SemiCo must ramp up its competencies as quickly as possible.

Measures of success: Within one year, software and firmware development will be considered a core competency for SemiCo. This can be determined by improved time to market for software products and a collection of software libraries and expertise that will allow SSG to turn out a new product within six months or less. Manufacturing and marketing skills will also be enhanced to include understanding of manufacturing and selling products for high volume consumer markets.

Resources required: Time to meet at least once a month, plus time to explore external opportunities will be required from SSG's managers and other departments that are involved in the acquisition team. Capital will be required to acquire companies or hire people that can bring the required expertise. The cost will vary depending on the value of the acquisition target.

7.3.2 Rapid Follower Strategy

While expanding its competencies in the third quarter, SSG can begin building its expertise to maximize its abilities as a rapid follower. New skills will be required within SSG to be able to identify market opportunities where it can leverage its own or SemiCo's core competencies to cost reduce an existing product on the market. The skills required will be in-depth knowledge of the consumer and home networking markets, which SSG does not currently have, and the many players in the value chain. SSG will need existing or new people who have the contacts and experience to build relationships with ODMs and OEMs. These same people will need to have an understanding of SemiCo's products and competencies to be able to identify opportunities for producing a cost reduced product for the ODMs and OEMs. Initially, SSG should have only one or two people that are responsible for identifying these opportunities. However, in order for the people to be successful, this role should be their primary responsibility so that they are not distracted with other duties. SSG's managers will need to hire one or two people that have the required skills to fill this position. This process could take three to six months to find the right candidate.

Measures of success: By the end of the fifth quarter, SSG will have at least one person in the role of building relationships and identifying cost reduction opportunities. At least one product opportunity will be identified by the end of the sixth quarter.

Resources required: Time will be required from SSG managers and human resources to interview and recruit for this role. The costs of adding a new employee will be an expense as well as the ongoing salary burden.

7.4 Fourth Quarter

7.4.1 Organizational Structure

After the third quarter, almost one year will have passed since the beginning of the implementation plan. At this time, implementing changes that will have a larger impact can be possible because the affects of earlier changes should have been worked through. This is when SSG should consider methods for centralizing its teams into as few physical locations as possible. The collocation of teams working on the same project will benefit the company with improved communication and less management overhead. This phase will need to be implemented over a longer period of time due to the possible relocation of key employees or the redistribution of products so that an entire product management team is located as close as possible. All of SSG's products do not necessarily have to be developed from a single location; in fact there may be benefits to having development groups located where there is available talent. However, the key is to ensure that a product management team for any one product is centralized. This will require software, firmware, operating system, hardware and marketing people to be collocated. One way that SSG could implement this is to build a collocated team for the first development project that begins in the fourth quarter. This can be used as a pilot project to see if the benefits warrant rolling the structure out across all future projects. The process of piloting this model will take the duration of the project, which can vary from project to project, plus at least one month to allow review and identification of lessons learned. The results of the review should include a recommendation of proceeding with this organization model for all SSG products in the future. The total time for implementing this could take six to eighteen months depending on the size and length of the project.

Measures of success: By the end of the fourth quarter, a product management team will be in place for at least one project and the people will be collocated for the duration of the project. Within one month after the project is completed, a review will be done to gather information for a presentation of lessons learned for future product management teams.

Resources required: Some relocation of existing employees may be required, which could come at a significant expense. Depending on the number of employees that need to be moved, it is estimated that this could cost $100,000 to $300,000.

7.4.2 New Division

The other organizational change that can take place more quickly in the fourth quarter is to create a new autonomous division for SSG with its own product planning processes that fit its shorter lifecycles. This would involve splitting off the development, marketing, and applications support groups. Before this recommendation can be implemented, SSG will need to have reached a large enough size that it can split off without needing to hire too many additional overhead resources to support it. With the current plans to double the size of SSG by the end of 2005, creating a new division should be achievable in the fourth quarter. The division would initially start off with existing employees that are working on SSG related projects. People from product development, marketing and applications support will be required. Some additional staff may be needed to fill out the division to ensure it can operate independently. The transition may take up to three months to complete.

Measures of success: By the end of the fifth quarter, a new division will exist that is self sufficient and can manage its own products from end-to-end.

Resources required: Time will be required from many of the senior managers at SemiCo and within SSG during the three month period to ensure the reorganization is successful. Some expenses may be required to hire any missing support resources for the new division.

7.5 Eighth Quarter (and beyond)

7.5.1 Wrap-up

The final phase of the implementation should evolve into an ongoing evaluation of SemiCo's and SSG's strategies over time. The strategies will need to change as market conditions do. In this final phase, an evaluation of the effectiveness of the implemented strategies should be done as well as an assessment of what future changes should be made. This phase should not be started too soon, and should be done at least one year after beginning any major strategic change because it can take that long for the changes to have any effect.

Measures of success: Many of the recommendations that were implemented are found to have had a positive impact on SSG and its strategy. SemiCo will plan to continue investment in SSG and its products into the future.

Resources required: Time from all SSG and SemiCo senior management to present and review findings of the previous two years. No capital expenses are required.

8 SUMMARY AND CONCLUSION

This paper has analysed the current strategies of SemiCo and its SSG business unit to present recommended areas for improvement. An analysis of the semiconductor industry and competitors was done to provide a context for the environment that SemiCo operates. The company's strategy and that of SSG were analysed to determine how well the two fit together. An internal analysis of SemiCo was done to explore the financial and cultural state of the company. All of the information gathered was used to identify strategic issues that SemiCo and SSG are facing.

Developing software and systems is something new for SemiCo, so there are many areas that the company still needs to gain experience in order for SSG to become an asset to the organization. Entering into new markets requires new skills that SemiCo does not currently have. The recommendations have given various ways to develop or acquire the skills that will be needed for SSG to be successful. The implementation plan outlines a possible timeline and prioritisation of when particular recommendations should be implemented.

The strategic analysis that has been done makes it apparent that some things must be changed at SemiCo to enable it to compete successfully in the consumer and home networking markets. These markets compete primarily on cost, so SSG must implement a low cost strategy to give the company a sustainable competitive advantage. This is in conflict with SemiCo's overall product differentiation strategy. To achieve a cost based strategy, SSG will need to be structured differently and adopt processes that better match a software development environment. By minimizing costs throughout SSG, SemiCo will be able to achieve a competitive advantage in the consumer and home networking markets.

APPENDICES

Appendix A: SemiCo Consolidated Financial Statements

SemiCo
CONSOLIDATED BALANCE SHEETS
(in thousands of dollars)

	December 31,								
	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996
ASSETS:									
Current assets:									
Cash and cash equivalents	222,490	414,539	129,345	279,076	470,015	186,235	62,271	51,196	64,280
Short-term investments	281,443	341,175	625,272	474,438	218,164	206,850	93,367	75,830	12,886
Accounts receivable, net	36,565	39,709	30,493	29,361	172,179	77,513	48,115	27,708	25,513
Inventories, net	29,029	33,527	48,470	62,827	100,742	26,192	6,636	5,869	16,937
Restricted cash	—	—	9,776	—	—	—	—	—	—
Deferred tax assets	—	—	1,987	27,174	25,587	17,117	—	—	—
Short-term deposits for wafer fabrication capacity	—	—	—	—	11,494	8,507	7,338	7,338	—
Prepaid expenses and other current assets	31,265	23,018	28,434	33,820	49,368	16,533	7,045	3,592	5,695
Total current assets	600,791	851,969	873,776	906,696	1,047,549	538,948	224,772	171,533	125,311
Long term assets									
Investment in bonds and notes	255,210	76,262	273,158	313,759	155,328	21,698	8,135	8,116	13,985
Other investments and assets	8,375	20,797	40,320	126,335	—	—	—	—	—
Property and equipment, net	29,678	38,067	93,910	164,589	233,971	95,358	57,963	36,139	30,597
Goodwill	14,506	14,506	15,376	17,465	598,348	30,619	36,011	15,842	18,691
Intangible assets, net	9,178	404	—	—	—	—	—	—	—
Deposits for wafer fabrication capacity	12,437	12,437	40,346	40,346	30,703	26,570	35,077	42,415	49,754
Total long term assets	329,384	162,472	463,110	662,494	1,018,350	174,245	137,186	102,513	113,026
TOTAL ASSETS	930,175	1,014,441	1,336,886	1,569,190	2,065,900	713,192	361,959	274,046	238,337
LIABILITIES AND STOCKHOLDERS' EQUITY:									
Current liabilities:									
Accounts payable	30,450	50,187	45,309	39,113	111,869	32,766	16,445	13,614	17,700
Accrued liabilities	73,741	92,169	98,205	90,533	72,877	37,136	26,818	21,378	17,513
Income taxes payable	53,076	68,287	39,541	36,218	116,479	47,538	25,495	16,108	7,430
Accrued restructuring costs	25,198	30,111	237,576	295,730	—	—	—	552	33,672
Deferred income	14,027	28,840	32,989	50,776	117,514	63,583	22,963	3,849	—
Current portion of long-term debt	124,882	—	—	862	3,245	7,487	9,006	8,534	11,501
Total current liabilities	321,374	269,593	453,620	513,232	421,984	188,508	100,727	64,036	87,816
Long term liabilities									
Convertible subordinated notes	—	321,051	504,509	504,509	—	—	—	—	—
Deferred taxes and other tax liabilities	51,509	347	5,071	42,272	69,391	16,678	5,230	7,381	5,029
Non-current portion of long-term debt	—	—	—	—	1,035	9,388	9,582	16,680	33,698
Commitments and contingencies	—	—	—	—	—	—	—	—	—
Preferred stock	—	—	—	—	—	73,290	57	55	—
Special convertible shares	8,135	8,290	9,268	9,754	11,681	12,838	15,387	19,801	22,921
Total long term liabilities	59,644	329,688	518,848	556,536	82,107	112,194	30,256	43,916	61,647
Stockholders' equity									
Common stock and additional paid in capital	1,639,569	1,597,655	1,530,524	1,512,281	1,460,744	440,983	332,787	262,625	248,255
Deferred stock compensation	—	—	(2,124)	(7,680)	(79,122)	(10,800)	—	—	—
Accumulated other comprehensive income	642	3,372	7,226	46,767	59,739	—	—	—	—
Accumulated deficit	(1,091,055)	(1,185,867)	(1,171,207)	(1,051,947)	120,447	(17,693)	(101,812)	(96,532)	(159,381)
Total stockholders' equity	549,157	415,159	364,419	499,422	1,561,809	412,490	230,975	166,093	88,874
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY:	930,175	1,014,441	1,336,886	1,569,190	2,065,900	713,192	361,959	274,046	238,337

Source: Author (data has been altered for confidentiality reasons)

SemiCo
CONSOLIDATED STATEMENTS OF OPERATIONS
(in thousands of dollars)

	Year Ended December 31,											
	2,004	2,003	2,002	2,001	2,000	1,999	1,998	1,997	1,996	1,995	1,994	1,993
Net revenues	545,572	457,696	400,109	592,088	1,274,452	542,609	319,745	255,625	355,893	346,229	192,198	152,930
Cost of revenues	160,603	161,214	164,272	251,818	304,835	134,730	83,088	62,491	174,189	178,156	106,046	83,840
Gross profit	384,970	296,482	235,837	340,270	969,617	407,880	236,657	193,133	181,704	168,073	86,152	69,090
Other costs and expenses:												
Research and development	221,052	219,183	252,684	368,910	328,034	153,510	93,362	63,491	69,072	42,980	28,807	28,324
Marketing, general and administrative	84,638	84,343	116,347	165,666	184,538	95,950	62,086	48,620	58,978	55,131	43,448	41,254
In progress research and development	—	—	—	—	—	—	—	—	14,279	19,491	23,387	—
Amortization of deferred stock compensation:												
Research and development	—	582	4,852	59,635	59,180	6,858	2,438	—	—	—	—	—
Marketing, general and administrative	1,279	1,268	308	15,920	7,349	2,537	257	—	—	—	—	—
Impairment of property and equipment	—	—	3,346	—	—	—	—	—	—	—	—	—
Restructuring costs	6,458	28,095	—	358,084	—	—	—	(2,537)	118,642	0	(2,860)	23,242
Impairment of goodwill	—	—	—	495,019	—	—	7,909	—	—	—	—	—
Amortization of goodwill	—	—	—	80,740	66,773	3,508	1,679	550	550	—	—	—
Costs of merger	—	—	—	—	69,666	1,589	—	—	—	—	—	—
Acquisition costs	2,224	—	—	—	70,081	—	71,871	—	—	—	—	—
Income (loss) from operations	69,320	(36,987)	(141,701)	(1,203,703)	183,995	143,928	(2,944)	83,009	(79,817)	27,511	(3,614)	(12,935)
Other income (expense)												
Interest income, net	8,914	3,135	11,958	25,490	34,721	14,534	5,326	—	—	—	—	—
Foreign exchange loss	(2,376)	(1,750)	(2)	—	—	—	—	—	—	—	—	—
Gain on extinguishment of debt	(4,097)	527	(2,869)	—	—	—	—	—	—	—	—	—
Loss from discontinued operations	—	—	—	—	—	—	—	—	—	(41,272)	(1,222)	—
Gain (loss) on investments	16,955	4,432	(21,243)	(26,768)	107,306	49,167	—	—	—	—	—	—
Income (loss) before recovery of income taxes	88,717	(30,643)	(153,857)	(1,204,982)	326,023	207,628	2,381	83,009	(79,817)	(13,761)	(4,836)	(12,935)
Recovery of income taxes	(6,096)	(15,983)	(34,596)	(32,588)	187,883	75,852	42,190	26,990	(174,800)	6,485	7,892	88
Net income (loss)	94,813	(14,660)	(119,260)	(1,172,394)	138,140	131,776	(39,809)	56,019	94,983	(20,247)	(12,728)	(13,023)

Source: Author (data has been altered for confidentiality reasons)

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