STRATEGIC ANALYSIS OF A SEMICONDUCTOR COMPANY'S MIGRATION INTO CONSUMER MARKETS

by

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ABSTRACT

SemiconInc is a Canadian fabless semiconductor company that has been successful developing innovative, high-margin semiconductor devices for the telecom industry. The company was affected by the slowdown in telecom spending that followed the crash of the technology sector in 2000/2001, but has since recovered and is pursuing new areas for growth.

The rapidly growing consumer electronics industry is one potential market that SemiconInc should explore, as SemiconInc's core competencies in semiconductor design and integration will help create sustainable competitive advantage. Despite these core competencies, entering the consumer electronics industry will be a challenge. SemiconInc's current products, processes, cost structure, and culture are that of a differentiator. In order to compete in the high-volume, low-margin consumer electronics industry, the company will need to develop a lower cost strategy, develop new core competencies, and optimize development costs wherever possible. This paper analyzes several of these strategic issues, and recommends solutions to help address them.

DEDICATION

To my children Graham and Alexandra for their endless enthusiasm, and to my lovely wife Gayle for her love, support, patience, and encouragement throughout this endeavour.

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GLOSSARY

21CN	British Telecom's 21st Century network upgrade plan, to bring voice, data, video, and mobility services to telephone network customers.
1G, 2G, 3G	Refers to the generation of wireless telephone technology: 1G refers to the original analog-only cellular phone systems, 2G refers to the newer digital equipment that replaced 1G analog systems, 3G allows very high speed digital data transfer.
Access Network	The portion of the global telecommunications network that connects subscribers to their service providers.
ADSL	Asymmetric Digital Subscriber Line. A high speed data communication technology common in metro areas.
Analog switched circuit	A common telephone connection. Standard telephones connect via analog switched circuits.
ATM	Asynchronous Transfer Mode. A telephone network data protocol based on fixed-size data packets.
Broadband	Refers to data communication techniques where multiple pieces of data are communicated simultaneously, on different channels, to increase the overall throughput.
Bursty traffic	Refers to the sporadic nature of Internet data traffic. When a user requests a large data transfer, the data transfer rate will peak for the duration of the transfer, then drops as the transfer is completed.
Core network	Refers to the high-speed communication network connections between service providers.
DFM	Design for Manufacturability. Refers to the methodologies that are used to ensure a product is designed to be easily mass produced.
DS-0 – DS-4	Digital Signal Levels 0 through 4 are telecommunication standards. DS-0 refers to a single phone connection to a subscriber's phone. Multiple DS-0s are combined together to carry higher rates.
EoS	Ethernet over SONET. A telecommunication standard designed to carry Internet data traffic over standard SONET voice equipment.

Ethernet	A standard communication protocol used for local area network connections.
EV-DO	Evolution Data Optimized. A next generation stationary wireless communication standard optimized for high speed data transfer.
Fabless	Refers to semiconductor vendors who do not maintain their own wafer fabrication facilities. Fabless vendors generally outsource manufacturing allowing them focus on design, marketing, and support.
FAE	Field Applications Engineer. A technical support generalist who is located near customers.
GSM	Global System for Mobile Communication. The most widespread mobile phone standard, connecting billions of users.
HSDPA	High-Speed Downlink Packet Access. A new mobile phone protocol that allows higher speed downlink connections.
Integrated circuit	IC. A miniaturized electronic circuit constructed of millions of individual semiconductor devices combined together on a single semiconductor wafer. Sometimes called a microchip or computer chip.
Interop	Interoperability. The ability of products or systems to communicate together according to an agreed upon standard. Interop testing of telecommunication equipment is a common task of equipment and component vendors.
IP	Internet Protocol. A data oriented communication standard that allows for unique addressing for each unit connected to the network.
IPTV	Internet Protocol Television. Refers to a network where digital television content is delivered using the Internet Protocol.
ISO9001	International Organization for Standardization. A body of standards that help suppliers guarantee quality by ensuring quality management processes are in place.
LMA	Last Mile Access. Refers to the connection between a subscriber premise and the closest service provider node. The Last Mile is an important area for optimization because of the large number of connections and low speed bottlenecks on currently available connections.
Metro	The portion of the network that connects Access equipment to Core equipment. Metro connections are normally higher capacity optical connections that run within a city or metropolitan region.

Moore's Law	Refers to the 1965 prediction by Intel founder Gordon Moore, that says the density of transistor devices that can be cost-effectively manufactured on an integrated circuit will double every 18 months. This law continues to hold true today.
OC-x	Optical Carrier Specifications. Refers to different data rates for SONET network components. The line rate for OC-x is given by x*51.8Mbit/sec.
ODM	Original Design Manufacturer. Refers to companies who manufacture a product that will be branded by another company for sale.
OEM	Original Equipment Manufacturer. Refers to companies who build and sell their own products.
Packet switched network	In a packet switched network data is broken down into smaller packets and assigned a destination address. Each packet can follow a different path to the end address, which helps optimize network performance and ensure robust communications.
PON	Passive Optical Network. A shared optical network architecture that allows a single optical fibre to be split across multiple subscribers using inexpensive passive splitters.
PSTN	Public Switched Telephone Network. Refers to the global connection of telephone systems.
Reference design	Refers to an example prototype system designed for others to copy. Semiconductor companies often produce reference designs to help reduce customer design efforts.
Residential Gateway (RG)	Refers to a digital home networking appliance that consolidates various networks and components in a single unit, allowing a single point of connection to the service provider.
SDH	Synchronous Digital Hierarchy. A high-capacity synchronous telecommunications standard that uses optical fibres to connect nodes together. SDH is in widespread use throughout the world. SONET, a subset of SDH is used in North America.
SONET	Synchronous Optical Network. A high-capacity telecommunications standard that uses optical fibres to connect nodes together. SONET is a subset of SDH, and is the basis of core telecom networks in North America.
T1/E1	One of a series of T-Carrier telecom standards. T1 refers to the wired connection that carries a DS-1 signal.

TAM	Total Available Market.
Telco	A generic term that refers to a telecommunication service provider or telephone company.
VDSL	Very High Rate Digital Subscriber Line. Sometimes known as Video Digital Subscriber Line. A DSL technology that provides higher speed throughput than ADSL, such that it is capable of carrying high definition video streams.
Verilog	A hardware description language used to describe the behaviour of an integrated circuit.
VHDL	VHSIC Hardware Description Language. A hardware description language used to describe the behaviour of an integrated circuit.
VoIP	Voice over Internet Protocol. A protocol for carrying live voice calls over an IP network, while ensuring call quality is maintained.
VPN	Virtual Private Network. A private communications network that encrypts user data traffic to ensure privacy and security as it traverses a public network.
WiMAX	Worldwide Interoperability for Microwave Access. A 2001 wireless standard designed to provide wireless access as an alternative to cable or DSL connections.
xDSL	Refers to the family of Digital Subscriber Line protocols. See ADSL and VDSL for more details.

1 INTRODUCTION

SemiconInc (SemiconInc) designs, develops, and supports a wide range of semiconductor integrated circuits (ICs) used in the communication service provider, storage, and enterprise markets. SemiconInc maintains a portfolio of over 250 different IC products that are sold to equipment and design manufacturers, who in turn supply their equipment to communications network service providers and other companies.

1.1 SemiconInc History

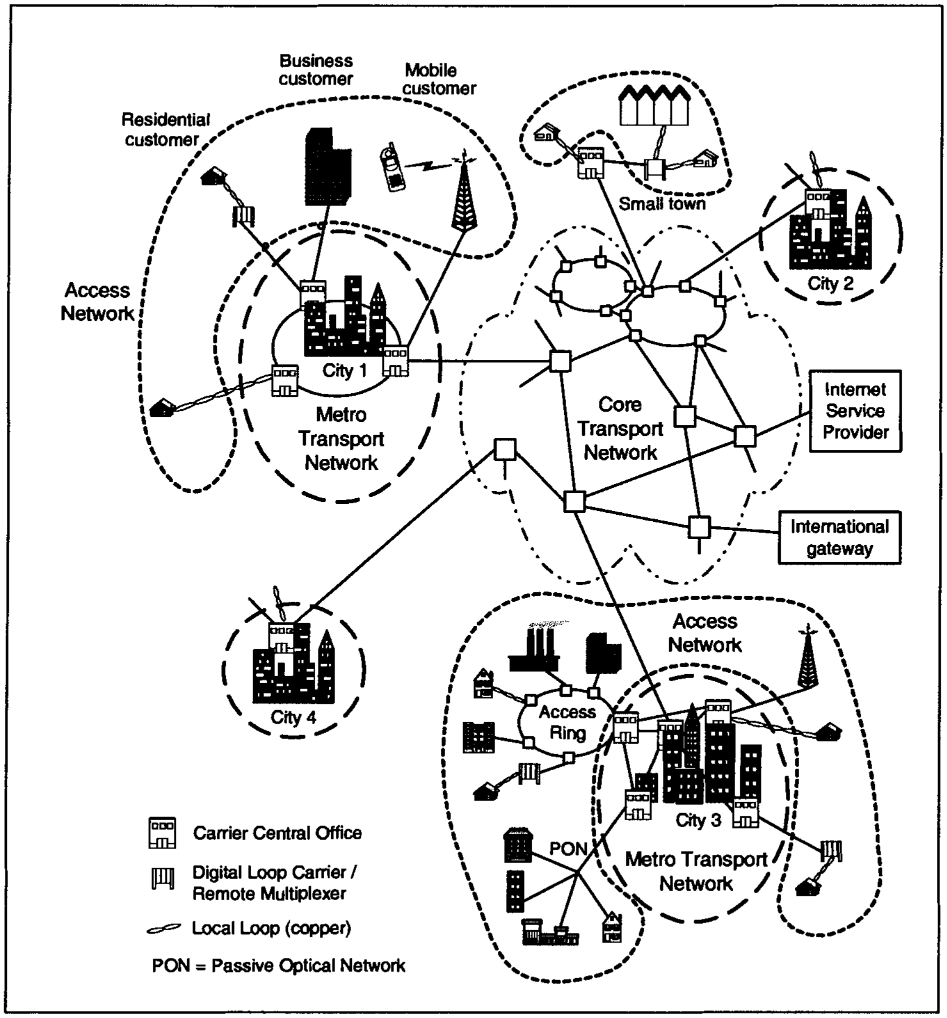
Prior to 1984, AT&T maintained a monopoly over most long-distance and local telephone service in the USA, including installation and operation of the network, as well as manufacture of equipment. The AT&T monopoly came to an end in 1984 when a US Antitrust court ruling ordered the break-up of AT&T, resulting in the creation of over one hundred new telephone network operators. Some of these new carriers installed proprietary network equipment within their own systems, and it soon became clear that the lack of standardized interconnect protocols made inter-carrier communications difficult, and did not allow equipment manufacturers to reach economies of scale. Eventually, carriers came to consensus that they needed national and international standards in order to drive down the costs of the equipment they purchase, have ready access to new technologies, and reduce the costs of interconnection with other carriers. As a result, new standards such as SONET were developed, requiring development of new communications components and equipment. The founders of SemiconInc, veterans of the telecom equipment industry, recognized this opportunity and launched a private company to begin developing communication ICs for this new generation of SONET based telecom equipment. SONET, the standard in North America, is a subset of the global SDH standard.

1.2 Communication Network Overview

The world wide communication network has been going through a significant stage of evolution in recent years. For many years the network was devoted to voice communication only, using analog switched circuits over copper wire. The network then evolved to a primarily digital system using virtual circuits over copper and optical fibre. This network became known as the Public Switched Telephone Network (PSTN), and was dedicated to carrying voice traffic. In the mid-sixties, networks devoted to data transmission using packet switching techniques began to appear. Eventually, these data networks were interconnected with the PSTN to form the world wide Internet. The problem with using the PSTN for data transmission is that its circuit switched infrastructure is optimized for voice transmission, which makes it inefficient for the bursty traffic patterns common in data networks. Since building a completely new network to handle both voice and data was not a viable solution it was determined that the existing network infrastructure should be modified to achieve this objective. This was the main driver for the development of the SONET data hierarchy discussed above. Figure 1 shows a conceptual diagram of a typical data communications network.

It is generally agreed that the communication network is divided into three major subdivisions named Access, Metro, and Core. The Access network is made up of transport equipment and services that connect directly to the end customers. It is responsible for combining traffic from these subscribers interconnecting to the Metro network. The Metro network provides higher speed transport equipment and services required to interconnect all of the access subdivisions in its area. The Metro subdivisions are interfaced to the Core (or Long-Haul) network that consists of even higher speed transport equipment and services. In general, the closer to the Core of the network, the higher the transmission speed.

Figure 1 Network Diagram



Source: SemiconInc internal documents, used with permission.

1.3 Industry Trends

In 2006, two fundamental trends are driving continued growth in the Communication Networking products arena:

1. New converged voice/data/video/mobility services for both consumers and business customers are driving increased demand for more powerful, integrated, and mobile data networks
2. Delivery of next-generation services will exhaust existing broadband access network capacity

Each of these trends is discussed in the following sections, and includes details of how each trend may affect SemiconInc.

1.3.1 New Services Driving Demand

Termed "Quadruple Play", new services that combine voice, broadband data, video, and mobility services for both consumers and business customers are driving increased demand for more powerful and integrated communication networks. Rapid developments in consumer electronics, home entertainment, and online content will require high-speed broadband connections, and in many cases, mobile wireless connectivity, to allow for a seamless user experience. These new services are not simply planned for the future, they are here now, and are in the process of being launched by various service providers.

For example, British Telecom's 21st Century Network (BT 21CN) upgrade plan is designed to provide converged voice, mobility, data, and video content delivered to whatever device the user chooses, wherever they happen to be at the moment. Another service provided by 21CN is combined fixed/mobile phone service that functions like a standard cellular telephone when users are mobile, but switches automatically and seamlessly onto the BT broadband access link when users return home.

Interest in new online services is not restricted to a small subset of early adopters only. Rather, these new services will appeal to a broader consumer market because they offer significant cost savings over current services, or provide advanced new features for the same price as previous less-comprehensive applications. For example, the combined fixed and mobile telephone service mentioned above will provide the convenience and features of a mobile phone, but with price plans and voice quality that users expect from fixed telephone service.

The video portion of new Quad-play services is IPTV (Internet Protocol Television). Higher bandwidth connections to subscriber homes, combined with intelligent appliances within the home, will allow telcos to deliver high definition video content over the telecom network, in direct competition with cable providers. Other new applications for IPTV are likely, including Video phones, video-enabled instant messaging, security monitoring, and more.

In a 2006 research note Credit Suisse analyst Chris Larsen indicates that telco revenue from traditional voice subscribers has dramatically decreased in recent years due in part to technology substitution and pricing pressures (Larsen, 2006). As a result, telcos are expected to rapidly adopt and deploy equipment capable of delivering Quad-play services to customers, in an effort to increase revenues. The challenge for telcos is to try and increase market share or offer more services without large increase in prices. This push to offer more services while minimizing price increases will encourage service providers to upgrade current communication network infrastructure to maximize efficiency, lower operating costs, and support advanced new features. These projects involve significant equipment upgrades, as their cost estimates indicate. British Telecom has estimated that they will spend nearly 20B USD on 21CN (Imam, Fang, and Popescu, 2006) and other service providers are planning similar expenditures to upgrade their networks to be Quad-play capable. Examples include France Telecom and Deutsche Telecom in Europe, China Telecom, and Reliance Telecom in India (Imam, Fang, and Popescu, 2006)

This presents an opportunity for SemiconInc to develop IC component solutions for these new products and services, and will also result in continued strength in SemiconInc's traditional telco markets. Several examples of potential new services that telco Quad-play capability will enable are shown in Figure 2 below.

1.3.2 Limited Broadband Access Capacity

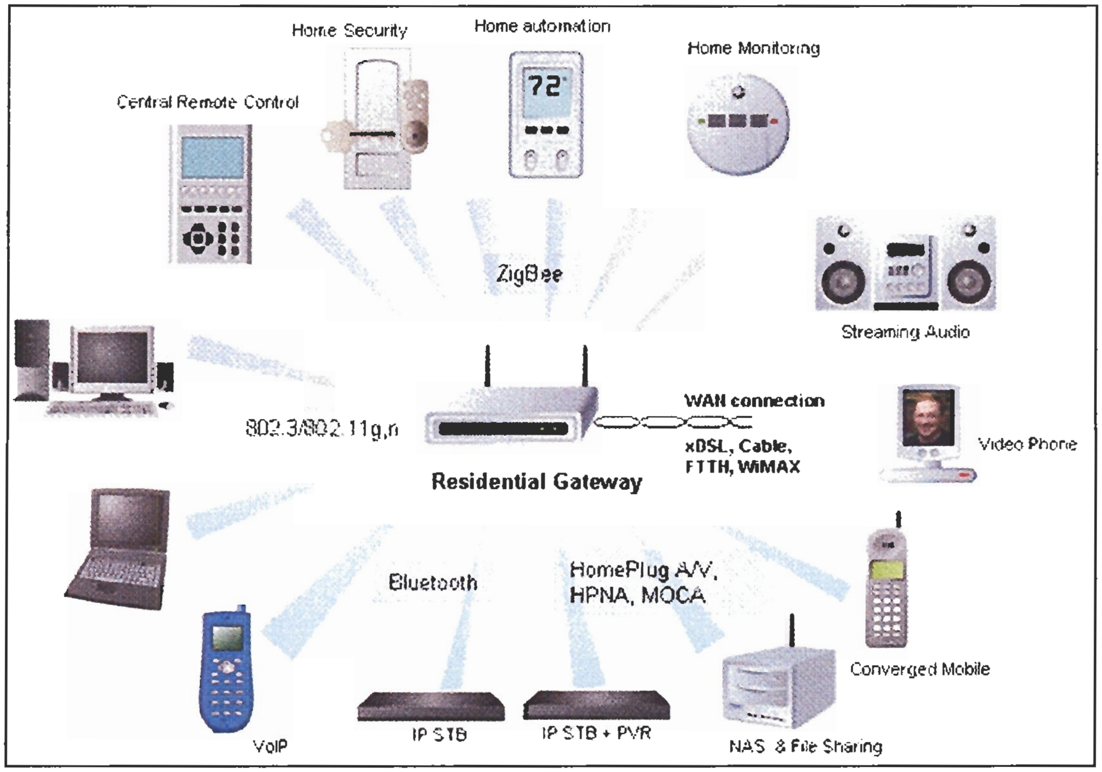
Continued broadband subscriber growth, combined with increased bandwidth required by new services continues to cause network data traffic to grow rapidly. Research conducted in 2005 by Thomas Weisel Partners LLC indicates that growth in network data traffic can be attributed to growth in three separate areas:

- Wireless Mobile Phone network traffic
- Residential Broadband traffic
- Business Enterprise traffic

The largest component of network data traffic is data from wireless mobile phone networks. In 2005 approximately 30% of the total traffic on US backbone networks was data from mobile phone networks. Growth in this traffic is expected to increase due to continued worldwide subscriber growth, as well as increased adoption of 3G wireless services such as GSM and CDMA. Data rates for 3G networks can be 10 to 100 times the throughput from existing 2G networks, and newer video-capable 3.5G networks such as HSDPA and EV-DO will push this even higher.

In 2005, residential broadband traffic made up nearly 20% of total traffic carried on US backbone networks. Growth in residential broadband traffic is also expected to accelerate, driven by subscriber growth, continued penetration of higher speed access lines such as xDSL, and adoption of new services such as Voice over IP (VoIP) and online gaming. Currently, peer to peer network file-sharing is responsible for the majority of residential traffic, but the next 'killer-app' is expected to be IPTV and video-on-demand. Beginning in 2005/2006, IPTV will allow traditional telephone service providers to finally compete head to head with cable providers, and supply their own video content.

Figure 2 Example of Digital Home Services



Source: internal SemiconInc documents, used with permission.

Deploying these services will require approximately 3-10 times the throughput provided by current broadband connections. Next generation high-definition video will drive this demand for increased residential bandwidth even higher.

The last major component of network traffic is driven by Business/enterprise customers. In 2005, traffic on US networks for enterprise customers was estimated to be approximately 25% of overall capacity. Dominant services driving enterprise data traffic include Virtual Private Networks (VPN), video-conferencing tools, and file storage/backup/redundancy services. These services are common in large businesses and institutions, but adoption by small and medium sized businesses will result in continued growth in enterprise data traffic.

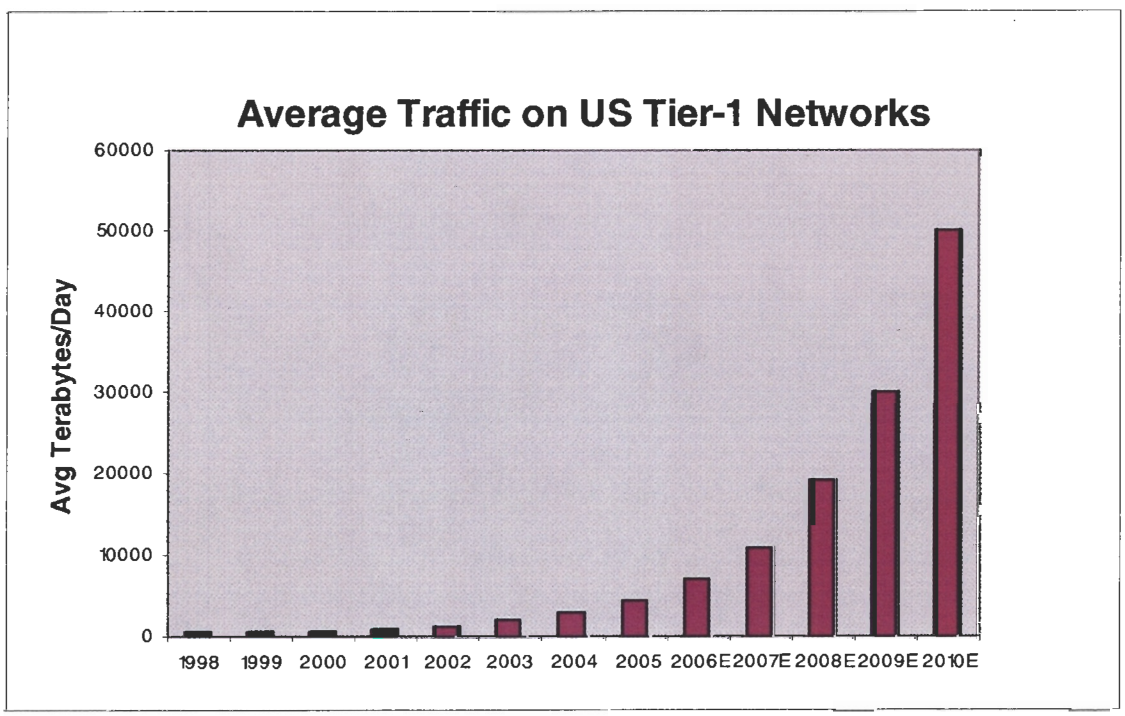
Clearly, broadband capacity requirements continue to grow. As shown in Figure 3 and detailed in Table 1, US network traffic grew at a compound annual growth rate of 85% from 2002 through 2005. This growth is expected to slow slightly, but growth forecasts for wireless, residential, and enterprise users over the next five years predict a CAGR of over 50% over the next five years.

Table 1 Estimated Network Traffic Growth 2006-2010

	2006E	2007E	2008E	2009E	2010E	5 year CAGR
Aggregate Traffic Growth						
Wireless	105%	95%	90%	92%	87%	94%
Residential Broadband	65%	63%	60%	58%	55%	60%
Enterprise	30%	28%	25%	23%	20%	25%
Other	27%	26%	24%	23%	21%	24%
Total	**59%**	**61%**	**63%**	**68%**	**69%**	**64%**

Source: Author, adapted from Imam, Fang, and Popescu, 2006.

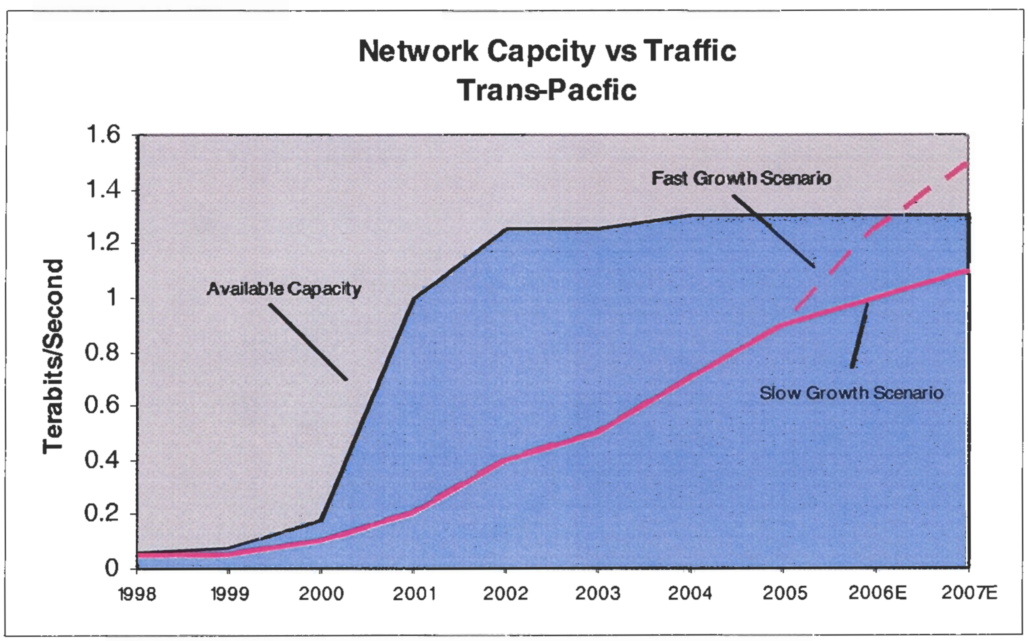
Figure 3 Measured and Forecast USA Data Network Traffic



Source: Author, adapted from Imam, Fang, and Popescu, 2006.

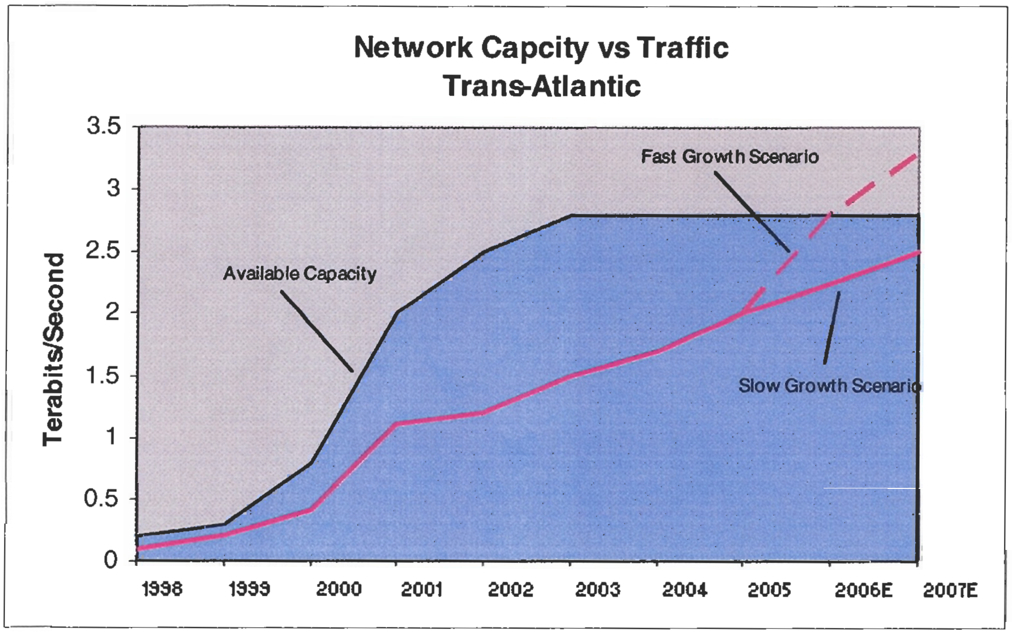
During the 'dot-com' tech bubble of the late 1990s and 2000, a significant amount of optical fibre was installed world-wide to support the predicted explosion in internet traffic. This traffic did not materialize as anticipated, and as a result there was significant overcapacity for a number of years. However, traffic growth has now caught up, and network capacity will soon be exhausted. Recent research from TeleGeography (2005) on international Internet traffic usage suggests that growth rates have outpaced growth in backbone capacity. As shown in Figure 4 and Figure 5, if traffic continues to grow as predicted in the 'Fast Growth Scenario', demand will exceed available capacity in the next few years.

Figure 4 Trans-Pacific Network Capacity vs. Measured Traffic



Source: Author, adapted from TeleGeography (2005)

Figure 5 Trans-Atlantic Network Capacity vs. Measured Traffic



Source: Author, adapted from TeleGeography (2005)

1.3.3 Implications for SemiconInc

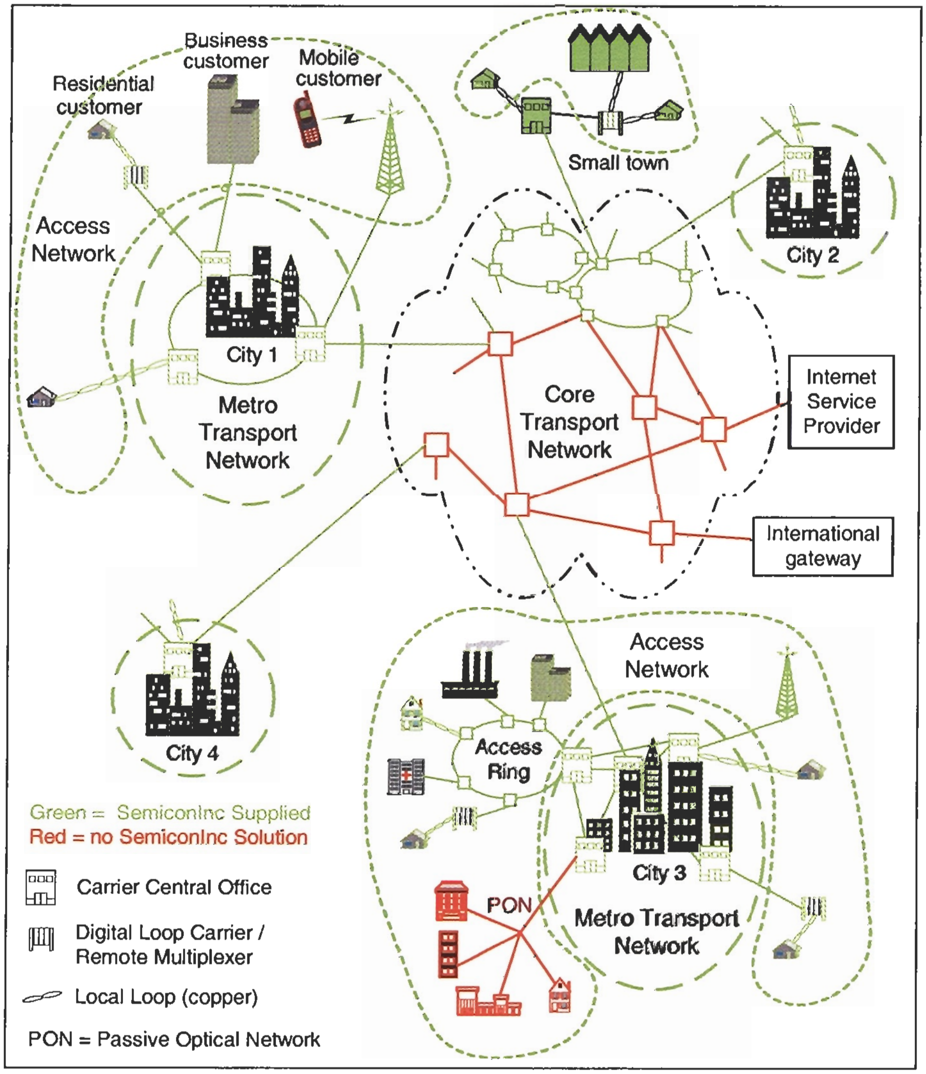
These industry trends have several implications for SemiconInc. The growing demand for broadband network capacity means that demand for SemiconInc's Access and Metro products will likely continue to be strong. If SemiconInc can maintain market share in Access and Metro markets, this will provide a long-term source of R&D funding to invest in developing semiconductor solutions that address new markets. It will be critical to review the existing portfolio often to launch new cost-optimization revisions, or scale device density up as semiconductor manufacturing processes allow, ensuring that device functionality and pricing remains competitive. SemiconInc will also need to be attentive to potential new entrants to the market, notably competitors in low-cost regions of the world that may be able to capture market share with low prices and 'good enough' functionality.

The explosion of new data services in a modern digital home has created the opportunity for a new home appliance, the integrated Residential Gateway or RG. Currently the functions of an RG are handled by several separate units in the home: network router/firewall, wireless access point, ADSL modem, set-top box, personal video recorder, Voice over IP telephone, network attached storage device, and others. Currently, maintaining this multitude of separate data processing units is expensive and cumbersome for users and service providers alike. The opportunity exists to develop a new class of integrated system-on-chip (SOC) data processors that combine most, if not all, of these services into a single cost-effective device. SemiconInc has the semiconductor core competencies needed to develop high-performance processors, as well as integrate reliable analog physical layer connections such as DSL, so is well positioned to take advantage of this opportunity.

1.4 SemiconInc's Product Portfolio

SemiconInc has a comprehensive portfolio of networking IC solutions to address the majority of subscriber data rates and protocols used in the Access and Metro network infrastructure space. As shown in Figure 6, SemiconInc provides IC solutions to Access and Metro networks, (shown in green). Portions of the network that SemiconInc does not have a wide selection of products for are coloured red in Figure 6. These include Long-Haul Core transport, mobile handsets, or passive optical networking (PON). Analysis of SemiconInc's market share in each of the Access, Metro, and Core network industries, as well as forecasts for future growth, are discussed in the following sections.

Figure 6 Network Diagram Highlighting SemiconInc Product Portfolio



Source: SemiconInc Internal documents, used with permission.

1.4.1 Broadband Access

The Access area of telecom network infrastructure refers to the portion of the network that connects to the subscribers. It aggregates lower capacity voice and data traffic from end users, such as homes and businesses, for transmission to central telco offices where it is combined with other Access channels and passed to higher capacity Metro network equipment. Access networks support a wide variety of end equipment that connects Wireless, Residential Broadband, and Enterprise customers to the Metro network.

As shown in Figure 7 below, a "DS-0" channel is the smallest unit of data supported, and represents the throughput from a single home telephone. Multiple DS-0 Access channels are combined together to form a DS-1, and so on until the connection is made to high-speed Metro equipment, usually at DS-3 or DS-4 rates.

Residential customers in North America normally have a single DS-0 channel connected to their homes that provides a standard voice connection as well as an ADSL data connection. Large business or institutional customers will normally have one or more DS-1 connections to their office to provide higher capacity.

Nearly all telecom network equipment being installed today is based on a combination of key SONET standards. Key industry standards that help to aggregate Access network voice and data traffic into formats for transmission across SONET Metro networks are:

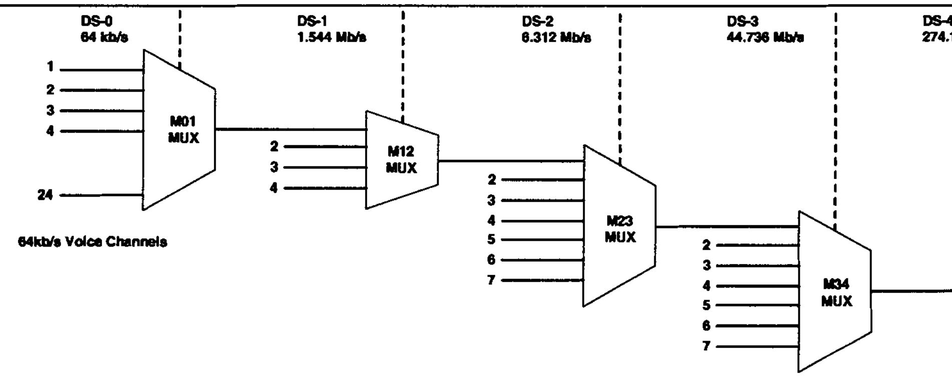
- T1/E1
- Asynchronous Transfer Mode (ATM)
- Internet Protocol (IP)
- Ethernet Over Sonet (EOS)

SemiconInc's Access IC portfolio includes products that address all of these standards, at rates from DS-0 up to maximum Access rates. As a result, SemiconInc is well positioned to profit from the growth in Access network equipment.

1.4.1.1 Wireless Access – Mobile and Fixed

Wireless infrastructure to support mobile phone users is a subset of the Access network, and is becoming an increasingly important component of Access network growth.

Figure 7 T/E Data Rates and Standards for Access Equipment

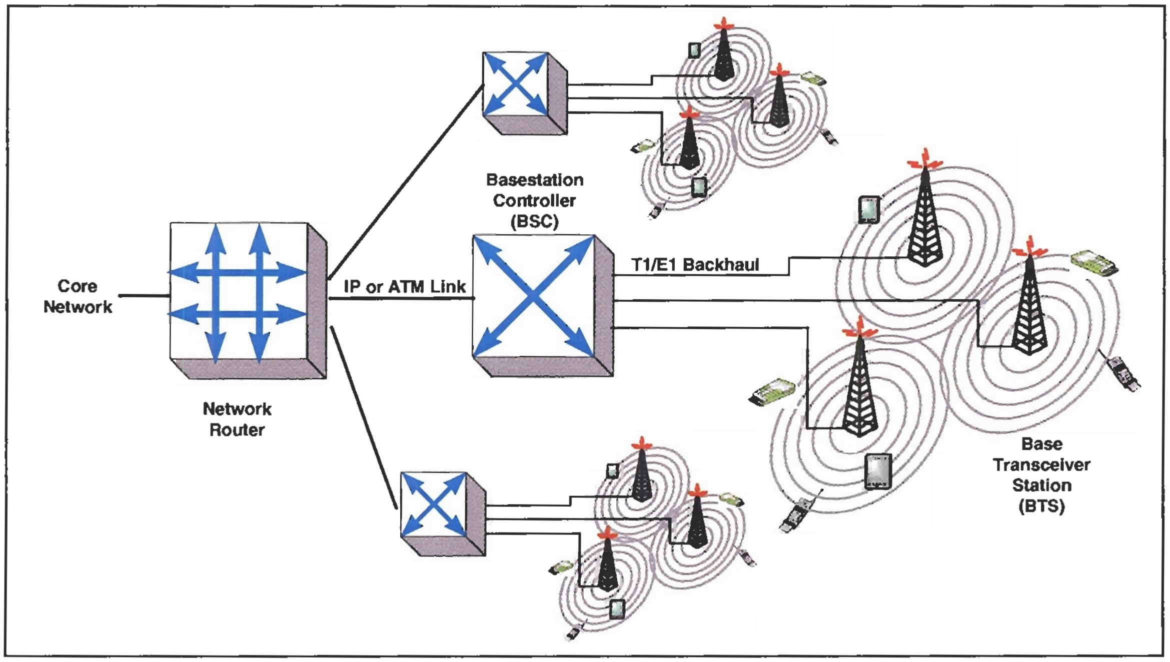


Signal Level	Number of DS-0s	Data Rate	Region
DS-0	1	64 kbps	North America, Europe and Japan
DS-1/T1/J1	24	1.544 Mbps	North America and Japan
E1	30	2.048 Mbps	Europe
DS-1C	48	3.152 Mbps	North America and Japan
DS-2/T2/J2	96	6.312 Mbps	North America and Japan
E2	120	8.448 Mbps	Europe
J3	480	32.064 Mbps	Japan
E3	480	34.368 Mbps	Europe
DS-3/T3	672	44.736 Mbps	North America
DS-3C	1,344	91.053 Mbps	North America
DS-3C	1,440	97.728 Mbps	Japan
E4/DS-4E	1,920	139.264 Mbps	Europe
DS-4/T4	4,032	274.176 Mbps	North America
J4	5,760	397.2 Mbps	Japan
E5	7,680	565.148 Mbps	Europe

Source: Author.

As shown in Figure 8, standard T1 connections are often used to connect Base Transceiver Stations (BTS) to the Basestation Controllers (BSC).The BSCs provide the interface into the high-capacity Core network, where data traffic from mobile phone customers is carried. As discussed in the market analysis section below, growth in wireless infrastructure due to the proliferation of mobile phone users is expected to drive further growth in the Access network, increasing demand for SemiconInc Access products. Fixed-wireless Access is also becoming more important. Instead of providing a data communication link from a base transceiver station to a mobile phone user, the wireless link connects to a fixed location, such as a home. Emerging economies such as China and India, with massive populations but limited communication infrastructure are looking towards fixed wireless to provide broadband access to their populations. This is a much cheaper alternative than digging new cables into the ground to provide wired access. This is a trend that may also further increase congestion on the Access networks, and drive further capacity expansion.

Figure 8 Wireless Infrastructure Network Diagram

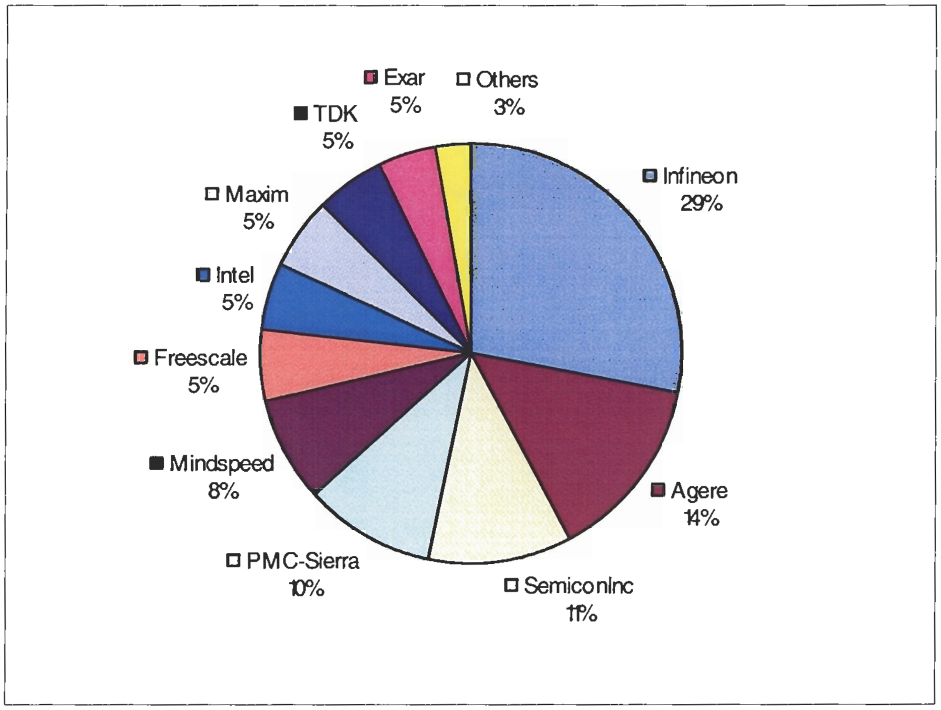


Source: Author.

1.4.1.2 SemiconInc Market Share

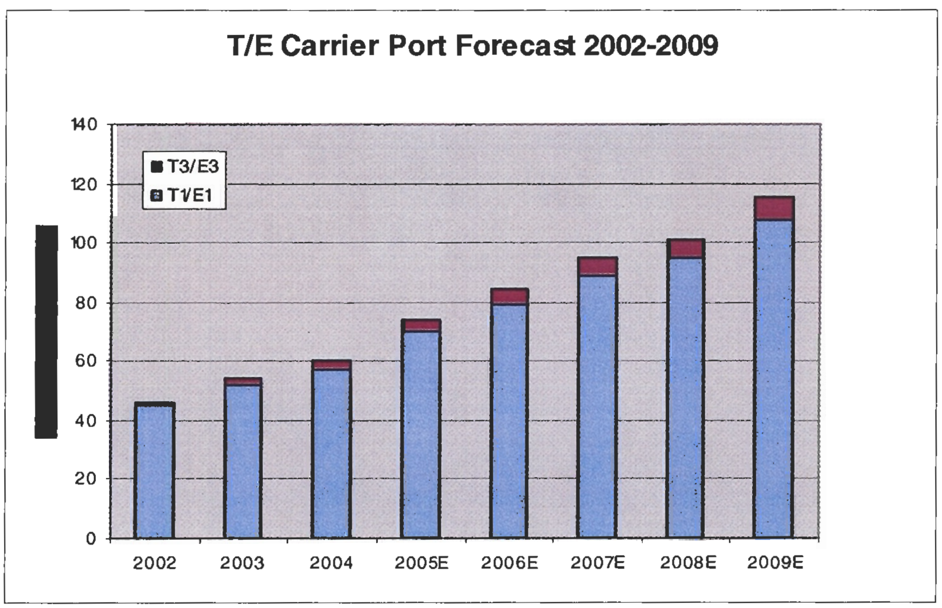
Growth forecasts for communication network ICs used in Access network equipment are strong. Mishan (2005) estimates this market will grow at 13% CAGR, from 60 million ports installed in 2004 to 111 million in 2009, illustrated in Figure 10. TAM in 2004 was $327M USD (Mishan 2005). SemiconInc was estimated to have a significant market share, as shown in Figure 9. Forecast growth, combined with SemiconInc's significant market share, indicates that this is a market SemiconInc should remain committed to.

Figure 9 T/E Carrier Industry Market Share Breakdown



Source: Author, adapted from Mishan (2005).

Figure 10 T/E Carrier Port Forecast 2002-2009



Source: Author, adapted from Mishan (2005).

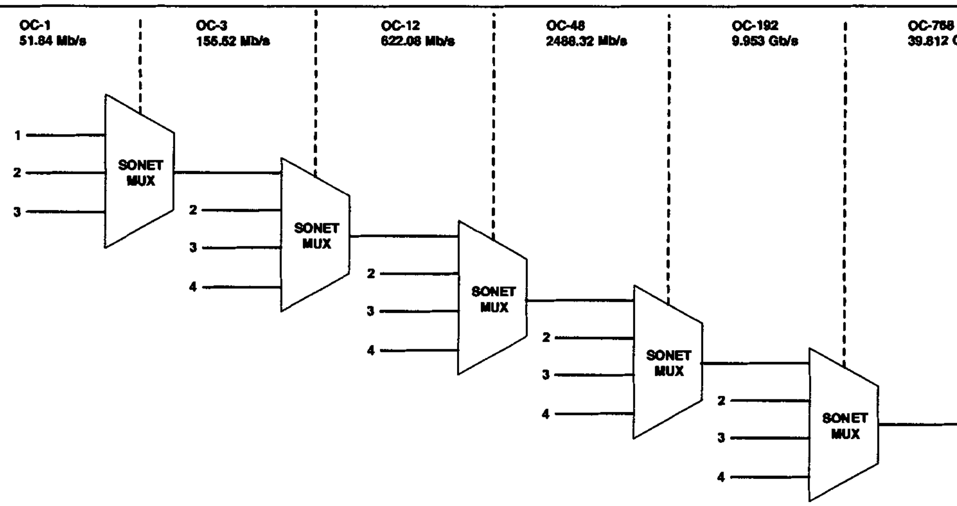
1.4.2 Metro/Core

The Metro area of telecom infrastructure is primarily a fibre optic based SONET network designed to provide high capacity voice and data transfer within a city or regional area. Metro products usually provide the interconnection between ultra high capacity Long-Haul (or Core) network equipment, and lower speed Access equipment.

The basic building block for SONET is the OC-1 frame. The Metro network combines multiple OC-1 channels together to reach the ultra-high capacity OC-768 Long-Haul communication links used in the Core Transport Network. The combination (or multiplexing) hierarchy for Metro and Core network components is shown below in Figure 11. Note that a single OC-768 Core Transport connection will carry 516,096 DS-0 channels simultaneously. Each OC level requires a different type of IC component capable of interfacing to connecting devices at higher or lower rates. In order to have a complete solution from end to end, a telecom component supplier needs to have developed ICs for each of the OC levels shown in Figure 11.

SemiconInc has a wide range of products that can be used to address all Access and Metro data rates from OC-1 through to OC-192. SemiconInc does not currently supply any ICs for OC-768 rates, but have recently released a dual OC-192 device that combines two separate OC-192 devices in the same package, designed to minimize size and power consumption.

Figure 11 SONET Data Rates from Access to Long-Haul



			Equivalent Number of		
OC Level	STS Level	Line Rate	DS-3	DS-1	DS-0
OC-1	STS-1	51.84 Mbps	1	28	672
OC-3	STS-3	155.52 Mbps	3	84	2,016
OC-12	STS-12	622.08 Mbps	12	336	8,064
OC-48	STS-48	2488.32 Mbps	48	1,344	32,256
OC-192	STS-192	9.953 Gbps	192	5,376	129,024
OC-768	STS-768	39.812 Gbps	768	21,504	516,096

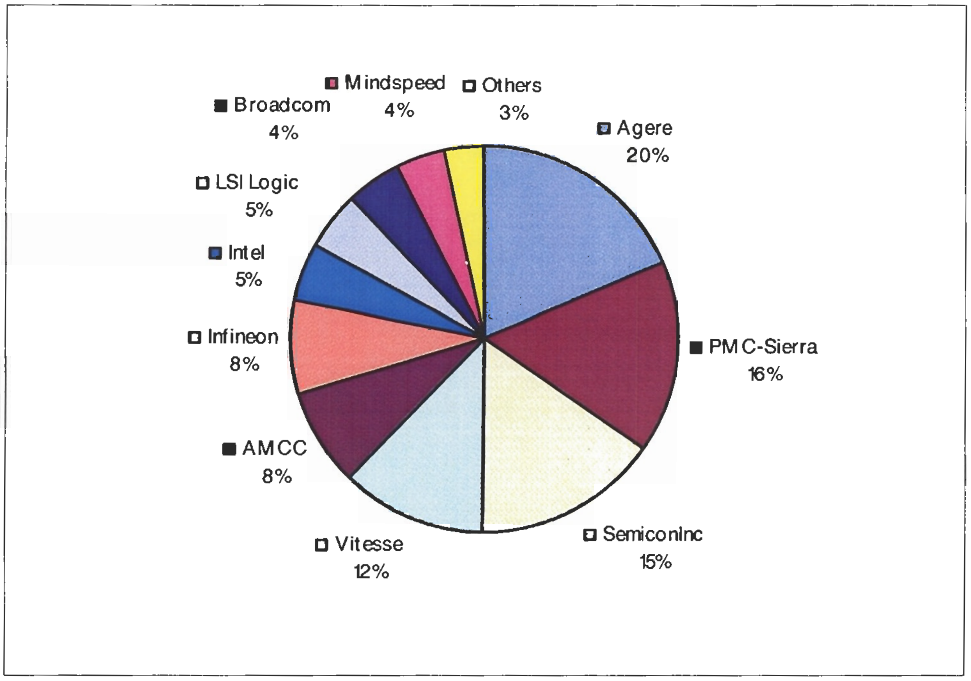
Source: Author.

1.4.2.1 Market Analysis

Growth forecasts for SONET communication network ICs used in Metro network equipment are also strong. Mishan (2005) estimates this market will grow at 14% CAGR, from 1.5 million ports installed in 2004 to 2.9 million in 2009, as illustrated in Figure 13.

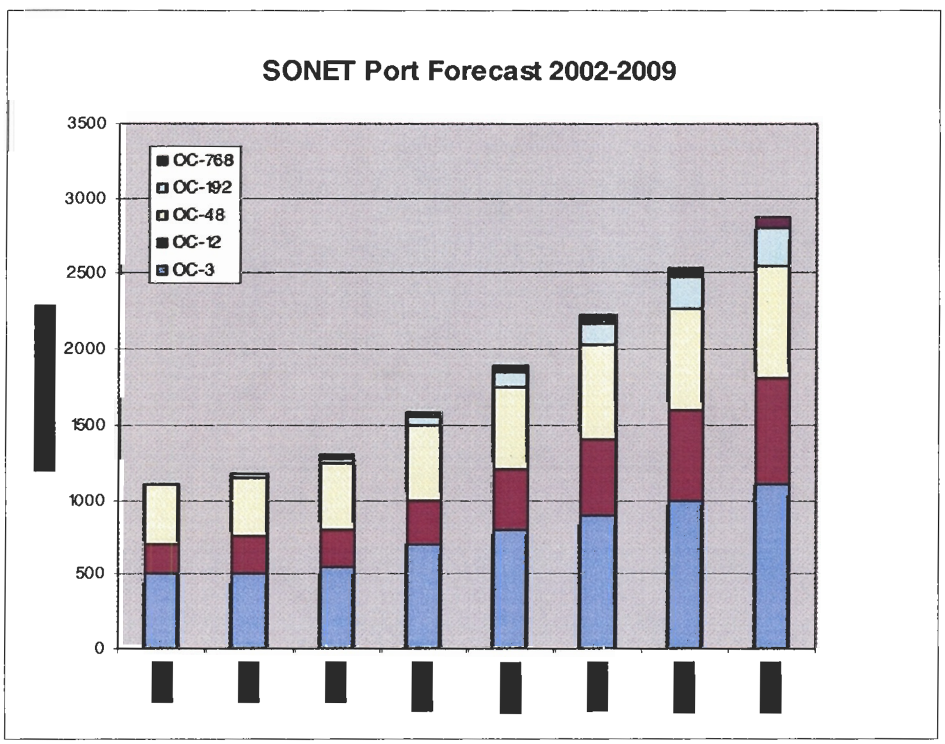
Although the port count is a fraction of the Access ports, revenues for higher speed SONET devices is much higher. TAM in 2004 was $413M USD (Mishan 2005). SemiconInc was estimated to have a substantial market share, as shown in Figure 12. Forecast growth, combined with SemiconInc's significant market share, indicates that this is a market SemiconInc should remain committed to.

Figure 12 SONET IC Market Share Breakdown



Source: Author, adapted from Mishan (2005).

Figure 13 SONET Port Forecast 2002-2009



Source: Author, adapted from Mishan (2005).

1.5 Geographic Breakdown

SemiconInc is an international company servicing customers around the world. The following sections outline where customers are concentrated, as well as where SemiconInc design centres and technical support offices are located.

1.5.1 Key Customers

Table 2 below provides a list of some of SemiconInc's largest customers, discussed in the company's 2005 Annual Report.

Table 2 Several of SemiconInc's Largest Customers

Region	Customer
North America	Ciena
	Cisco
	Juniper
	Lucent
	Nortel
	Tellabs
Europe	Alcatel
	Ericsson
	Nokia
	Siemens
Asia	Fiberhome
	Fujitsu
	Huawei
	ZTE

Source: Author, adapted from SemiconInc (2006).

Note that the majority of customers listed in the Annual Report are located in North America, and Cisco remains the one customer who drives more than 10% of annual revenue. However, the report also states that 50% of 2005 total revenues were received from the Asia Pacific region. The report also indicates that SemiconInc's customers in Asia are broadening their product offerings in 3G wireless infrastructure, metro transport, and customer premise equipment. As discussed in the Industry Trends section above, these are key areas of growth in the communication networking industry, so a focus on Asian customers will be critical to capturing a share of this growth.

1.5.2 SemiconInc Worldwide Locations

Figure 14 indicates the locations of SemiconInc offices. There are three different types of facilities that SemiconInc maintains.

Combined Design Centre and Sales Offices: these are large facilities in Canada, Oregon, and California. Teams of design engineers, design and test labs, as well as sales and support staff are located in these locations.

Dedicated Design Centres: these are smaller facilities located in central and eastern Canada. Only design teams are located here, there are no sales or support teams stationed at any of these locations. These locations were the result of prior acquisitions that SemiconInc made.

Dedicated Sales Offices: these are spread throughout North America, Europe, and Asia, and have Sales and Support staff. These offices are located in: Richardson TX, Boston MA, London UK, Munich Germany, Bangalore India, Shanghai China, Shenzhen China, and Yokohoma City Japan.

1.6 Distribution

SemiconInc sells products through a variety of channels:

- direct to end customers (10% of overall revenues)
- through third party distribution companies (50% of overall revenues)
- direct to contract manufacturers (40% of overall revenues)

Distribution companies stock SemiconInc's products in their warehouses, and provide their own sales and support staff to handle many accounts that may be low volume, low priority customers that SemiconInc does not have the resources to handle direct.

Figure 14 SemiconInc's 2005 Geographic Footprint

Source: Author, adapted from SemiconInc public documents.

1.7 SemiconInc's Differentiation Strategy

SemiconInc is a "fabless" semiconductor company, which means that the wafer manufacturing process is completely outsourced. SemiconInc focuses all resources on the design and testing of semiconductor devices, as well as the peripheral systems required to ensure proper device operation.

Many communication equipment vendors have concluded that their core competencies lie in the design of large scale communication networks and the management software required to control it, rather than the communication ICs used in the equipment. As a result, SemiconInc is positioning itself to take advantage of customers' growing requirements to outsource more of the development of communication ICs required for their equipment. This deverticalization trend helps equipment manufacturers reduce development costs and time-to-market while maintaining flexibility to differentiate their products in other ways, usually by means of network control software or physical/mechanical characteristics.

SemiconInc has a long history of differentiation and innovation in analog, digital, and processor ICs. SemiconInc continuously looks for ways to increase device capability, density, and integration. Internally, SemiconInc design control procedures are structured to consistently deliver high quality and reliable products while minimizing device revisions. As discussed in the Strategic Fit section, Innovation, High R&D Spending, and Highly Skilled Labour help support this differentiation strategy.

1.8 Focus of This Paper

SemiconInc successfully weathered the recent technology downturn and is now positioned to leverage their financial strength and core competencies in semiconductor IC development to enter new growth markets. The main focus of this paper is a discussion of strategic issues that SemiconInc, a differentiator, will face as it prepares to enter the emerging low-cost consumer SOC industry. Successfully competing in the consumer SOC market will require culture changes, development of new core competencies, optimized R&D development costs, and development of a talent pipeline to recruit overseas engineering staff. As well, recommendations are made to help ensure a successful expansion into Asia.

2 INDUSTRY OVERVIEW

2.1 Description of Wireline Telecom IC Industry

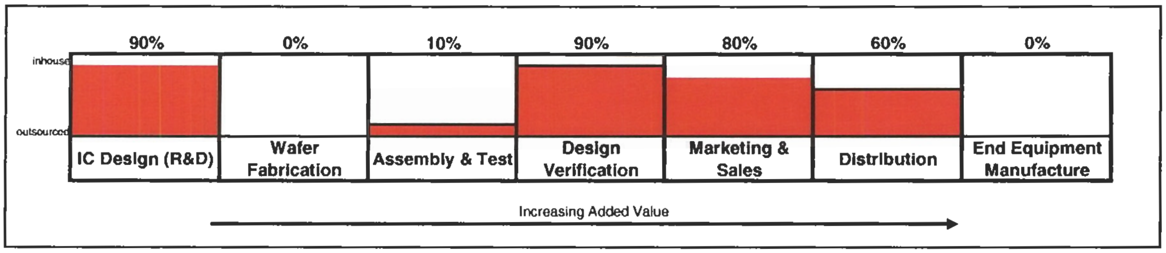
SemiconInc develops products for the Wireline Telecom IC industry, a segment of the global semiconductor market. Competitors in this industry supply global telecom equipment manufacturers with advanced semiconductor ICs designed to carry various communication standards and data rates.

Many of the competitors in the Telecom IC space do not maintain their own semiconductor manufacturing facilities (sometimes referred to as fabrication facilities, or simply "fabs"). As such, companies such as SemiconInc are commonly called "fabless" semiconductor companies. Fabless companies design, test, sell, and support devices, but contract manufacturing and assembly out to other companies who specialize in semiconductor manufacturing or assembly. Implications of the fabless business model will be discussed in more detail in upcoming sections.

2.2 Industry Level Value Chain

The industry level value chain for the fabless semiconductor industry is shown below. Each of the seven segments outlines the different activities that are performed in brining a new chip to market. The coloured bars represent the portion of each activity that fabless companies like SemiconInc perform in-house, with 100% being done completely in-house, while lower numbers indicate some level of outsourcing. Each of the activities is discussed in the following sections.

Figure 15 Industry Level Value Chain Diagram



Source: Author, adapted from Bukszar (2006).

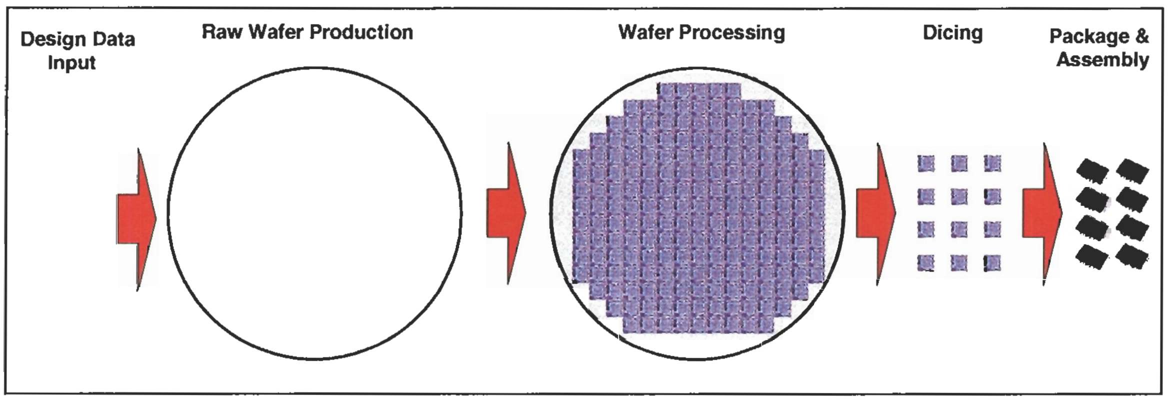
2.2.1 IC Design

The design phase of the IC industry value chain begins with the research and development of new integrated circuit devices to address a new standard or specific customer requirement. For example, a customer may require a new device to handle a new communication protocol (for example: VDSL), or may want to cost-reduce an existing design by combining several features into one IC. Once this need is established, one or several IC manufacturers may launch development projects to build new devices to address that customer requirement. The design phase of an IC development project is the most labour intensive portion of the entire process, and provides the most opportunity for a manufacturer to differentiate their products and add value by adding additional features. As a result, the majority of design work at many fabless IC companies is done in-house. At SemiconInc, approximately 90% of the design phase is done in-house. Approximately 10% of IC design work is outsourced to third party contractors for development of low value add IP, such as standardized interconnect busses (USB for example) or other commoditized software development requirements.

2.2.2 Wafer Fabrication

Wafer Fabrication involves the manufacturing processes where transistors and interconnections are deposited onto raw silicon wafers to create a complete IC design. State-of-the-art wafer fabrication facilities are extremely capital intensive, costing in excess of $2B USD to construct. Furthermore, technology in the semiconductor equipment industry changes so rapidly that fabs become obsolete in about 2 or 3 years. As a result, only the few largest IC manufacturers such as Intel and AMD can afford to build their own fabs. By definition, 'fabless' IC companies like SemiconInc outsource 100% of wafer manufacturing to contractors such as Taiwan Semiconductor Manufacturing Corp. (TSMC). These contractors process the raw silicon wafers through several dozen process steps to create the millions of transistors and layers of metal interconnect wires that make up a completed IC design. Many individual ICs are created on a single wafer, ranging from a few dozen ICs per wafer for a large design, to several hundred ICs per wafer for a small design.

Figure 16 Manufacturing Steps Outsourced by Fabless Semiconductor Companies



Source: Author

2.2.3 Assembly & Test

Once the wafers are completed, they are transferred to other contractors for assembly. These contractors are normally located close to the wafer fabs to minimize shipping complexity and risk. SemiconInc uses a Taiwan assembly contractor called Amkor Technologies. Assemblers slice the full-size wafers up into the individual ICs (sometimes called 'die'), and then place these die into individual packages ensuring each one is assembled reliably. Packages are necessary for several reasons: to protect the IC die from physical or environmental damage, to provide connection points to the IC, and to provide a path for thermal dissipation so the IC does not burn itself up when operating. In most fabless semiconductor companies, assembly is 100% outsourced.

Once the IC is safely assembled inside the package, the assembly contractors subject each device to a series of basic tests as outlined by the manufacturer. ICs that pass these tests are packaged into airtight bags and shipped to the fabless semiconductor vendor for a final production test before being shipped to the customer for assembly in end products. This final test phase consumes only a fraction of the entire assembly and test cycle, approximately 10%.

2.2.4 Design Verification

Verification of a new design is one of the most time consuming phases of new IC development. In some cases this testing may take as long as the design cycle, spanning many months or even years. Before being approved for production, every new device must undergo a very comprehensive series of functional tests to verify that all features operate according to the design specification. At SemiconInc, approximately 90% of this functional testing is performed in-house by the Product Validation group, and is considered a core competency. It is discussed in more detail in the firm-level value chain discussion.

2.2.5 Marketing, Sales & Support

IC companies' Marketing and Sales teams are responsible for understanding customer requirements and promoting the use of certain ICs in order to win the design opportunity in the end-customer product. To be effective here, the Marketing and Sales teams require solid relationships with the end-customers, as well as very detailed knowledge of the telecom industry and product design issues. At SemiconInc, the majority of the Marketing and Sales function is performed by SemiconInc staff, approximately 80%. The remaining 20% of this activity is done by "Manufacturer's Representatives" (also called "Reps"). In exchange for a commission, Reps help market and sell IC products, addressing the smaller, low-volume, low-priority customers that the direct marketing and sales teams don't have time to focus on.

A similar structure exists for Support. IC vendors provide direct pre- and post-sales support to ensure that customers are able to quickly decide on the right product for their needs (pre-sales support), and following design-in, they provide system integration and debug support to ensure the customer's end product is successful and is available to the market in a timely fashion (post-sales support). At SemiconInc, approximately 80% of this support requirement is addressed with in-house technical experts dedicated to supporting key customers. Reps provide their own support teams to look after their customers.

2.2.6 Distribution

Distribution involves maintaining an inventory of products and managing distribution logistics to ensure that products arrive at customer factories on time. Fabless IC companies usually find it cost-effective to manage inventory and distribution for their high-volume customers directly, using in-house warehousing and logistics. Similar to the Manufacturer's Representatives discussed above, most fabless IC companies choose to outsource distribution for low-volume, low-priority customers to one of the very large Electronic Component Distribution companies.

2.2.7 Manufacture of End Equipment

The final step in the IC industry value chain is the manufacture of end equipment. This step is carried out by equipment manufacturers such as Cisco, Lucent, and Alcatel, who are referred to as Original Equipment Manufacturers, or OEMs. They use the devices developed by fabless IC companies in their products, to help deliver advanced communication and/or data processing capabilities. Fabless IC companies such as SemiconInc need to be aware of the issues facing OEMs in order to design better IC solutions, but generally they will not be directly responsible for development of end equipment. The extent of IC component vendor involvement is likely to be restricted to a supporting role, where technical support is provided to the OEM design teams for the duration of the development project.

In addition to the well known OEMs listed above, there are many other companies who act as third party contractors to OEMs, and also build end equipment. These companies are referred to as Original Design Manufacturers (ODMs), and are increasing in importance to IC component suppliers like SemiconInc. ODMs are often located overseas (China, Taiwan, India, or other regions) to take advantage of low labour costs, and are used by OEMs to help develop very high volume products. Depending on the ODM focus, they may have different skillsets from traditional OEM customers, and may require more comprehensive design support. To help enable the success of these ODMs, fabless companies like SemiconInc will often design and build example systems that will help ODMs complete their designs successfully. These example systems, called Reference Designs, are similar to end equipment, but do not address complete feature requirements or specifications. If SemiconInc expands into markets served by ODMs, then reference designs will become a necessary part of the product support collateral. Refer to Section 4.3.1 Growing Importance of Reference Designs for more details on Reference Design requirements and strategic issues.

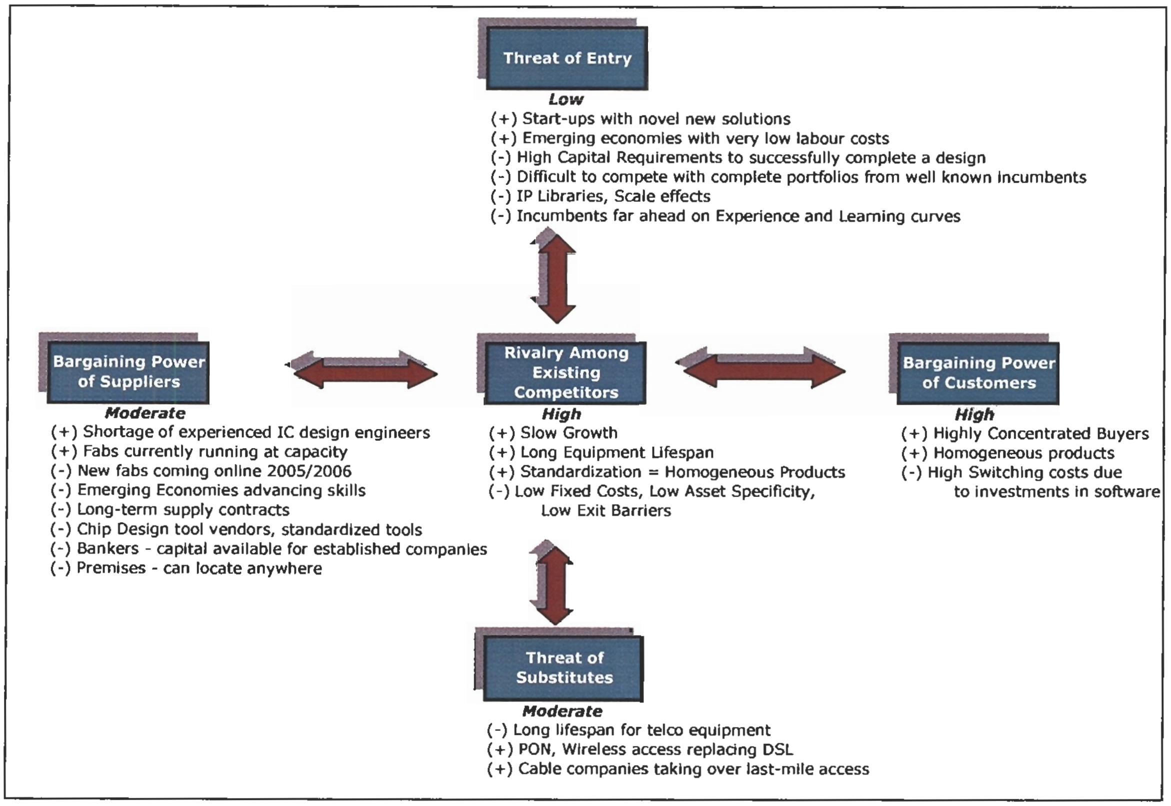
2.3 Competitive Analysis of the Fabless Semiconductor Industry

Michael Porter (1979) identifies five forces that influence the profitability of an industry:

- Bargaining Power of Suppliers
- Bargaining Power of Customers
- Threat of Entry
- Threat of Substitutes
- Rivalry among Existing Competitors

Figure 17 below summarizes Porter's Five Forces for the Telecom IC industry. Each of the five factors is discussed in detail in the following sections.

Figure 17 Porter's Five Forces Diagram



Source: Author, adapted from Bukszar (2006).

2.3.1 Rivalry Among Competitors: HIGH

Growth rates in the telecom IC industry are estimated to be low for the foreseeable future. As a result, there is significant competition for the few new design win opportunities with customers, and any increases in market share are obtained by stealing design wins away from competitors (a zero-sum situation). This results in significant competition and rivalry.

As discussed in the Threat of Substitutes section, the SONET telecom standards adopted recently mean that new equipment designs are likely to remain shipping for many years before new technologies render them obsolete. As a result, there is fierce competition to win the high volume design opportunities, pushing profit margins lower. Often, competitors in the telecom IC space will price products for high-volume design opportunities below their usual margins with the expectation that scale and learning effects will help reduce production costs and result in increased profit margins in the future.

Two factors that help to reduce rivalry among competitors are the fixed costs and lack of exit barriers. This means that competitors can exit the market relatively easily. In a knowledge-based industry such as IC design, low fixed costs and low asset specificity also mean that a competitor can easily choose to cancel a design in progress if there doesn't seem to be much customer demand for the product, or if the design has been lost to a competitive solution. Design work completed prior to project cancellation would be wasted, but the competitor may choose to pursue other opportunities instead. This ease of project cancellation or industry exit helps to reduce rivalry somewhat, but overall competitive rivalry is still very high in the telecom IC industry.

2.3.2 Threat of Entry: LOW, INCREASING

It is relatively easy to launch a startup company to develop products in the telecom IC space, because the initial capital requirements to get started are low. However, design start is only the beginning. Potential entrants also need to finance the manufacturing, testing, and marketing phases to ensure a successful product. These stages are very expensive and time consuming. The initial design time for a complex telecom IC is measured in hundreds of person-months, tooling costs to build the first batch of prototypes is measured in the millions of dollars, and final test and verification is measured in tens of person-months. Despite all this time and effort, there is no guarantee that the first prototype of a telecom IC will work as designed, so additional million-dollar tooling charges are required to fix and launch a new prototype manufacturing run. This very high capital requirement to see a design through to commercial success dramatically reduces the threat of entry into this industry.

Incumbents in the telecom IC industry, such as SemiconInc, have very comprehensive portfolios of devices that have been tested and are proven/guaranteed to interoperate together. A new entrant with a point solution will have a difficult time guaranteeing that their product interoperates with other solutions on the market because it is not in the incumbent's interest to provide detailed design specifications to the new entrant, or to allow interop testing. Risk averse customers prefer to purchase the complete solution from a single vendor, rather than risk interoperability issues in the future. This reluctance to adopt products from new entrants further reduces the threat of entry.

A new entrant may choose to purchase or develop their own portfolio of products in order to compete against the comprehensive product portfolios of the incumbents. However, incumbent telecom IC manufacturers such as SemiconInc have progressed to such an extent along the learning/experience curve, that it would be very difficult for a new entrant to develop competitive products that compete on price, features, or time to market, because incumbents have competitive advantages in all these areas. If new entrants are able to innovate and gain some short-term competitive advantage, incumbents would likely be able to quickly catch up by developing competing solutions, and winning back designs. This contributes to a lower threat of entry.

The final entry threat comes from emerging global markets such as China and India that have labour costs that are a fraction of North American labour costs. Sigurdson (2004) indicates that by 2010, companies in China and other low-cost economies will have developed sufficient expertise in semiconductor design to be able to develop products with equivalent complexity as North American semiconductor manufacturers. It may even be sooner than 2010, since many companies in these regions are already acting as subcontractors for North American design firms, so they are likely progressing along the learning curve faster than anyone expects. Semiconductor IC companies spend approximately 40% of annual revenues on R&D (Luke, Shah, and Kvaal 2005), so dramatic labour cost savings would result in a very competitive product offering.

Last, some low-cost countries like China and India already have well-developed software industries. Software is becoming an increasingly dominant portion of R&D expenses for many semiconductor products, so incumbent suppliers need to ensure their cost structures remain competitive.

As a result, the low labour costs in emerging economies will likely result in new companies setting up operations in India or China, and driving the threat of new entrants higher.

2.3.3 Threat of Substitutes: MODERATE, INCREASING

Much of the telecom IC industry is built upon the SONET telecommunications standards in use around the globe, which were designed to carry core network traffic. These standards were adopted relatively recently, in the past 15 years or so, and will be in use for the foreseeable future. As a result, it is unlikely that new telecom standards will be adopted rendering current SONET products obsolete, so the threat of substitutes is LOW for the core network segment of the telecom IC industry. However, telecom IC companies cannot switch into a low investment harvest mode, they need to continuously innovate because much of the growth in this area will be driven by end-customer demands to improve density, power consumption, and cost.

As discussed above, SONET telecom products for use in core network equipment is a stable industry with limited threat for substitution. However, there is an increased threat of substitution in what is called the "Last Mile", the connection from the service provider central office to the consumer, usually a business or home user. Presently, the majority of these connections use the existing copper wire already installed for telephone service to carry Digital

Subscriber Line (DSL) traffic. Most telecom IC companies have a portfolio of DSL products to service this industry. But future services such as Video-on-demand will exceed the capacity of DSL, so research is underway to develop new Last Mile access technologies that will support higher data rates. Some examples include WiMAX (high-speed stationary wireless), and PON (Passive Optical Network). If adopted, these new technologies may well render traditional Last Mile access technologies obsolete.

The Cable industry also poses a significant threat of substitution to the existing telecom IC industry. Data communication standards used in the cable industry are different from those used in the telecom industry, and very few of the competitors in the telecom IC industry also develop products for the cable industry. Cable companies are beginning to take market share away from the incumbent telecom carriers, and if this trend continues, cable access could possibly replace the existing Last Mile infrastructure.

2.3.4 Bargaining Power of Customers: HIGH

The bargaining power of customers is HIGH in the telecom IC industry. Buyers are highly concentrated, and as a result many telecom IC companies rely on revenue from only a few customers to survive. For example, 30% of SemiconInc's 2005 revenue was derived from only three customers, with the remaining 70% of revenue spread among dozens of other customers (SemiconInc, 2006). Other competitors in the telecom IC industry are in the same situation. These large customers are also able to negotiate very low prices. Examples from SemiconInc show that key high-volume customers often pay a fraction of what other customers pay for the same product, which is further proof of their high bargaining power.

Most of the products developed by telecom IC companies need to interoperate with equipment from other companies, as well as older equipment already in operation. As a result, telecom ICs are designed around industry standards, and are homogeneous products. This standardization further increases the bargaining power of customers, because their switching costs are low so the threat of redesign is credible.

In contrast, there are some end products where customer bargaining power is limited slightly due to high switching costs. This is usually the situation where there is no dominant industry standard, and a customer has invested significant time and resources to develop their system around a differentiated product from a telecom IC vendor. A good example is a customer's network management software suite that has been developed and tuned to a specific product from a single telecom IC vendor. It might take two years or more to redesign and launch a product using a new IC solution, so switching vendors is not a credible threat. However, in these cases customers still maintain some power because they can threaten to design out other more homogenous products that have lower switching costs. For example, SemiconInc maintains a portfolio of over 100 unique IC designs, and it is likely that a large customer will use many different devices from this portfolio, some homogeneous, others differentiated. Switching costs for the homogeneous products are low, so threat of redesign for these products is credible, allowing them to maintain some bargaining power over the bundle of products.

2.3.5 Bargaining Power of Suppliers: MODERATE, DECREASING

One of the key suppliers to the telecom IC industry is labour, the majority being highly skilled electrical, computer, and/or software engineers. This job market has rebounded since the layoffs of 2001, and engineers with experience in these areas are in short supply. These skills are relatively portable, and there is competition among IC design companies for top talent. As a result, these engineers command high salaries, and make up the majority of R&D spending at most fabless IC companies. In general, these suppliers have not organized into unions, which means they are not as powerful as they could be. However, they can easily quit and find work with competitors, especially in highly concentrated regions such as Silicon Valley.

However, outsourcing IC developments to regions with low-cost labour such as China or India is beginning to affect the supplier bargaining power for labour. To date, outsourcing has displaced relatively few highly skilled IC development engineers, but these emerging countries are rapidly progressing along the learning curve, and are becoming more competitive. As an example of growth in emerging economies, for the past several years SemiconInc's headcount for IC development staff in North America has remained flat, instead SemiconInc's executive have decided to open new design centres in Bangalore and Shanghai. These facilities are rapidly becoming effective, and will soon be significant contributors to R&D efforts, yet with very low labour costs. As a result of this outsourcing trend, Bargaining Power for Labour is Moderate but Decreasing.

The next most significant suppliers with bargaining power over telecom IC companies are the semiconductor foundries. As outlined earlier, many of the competitors in the telecom IC industry contract out the complex IC manufacturing to large Asian semiconductor manufacturers (also called 'foundries') such as Taiwan Semiconductor Manufacturing Corp. (TSMC). This trend towards fabless IC companies makes good business sense because of the massive capital requirements necessary to build and maintain state of the art semiconductor foundries. But, it also means that these suppliers can exert a significant amount of power over the fabless IC companies who use their services. New capacity is being added every year, but in early 2006, a semiconductor research report published by Lehman Brothers indicated that global contract foundry capacity was running at nearly 100% (Luke, Shah, & Kvaal 2005). In this environment where fabless telecom IC companies must compete for manufacturing capacity, the contract foundries will be able to increase prices, or prioritize capacity to the highest bidder, forcing some companies to wait longer than expected for their orders. Fortunately, many of the larger, well-established IC manufacturers like SemiconInc are able to take advantage of the cyclic nature of the semiconductor market to negotiate long-term foundry capacity contracts when capacity is available and prices are low. This helps to minimize the chance of supplier hold-up, and reduces the bargaining power that the foundry suppliers have. Therefore, the bargaining power for foundry suppliers is rated as MODERATE.

The third most significant group of suppliers to the telecom IC industry are the IC design tool vendors. These are companies such as Cadence and Synopsys, who develop complicated and expensive software tools to convert chip design code language into the hardware circuits that are implemented on an IC. Expenses for IC design tools are second only to labour costs in annual R&D spending. The design language for IC development is standardized across the industry (called VHDL), and tools from most vendors use VHDL as the input. As a result of this standardization, switching costs for telecom IC companies to switch tool vendors are relatively low, and competition is fierce in their industry. As a result, tool vendors have LOW bargaining power over telecom IC companies.

The telecom IC industry has many other suppliers, such as bankers supplying capital (MODERATE power), and landlords supplying facilities (LOW power). These variables are not as significant as the first three, and are not discussed here. Overall, Bargaining Power for Suppliers is Moderate but Decreasing.

2.4 Overall Five Factors Assessment

Based on the Five Factor analysis, the Telecom IC industry seems to be an attractive industry for established companies to continue in, but is not an attractive industry for new entrants. If incumbents can continue to leverage scale and learning effects to keep costs down, they should be able to maintain market share. There exist significant barriers to entry that new entrants will be faced with, notably development of IP portfolios, development of customer relationships, and tooling costs. These are real barriers to entry that will require significant investments in time and money for new entrants to overcome.

New entrants likely have a better chance of commercial success if they focus on developing substitute technologies that threaten to replace the existing infrastructure. These areas include Wireless Last Mile Access as well as Passive Optical Networks. New entrants could pursue two strategic options:

- Develop successful substitute products, but this requires significant funding for several years of development before customer commitment could be secured
- Begin work on development of substitute products, with the goal of being acquired by an incumbent before the significant expense of device manufacturing is incurred.

Both options have been used in the past, but the acquisition strategy has been the dominant one since the tech bubble burst in 2000. Incumbent companies with strong balance sheets, such as SemiconInc, are always looking to acquire companies with new technologies that could help accelerate future growth. Consolidation in the Telecom IC space is expected to continue, so this is likely the best way for a new entrant to succeed in this intensely competitive industry.

Incumbents in Telecom IC industry would be well advised to constantly evaluate the potential threat of substitutes and either launch developments for new products to address these areas, or look to acquire promising start-ups who are focused on these technologies. As well, incumbents need to watch the progress of emerging economies, such as China and India, to evaluate the threat of new entrants from these regions. Some incumbents may also want to establish a presence in these regions to begin to take advantage of the low labour costs to further reduce their own R&D or manufacturing expenses. Porter (1998) does not consider cost optimization as strategy, because everyone can and should be doing exactly the same thing, but ensuring that operational effectiveness is maximized is necessary to remain competitive.

2.5 Key Success Factors

The most immediate threat to continued success in the telecom IC market is the Threat of New Entrants. As a result, the key success factors are directly related to minimizing the threat of new entrants.

Incumbent semiconductor suppliers located in high cost economies need to ensure their cost structures and operational effectiveness allow them to remain competitive, and reduce the threat of new entrants. Most North American semiconductor companies would likely be able to reduce R&D expenses if they developed some portions of their new designs in low-cost regions. Software is the most likely choice to offshore, because many low-cost regions such as India and China already have well developed software industries that are just as efficient and sophisticated as North American software industries, but at a fraction of the cost.

Incumbent suppliers should continue to make incremental investments in IP development projects to ensure that their existing IP portfolios remain a competitive advantage. There are several ways to accomplish this, such as ensuring that all IP is available in the most modern, low-power, high-density technologies. This will ensure lower variable costs, but will also allow companies to differentiate their products by integrating higher density devices with extra features, combined with faster time to market. This will help reduce the threat of new entrants.

The final key success factor for incumbent communication IC companies to focus on is using their established financial resources to invest in emerging new technologies, either by launching internal R&D programs, or acquiring promising start-up companies.

3 SEMICONINC INTERNAL ANALYSIS

3.1 Corporate Strategy

SemiconInc is a leader in the telecommunications semiconductor industry, with offices around the world, and main design centres in Canada and the USA. The Generic Strategy of SemiconInc is Differentiation, with high quality innovative products sold at adequate cost. Evidence of the value SemiconInc offers to a customer is shown in the very high margins that SemiconInc earns each quarter. Clearly, customers value SemiconInc's dedication to quality, innovation, and time-to-market, and are willing to pay the additional margin for SemiconInc's innovative products.

Figure 18 Strategic Fit Chart for SemiconInc

	Low Cost	1 2 3 4 5 6 7 8 9 10	**Differentiator**
Product Strategy	Rapid Follower		Innovative
R&D Expenses	Low		High
Structure	Centralized		Decentralized
Decision Making	Less Autonomy		Autonomous
Manufacturing	Economy of Scale		Economy of Scope
Labour	Mass Production		Highly Skilled
Marketing	Comparative/Push		Pull/Pioneering
Risk Profile	Low Risk		High Risk
Capital Structure	Leveraged		Conservative

Source: Author, adapted from Bukszar (2006)

The Strategic Fit Chart shown in Figure 18 provides a graphical representation of nine different variables commonly used to indicate whether a company is weighted towards the Differentiator Strategy, or the Low-Cost Strategy. Many of SemiconInc's variables are clearly weighted towards a Differentiator Strategy, which is as expected. Each of the individual variables is analyzed in the following sections.

3.2 Strategic Fit of Corporate Strategy

3.2.1 Product Strategy

SemiconInc's Product Strategy emphasizes **Innovation**, which is consistent with a Differentiated Strategy.

The focus at SemiconInc is to continuously innovate in order to keep ahead of fast-follower competition, expand market share in traditional markets, and to fuel growth into new areas. Pilot projects and "Test Chips" are regularly developed to gain experience with new state of the art processes and technologies, with the ultimate goal of integrating these new technologies into future products. Often customers will drive investigation into these new technologies, or the SemiconInc CTO organization will identify a technology that it predicts will be critical in the future, and will launch a pilot project to learn more about it.

SemiconInc also innovates in well-established markets where it already has a dominant market share. Customers are always looking for ways to cost-reduce their products, so as semiconductor processes advance in accordance with Moore's Law, SemiconInc looks for opportunities to combine multiple features that previously required several separate devices into one, thus helping customers reduce their product cost, power consumption, and physical size. While this does not involve new feature innovation, it does require innovation to exploit the new processes to maximize density.

Last, SemiconInc also works to differentiate based on highly skilled Sales and Support staff. The SemiconInc sales team holds regular training sessions at the factory to ensure members are as up to date as possible with all products and the competitive advantages over other solutions. As well, the field and factory support teams regularly conduct training sessions, and attend industry events to ensure they are as up to date as possible.

3.2.2 R&D Expenses

SemiconInc's R&D Spending is **High**, which is consistent with a Differentiated Strategy.

In 2005, SemiconInc spent 119M USD on R&D, while generating revenues of 291M USD, resulting in an R&D spending ratio of approximately 41% of Revenue. This is significantly higher than many of SemiconInc's peers in the semiconductor industry, who typically spend approximately 25-30%.

SemiconInc management believes that it is necessary to maintain this level of R&D in order to continue to innovate and penetrate new markets. Many of SemiconInc's competitors reduced R&D budgets following the technology downturn of 2001, preferring instead to sell what they have until market conditions improve. In contrast, due to its strong financial position, SemiconInc was able to continue aggressively funding R&D to ensure it maintained its lead in product innovation.

3.2.3 Structure

SemiconInc's Structure is **Partially Centralized**, which is not entirely consistent with a Differentiated Strategy. However, it does combine the benefits and flexibility of a decentralized structure with economies of scale in various overhead departments that can only be achieved with a centralized structure.

Centralized in the Canadian offices are the Senior Executives (CEO, CFO, CTO), and support staff, as well as product testing, finance, accounts receivable, purchasing, and information technology (IT). The centralized IT team includes administrators for the corporate network, chip design tools, Peoplesoft, and external website. Consolidation of these groups in one location allows SemiconInc to realize efficiency gains by not having to keep maintenance staff at all global sites, instead it is centrally administered out of the Canadian headquarters.

SemiconInc operates engineering design centres in several locations around the world, including Silicon Valley, Northeast USA, Canada, India, and China. As discussed in the Labour section below, these sites were chosen to access the talent pool available in each region. Each of these offices has a site manager, as well as administrative staff including HR, payroll, and other admin functions. These remote design centres rarely develop an entire chip or product, instead they develop portions of the IP that will be integrated together to form a complete product. Integration of these individual IP components into a complete design occurs at the main Canadian design centre, because it requires complex CAD tools and expertise to accomplish, and these tools are centralized at the major design centres.

SemiconInc's sales force is also completely decentralized, ensuring that the sales team is located near the customers. SemiconInc maintains sales offices in all of the design centres listed above, as well as additional sales managers in the United Kingdom, Germany, France, Israel, China, Taiwan, Japan, and Korea. Each of these locations maintains autonomy, with local Sales Directors responsible for accounts in each region. As well, each sales office maintains a staff of Field Applications Engineers who work with customers on a daily basis to troubleshoot and help customers bring their products to market.

3.2.4 Decision Making

SemiconInc's Decision Making Strategy is **Less Autonomous**, which is not entirely consistent with a Differentiated Strategy.

Most of the Senior Executives are located at SemiconInc Headquarters in Canada, so the majority of critical corporate decisions are made there. This includes decisions on project launches, project cancellations, capital expenditures, and budgets.

Each of the remote design centres has flexibility in how it executes project assignments, and each one has some level of autonomous decision making. However, since all the IP components created by these remote design centres will ultimately be integrated into a complete product by the CAD team in Canada, it means that schedules and deliverables must be coordinated by the Canadian design teams.

One of the main drawbacks to this limited autonomy is a lack of focus on potential acquisition targets outside of North America. SemiconInc has a poor acquisition track record that could be improved if the remote offices were given the autonomy to pursue acquisitions or partnerships in their local regions.

3.2.5 Manufacturing

SemiconInc's Manufacturing Strategy emphasizes **Flexibility and Economies of Scope**, consistent with a Differentiated Strategy.

SemiconInc is a 'fabless' semiconductor manufacturer, meaning that all silicon wafer production is outsourced to large contract manufacturers. This fabless model makes good economic sense, because it would be cost prohibitive for a single chip company like SemiconInc to build and maintain a state of the art fab, and would be impossible to reach the economies of scale that a large contract manufacturer could reach.

Instead, fabless companies like SemiconInc focus only on developing innovative new devices and technologies, and build this expertise into a library of intellectual property that can be re-used on future devices. This library of IP allows SemiconInc to create innovative new devices based on a new combination of existing IP building blocks, ensuring rapid time to market, low cost, and reliability.

3.2.6 Labour

SemiconInc's Labour Strategy is based almost exclusively on a **Flexible/Highly Skilled** workforce, consistent with a Differentiated Strategy.

The majority of SemiconInc's workforce is highly skilled engineers, many with advanced degrees such as M.Eng. and PhD. Most have experience with IC design, system architecture design, software development and test, communications, and/or signal integrity. Flexibility is key, since people change projects regularly, and often need to ramp up on new technologies or protocols rapidly.

In order for any differentiator to continuously innovate and expand into new areas, it is critical to search out and hire talent with expertise in the areas of focus. SemiconInc's global workforce is a good example of this. SemiconInc maintains sales and design centres in various locations around the world. Sales or design centres are located in the USA, Canada, China, and India. Furthermore, SemiconInc is beginning to outsource more and more design work to low-cost locales such as India, and is always on the alert for potential acquisition targets to acquire new IP and talent. Many of the worldwide design centres were acquisitions, now successfully integrated into SemiconInc's structure.

3.2.7 Marketing

SemiconInc's Marketing Strategy combines activities consistent with both **Low-Cost/Push** and **Pioneering/Differentiated** Strategies.

SemiconInc maintains a portfolio of over 100 unique IC designs, many of which were developed 5+ years ago. These older products have reached commodity status, and the development costs have long been amortized. For these products, SemiconInc has a dedicated "Legacy Products" Marketing team, who use a Push strategy to try to squeeze additional revenue out of these older designs. Their mandate is to approach customers who currently use competitor devices and convince them to redesign with SemiconInc products to achieve cost reductions. Since these products compete exclusively on price, the margins are somewhat lower than SemiconInc's newer products. However, often these low-margin devices help to break into an account, and lead to additional design wins with new devices, or are occasionally bundled with newer devices to achieve an overall lower cost for the customer.

In contrast, most of the newer products use a Pioneering marketing strategy, consistent with a Differentiation Strategy. Often SemiconInc works with a few early-adopter customers to develop new products with innovative new features, and then communicates this to other customers at standards meetings or trade shows. Customers are risk averse and sceptical, so SemiconInc is normally forced to invest in the project up front, and develop comprehensive demonstration tools that allow customers to evaluate the technology before adopting it.

Other examples of a Pull strategy are the relationships SemiconInc works to build with telecommunication service providers around the world. SemiconInc does not sell directly to these service providers, but products are sold to equipment vendors who in turn sell to these service providers. For example, SemiconInc sells devices to Cisco, who sells networking equipment to Verizon, but it is still valuable for SemiconInc to work directly with Verizon to demonstrate their value proposition. Therefore, in addition to focusing marketing resources directly on the customer (in this example, Cisco), SemiconInc also focuses on demonstrating the value of its products to service providers so that they might specify SemiconInc products to their vendors, or write RFQs with SemiconInc performance specifications in mind.

While this combined strategy is not typical of a purely Differentiated Strategy, it is an enviable position. The Push strategy is used to promote a portfolio of legacy products that continue to provide a significant source of revenue, which is then used to help fund development of newer innovative products that require expensive Pull marketing.

3.2.8 Risk Profile

SemiconInc's Risk Profile is **High Risk**, resulting from its Differentiation Strategy.

The project development cost for a state-of-the-art 90nm integrated circuit is in the order of 20M USD, which is approximately 20% of the 2005 R&D Budget. This means SemiconInc can execute on only a limited number of projects per year, and if any one fails due to design problems or deteriorating business conditions, SemiconInc could lose a significant portion of revenue potential for the coming years. Adding to the cost of a failed project is the opportunity cost, since executing on one project means choosing to not execute on the next best alternative, which may have provided a better return on investment.

Current state-of-the-art 90nm integrated circuits contain hundreds of millions of transistors arranged in complex circuits that are very time consuming to verify. Time-to-market demands mean that SemiconInc cannot possibly simulate and verify the entire design before committing it to silicon, so the possibility of a design flaw on a new device is extremely high. Normally one revision cycle is factored into each project's cost estimation, but a second revision may render the entire device business case a failure. Further, customers require both innovative new features *and* rapid time-to-market in order to launch a successful product. This short design cycle business model is inherently risky for SemiconInc, because being the first mover into a market isn't always the winning position. Often standards change, or new requirements are identified late in the design cycle when it is too late to change a design, allowing other fast-follower competition to make the required changes and win the design.

In some cases, customers demand products that are so differentiated and unique, that the entire business case for a product development project depends on the success of a single product with one key customer. If this product does not reach the production volumes that were predicted, then the project may never even reach break-even. In extreme cases like this where the success of a product depends heavily on a single customer, SemiconInc will normally require several sizable NRE (non recurring engineering) charges as milestones are met, in exchange for lower cost volume pricing agreements. This is a way for SemiconInc to hedge their bets – if a customer cancels the product that a device was designed for, or otherwise does not meet volume targets, at least the NRE will cover a portion of the development cost. If the product does reach the intended volumes, then profits may be slightly lower due to the volume discount pricing, but this is a fair trade-off to reduce the risk profile somewhat. This type of arrangement is only entered into when the end customer is a key partner with a strong business case and very significant volumes predicted, but still there have been many examples of these projects not being as successful as originally predicted.

3.2.9 Capital Structure

Traditionally, SemiconInc has maintained a **Conservative** Capital Structure, consistent with a Differentiated Strategy. However, this has changed recently to be more Leveraged than usual, which is more consistent with a Cost-based Strategy.

Due to the high-risk profile discussed above, it is common for a company with a Differentiated Strategy to maintain a Conservative Capital Structure to be able to weather changes in business conditions, to sustain the high costs of innovation, and to be prepared to take advantage of acquisition opportunities as they arise. For the past few years this was true of SemiconInc's strategy as well, having nearly zero debt outstanding. The majority of

SemiconInc's peers in the communication semiconductor industry are also almost exclusively 100% equity financed.

However, in late 2005 SemiconInc issued a substantial debt offering. This is a significant departure from the conservative capital structure SemiconInc had maintained in the past, but this is believed to be a short-term anomaly. SemiconInc senior executive reported that they chose to issue this debt in order to quickly take advantage of an acquisition opportunity. According to SemiconInc executive, this acquisition will be immediately profitable, allowing the debt to be retired quickly.

2005 saw a departure from the expected Conservative Capital Structure, but this does not indicate a Strategic Fit problem. The ability to issue debt to quickly act on an acquisition opportunity is exactly why differentiators maintain a conservative structure in the first place. It is expected that this debt will be retired quickly, seeing a return to the conservative Capital structure typical of a differentiator.

3.3 Summary of Strategic Fit

Overall, SemiconInc's Fit is relatively consistent with an Innovation/Differentiation Strategy, which is positive. The notable exceptions are the Capital Structure and Autonomy. The deviation in Capital Structure to a more leveraged position is a short-term exception, but the lack of autonomy has affected SemiconInc negatively, and management would be well advised to make changes to take better advantage of the expertise in the remote sites.

There are some challenges ahead. Foreign competition is becoming more and more sophisticated, and these fast-followers continue to close the innovation gap, especially those based in Asia. While they still lag behind in feature set innovation, their ultra-low cost structures may eventually allow them to take market share with 'adequate but cheap' solutions. SemiconInc needs to continue to innovate and expand into new markets where their knowledge and experience can be leveraged into significant competitive advantage, and at the same time continue to evolve operational efficiencies to ensure their cost structures are as low as any other competitor.

Finally, with growth in the high-margin telecom space slowing, SemiconInc may be faced with entering higher-volume, lower-margin markets, such as consumer home networking products. If this is a market SemiconInc chooses to attack, it is likely that it will need to adopt more of a cost-based strategy.

3.4 Firm Level Value Chain

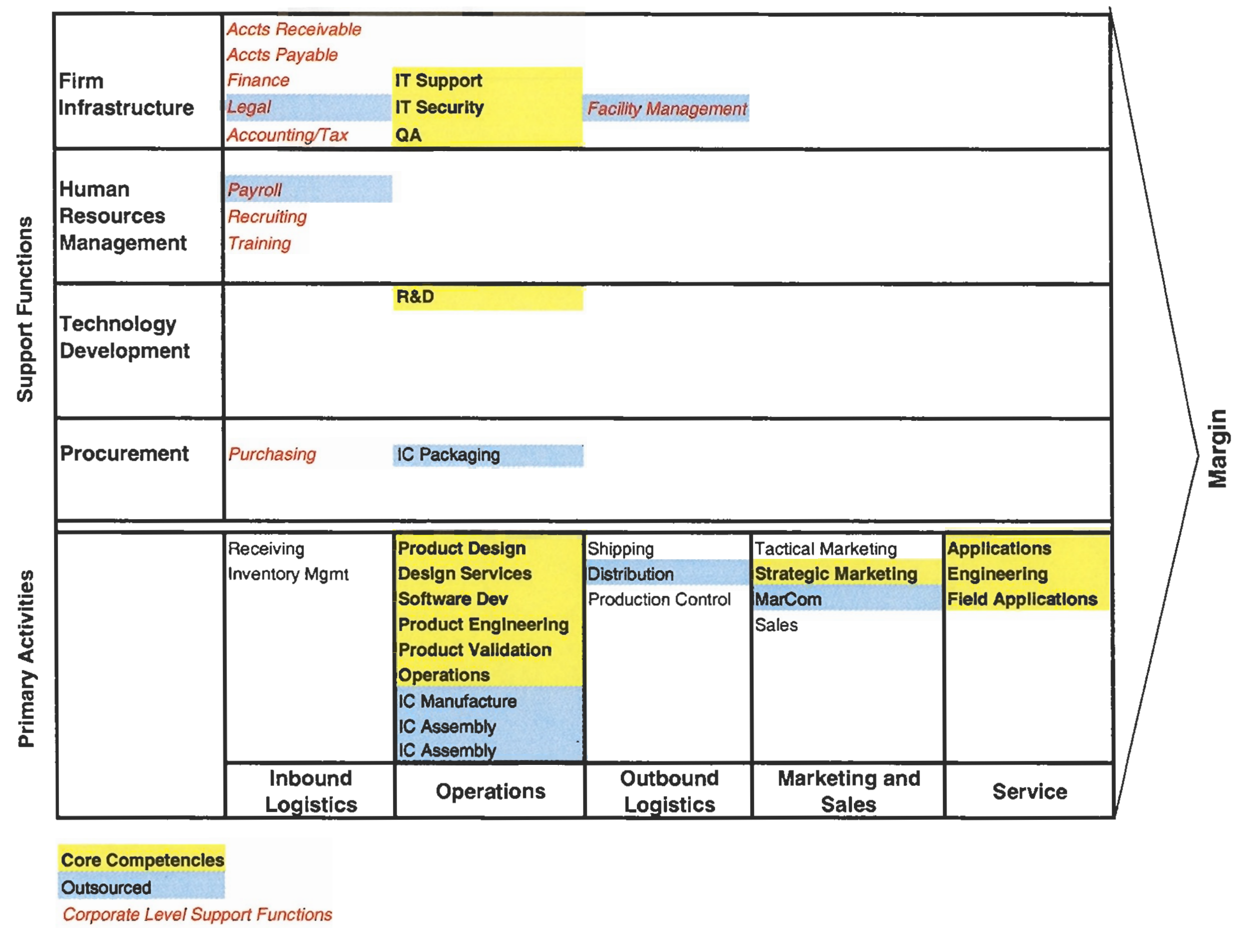
In Porter's 1995 book Competitive Advantage, he introduces a generic value chain model that outlines common value generating activities that firms perform, with the end goal to create more value for the customer than the cost of carrying out the activity. In the following sections, the Firm Level Value Chain specific to SemiconInc is discussed. Each of the Primary Activities and Support Functions are detailed, as shown in Figure 19 on page 51.

3.5 Primary Activities

3.5.1 Inbound Logistics

At SemiconInc, all Inbound Logistics activities are handled by Receiving, one half of the combined Shipping and Receiving Department.

Figure 19 Firm Level Value Chain Diagram



Source: Author, adapted from Bukszar (2006)

3.5.1.1 Receiving

The Receiving Dept. accepts goods from couriers and trucking companies that arrive at the factory loading docks. It inspects the shipments to reconcile what was received with the purchase orders on file, so that accounts payable can pay the vendors accordingly. Following receipt, Receiving will also notify the employee or department who filed the purchase order that their shipment has arrived, and arrange for transport to the appropriate area.

3.5.1.2 Inventory Management

The other function of the Receiving Department is Inventory Management, which is critical to the smooth operation of the business. Hundreds of thousands of individual ICs are received by the Receiving Dept. each year, and are stored in inventory in preparation for shipment to customers and distributors. Semiconductor devices are expensive and fragile, which poses some challenges when keeping large supplies in inventory. The first issue is security. Some of the more complex ICs that SemiconInc carries sell for thousands of dollars, so precautions must be taken to ensure that inventories are adequately protected against theft.

In addition, semiconductor devices are fragile and susceptible to damage from static electricity, excessive moisture, extremely high temperatures, or other environmental effects. In order to protect against these environmental effects, the Receiving Dept repackages the bulk shipments of ICs received from the assembly contractors into smaller trays suitable for shipment to customers. These trays include desiccant to ensure the ICs do not absorb moisture during shipment, and a moisture monitoring card to notify the customers if the moisture content has exceeded specification so they know to bake the devices before using them to avoid damage. The last step before the trays are placed into inventory is to vacuum pack the tray of devices in a conductive bag to dissipate any static electricity that may accumulate. Following this step, the trays are logged into inventory, and become the responsibility of the Production Control Dept, discussed in the Outbound Logistics section.

3.5.2 Operations

Activities in the Operations section of the value chain are where SemiconInc has the majority of its Core Competencies. Each of these critical functions is discussed in the following sections.

3.5.2.1 Product Design

The Product Design group is the largest team at SemiconInc, and is made up of several different teams each with a specialized focus. Product Design is the most important Primary Activity performed at SemiconInc, and is a core competency.

The Product Design group gets involved at the very earliest stages of any chip development, in the feasibility stage, to help specify the required features, estimate the cost, and establish the schedule. Usually this step is completed in discussions with one or more lead customers. Once the product specification and schedules are agreed upon, the Product Design team can launch the project.

The first step in launching a project is to form a Product Management Team (PMT), with representatives from all areas of the company who gather at weekly device status meetings. These meetings are usually chaired by the Product Design Manager assigned to the project. The PMTs follow a very detailed device development process that has evolved over the years, called the Design Control Procedure (DCP). The DCP is an ISO9001 certified flow, documented by a collection of checklists and guidelines that define all of the requirements, milestones, deliverables, and executive approvals required as a project progresses. The DCP was developed to help eliminate process-related design flaws, and also helps new engineers rapidly progress along the learning curve. The DCP is updated regularly, and additions are made to eliminate any new process-related problems that have been identified. This DCP process of developing best-practice guidelines and adhering to them is practiced by all staff at SemiconInc, and helps to maximize efficiency and reduce risk of design flaws. In an effort to continuously improve the DCP, project team performance is measured and tracked by an executive Best-In-Class (BIC) team. This team compares project performance to a set of BIC goals, such as time to market, or number of flaws designed in, number of revisions required, or number of weeks to test. This focus on maximizing DCP performance helps SemiconInc develop and sustain competitive advantage by ensuring rapid time to market and reduced device design flaws.

SemiconInc's Telecom System Block design and integration methodology is a core competency. One of the key decisions made in SemiconInc's infancy, was to build logic for ICs in a modular, hierarchical fashion, based on blocks of logic called Telecom System Blocks (TSBs). This modular approach has served SemiconInc extremely well, and allows for a much greater degree of logic reuse than competitors who design their products with a flat hierarchy. A TSB is first developed and tested in isolation, and is then connected to other TSBs in the device over a standardized interconnect system. This allows changes to a design to be made very easily, by swapping TSBs in or out to realize a different feature set. If a bug is found in one TSB, changes can be made within that TSB without affecting other TSBs in the device, allowing for faster revision cycle times. An added benefit of this modular structure is that IP from third party contractors can easily be included in the design, if it follows the same standard interconnect structure. SemiconInc has developed world-class modular device design and integration capabilities.

The entire TSB design, test, and device integration phase is conducted in a virtual environment. To design a device, the functional behaviour is described using an IC design programming language, usually VHDL or Verilog. These logical representations are exhaustively simulated and verified to ensure that they function as intended, and changes are made to guarantee that a device will function as designed under any circumstances. SemiconInc has developed unique capabilities in verification that help to reduce the test time, but also maximize error checking coverage. This is also a core competency for SemiconInc.

3.5.2.2 Design Services

Once the Product Design team is satisfied with the results from exhaustive simulations of the virtual design, responsibility is passed to the Design Services team who take the logical representation of the device created by the Product Design team and generate a physical implementation of the device. There are two distinct steps involved. The first step is called synthesis, where the IC design tools convert the VHDL software representation of a device into the actual transistors and interconnects that will be required to realize the design. This step requires extremely expensive and complicated design synthesis tools from third-party vendors such as Cadence or Synopsys. Following synthesis, the Design Services team begins a process called Layout that is the final step in transforming the virtual design into a real physical implementation. The series of transistors and interconnects generated by the synthesis tools is arranged in a graphical fashion to specify where each transistor and interconnect should be located on the IC die. When layout is complete, this information is converted into a series of masks that the IC manufacturer uses to build the actual circuits on the surface of the silicon wafer.

Once layout is complete, final detailed timing, thermal, and electrical analyses are completed by the Design Services team to ensure the device has been implemented properly. Following successful final analyses, the chip is ready for manufacture, and the design files are sent to the fabrication contract manufacturer.

Fast and effective execution of Layout is critical to a successful chip development, and is a core competency.

3.5.2.3 Software Development

In the past, development of software has not been a differentiating feature that customers demanded from SemiconInc. The telecom products that SemiconInc developed and sold to customers such as Cisco and Alcatel would be incorporated into systems that are based on proprietary operating systems and network management architectures. As a result, telecom customers almost always chose to develop software in-house. Since availability of software was not a competitive advantage for SemiconInc, there was little focus on it, except where required for testing or demonstration systems. For these systems, the Applications or Product Validation teams would develop basic software sufficient for testing or demonstration, but would not deliver industrial quality, standards compliant code to meet end-customer requirements. However, as SemiconInc moves into new areas, availability of industrial quality mission critical software is a requirement.

Many of the new devices being designed at SemiconInc are processor devices that run code on real time operating systems. Customers are constantly looking for ways to reduce time-to-market, and demand that any new devices they design into their products come with standards compliant software already written for them. Without a basic software package to run on SemiconInc processors, customers would simply choose another supplier who has the software ready.

Efficient software development requires a different development flow from SemiconInc's traditional hardware-focused IC development process. Circuitry on an IC cannot be modified once it is manufactured, so there is significant effort spent on verifying and simulating IC designs prior to manufacture. Software can easily be modified, so a more efficient development process involves no simulation, and less intensive prototype testing. Preliminary versions of software can be released to key customers so they can start testing in parallel, rather than waiting for development teams to complete all testing. This process of releasing code knowing it still has problems to fix is vastly different from the IC process of spending months verifying an IC design prior to manufacture. This will require a culture change at SemiconInc.

To be successful in the processor or consumer SOC markets, SemiconInc will need to develop core competencies in software development. Software for standards-based functions has been commoditized and is available from third party contractors, so SemiconInc should choose to buy rather than build these non-differentiating modules. However, there are many functions that have not been standardized, and may provide opportunities for SemiconInc to differentiate their products. These are the areas that SemiconInc software teams should focus on, to help create sustainable competitive advantage.

3.5.2.4 Product Engineering

Once an IC prototype comes back from manufacture, the Product Engineering (PE) group completes a very detailed analysis of the electrical characteristics of the device to ensure it can be reliably produced in volume. In addition, the PE group is responsible for developing a detailed production test program that very quickly tests as much functionality of the device as possible prior to shipping to the customer. Not all parts are subject to this testing, but PE completes regular spot-checks on different batches of devices to ensure they are performing within specification.

Product Engineering is also responsible to complete a 'post-mortem' analysis on any damaged parts that are returned from customers. PE will try to recreate the observed problems to see if a new design flaw has been uncovered, or determine why the part was damaged in the first place. The most common problem is damage from static discharge, caused by improper handling. The PE group helps to maximize reliability of SemiconInc products, and is a core competency.

3.5.2.5 Product Validation

The Product Validation (PV) group is also responsible for testing new prototypes, but it has a different focus than the PE team. Product Validation is concerned with ensuring each functional portion of the device operates according to specification. In order to complete this testing, PV needs to design very complex systems around each chip, similar to the products that customers design, in order to test device operation under realistic loading conditions. Every interface and functional subsystem of each new device is subjected to a variety of different traffic patterns and error conditions to ensure that the device operates correctly, and responds to error conditions appropriately.

The validation phase is very time consuming, and requires detailed knowledge of both the device under test and also system design issues. A modern complex telecom IC may require up to year of testing before all features are completely tested. The longer a device takes in Validation, the longer before it can be released for volume production, so every moment spent in PV is revenue lost. As a result, the PV team is under significant pressure to execute testing quickly and efficiently. All efforts are made to maintain state-of-the-art testing facilities to ensure that time spent in PV is minimized.

However, as expensive as it is to delay volume shipments of a device to complete testing, it is even more expensive to miss finding a device error or bug, and have to revise (or "rev") the device again. Best In Class metrics for device revs call for one prototype used for testing (called Rev A) followed by one rev to fix problems (called Rev B). The goal is to discover all bugs through Rev A prototype testing, and then fix them in Rev B, so Rev B can be released for volume production. If a bug or design flaw is missed in Rev A testing, and is not fixed prior to Rev B, then it could potentially cause yet another rev of the chip, costing an additional several million dollars.

As a result of the importance of accurate and efficient Product Validation, this is a critical core competency and must be maintained in-house. However, it is also very labour intensive, and currently all PV activities are performed in high cost North America. Some alternatives to reducing the cost of PV by moving to lower cost regions are discussed in the Strategy section.

3.5.2.6 Operations

The Operations group is responsible for ensuring that there is always enough product being manufactured to meet demand, while simultaneously optimizing inventory levels according to sales forecasts. A typical batch of devices takes approximately 2 months from wafer start to parts received at SemiconInc, and once a batch is started it cannot be stopped without scrapping the wafers. This is a difficult environment to forecast and optimize orders in, so the operations group must work very closely with the internal sales teams, and also with the manufacturing contractors, to ensure the product pipeline is full enough to meet forecast demand, but inventory is not excessive.

The other role that Operations takes on is negotiating with the fab and assembly suppliers for best pricing, and also for guaranteed supply contracts. The semiconductor industry is cyclic, so fab capacity can be difficult to secure when the industry is in an upswing. For this reason, SemiconInc's operations group maintains very close relationships with the fabs and negotiates long-term capacity agreements that ensure access to product even during periods of 100% fab utilization. Operations is also a core competency.

3.5.3 Outbound Logistics

Two groups are responsible for outbound logistics activities: Production Control and Shipping.

Production Control receives product orders from customers or distributors, and manages the logistics of getting the right number of devices ready for shipment on time. SemiconInc has over 250 unique part numbers, and hundreds of customers, so coordinating these activities and ensuring each and every order is ready to ship within committed lead-times is not a trivial task.

Once Production Control has an order ready, it is transferred to the Shipping department and shipped to the customer. It is the responsibility of shipping to ensure that shipping costs, customs delays, and risks are all minimized. SemiconInc's Shipping department uses a variety of couriers to expedite shipping of product around the world.

SemiconInc handles distribution for high-volume customers in-house. SemiconInc does not sell product or ship directly to smaller customers, simply because it is not cost-effective to do so. These smaller customers are handled through distribution partners, who maintain an inventory of SemiconInc products and manage distribution themselves. Normally these distribution partners buy product from SemiconInc at high-volume prices, and then resell it at a higher price to the lower-volume customers. Once customers reach very high volumes, they can buy directly from SemiconInc and bypass the distribution channel, saving some profit margin that is provided to the distributor.

3.5.4 Marketing & Sales

The Marketing group at SemiconInc is divided up into three separate groups: Strategic, Tactical, and Marketing Communications (Marcom). Each is described below, but only Strategic Marketing is considered a core competency.

3.5.4.1 Strategic Marketing

The role of Strategic Marketing is twofold. The first activity is to work very closely with customers to understand their current requirements, and to promote SemiconInc's existing products as solutions to their current needs. This role requires very detailed knowledge of both SemiconInc's product portfolio, and also of end-customer or network requirements. In order to gain a competitive advantage, or to differentiate from competing solutions, SemiconInc may define a chipset differently from the other solutions available. Strategic Marketing then works with the customer to explain the advantages of the SemiconInc solution over the competition.

The second important function performed by Strategic Marketing is to understand how technology and customer needs will evolve over the longer term, and drive development of new products to address these needs. As above, both of these activities requires very detailed knowledge of network operation, customer requirements, and also requires maintenance of solid relationships with customers. Often a customer will request a new device with several new features that are not addressed by any device in SemiconInc's portfolio. In these cases, SemiconInc may launch a new project and work very closely with one or many customers to accurately define the product feature set to ensure that it meets customer feature requirements and cost targets. In some cases, a device may have limited value to other customers, but is being requested by a key high-volume customer, so is still a worthwhile investment. In these cases, a sponsorship agreement is normally required to reduce the risk to SemiconInc. A sponsorship agreement may come in the form of an NRE (non-recurring engineering) fee, or guaranteed purchase order quantity, called an NCNR (non-cancellable, non-returnable) purchase. In exchange, the sponsor customer will have the products custom designed for their needs, and may also receive guaranteed lowest pricing, or early availability of products. Of course, customer needs often change unexpectedly as market conditions change, so any company must be careful how much time and resources it spends working on a customized product with limited versatility.

For these reasons, an experienced Strategic Marketing team, with well developed network of industry contacts, is a source of competitive advantage, and is considered a core competency that needs to be maintained in-house. At SemiconInc, staff in Strategic Marketing usually come from two different backgrounds, either from internal product development teams, or have been recruited from end customer companies, such as network service provider companies.

3.5.4.2 Tactical Marketing

Tactical Marketing deals mainly with price negotiations and scheduling of customer shipments. It is not considered a core competency, but is not likely to be outsourced due to the confidentiality of pricing information.

Tactical Marketing at SemiconInc also manages the distribution channel. A significant portion of SemiconInc's revenue is sold through distributors. Currently, there is no formal method to gather and communicate customer feedback received by distribution. As a result, many suggestions for product improvements or future requirements are lost.

3.5.4.3 Marketing Communications

Currently, the role of Marketing Communications is to prepare and distribute device documentation, manage advertising activities, and coordinate trade show presence. Preparation of advertising, as well as trade show logistics are all outsourced.

Preparation of accurate, easy to understand device documentation is critical to any semiconductor manufacturer, and should be a core competency. This is not the case at SemiconInc. As products have increased in complexity, the accompanying user's manuals have become unmanageable. For example, the user's guide for one product released in 2005 was over two-thousand pages in length. Devices continue to follow Moore's Law, and therefore continue to increase in complexity. As a result, documentation will also continue to become more unmanageable. SemiconInc needs to modify how device user documentation is presented, leveraging new electronic capabilities to create device documents that are easy to read, navigate, search, and perhaps can also help automatically generate software configuration details.

As onerous as device data is to navigate and read, it is even more time consuming to create. As discussed in the Product Design section, smaller teams of design engineers work on different device subsections simultaneously, pulling them all together in an overall design towards the end of the project. Documentation follows a similar flow, where each team documents their individual sub-sections, and all these sub-section documents are combined together to form the complete engineering document. This creates some problems, because global teams have very different documentation standards, and often work in different languages.

A further complication is that global customers require documents to be translated into different languages, which can be very expensive, time consuming, and error prone if done manually. Again, some electronic tools would be beneficial here to help automate, and ensure accurate documentation is created as efficiently as possible.

3.5.4.4 www.SemiconInc.com

SemiconInc maintains a very comprehensive web site where customers can search product information, download device data sheets, read information about the company, or review online learning information. However, the web site is static and does not adjust the information displayed according to who the user is, or what they are looking for. This tailored online access is a powerful technique to deliver optimized content to customers, minimizing their search time and improving their experience with SemiconInc.

The first step towards a tailored online experience is to add an authentication feature to www.SemiconInc.com to know exactly who each visitor is. Based on this information, the content displayed can be customized to optimize the user experience, screen out competitors, or to offer more comprehensive content to Tier-1 customers, such as a 'click here to launch a VoIP call to SemiconInc Customer Support' window, which would not be provided to Tier-3 customers. Key customers could also be given the opportunity to provide real-time feedback on product features, or quality of documentation. Important notices or updates could be sent to users based on the information that they had previously downloaded, ensuring they are kept up to date, and minimizing calls to technical support.

3.5.4.5 Sales

SemiconInc maintains local sales offices around the world. The job of the local sales teams is to identify key customer decision makers, and work with them to ensure SemiconInc products are chosen for designs. Large companies like Cisco or Nortel have many different levels of authority where the sales team needs to operate to win design opportunities. For example, to win a particular design, SemiconInc might need to satisfy the design engineers and design managers that the SemiconInc devices offer superior performance or features, then negotiate price and volume agreements with procurement managers, and finally convince customer executives that SemiconInc is the partner to choose based on planned product roadmaps and company longevity. This advanced organizational selling requires well developed sales skills, and ability to communicate with design engineers and executive alike. The Sales team engages in regular training sessions and seminars to ensure their techniques are as effective as possible.

Alternatively, if SemiconInc is not selected for a design, the sales team works to understand why, so adjustments can be made to pricing, or features. Similar to the role of Strategic Marketing, the Sales team needs to maintain very close contact with customers to understand how to best position SemiconInc devices for success, and to help understand customer product roadmaps to ensure SemiconInc has designs underway that will address future requirements.

Sales people are usually very experienced industry professionals who are recruited from competitors or customer companies. The Sales team holds regular update meetings to coordinate customer priorities to ensure that the Sales, Marketing, and Support teams are looking after customers in a consistent manner. In his book Competitive Strategy, Porter recommends that in order to keep costs down, competitors should avoid 'marginal customers' (Porter, 1980). Classifying customers according to sales potential and timing is one of the key jobs of the Sales team. Marginal customers who are normally directed to SemiconInc's distributors for product and support, because SemiconInc can only focus direct sales and support resources on a few Tier-1 customers. Finally, the SemiconInc Sales team is responsible for generating accurate revenue forecasts to help the Finance team manage the company.

SemiconInc's Telecom Sales teams in North America and Europe are very experienced, and can be considered a core competency. However, growth into new markets, technologies, or regions, will require SemiconInc to augment its sales teams to help address customers in those markets.

3.5.5 Service

The last primary activity in SemiconInc's value chain is Service. The products that SemiconInc builds are very complex and feature-rich data processors, and as such require significant after-sales troubleshooting support to ensure customers get their products to market quickly. It is well understood that even though a design has been secured in a customer product, SemiconInc will not receive any significant revenue beyond prototype purchases, unless the customer product is a market success. Therefore, SemiconInc staffs a large Applications Engineering team, to help customers debug their systems and get to market quickly.

The Applications team is made up of two groups, the Factory Applications Team, and the Field Applications Engineers (FAEs). The Factory team consists of a group of highly skilled engineers who work directly with key customers to train them on how to work with SemiconInc products, and to help them troubleshoot their systems when they have difficulties. Each Factory Applications engineer is a specialist in a product family, to ensure that in-depth support is available. In general, FAEs have less in-depth knowledge, but maintain responsibility for a wider range of products. They are located in most sales offices around the world, near the customers, with the mandate to help customers solve simpler problems, and to gather information on more complex issues to help the factory Applications team be more effective. Without the local FAEs, the factory team would be forced to travel globally, reducing their ability to support many customers.

The Factory Applications team creates all the technical collateral required to help speed customer design cycles, and provides direct troubleshooting support to Tier-1 customers. Often this involves on-site visits to customer labs around the world. The Factory Applications team is also responsible for building prototype systems that are similar to the end products that customers will be designing. These systems are called Reference Designs, and are developed so that customers can reuse as much of the design as possible, such as hardware design recommendations or software, to help speed their developments or reduce the chances of errors. As SemiconInc moves into consumer products and works with less-sophisticated customers, detailed Reference Designs will be critical to customer success.

The majority of the SemiconInc Factory Applications team members are co-located with the design teams in one of SemiconInc's design centres in North America. This allows for rapid transfer of expert knowledge from the design team to the support team, but has one primary drawback, that support teams are not located near customers. This has several ramifications, including increased travel costs, long turn-around times due to time zone differences, or communication difficulties due to language differences. As SemiconInc continues to expand its market globally, it will also need to expand expert technical support teams globally, to address these issues and provide good service to customers in regions other than North America.

The Applications Support Teams help SemiconInc maintain a reputation for reliable customer support, and help to reduce customer time to market. This is a valuable source of competitive advantage, but is only a core competency in North American markets. SemiconInc must expand this competency to other regions as well.

3.6 Support Functions

In the following sections, the Support Functions that are performed to support the Primary activities are discussed. There are several core competencies included in the Support Functions, including Quality Assurance, IT, and Technology Development by the CTO organization.

3.6.1 Firm Infrastructure

Firm Infrastructure support activities include the corporate financial offices, including Accounting, Finance, Accounts Receivable, Accounts Payable, and Corporate Tax. None of these activities are core competencies, so have the potential to be outsourced.

The Legal Department is already completely outsourced. SemiconInc researches and files patents on a regular basis, but having in-house Legal representation would not provide a competitive advantage, so this function has been outsourced.

Similarly, Facilities Management is outsourced. SemiconInc leases space from a corporate real-estate company, and outsources building maintenance to a contractor. As well, the cafeteria is run by a contractor. There is a small number of in-house Facilities staff who coordinate with the facilities contractors.

SemiconInc is a publicly traded company who acquires other companies on a regular basis. The Finance Department is critical to successful execution of these acquisitions, and the subsequent merging of companies. Finance Department needs to ensure the business is run effectively within the confines of the SEC and Sarbanes-Oxley legislation, but much of the core competency skills necessary here are outsourced to specialized legal or accounting firms.

SemiconInc's in-house Information Technology (IT) group is a source of competitive advantage. Development of ICs is done using complex software tools to design and simulate circuit operation, so a fast and reliable network is critical to ensuring an efficient workforce. If any power failures, software bugs, or network problems disrupt the operation of the IC design tools, then hundreds of expensive design engineers will end up sitting idle, and completed work may even be lost. SemiconInc also maintains several design centres around the globe, so a reliable global communication network is required to allow these groups to cooperate on designs together.

Network security is also a critical function that the IT group provides. Since all of SemiconInc's IC designs are developed in software, this data must be protected from theft or damage from malicious users who could gain access from the Internet or via wireless connection. Clearly, maintaining efficient, cost-effective, and secure IT Infrastructure is critical to a successful IC design company, which is why IT is considered a core competency and these functions are performed in-house.

The final Support group under Firm Infrastructure is the Quality Assurance group. This team has the mandate to drive 'Six-Sigma' quality programs throughout the company to ensure that products delivered to customers have near-zero failure rates. QA conducts regular audits to ensure ISO 9000 procedures are in place and enforced. The support provided by the QA group helps to maximize SemiconInc's customer satisfaction, and is considered a core competency.

3.6.2 Human Resources Management

The HR department is responsible for many Support Functions, including recruiting of new employees, managing employee training programs, handling employee benefits, and administrating the stock option program. All payroll functions are outsourced to a payroll contractor.

Recruiting new talent at SemiconInc is generally handled using internal staff, although professional search firms are occasionally retained to help find candidates for senior positions. The recruitment process follows a series of well-defined steps:

1. Department managers meet regularly with divisional VPs to review staffing plans and new requests
2. VP presents staffing plans and requests for new resources to COO at monthly budget review meeting
3. VP of HR and COO staffing plans, and approve highest priority resources as budgets or corporate staffing plans allow
4. Once a new position is approved, HR team begins to advertise the position on the company website, or online job boards such as monster.com
5. A contract recruiter may be retained to find candidates for senior or hard to fill positions
6. As resumes are received, the HR team may screen them based on key criteria, and forward to hiring managers for review
7. Hiring manager reviews resumes and selects potential candidates
8. HR team and hiring managers conduct phone or in-person interviews to shortlist candidates
9. Short-list of candidates are brought in for a series of face to face interviews with various team members
10. HR team presents offers to selected candidates, and negotiates compensation based on market and internal comparisons
11. HR team coordinates visa, relocation, and orientation to bring the new employee on board.

SemiconInc's recruiting process is handled in a similar fashion as the process at other technology companies, and is not a core competency or competitive advantage. In order to compete for top talent in the coming years, SemiconInc needs to develop innovative new techniques for hiring top talent, or hire outside contractors who specialize in the field.

There are no HR resources located overseas, which will soon become a problem as SemiconInc works to grow overseas. Currently, the most effective means of recruiting overseas has been through referrals from existing employees. In order to encourage new referrals, employees are eligible for a substantial cash bonus if a candidate they referred is selected for hire. Hard to fill positions are often eligible for higher bonuses than easier to fill positions. Open positions and the referral bonus associated with each position are posted on the internal company website for everyone to access.

3.6.3 Technology Development: R&D

Development of new technologies, processes, and products is key to maintaining and expanding market share in the semiconductor industry. The mandate of the R&D group at SemiconInc is to investigate advanced new technologies, processes, future trends, or long-term customer needs and develop a technology vision/roadmap of which technologies to invest in for the future. The R&D team falls under the guidance of the Chief Technical Officer, and has many different roles to fill, discussed below.

SemiconInc's Research and Development expertise is a true source of competitive advantage, and is clearly a core competency. R&D activities involve keeping up with the latest developments in advanced technologies, and researching ways to cost-effectively incorporate the latest techniques into real-world products. Generally it is too risky to include untested technologies on a new chip development, so the R&D department often launches 'skunk-works' projects to build small-scale prototype test chips to experiment with novel new architectures. Once these new architectures are well understood and tested, they may be included in a large-scale chip development.

Members of the R&D group are generally very experienced industry experts, often with advanced degrees, and years spent working in a research or system architect role. They are often recruited from competitors or customer companies to help SemiconInc develop a roadmap in a very specific area. Team members are organized by skillset, rather than by hierarchy, which allows them to move from project to project as their skills are required.

R&D engineers chair various Vision Teams at SemiconInc, with the mandate to investigate new technologies or markets that SemiconInc could develop new products for. Members of the marketing team are also involved, and together the Vision Team will develop a product strategy or roadmap. R&D team members often sit on industry standards bodies, to understand where the industry standards are headed so SemiconInc can design products that meet those standards. In addition, the R&D engineers lobby standards committees to help influence the adoption of standards that are favourable to SemiconInc.

This group works on advanced new technologies, often in conjunction with university research programs, or new start-up companies. The projects completed by the R&D team are usually five or more years away from being commercially viable, but gaining experience in these new technologies long before they become viable can lead to a competitive advantage when the technology approaches mainstream adoption. Successful incubation programs often result in patentable ideas, which the R&D team is also responsible for.

In addition to the technology incubation function, R&D engineers are also involved in evaluating other companies for acquisition or partial investment. Often, a member of the CTO R&D group will sit on the Board of Directors of a start-up company after SemiconInc has made an investment in them. This board-level visibility into the progress of the start-up company is valuable to help SemiconInc better understand the market conditions or estimate the company valuation prior to outright acquisition.

The activities performed by the R&D organization are critical to setting the overall strategic direction of the company, and are a core competency.

3.6.4 Procurement

At SemiconInc, the Procurement Functions are performed by the Purchasing group. This group is responsible for buying all of the products that SemiconInc requires for day-to-day operations, including raw materials for IC development, test equipment for testing of ICs, computers and network equipment, and office supplies. Purchasing receives Purchase Requisition Forms from around the company, routes them to the appropriate executive for approval, and then issues a Purchase Order. Purchasing also works with selected vendor partners to source products as cost-effectively as possible while working to ensure rapid delivery times. When products are received at SemiconInc by the receiving department, the Purchase Orders are reconciled with the received goods, and the Purchase Order is closed. Purchasing also works with the IC Assembly contractors to ensure an adequate supply of raw materials is available, but all of the assembly functions are outsourced.

Larger expenditures are reviewed at a monthly budget review meeting, where corporate controllers factor expenses into the quarterly budget. A detailed due diligence and ROI report must be completed prior to this budget review meeting, where the finance department will give approval, and procurement can proceed with the purchase.

3.7 Summary of Core Competencies

SemiconInc's Core Competencies were outlined in the previous discussion of the Firm-Level Value Chain, and include:

- IC Design
- Technology Development
- Strategic Marketing

- Quality Assurance
- Customer Technical Support

These are the primary activities and support functions that SemiconInc uses to gain a competitive advantage over other competitors or new entrants to the IC industry, and will likely remain in-house rather than being out-sourced in the future.

3.8 Financial Analysis

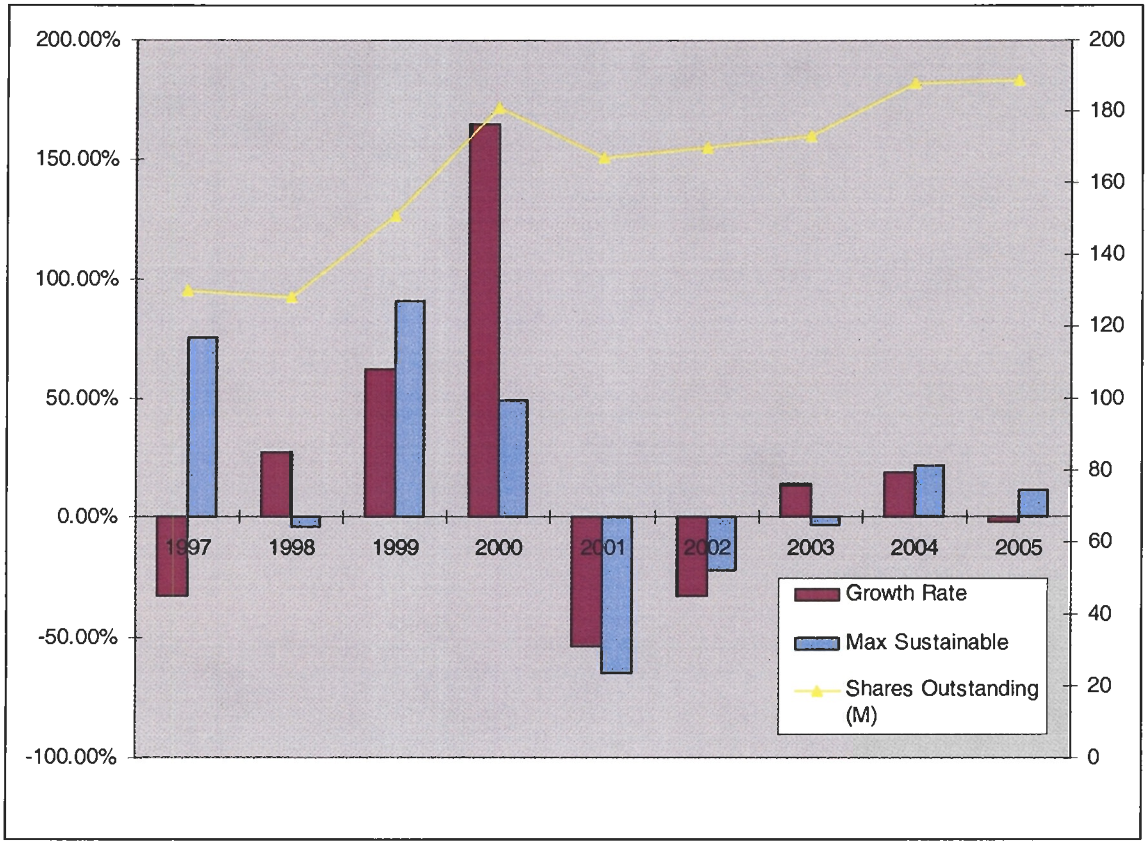
Some of SemiconInc's financial metrics are discussed in the following sections, including Growth Rates, Profitability, Liquidity, and Efficiency. Similar to many technology companies, SemiconInc was dramatically affected by the rapid rise and fall of the tech industry from 1998 through 2001. Following the crash of the technology industry in 2000, SemiconInc has seen a return to more realistic revenues, margins, and growth rates.

3.8.1 Growth Rates

Figure 20 below shows the Actual and Sustainable Growth Rates for SemiconInc. Clearly, for several of the past ten years, SemiconInc has grown faster than its Sustainable Growth Rate. Higgins (2004) warns that growing at rates higher than the calculated sustainable growth rate can be risky for a company, even if it is profitable, because the company will require additional cash to finance operations that may exceed its current debt capacity. Some companies may solve this problem by increasing leverage, or by issuing additional equity.

As shown on Figure 20, SemiconInc chose to finance growth by issuing equity, as indicated by the increase in outstanding shares from approximately 120M shares outstanding in 1998 to 190M outstanding in 2005. Financing growth by issuing new shares is consistent with SemiconInc's conservative financial strategy. Debt levels are kept low to ensure the company will not run into difficulties during downturns in the cyclic semiconductor industry.

Figure 20 Actual vs. Sustainable Growth Rates for SemiconInc 1997-2005



Source: Author. Adapted from data in SemiconInc 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006.

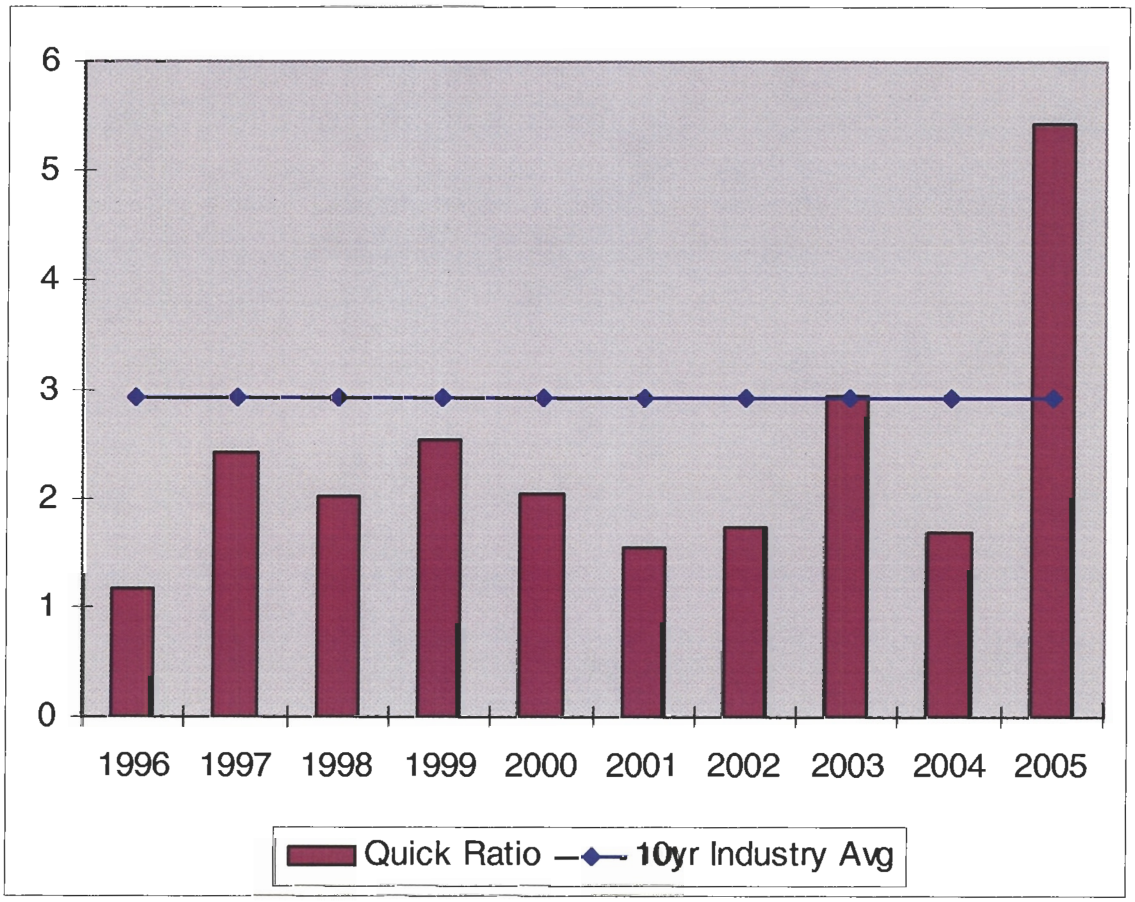
SemiconInc's growth rates for 2004 and 2005 were both lower than the calculated sustainable growth rate. If management feels this is the beginning of a trend, rather than temporary, then new areas of growth should be explored. This is discussed in more detail in the Liquidity section below.

3.8.2 Liquidity

SemiconInc's liquidity as measured by the Quick Ratio (also called Acid-Test Ratio) seems reasonable. As shown in Figure 21 below, for the past ten years SemiconInc's quick ratio has varied between 1 and 3. Higgins (2004) indicates that a quick ratio between 1 and 2 is ideal, but different industries may vary slightly from this benchmark. This is the case with the semiconductor industry, which has a 10yr Average Quick Ratio of approximately 3.

However, SemiconInc's quick ratio for 2005 indicates that there may be some changes coming. In Q4 2005, SemiconInc issued a significant debt offering in anticipation of making an acquisition in early 2006. As a result of this additional cash reserve on the books at the end of 2005, the Quick Ratio for 2005 was approximately 5.5, nearly three times what it was the previous year.

Figure 21 Quick Ratio for SemiconInc 1996-2005



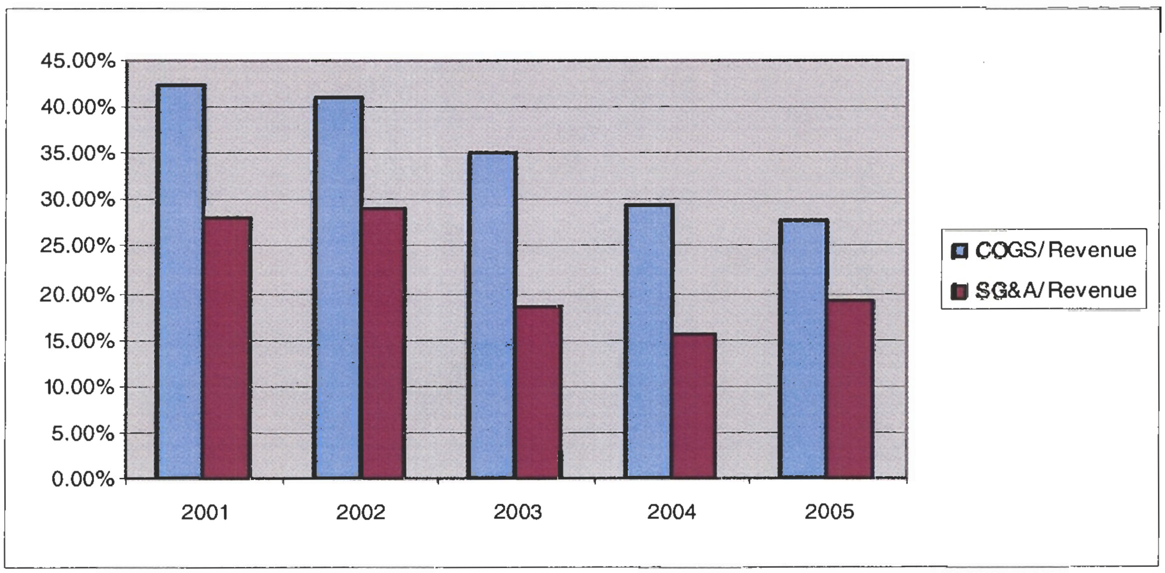
Source: Author. Adapted from data in SemiconInc 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006.

The Quick Ratio for fiscal year 2005 is temporary, and is not expected to persist, because the anticipated acquisition will close in Q106, and the Quick Ratio for fiscal 2006 should return to normal levels.

3.8.3 Expense Ratios

Figure 22 below shows how operating expenses have trended over the past five years. Both COGS/Revenue Admin Expenses/Revenue have been trending downwards. This is a positive sign, as it indicates additional efficiencies are being gained. However, there is a significant uptick in Admin/Revenue ratio for 2005, from approximately 15% to 20%. This is indicative of additional development and marketing costs associated with launch of new products.

Figure 22 Expense Ratios for SemiconInc 2001-2005

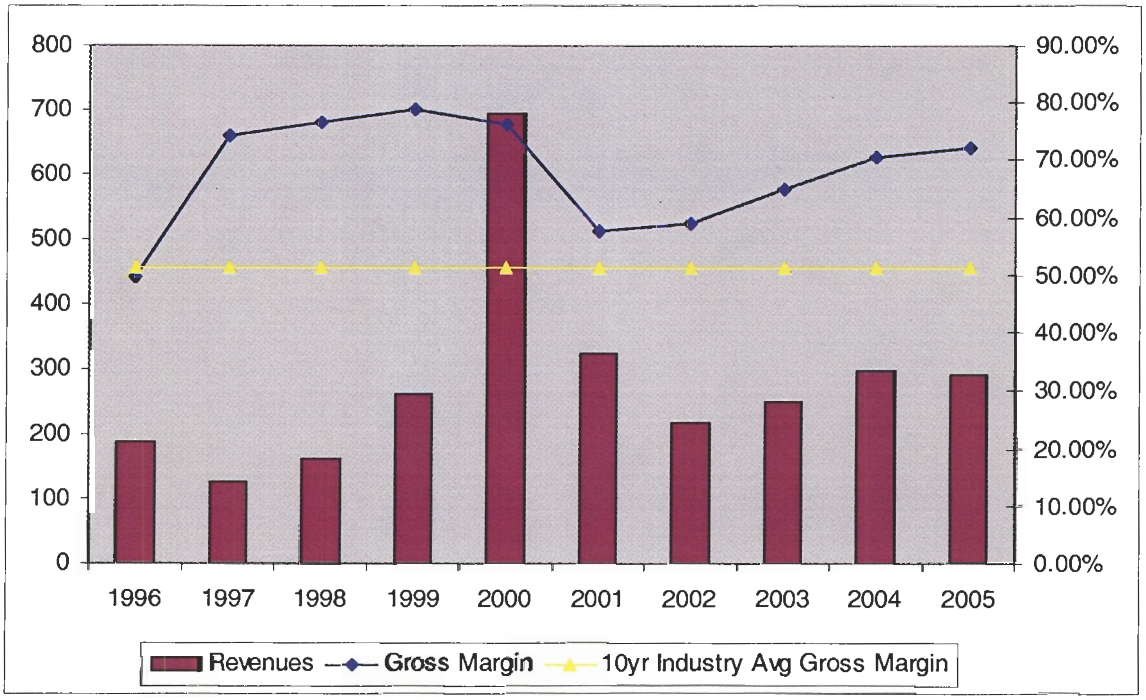


Source: Author. Adapted from data in SemiconInc 2002, 2003, 2004, 2005, 2006.

3.8.4 Profitability

SemiconInc earns some of the highest Gross Margins in the industry, as shown in Figure 23 below. The ten year average Gross Margin for peers in the semiconductor industry is approximately 50%, but SemiconInc earns approximately 70% on average. These margins are indicative of the technical innovation strategy that SemiconInc has adopted. However, this trend may not continue. If SemiconInc chooses to invest heavily in development of ICs for consumer products, it should be expected that gross margins will decline to be more in line with other semiconductor vendors who supply the price-sensitive consumer market.

Figure 23 Gross Margins for SemiconInc 1996-2005

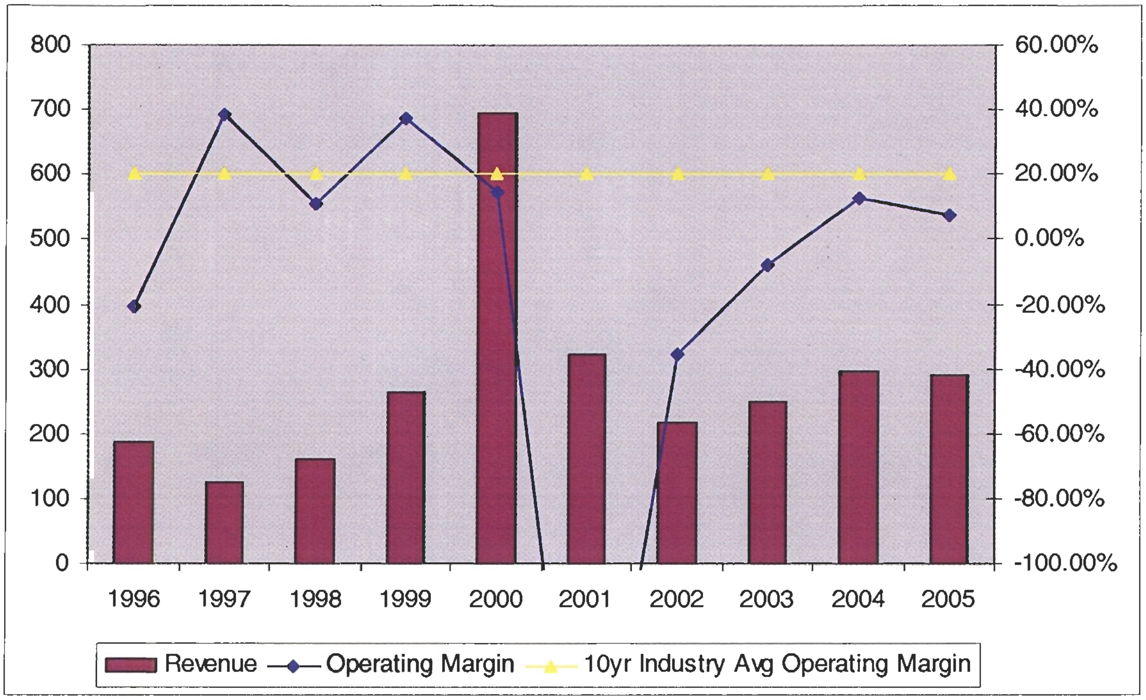


Source: Author. Adapted from data in SemiconInc 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006.

The trend of SemiconInc's operating margin is shown in Figure 24 below. Prior to the slowdown in the tech industry in 2000, SemiconInc earned approximately 20% operating margins, in line with other semiconductor peers. Operating margin has begun to recover following the tech slowdown, and is on a trajectory to reach 20% again soon.

However, if gross margins drop due to expansion into the price-sensitive consumer device space, management will need to ensure that operating expenses can be further reduced. Consumer devices typically drive higher volumes and revenues, so there may be some scale effects that will help to reduce operating expenses. But the dominant portion of Op-Ex is due to product development (R&D) costs, so reducing development costs should be a focus for senior management.

Figure 24 Revenue and Operating Margins for SemiconInc 1996-2005



Source: Author. Adapted from data in SemiconInc 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006.

3.9 Culture

Over the past decade, SemiconInc has differentiated itself as an innovative technology leader with high end, high quality products. This innovative, corporate strategy has several ramifications on company culture.

The dedication to quality has resulted in development of a risk averse and bureaucratic culture with very long verification and test cycles. Many internal procedures (audits, checklists, review meetings) are in place to minimize device design errors, and design error analysis reviews are held regularly to discuss device bugs and how to prevent them in the future. This risk averse and bureaucratic culture leads to longer time to market and higher development costs, so there may be suggestions to reduce this dedication to quality to create products that are "good enough" with faster time to market or lower costs. But as IC tooling costs rise, the costs to revise a device because a bug was not discovered early enough become a much more significant portion of overall project costs. As a result, this dedication to minimize the number of device revisions will ultimately result in additional significant cost savings. As SemiconInc outsources more design work, establishes overseas design teams, or acquires new companies, it needs to ensure that these new teams adopt the quality-enhancing culture and processes that have been so successful at SemiconInc to date. This will help to keep device revision costs down, and maintain SemiconInc's reputation for quality and reliability.

One area of focus that could help to further reduce product development costs, without risking quality, is process optimization. There may be an opportunity for SemiconInc to further innovate on the product development process, in order to speed up design or test time, further reducing costs. But many of the bureaucratic design flow processes have become engrained in the culture, and there is reluctance to change or adopt new processes or tools. This is a cultural issue that needs to be addressed if SemiconInc expects to compete with competitors from low-cost regions.

The culture of technological leadership and product innovation comes at a cost, the deterioration of leadership/management development programs. There is little focus on development of future leaders and managers within the company, but significant emphasis continues to be placed on development of technical expertise. This will become a problem as SemiconInc grows, and expands operations globally. Projects will be staffed by international teams, and will require managers who are able to bridge language/culture gaps in addition to providing technical leadership.

Last, SemiconInc's dedication to technical leadership leads to a culture that is not as tightly engaged with customers as it could be. Engineers on the product design team are incented based on technical performance metrics, such as zero device defects, or meeting aggressive project milestones. There are no incentives that relate to customer responsiveness. A potential solution to help the engineering team become less schedule-driven and more customer-driven would be to include customer satisfaction metrics as part of their quarterly performance evaluations. Another more radical step would be to start rotating design engineers into the customer technical support group for a temporary tour of duty working directly with customers. This would help the design teams develop a better sense for what customers want, and help them improve the products that they build. Currently, customer feedback is communicated through the Marketing and Applications Support teams, but having members of the design team work directly with the customer in their labs may help SemiconInc design teams break away from their autocratic processes to become more understanding and reactive to customer demands.

4 STRATEGIC ISSUES

Following the technology market crash of 2001, SemiconInc has maintained strict cost controls on R&D and SG&A spending. Many teams were downsized, and since 2001 the entire company has been diligent to cut costs and optimize processes where possible. There is little potential left to drive profit growth by cutting costs. Instead, with costs minimized, SemiconInc needs to look for opportunities for top line revenue growth, while continuing to keep expenses as low as possible. Some of the ways this can be accomplished is by acquiring new businesses, or expanding into new markets. The consumer SOC market is one opportunity that SemiconInc should address, because this market continues to grow exponentially, and SemiconInc has core competencies that will provide sustainable competitive advantage. In a Q4 2005 research note, Lewis (2005) suggests that SOC devices are the most important type of semiconductor device since the microprocessor, and are the catalyst that drives progress towards smaller, faster, cheaper, and more integrated semiconductors. Lewis forecasts that the SOC market will grow from $46B USD in 2005 to $86B USD in 2010, addressing such consumer devices as multimedia phones, wireless routers, set-top boxes, among others. SemiconInc has the core competencies to be competitive, and with the right entry strategy should be able to differentiate themselves to capture a significant share of this market.

However, there will be some changes that SemiconInc will have to make. In the past, SemiconInc has followed a Differentiation Strategy, by developing highly advanced telecom ICs with premium pricing. In the telecom space, product price elasticity of demand is lower, and there are significant barriers to entry, which result in long product life cycles and healthy returns. The

Consumer SOC market is completely different. Product life cycles are short, profit margins are slim, but volumes are significant.

Porter (1998) describes two ways that companies can differentiate:

- increasing operational effectiveness - which entails doing the same activities as competitors but doing them better.
- strategic positioning - doing things differently and delivering unique value for customers.

In the following sections, several opportunities for SemiconInc to improve operational effectiveness or strategic positioning are presented. In Section 5, some implementation recommendations are discussed that will help address these challenges.

4.1 Adopting a Focus Strategy

If SemiconInc chooses to enter the Consumer SOC market, by offering the same products at the same price as current competitors, it will likely fail. Neither can SemiconInc compete solely on differentiation, because the consumer market will not support high-priced products, despite innovative differentiating features. For SemiconInc, the best strategy for success in the competitive consumer SOC market is to adopt what Porter (1980) refers to as a Focus Strategy. With a Focus Strategy, SemiconInc can compete by targeting a narrow segment of the market with a combination of features that is currently not offered by the high-volume incumbents, with a slight price premium that focus customers are willing to pay extra for.

In order to sustain a competitive advantage, the Focus Strategy should take full advantage of SemiconInc's primary core competencies:

- Process: years of experience integrating complicated pieces of IP together into a functional IC with minimal device design flaws
- Expertise: world-class high performance Analog IC development
- Service: responsive customer support and willingness to customize products.

SemiconInc's experience in developing highly integrated ICs on schedule and on budget, will allow them to meet demanding customer design milestone targets. Leveraging their world-class analog development experience will allow SemiconInc to integrate expensive analog components such as wireless or ADSL/VDSL modem functionality into their ICs. This bundling of analog components allows SemiconInc to earn additional margin, but reduces the overall end-customer product cost by eliminating modem vendors, minimizing device count, reducing board space, and reducing power consumption.

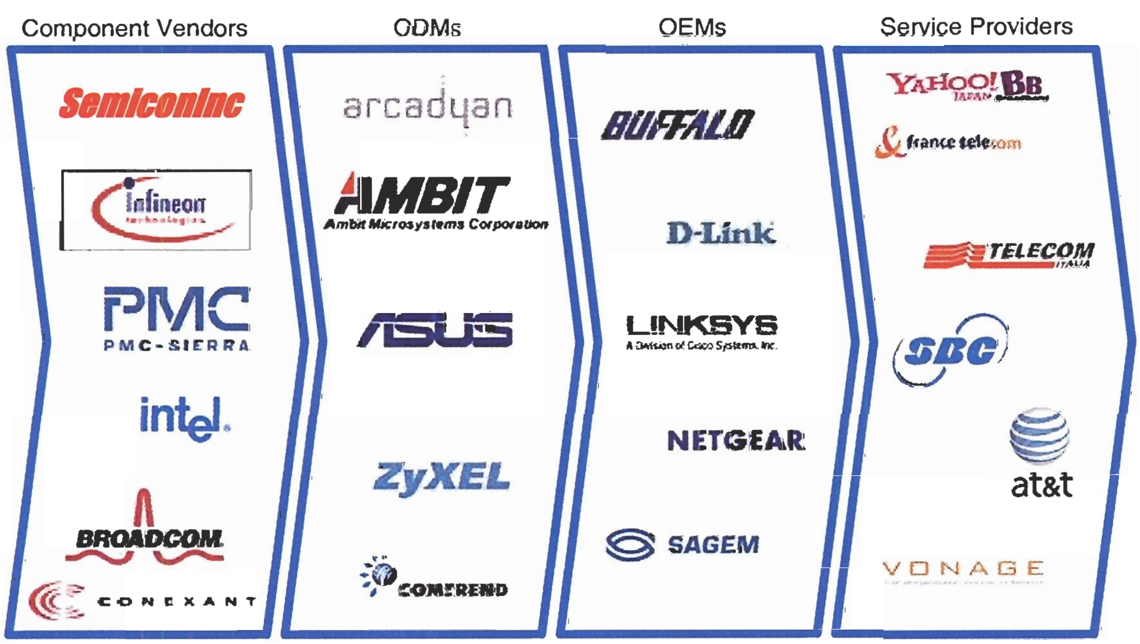
There are challenges with this focus strategy. While SemiconInc has core competencies in IC integration and analog design, it is missing key skills such as SOC software development and xDSL interoperability testing experience. In addition, consumer products are most often manufactured by Asian Original Design Manufacturers (ODMs), a new group of customers that SemiconInc does not have a long history of working with. These issues are discussed in sections below and addressed in Section 5.

4.2 Supply Chain: Working with New ODM Customers

In the traditional Telecom IC market, SemiconInc supplies ICs directly to OEM customers such as Nortel and Cisco, who design and build equipment for telecom carriers. However, in an effort to reduce product development costs, OEMs such as Dell, Linksys, and HP have begun to outsource much of the design and manufacturing for their consumer products to ODMs in low labour cost regions, mainly in Taiwan and China.

In general, OEMs use ODMs in two ways, either buying a completed product from the ODM, or contracting the ODM to build a custom product to their specification. In the case where the OEM purchases completed products from the ODM, these are typically re-branded with the OEM label on them, and shipped to customers. OEMs contribute zero IP, and might use this strategy to quickly fill a hole in their product portfolio. In the case where the ODM is engaged as a design and manufacturing partner, the OEM would provide the ODM with detailed specifications, and the ODM would complete the majority of the hardware/software development, testing, and manufacturing work. This mode of engagement is useful when OEM requires an innovative differentiated product, and is willing to contribute some IP or design guidance. Often, this is the case when an end customer, a telecom service provider for example, issues a Request for Quotation (RFQ) with detailed features or components already specified. If the OEM/ODM partnership wants to win that bid, then they will need to design their product offering to meet the specifications as outlined by the end customer. Figure 25 shows a selection of companies along the manufacturing hierarchy, with component vendors like SemiconInc at the left, through ODMs, OEMs, and finally to the Service Providers, who bundle products together with their services, to sell to consumers.

Figure 25 Supply Chain Hierarchy



Source: Author.

The trend towards ODM outsourcing has been increasing for years, and is expected to continue. Engardio and Einhorn (2005) outline that in 2005, Taiwanese ODMs such as ASUStek, Gemtek, Delta, Zyxel, and others designed and manufactured a significant portion of global consumer electronic products see Table 3 below. Other research indicates that semiconductor purchases by ODMs will grow at a CAGR of 21 percent through 2007 (Pick, 2005)

Table 3 Taiwan ODM Market Share

Product	% of Global Production by ODMs
Notebook PCs	65%
Mobile Phones	20%
Digital Cameras	30%
MP3 Players	65%
PDAs	70%

Source: Author, adapted from data in Pick (2005).

These growth projections indicate that ODMs supply a large portion of the global market, and therefore have some power and/or influence in which components are designed into the end product. Typically, as long as the end product meets OEM specifications, price, and schedule, ODMs are able to choose the best solution that will minimize their development costs and materials costs, and maximize product reliability. As a component supplier, SemiconInc needs to be aware of the increasing power the ODM holds, and work to develop relationships with them to ensure SemiconInc solutions are chosen. Currently, SemiconInc has strong relationships with OEMs, but not with ODMs. This must be addressed to ensure SemiconInc is considered for future ODM designs.

4.3 New Core Competencies Required for SOC Development

To successfully move from hardware-focused telecom IC development into software-intensive SOC development, SemiconInc will need to develop skills in new areas, discussed below.

4.3.1 Growing Importance of Reference Designs

In SemiconInc's traditional telecom IC markets, customers use prototype reference designs as a starting point to help them quickly define the 'commodity' portions of their designs, so they can focus the majority of their engineering resources on developing value-added differentiated features. These prototype reference designs are not production-ready systems, rather they are tools to demonstrate performance in a generic application, or may demonstrate recommended best-practice implementations for complicated portions of the design.

When working with ODMs in Consumer SOC markets, the availability of a more complete production-ready reference design is required. By definition, ODMs have design expertise, but also rely on previously tested design recommendations supplied by component manufacturers to mitigate risk. If this reference design information is not available from one SOC vendor, then they may well choose another vendor to avoid the risk associated with developing a product based on an untested design. ODMs generally require a full-featured demo followed by a comprehensive evaluation period to prove SOC performance specifications and guarantee interoperability. These hurdles must be cleared *before* an SOC is selected for a design, so near-complete hardware and software is required very early in the design cycle. This capability to rapidly produce near production-ready reference designs is not a core competency at SemiconInc, and will need to be developed.

4.3.2 Software Development

A focus supplier creates value over generic low-cost solutions by developing products customized for customers. In order to have a successful focus strategy in the consumer SOC industry, SemiconInc will need to have the capability to differentiate through software features and customization. This will require SemiconInc to significantly augment their software development capabilities to be able to develop and support multiple custom software feature-sets for multiple customers. If SemiconInc is resourced-constrained in software development and support, this will effectively limit the number of customers who will purchase SOC devices, resulting in lower margins. Therefore, SOC program success will be affected by SemiconInc's ability to find and hire a critical mass of skilled embedded software developers.

SemiconInc has traditionally been an IC manufacturer focused exclusively on hardware development, and as a result software development is not a core competency. However, a successful SOC strategy requires both IC development and software development expertise. In order to successfully compete in the SOC market, SemiconInc will need to add software development expertise to complement the existing IC development teams.

4.3.3 Interoperability Test Capability

Consumer SOCs are targeted at home networks, but need to communicate with Service Provider central office equipment over Access networks such as ADSL and VDSL. Service providers require all equipment that will be part of their network to complete rigorous Interoperability (Interop) testing to ensure all equipment in the field is compatible with all current and future equipment that could be installed in the rest of the network. Data rate throughput, min/max cable length, error recovery, environmental effects, and interop with equipment from multiple vendors are all tested. SemiconInc will need technical field staff who are experienced with this level of detailed carrier testing. Similar to the discussions above, traditionally it has not been necessary for SemiconInc to provide this support, so currently is it not a core competency.

4.4 Cost Competitiveness

Traditionally, SemiconInc's strategy has been that of a high-cost differentiator. The majority of SemiconInc's R&D resources are located in high-cost regions, either Canada or USA. However, in a 2005 research note, Reippo forecasts that by 2010 nearly 50% of semiconductor TAM will be tied to consumer products, a market he characterizes as "notoriously fickle, low-margin, and time-sensitive". In order to compete in the consumer SOC market, SemiconInc will need to lower R&D expenses as a percentage of revenue, by outsourcing or adding software expertise from low cost regions.

4.4.1 Offshore Design Teams

Porter (1998) suggests that a differentiator cannot ignore its cost position, and must aim for cost parity relative to its competitors. Incumbents in the consumer SOC space have already turned to offshore labour to help reduce R&D costs by opening design centres in low-labour cost regions, and SemiconInc will need to do the same. SOC development will require software development staff, so SemiconInc should add this capability in low-cost regions such as China or India.

One such example is Infineon Technologies, an incumbent in the consumer SOC industry. At a 2005 conference, Infineon executives outlined that from 2005-2007 they planned to add 1000+ engineers in China (Loh, 2005). Loh outlines the reasons for expanding into China, these include:

- availability of a large engineering talent pool
- low labour costs
- low turn-over rates
- high number of highly qualified students.

Similar to Infineon, other incumbents in the consumer SOC industry have expanded development into Asia to help lower costs. The CEO Outlook 2005 survey from Sand Hill Group found 60 percent of software companies are off shoring some part of their business, and two-thirds of executives report satisfaction with these efforts (Rangaswami, 2005).

To successfully execute a focus strategy, SemiconInc will need to add a significant number of software engineers. To ensure R&D costs remain at parity with competitors, SemiconInc should look towards Asia and other low-cost regions to staff these development teams.

4.4.2 Outsourced Software Development

Some competitors in the semiconductor industry have outsourced portions of software development to contractors in low labour-cost regions such as India or China. This can be an effective way to reduce R&D costs, but also carries significant risks.

Software development projects are often very complicated, and require strict process rules to be followed to ensure quality of the completed product. SemiconInc is in the process of developing detailed software design control procedures internal to the company, and will need to ensure that external contractors follow the same processes. For example, internal and external teams need access to the same code base, with automated real time revision control processes. This is often difficult to coordinate across geographically separated regions, and across multiple time zones.

Software development projects often require more than just technical skills, but also an understanding of business priorities. In the early stages of a product, priorities can be very dynamic, and software teams need to be able to rapidly make tradeoffs to project scope, quality, and schedules when business priorities change. An outsourced overseas team may not be able to react quickly or appropriately to these changes.

Outsourcing of low value-add commodity software development should not be a significant concern. However, if SemiconInc adopts a Focus strategy with a customized, differentiated feature set, it will need to be careful to ensure this IP is protected. Otherwise, SemiconInc runs the risk of helping the outsourced contractor develop core competencies in competing areas, and ultimately becoming a new competitor. Other risks include migration of

SemiconInc innovations into products from other competitors who use the same outsourced contractor. See Section 5.5 below for further discussion on protecting IP.

4.5 Overseas Recruitment

In order to be competitive in the consumer SOC market, SemiconInc needs to attract top talent in IC design, software development, and customer engineering/support. Currently, SemiconInc's recruiting strategies are not sufficient to meet these corporate goals.

The current recruitment process is very bureaucratic, with several stages of approvals required before a position can even be advertised. In a worst case situation, it may take months from the time that departments decide they need to hire, until the position is finally approved and advertised to the public. Finding the right candidate may take many more months.

Once resumes start rolling in, they follow a manual process subject to errors and delays. Resumes received from online job boards may be screened using basic keyword searches, but resumes received directly from candidates or contract recruiters are manually screened by HR and routed to the hiring manager by email. This manual screening/review process results in many errors and/or delays, including:

- resumes rejected by one hiring manager are not archived or automatically made available for other managers to review
- interviewer comments are not stored in a central repository for future review by other departments
- rigid keyword screening filters out talented people that may not have the precise skill set, but could grow into the position or bring new ideas from other industries.

This bureaucratic system and lack of automation makes it difficult for SemiconInc to maintain a 'pipeline' of potential talent. Each position is requested, advertised and filled in isolation of others. SemiconInc needs to make recruitment a strategic focus, and develop innovative new recruiting techniques to ensure it has a continuous flow of top talent already screened in anticipation of new positions approved.

SemiconInc does not have regular recruitment training sessions for hiring managers. As a result, interviewing techniques and skills vary from manager to manager, with candidates often selected based on qualitative 'gut-feel' criteria. SemiconInc needs to invest in the recruiting training process, to raise the level of interviewing skills and candidate assessment methods to ensure only top talent is hired.

The final strategic recruiting issue is related to global expansion. With approximately 1000 employees worldwide, SemiconInc is a small company when compared with established multinational semiconductor companies such as Intel and Infineon, with approximately 99,000 (Intel, 2005) and 36,000 (Infineon, 2005) employees respectively. Hofstede (1980) asserts that in collectivist cultures like China and Taiwan, uncertainty avoidance plays a significant role in an employee's job satisfaction. As a result, SemiconInc will likely have difficulty attracting talent from larger companies, since a small player like SemiconInc is deemed as more risky than staying with the large well-established company. Potential candidates may also feel that a smaller company like SemiconInc does not have the same brand cachet/image or career development opportunities as a larger company. SemiconInc will need to focus on building their brand to alleviate some of these concerns. SemiconInc will need local HR recruiters stationed in China and Taiwan to help build the company image. Currently, there are no SemiconInc recruiters who work in Asia, all recruiting is done from North America.

4.6 Protection of IP

One of the key strategic areas of concern for any technology innovator seeking to outsource or build design teams in Asia is adequate protection of Intellectual Property (IP). For

SemiconInc, proprietary IP may take many forms, including: SOC IC device design information, printed circuit board layout files, or software source code.

In a 2006 briefing to the US Senate, Harvard law professor William Alford suggests that for millennia, Chinese culture has treated knowledge as a free commodity to be used for the general benefit to society (Alford 2006). This helped create a society where the ethics of IP protection are quite different than Western standards. An important part of China's accession to the World Trade Organization (WTO) in 2001 was its agreement to adopt new regulations protecting IP according to the WTO Trade-Related Aspects of Intellectual Property (TRIP) standards. Alford (2006) continues that in response to the WTO requirements, China did enact a fairly complete set of intellectual property laws, but because of ineffective enforcement of those laws, IP infringement is still rampant. Software piracy is one of the most widespread infringements of IP currently occurring in China. As an example, Cisco Systems accused China's largest telecommunications equipment vendor, Huawei, of stealing portions of Cisco's IOS operating system source code, and violating software copyright laws. The two companies negotiated a settlement in 2004 that saw Huawei remove or modify portions of their software that were deemed to have infringed on Cisco IP.

In the consumer SOC space, a company with a Focus Strategy will use customized software to help differentiate their products. If SemiconInc chooses to develop customized proprietary software using resources in China, adequate protection of proprietary software IP is critical. In addition to making full use of existing legal IP protection measures, SemiconInc should also be proactive and factor protection of IP into strategic decisions, such as where new software design teams should be located, or which outsourcing partners have the best reputation for protection of IP. More detailed recommendations are discussed in the following sections.

5 RECOMMENDATIONS

5.1 Working with ODMs

As successful ODM strategy will require SemiconInc to better understand and control the complex sale process that OEM/ODM partners follow. There are multiple layers of decision makers who will ultimately determine which components are selected for a design. This starts with the end customers, usually telecom service providers, carries through the OEM, and finally to the ODM. At each step along the way there are opportunities for SemiconInc to influence the decision makers in their favour. OEMs and end customers may be in North America, but the ODMs will likely be in Asia. This will require a sales team located where the ODMs are, able to communicate in the local language, likely Mandarin. SemiconInc will need to rapidly build an experienced team in Asia to effectively influence ODMs. SemiconInc already has well established relationships with many OEMs and telecom service providers.

Once SemiconInc is selected as the SOC component vendor for a particular design, there is still significant effort required to ensure this relationship is maintained. Providing responsive expert technical support is one of the top priorities to ensure the ODM can successfully deliver the product to the OEM on schedule. This will require SemiconInc to staff engineering support teams in the regions where key ODMs are. Without this support, ODMs may not meet their schedule, and may lose their design opportunities. If ODMs experience poor support, they will likely switch to a different component supplier, putting future design wins in jeopardy.

Other incentives could be offered to ODMs to help win the design, such as offering extended payment terms, bundled pricing for other components, or discounts on future purchases.

5.2 Develop New Core Competencies

5.2.1 Production-Ready Reference Designs

In addition to providing expert technical support, one of the most important selection criteria for ODMs is the availability of near production-ready reference designs. In general, the more complex a product, the more comprehensive the reference design needs to be. The ultimate goal is a reference design that an ODM can simply copy exactly, build millions of units, and ship to customers. Meeting this will require a level of design for manufacturability (DFM) skill that SemiconInc currently does not have. SemiconInc will need to invest in DFM training for hardware and software engineers, or commit to hiring experienced engineers to be able to deliver production-quality reference designs. This is a significant undertaking, and will require development of new core competencies. An alternative is to only engage with ODM customers who have DFM skills already, and can make due with a less comprehensive 'proof of concept' reference design to demonstrate performance.

5.2.2 SOC Software Development and Support

In order to support SemiconInc's Focus strategy, sufficient software design teams will need to be staffed to support initial product development, customer customization requirements, and technical support/troubleshooting. The staffing requirements to effectively complete all of these tasks for many customers is a massive and expensive undertaking, that would require a commitment to far more in R&D than SemiconInc is used to. Instead, SemiconInc will need to carefully choose a small number of customers to engage, so that schedules are met and support is top quality. As software matures, support requirements will decline, and more customers can be supported with the same team. If SemiconInc is not careful and engages any customer who seems interested, then the support and development requirements will quickly escalate out of control, the support and development teams will become overloaded, schedules will start to slip and customers will be dissatisfied. This scenario could permanently damage SemiconInc's reputation, making it difficult to successfully compete with incumbents in the SOC space.

For portions of the SOC software that are not differentiators, SemiconInc must investigate purchasing this from third party IP vendors, so that design teams can focus exclusively on developing unique innovative features that support the Focus strategy. Developing the entire software system from scratch, including standards-based commodity components, is a waste of talented resources that should be focused on adding value. Another alternative is to acquire a small company who has a team of experienced software engineers and who has portions of the required software already complete. Due diligence is critical here, to ensure that the software is functional and well written, such that it can be integrated and maintained by the SemiconInc team if the original team cannot be kept intact.

5.2.3 Interoperability Expertise

Consumer SOCs targeting the digital home make use of DSL connections such as ADSL and VDSL. SemiconInc will need to develop expertise deploying and testing these connections in real-world carrier applications. DSL connections, especially video-capable connections will require significantly more detailed testing than the traditional rate/reach testing that SemiconInc is familiar with. Detailed protocol interaction in dynamic noise environments become critical when high speed DSL is tested at carriers. Furthermore, performance of DSL links will vary depending on which manufacturer's equipment is used at the central office, and even the version of the software load running on the carrier equipment can affect results. This entire testing environment is new to SemiconInc, but customers will demand a level of expertise here, so SemiconInc needs to be prepared to deliver it. This requires investment in a team of experienced DSL engineers, as well as a comprehensive set of test equipment that will allow SemiconInc to duplicate the operating conditions expected at the carriers.

5.3 Lower Development Costs

Development of full-featured software for consumer SOCs requires a large software team that SemiconInc currently does not have on staff. SemiconInc should first look towards building these teams in regions with low-cost labour, such as China or India. Both of these countries have been investing heavily in technical education, so have large numbers of talented engineers available at low cost.

As this outsourcing trend continues, the wages in these low-cost regions may start to rise. So while SemiconInc should invest in China or India now, it should also continuously be looking at other low-cost regions that will support development teams in the future. Labour cost is not the only variable to evaluate however. Language, culture, political stability, availability of engineers, and proximity to customers all play an important role in determining the costs, so all need to be carefully evaluated when establishing future offshore design centres.

Currently, SemiconInc's management of outsourcing projects is not well coordinated across the company. As a result, each group who decides to outsource work must individually search for appropriate vendors, discuss contract details, and negotiate prices. This is time consuming, and since each project is negotiated individually, it results in less negotiating power for SemiconInc. Outsourcing work is key to keeping development costs down, so SemiconInc should develop a centralized outsourcing management team to ensure consistency and maintain control over vendor selection. This will result in more negotiating power and better financial terms, but will also eliminate redundant efforts by separate groups, and will help converge on a group of approved outsourcing contractors.

Finally, the last recommendation to help reduce development costs is to establish a business development team to search for opportunities to acquire solid technology from other companies, either by licensing, setting up a joint venture, purchasing IP, or by acquiring the company outright. Occasionally, there are start-up companies who are seeking an exit strategy because their funding has been terminated, and IP can be acquired for a fraction of the cost that it would take to develop internally. SemiconInc has business development people in North America who investigate potential partners or acquisitions, but not in Asia. This needs to be expanded to ensure opportunities to license, partner, or acquire technology are not overlooked, no matter where the companies may be located.

5.4 Recruiting: Develop a Talent Pipeline

SemiconInc needs to eliminate bureaucracy and inefficiencies in the recruiting process, and develop methods to ensure a constant flow of qualified candidates. The current process of request > approve > advertise > interview > select takes far too long and is not scalable. New recruiting processes should be defined to ensure that candidate flow is maintained, and hiring managers have a pre-screened database of applicants to refer to immediately following approval of new resourcing, rather than starting from scratch each time. It may be possible to outsource the pre-screening process to contract recruitment firms, as long as they clearly understand the job requirements and have a pool of qualified candidates.

If SemiconInc expects to grow internationally, particularly in Asia, then it needs to hire local recruiting staff. Asian-based contract recruiters could be used, but full-time SemiconInc recruiting staff would be preferred, since these people will also be able to spend time addressing the image/branding challenge that smaller companies like SemiconInc will have. When not directly recruiting, they could be attending trade shows, hosting career fairs, establishing relationships with universities and other creative methods to help establish SemiconInc's image as a great place to work.

SemiconInc should make more use of modern technology to help the pre-screening and assessment processes. Any candidate applying for a position in a high-technology company will be comfortable with (or may even expect) technologically advanced screening tools, such as online assessment, or video simulation tools. Other modern web methods such as search engine optimization techniques could be used to reach more qualified candidates, even ones who may not be currently looking for a new job. At the very least, an archive should be set up to hold received resumes and interviewer comments in a searchable database, accessible to hiring managers and recruiters across the company. Currently SemiconInc is still in the dark ages, relying on direct email to selected managers, and manual resume reviews.

Final candidate assessment and review must be done in-person. SemiconInc needs to implement formal interviewing skills training programs, with regular updates, for all hiring managers or team leaders. Also, a focus needs to be put on optimizing the candidate experience while they are at SemiconInc for interviews. Even if a candidate is not selected for the current position, they might be considered for future positions, so SemiconInc needs to ensure the candidates leave with a good impression of SemiconInc as somewhere they would like to work in the future. Having a candidate leave with a poor impression of SemiconInc means they will likely not be interested in future positions, and could damage SemiconInc's reputation if the candidate talks to colleagues about their poor experience.

One of the best recruiting tools available is referrals from current employees, but SemiconInc does not utilize this program effectively to ensure that every employee is acting like a talent scout. While the internal referral program does have financial rewards associated with it, it is strictly a passive program, where jobs and associated referral bonuses are advertised on internal websites, but no efforts are made to push this information to users. SemiconInc needs to adopt a more active approach, by identifying top performers in the company, and specifically tasking them to refer contacts, with associated incentives. Recent arrivals from other companies are particularly valuable, as they may have left behind many other good candidates who could be contacted and recruited.

5.4.1 Training

Expansion into new markets and regions will expose some skills deficiencies. SemiconInc will need to recruit experienced people to address these gaps, but will also need to re-train existing employees so they can better adapt to the new areas of focus. In the rapidly changing consumer space, single-focus technical skills may not be sufficient, additional diversified training in other areas, such as business or software development, should be advocated.

The battle for top quality talent is not exclusive to technical roles only, it also applies to managers. SemiconInc should make investments in leadership training, augmenting business skills, and mentoring/succession planning for promising management candidates.

5.5 Protecting IP

Despite the existence of comprehensive IP protection laws in accordance with WTO standards, China has been criticized for ineffective enforcement. However, as China continues to become more of an innovator itself, the expectation is that enforcement of IP protection will improve as China realizes the benefits of IP protection. In the meantime, SemiconInc will need to adopt policies to take full advantage of whatever legal recourse is available, and also take a proactive strategic approach to preventing IP loss in the first place.

5.5.1 Legal Recourse

SemiconInc will need to develop experience with the various forms of legal IP protection in China, or retain a law firm that specializes in this area. Patent registration in China is treated differently from the US. Patent protection is in effect for 20 years, but China follows a 'first-to-file' system, that means patents are granted to those who file first, even if they are not the original inventors. Under Chinese patent law, a firm must have a business office in China to be able to file a patent directly, otherwise they need to apply through an authorized patent agent. SemiconInc already has an established sales office in China, so this is not an issue, but the patent process is still unfamiliar. China also follows a first to file system for Trademark registration as well, but this is less of an issue with components and software.

Unlike patents, copyright protection does not require specific registration. Instead, copyright is granted to individuals or firms from countries that belong to the same international conventions for copyright protection that China belongs to. However, copyright owners can register with China's National Copyright Administration if they choose to do so. SemiconInc should ensure that software and IC designs are registered with the copyright administration to establish ownership, if copyright enforcement is required.

SemiconInc will need to be prepared to pursue parties who violate IP protection laws and infringe on SemiconInc's proprietary IP. However, the process that IP protection complaints follow in China is quite confusing. Determining which IP protection agency has jurisdiction over a complaint depends on the type of complaint and the geographic region where it occurred. This poses some challenges in how violators can be prosecuted, and may be better left to specialized law firms rather than legal council based in North America.

5.5.2 Preventative Measures

The most effective preventative measure is to avoid SOC software development in China entirely. SemiconInc will need to evaluate the tradeoffs of low-cost development against the risk of IP infringement. There may be opportunities to separate development efforts and have development of very critical proprietary components completed in North America, or India, where IP enforcement is stronger. In these cases, software will need to be partitioned such that the North American teams are the only ones who have access to source code for the critical components. Development of lower value-add commodity portions of the design could be completed in China or elsewhere without risk of affecting the business.

If the cost savings of developing software in China far outweigh the risks of IP infringement, then SemiconInc should investigate setting up an offshore design centre. This is preferable to outsourcing, because SemiconInc will have more control over the operation and staffing decisions. New staff should be screened to ensure high ethical standards, and clean background checks. SemiconInc should try to include as many foreign-trained engineers into the offshore team as possible, with the expectation that time spent working or learning in other countries will have helped them develop a respect for Western IP protection ethics. Regular training visits to the North American design centres should be scheduled to help reinforce this. Finally, SemiconInc should ensure that new employees accept a 1 year or longer non-compete contract to prevent them from leaving and going directly to a competitor, with proprietary knowledge in hand.

Another benefit that an offshore design team has over an outsourced partner is control over security and technology tools to prevent IP infringement. For example, SemiconInc would be able to install and maintain secure network equipment, such as firewalls or authentication services, to reduce the chances of unauthorized access, or to monitor large FTP file transfers. Other more radical protection measures can include restricted transportation of laptops or portable file storage devices such as iPods or USB keys into or out of the building.

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