

**STRATEGIC ANALYSIS OF
PMC-SIERRA'S ENTERPRISE THIN CLIENT BUSINESS**

by

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ABSTRACT

PMC-Sierra is a fab-less semiconductor company that designs, develops, markets and supports a broad range of high-performance integrated circuits used primarily in telecommunications, data networking, and enterprise equipment. The growth rates of these equipment markets began to slowdown in 2001 and have forced PMC-Sierra to explore new disruptive markets for future growth. In 2004, one of the markets the company chose to penetrate with an exploratory investment was the thin client market.

The thin client semiconductor market environment was analyzed and found to have low barriers of entry, dominated by two competitors, and a need for suppliers to provide cost optimized printed circuit boards. The analysis of PMC-Sierra's internal environment illustrated that the company lacks the required printed circuit board supply chain and technical expertise to build a sustainable competitive advantage. It is recommended that PMC-Sierra exit the business.

EXECUTIVE SUMMARY

The core of strategy is about choices, tradeoffs and fit. Winning business strategies start with a different value proposition and enable long-term sustainable competitive advantage. Corporations that are able to create fit between their activities and the needs of their customers can accomplish this. Therefore, when analyzing a company's strategy, both the external and internal environments must be examined to determine the extent to which a firm can create sustainable competitive advantage.

PMC-Sierra's ability to create sustainable competitive advantage in the thin client marketplace was investigated by analyzing the external and internal environments using Porter's Five Forces, the PESTEL framework, and a SWOT analysis. The results from the analysis revealed that the company must revisit its current strategy for pursuing this market. PMC-Sierra currently does not have the resources, the supply chain or the expertise to build a competitive advantage in the thin client marketplace. Therefore, the company has three strategic choices to consider:

- Exit Thin Client Business
- Increase Company's Thin Client Business Investment
- Create a New Venture

Each of these choices is discussed to determine which one fits best with PMC-Sierra's existing cultural processes, norms and competences. It is recommended that PMC-Sierra exit the thin client marketplace and reassign the resources to other company initiatives.

DEDICATION

Nigel Alvares

To my wife, Ritu, who has been patient and understanding with my workload and time over the whole course of the MOT MBA program. She was a pillar of support and provided non-stop encouragement that was instrumental in helping me complete the program.

To my parents, Nelson and Teresa, who have provided me with all the necessary support, guidance and resources to help me accomplish all my goals. I am very thankful and grateful to them both; my achievements would not have been possible without them. Their legacy of hard work and humbleness is an inspiration in everything that I do and pursue.

Shaila Bansal

To my parents, Savita and Satish, who have been, and continue to be, a constant support in my life. Their example has taught me to work hard and dream large. I am grateful to each of them; my successes would not have been possible without them.

To my brothers Vikas and Anil and my sister Priya. Thank you for the numerous conversations filled with endless laughter. During the most stressful times they were each there encouraging and supporting me.

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GLOSSARY

ASP	Average Selling Price
BOM	Bill of Materials
Fab-less	A fab-less semiconductor company does not own or operate its own silicon wafer fabrication foundries; instead it outsources manufacturing.
IC	Integrated Circuit
IT	Information Technology
Malware	Malware refers to software that attacks the PC such as spam, worms, viruses, spyware
MIPS	Million Instructions per Second
NC	Network Computer
NetPC	Network Personal Computer
OEM	Original Equipment Manufacturer
PC	Personal Computer
PCB	Printed Circuit Board
TAM	Total Available Market

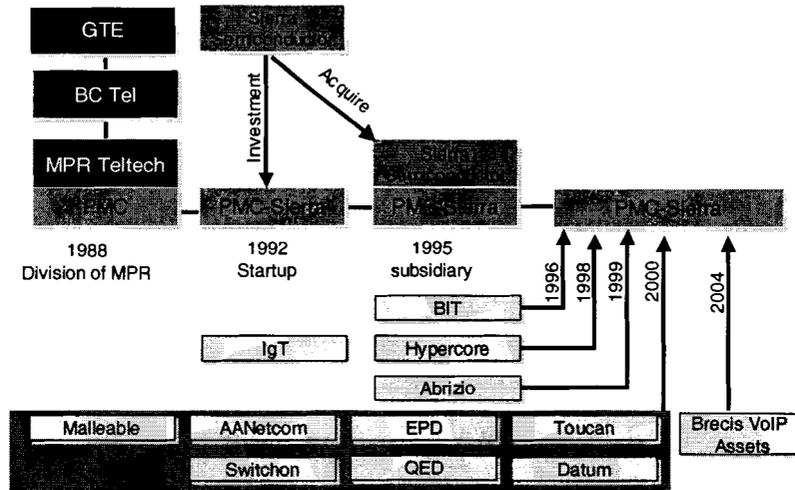
1 INTRODUCTION

This chapter aims to provide background on the company, an introduction to the thin client-computing model and the company's rationale for entering the market. The chapter concludes with an introduction to the paper's analysis, framework and aim, all of which address the company's strategic issue of determining if thin client computing is a disruptive technology and if there's strategic fit between PMC-Sierra and the thin client computing market.

1.1 PMC-Sierra Company Background

PMC-Sierra is a U.S. incorporated "fab-less" semiconductor company that designs, develops, markets and supports a broad range of high-performance integrated circuits used primarily in telecommunications, data networking, and enterprise equipment. Pacific Microelectronics Centre (PMC) was originally founded in 1988 as an integrated circuits design group within the research and development (R&D) organization of British Columbia's telecom service provider, BC Tel. In 1992, PMC received an investment from Sierra Semiconductor to spin out and become PMC-Sierra, a private company focused on providing networking semiconductors. In 1995, PMC-Sierra became a wholly owned, independently operated subsidiary of Sierra Semiconductor. In 1997, Sierra Semiconductor's business prospects started to diminish rapidly, forcing management to make the strategic decision of discontinuing Sierra Semiconductor operations and turning the company completely over to PMC-Sierra. From 1997 to 2001, PMC-Sierra experienced significant growth as sales of its data networking products accelerated with the worldwide adoption of the Internet. The company expanded via organic growth and through multiple acquisitions as shown in Figure 1.

Figure 1: PMC-Sierra Company History



PMC-Sierra is publicly traded on the NASDAQ Stock Market under the PMCS symbol.

The company currently has over nine hundred employees located across eighteen high-technology centres throughout North America, Europe and Asia as shown in Table 1. The company's worldwide headquarters are in Santa Clara, California and the company's operations headquarters are located in Burnaby, British Columbia.

Table 1: PMC-Sierra Locations

City	Country	Function
Allentown	U.S.A.	Design Centre
Beijing	China	Sales Centre
London	U.K.	Sales Centre
Montreal	Canada	Design Centre
Munich	Germany	Sales Centre
Ottawa	Canada	Design & Sales Centre
Paris	France	Sales Centre
Portland	U.S.A.	Worldwide Headquarters, Design & Sales Centre
Santa Clara	U.S.A.	Design & Sales Centre
Saskatoon	Canada	Design Centre
Seoul	Korea	Sales Centre
Shanghai	China	Design & Sales Centre
Shenzhen	China	Sales Centre
Taipei	Taiwan	Sales Centre
Tel Aviv	Israel	Sales Centre
Vancouver	Canada	Operations Headquarters, Design & Sales Centre
Winnipeg	Canada	Design Centre
Yokohama	Japan	Sales Centre

PMC-Sierra is composed of specialized technical individuals with more than eighty-five percent of the company being engineers by training. The organization outsources all of its manufacturing to third party foundry partners such as Taiwan Semiconductor Manufacturing and Chartered Semiconductor Manufacturing. By outsourcing manufacturing, PMC-Sierra focuses the bulk of its resources on enhancing and building its capabilities to provide superior innovative semiconductor products. PMC-Sierra's expertise and competences reside in:

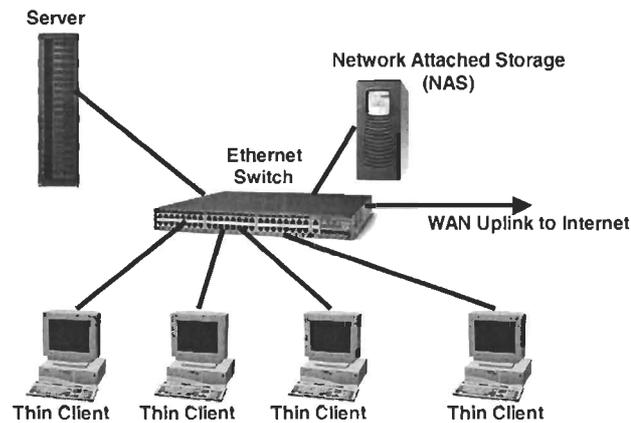
- Deep sub-micron integrated circuit design;
- High-speed mixed signal design;
- MIPS processor leadership and design;
- Networking system architectures, their deployment topologies and service models.

These technical capabilities have enabled the company to produce and build a large library of intellectual property (IP). This library of IP gives the company a distinct competitive advantage in the current markets PMC-Sierra participates in as it is able to leverage this library to build complex system-on-chips (SoCs) faster and with lower investment than competitors. Through continual investment that generates innovation, the company continues to build this impressive library. However, the company has started to experience slower growth in its traditional markets due to reduced carrier service provider spending. As a result, PMC-Sierra is seeking to diversify into new disruptive markets where its technology and capabilities are valued. One market where management sees potential is the thin client computing market since they suspect thin client computing is disruptive to the PC industry and PMC-Sierra's technology fits well into this marketplace. However, the company has not analyzed whether or not thin client computing is disruptive to the PC market and has not completed a strategic analysis of the market to determine if there's a strategic fit. Therefore, the focus of this paper is to complete the analyses and recommend a strategic option to PMC-Sierra's management team.

1.2 Introduction to Thin Client Computing

A thin client, sometimes called a network computer (NC) or a network personal computer (NetPC), is a diskless desktop computing device that relies on a centralized network-computing model for its computing power and data storage. This model consists of a network of application servers and storage devices to which a thin client would connect to as shown in Figure 2.

Figure 2: Thin Client Network Computing Model



While it is common for a desktop personal computer (PC) to be connected to a similar or identical network, it is not essential for it to function. Conversely, a thin client is completely dependent on the network for its functionality since all its data and applications are centrally stored on the network's servers and storage devices. While this limitation would seem to be a detriment to the future success of thin clients, it provides distinct advantages for corporations and their information technology (IT) departments. Enterprise thin clients offer organizations the prospect of achieving two somewhat differing goals: improving security while lowering IT costs.

Thin clients facilitate increased security by removing the major security sources created by PCs: user errors, viruses located on their hard disk drives, and non-uniform, non-standard security applications across the different PCs in the organization. This security improvement is

made possible by the centralization of computing processes and decision making, which form the thin client-computing model. This model makes it easier for IT departments to establish organization-wide security standards, a corporate user does not need to worry about making errors that could compromise their organization's security and in turn corporations are less concerned about the risk of theft given a thin client is useless when not connected to the organization's network.

Thin clients also offer substantial financial advantages. The hardware cost of a thin client is lower than the hardware cost of any PC thus providing organizations with lower acquisition costs. Lower overall maintenance costs can also be achieved due to the centralized architecture of thin clients where IT departments can ensure standardization of software applications and perform updates cost-effectively. Based on conversations with PMC-Sierra's Software and Solutions Group Development Manager, Aaron Gilroy, the company believes that the Asian marketplace can take advantage of thin client technology and is possibly its largest market opportunity.

1.3 The Asian Market Opportunity for Thin Client Computing

China and India are the world's two most populous countries with over a billion people each, representing together almost forty percent of the world's population. The current penetration of computing in both these countries is less than ten percent and thus represents the largest market opportunity for computing in the coming decades. The vendor that is able to introduce viable computing solutions will reap substantial profits since these markets will provide suppliers greater capability, large economies of scale, and ultimately lower cost. However, to be successful in both of these markets, it is vital to address their economic and technical requirements.

Both nations have begun to introduce computing capability into all facets of life. Their key requirements for these initiatives are:

1. Wide-ranging low cost deployment
2. Centralized management to oversee and regulate networks and users
3. Best-in-class network security that limits hacking and proliferation of computer viruses
4. Open source software and hardware architectures encouraging domestic development

These requirements match well with the thin client-computing model and are one of the main reasons that PMC-Sierra has decided to pursue the thin client market. The other main reason is the research and development (R&D) relationship that PMC-Sierra has with China's leading technical university, Tsinghua University. Tsinghua has been working with government officials to satisfy China's computing needs by building a prototype thin client device for the nation's use. Tsinghua's thin client device utilizes PMC-Sierra's MIPS-Powered™ microprocessor chipset and has thus given PMC-Sierra good visibility into the initiative.

Specifically in May 2004, PMC-Sierra hosted a summit of Chinese leaders in business, government, and academia to discuss the future of computing in China. The strategy that emerged from this summit was Kai Yuan (Open Stream) Networked Computing, a roadmap that addresses China's computing needs with a thin client model: open source Linux® software and open MIPS-Powered™ architecture clients. The first prototype device of Kai Yuan NC was developed by Tsinghua University and there are currently computer manufacturers in China building follow-on products based on this strategy. Kai Yuan NC is currently supported and funded by PMC-Sierra, MIPS Technologies, and ATI Technologies.

1.4 PMC-Sierra's Thin Client Computing Business Objective

PMC-Sierra is seeking to penetrate new disruptive markets that will enable the company to grow. The company believes that the thin client computing market is such a market. Therefore, in November 2004, the company started to invest modestly into this business with the long-term intent to build a significant business that uses its existing production released MIPS-based microprocessors. PMC-Sierra believes its MIPS-based microprocessors have distinct advantages over competing solutions that will not only allow it to succeed in this market but enable the thin client computing market to experience significant growth. However, the company has not completed any analysis to determine if thin client computing is indeed a disruptive technology and if there's strategic fit between this market and the company.

1.5 Introduction to Analysis and Framework

PMC-Sierra's strategy is to pursue emerging disruptive markets where its technologies and competencies are valued. The company entered the thin client market in November 2004 with the belief that the market is disruptive and that the company has the competencies to compete effectively. However, no analysis has been completed to confirm these beliefs and management desires this now. This paper performs the analysis, provides strategic options, recommends a strategy along with its implementation plan and concludes with the learning from the strategy process PMC-Sierra followed to pursue the thin client market.

The thin client-computing model is first analyzed to determine if it is a disruptive technology, as defined by Clayton Christensen, to today's personal computers. The paper will then examine PMC-Sierra's external and internal environments to determine if strategic fit exists or can be achieved. The external analysis will analyze the thin client market environment using Porter's five forces and the PESTEL framework. The internal analysis will examine PMC-

Sierra's organizational structure, business model, customer profile, resources and competencies. Based on the findings from these analyses, strategic choices will be presented and evaluated against selected criteria to determine a recommended strategic choice for PMC-Sierra's management team to pursue. The paper concludes with an implementation plan of the recommendation and the learning realized from PMC-Sierra's strategy process for pursuing this market.

2 ARE THIN CLIENTS A DISRUPTIVE TECHNOLOGY?

Since PMC-Sierra seeks to invest in disruptive technologies, this chapter provides a formal analysis to determine whether thin client computing is disruptive to today's personal computers (PC). Clayton Christensen coined the phrase 'disruptive technology' in his 1997 book "*The Innovator's Dilemma*". Christensen stated:

Disruptive technologies bring to market a very different value proposition than had been available previously. Generally, disruptive technologies underperform established products in the "mainstream" markets. But they have other features that a few fringe (and generally new) customers value. (Christensen, 2003, p.xviii)

Christensen studied the history of the hard-disk-drive industry and concluded that it was the industry leaders' dismissal of lesser technologies entering niche markets that caused the leaders to fall from their reigns. Christensen called these lesser technologies 'disruptive technologies'. A disruptive technology is inferior to an incumbent technology in the performance attributes that the mainstream market values, and enters the marketplace by targeting small niche applications. But with time the disruptive technology improves in those performance attributes, valued by the mainstream market, at such a rapid rate that the new technology can invade the established markets. By the time established leaders realize the threat, it is often too late for them to defend their market position.

PMC-Sierra's corporate strategy is to primarily enter disruptive markets, this is because the opportunities for potential rents are high and offer an excellent return on investment. To help PMC-Sierra understand the market potential of thin client computing the rest of this section will discuss the history of technology disruption in the computer industry, and whether the thin client-

computing model is disruptive to today's desktop PCs. This analysis will help PMC-Sierra determine if it should invest in this market and if there is a justifiable reason to change its current processes and systems to compete in the marketplace. Given that disruptive technologies offer significant returns for entrants who make those technologies a focal part of their business, the possible upside of investing in the thin client computing space is large. However, firms do not typically succeed in disruptive manoeuvres simply by "dabbling". It is important to understand the thin client space, and what potential it does offer to PMC-Sierra.

2.1 History of the Computer Industry

The computer industry, just like the hard-disk drive industry, has seen the rise and fall of its own leaders. IBM dominated the mainframe market but missed the emergence of minicomputers. Digital Equipment dominated the minicomputer market and missed the emergence of the PC. Apple then became the market leader of the PC, whose market share IBM and its clones stole, and is now threatened by the entry of the thin client and centralized computing model (Wikipedia, The Free Encyclopedia The Free Encyclopedica, 2005).

2.1.1 Mainframes

IBM introduced the first computer, the mainframe, in 1951; these systems took up entire rooms and required a group of 10 people to operate them. IBM sold 1000 mainframes in 1953 and by 1958 they were the unquestionable market leader with 75% market share. They introduced their second series of mainframes, the 360 series, in 1964 and sold 6 models. Mainframes sold for \$100,000+ during that time, and were marketed to large companies who required a great deal of personalized support (Wikipedia, The Free Encyclopedia, 2005). Their main use was running large databases (i.e. account database for banks, customer record database

for insurance brokerages) and had “simple” terminals interfacing to them. By the 1970s these machines were performing 1,780 5-digit additions or subtractions per second (IBM, 2005).

During the 1980s as microcomputers improved in performance, companies found that microcomputers could be deployed at a fraction of the cost and offered users greater control over their own systems than mainframes. Consequently, demand plummeted and new mainframe installations were restricted to financial services and the government (Wikipedia, The Free Encyclopedia, 2005). IBM dismissed the entry of the microcomputer as a threat because it did not meet the performance requirements of their existing customers. In the end IBM’s addressable market size plummeted and they were no longer the industry leader.

2.1.2 Minicomputers

In 1964 Digital Equipment Corporation (DEC) launched the first successful minicomputer (Ahl, 1984, p.1). The minicomputer addressed the market needs of customers who wanted machines that were not as powerful as mainframes and not as simple as microcomputers, later known as PCs. Minicomputers sold for \$16,000+, took up cabinets as opposed to rooms, could be operated by a single person and required minimal after-sales support (Wikipedia, The Free Encyclopedia, 2005). DEC’s minicomputers of the 1970s improved so much as to perform 1 million instructions per second (MIPS), thus satisfying the needs of the mainframe market as well as the minicomputer market. Its performance allowed minicomputers to run multi-user and multi-tasking operating systems to run batch files and process transactions, a benefit for large companies with computationally intensive operations (Wikipedia, The Free Encyclopedia, 2005).

The decline of minicomputers happened due to the lower cost of microprocessors, the emergence of inexpensive and deployable local area networks, and the end-users desire to be less reliant on inflexible minicomputer manufacturers and IT departments. During the mid-1980s

minicomputers were replaced by networked workstations and PCs. Because PCs entered the market technically inferior to the minicomputer, DEC never recognized their threat and eventually lost their market share.

2.1.3 Personal Computer

The first PC to be sold in high quantities was the Altair 8800, it was introduced in 1975 by MITS and contained the 8080 Intel microprocessor (Ahl, 1984, p.2). The microprocessor ran at 2 MHz, 0.64 MIPS (I-Probe, 2005). The Altair was targeted towards hobbyists and came in a kit, selling for approximately \$400 (Ahl, 1984, p.2).

Apple made its appearance in the PC market in 1976 with the introduction of the Apple I. Even though Apple I came fully assembled, it was still assembled on a per order basis and targeted towards hobbyists (Ahl, 1984, p.2). It was not until the advent of the Apple II in the late 70s and early to mid 80s that the home user and small business user markets became addressable by the PC. The late editions of the Apple II ran 2.8 MHz and sold for approximately \$2000 in 1986 (Wikipedia, The Free Encyclopedia, 2005).

Today's PCs run at 3.60 GHz, sit in a single case, and allow buyers full control over all of its components (Intel, 2005). All of these attributes exceed the needs of the minicomputer market and has caused the PC to own majority market share.

The advent of the Internet has had a positive impact on PC sales, 60% of home PC buyers purchased a PC along with an Internet subscription in 1999 (Country Monitor, 2005, p.5). But the Internet has also enabled the centralized computing model, companies can host applications and computers can interface to them without requiring any information to be stored locally. The PC is not optimized for this application, but the thin client is. The thin client is a stripped down version of a PC and risks stealing market share from leading PC manufacturers.

2.2 Disruption to Personal Computers

The question for PMC-Sierra at the present is: Does the average home or business user need 3.60 GHz of processing power? With an increase in web-enabled applications such as e-mail, word processing, photo imaging there is a question of whether the home user needs multiple-gigahertz processors. And with business applications such as ERP systems, where businesses depend on powerful centralized servers to host applications, will business users need high powered PCs? Web-enabled applications and ERP systems are referred to as centralized computing. Centralized computing is the model many experts such as Larry Ellison of Oracle and Scott McNealy of Sun Microsystems see the computer industry moving towards. Users will require less power in their interfacing terminals and depend on a network of powerful servers to host applications.

Another push towards centralized computing is manageability. According to Fortune magazine “Malware” had an exploding year in 2004 clogging e-mail systems, stealing information, violating privacy and costing companies millions of dollars in lost productivity and system downtime (Lewis, 2004, p.25). With a centralized system IT departments can effectively manage any security threats.

2.2.1 Thin Client

Wyse, Neoware and HP have already introduced thin clients to the marketplace, these thin clients range from 250MHz to 900MHz in speed and cost from \$150 - \$499 per workstation. According to IDC, a market research firm in Framingham Mass., thin clients will account for nearly 10% of the market for desktop computers at large and medium-sized companies by 2008 (Bulkeley, 2005, p. R.3).

Thin client's beachhead customers are those that have not already made a large investment in PCs, those who are building the infrastructure to support centralized computing, and prefer an alternative operating system to Windows, which most PCs run on. These customers will probably reside outside of North America in either Eastern Europe or Asia.

Today's centralized computing architecture does not satisfy the needs of today's PC user, therefore is not penetrating the mass market. But with time as ISPs become equipped to manage applications centrally, manage security threats centrally and provide users the flexibility that their own PCs provide today, thin clients can penetrate the mass market. Once the total cost of ownership of centralized computing proves to be significantly less than today's model and pays for transitioning over from decentralized to centralized, enterprises will start migrating over, further stealing market share from today's PC leaders.

2.2.2 Performance Attributes

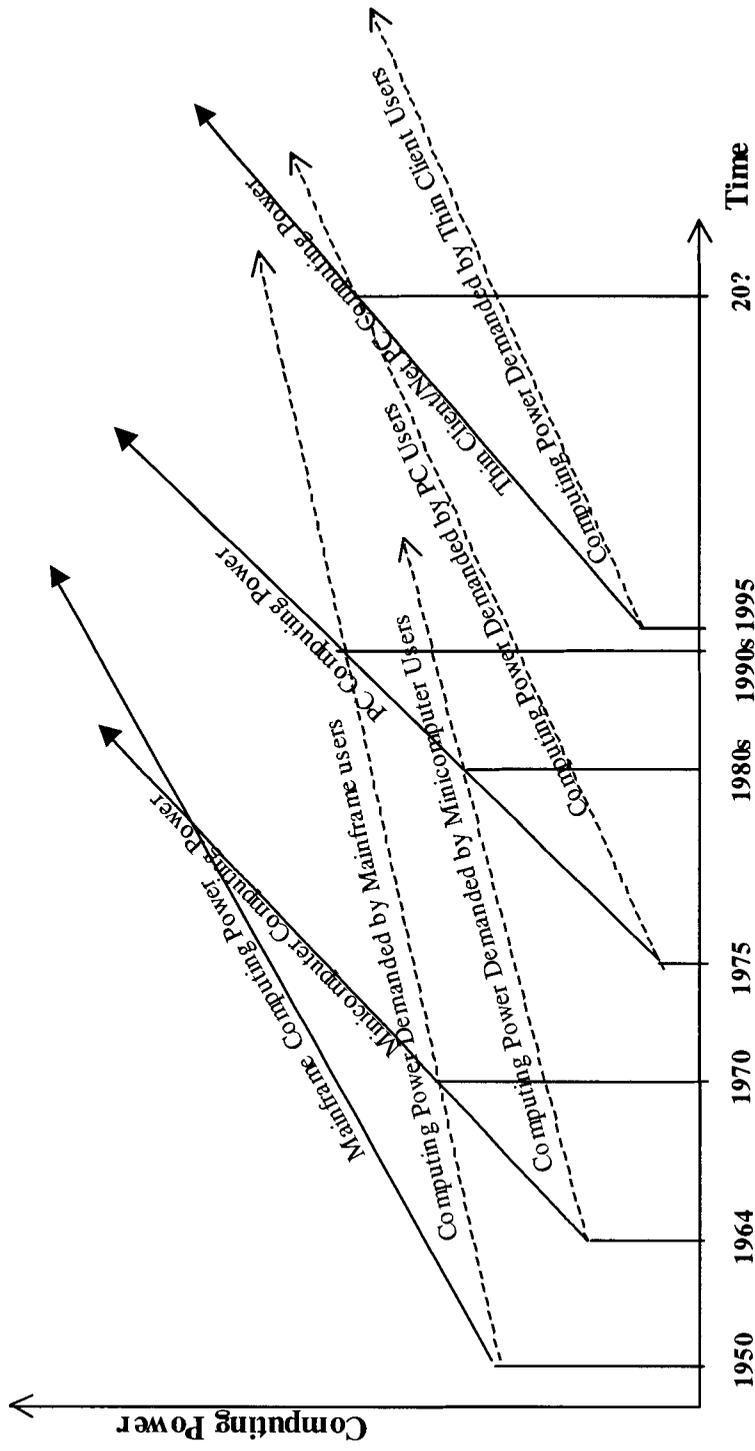
There are numerous attributes the mass-market bases computer purchasing decisions on; some of them are as follows: hard disk capacity, bus speed, processor speed, networkability, video card, manageability, and cost.

Each of these attributes are valued by the market and a mix of them is used to assess which computer to buy. It is difficult to pinpoint exactly which attribute is the most important but traditionally it has been total computing power that drove purchase decisions and will be what this paper uses to assess the disruption of thin client.

For the purposes of this analysis, the term *computing power* will be used. Computing power encompasses processor power as number of instructions per second as well as processor speed. Figure 3 illustrates the history of disruption in the computer industry and predicts continued disruption of thin client on today's PC market

Thin client computing fits many, if not all, of the characteristics of a disruptive technology with the incumbent being the PC computing industry. What remains at issue is whether the company has the strategic fit to compete in the market and capture significant rents.

Figure 3: Computing Device Performance Trajectories



3 EXTERNAL ANALYSIS

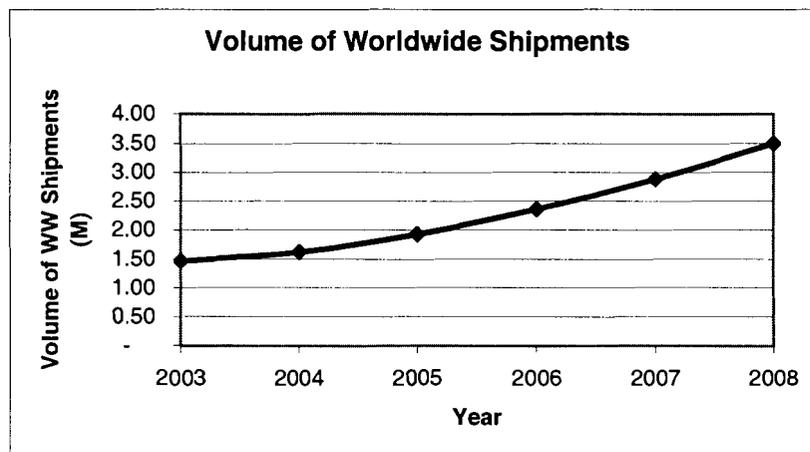
The previous chapters gave an overview of the company's history, how it came to be, and discussed the opportunity the company has to disrupt the PC market. It was mentioned in the introduction that the company has established a relationship with one of China's leading academic institutions, Tsinghua University. This relationship has given PMC-Sierra inroads into Asia and an opportunity to start exploring the market potential there, but since this is a disruptive technology the market is much larger than Asia. This chapter analyzes the global external environment of the thin client industry. It discusses PMC-Sierra's competitors and highlight the company's main opportunities and threats in the industry.

This chapter begins with an overview of the market size and analyzes the external environment using *Porter's five forces* as well as the force of the government (Porter 1980, in Johnson & Scholes, p. 112). It is important to note that none of these forces are independent of each other. Increased pressure from any one force may trigger pressure in another. Each of these forces is also affected by macro-environmental changes. Section 3.3 discusses the macro-environment using the PESTEL framework and highlights which influences have an impact on thin client computing (Johnson & Scholes, 2002, p. 112). The chapter concludes with an overview of the external opportunities and threats facing PMC-Sierra as they assess whether to enter the thin client computing market.

3.1 Market Size

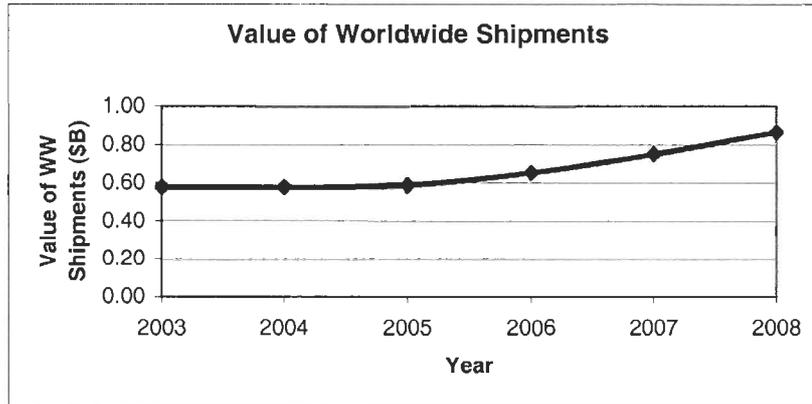
IDC performed a market analysis of the enterprise thin client market in September 2004 and March 2005. The number of thin clients shipped worldwide in 2004 grew 11% from 1.5M units in 2003 to 1.6M units in 2004 (O'Donnell, 2004, p.14). This is a significant increase for a market that is just starting to gain some traction. Figure 4 below illustrates the projected number of devices shipped worldwide from 2003-2008 and Figure 5 illustrates the projected dollar value of these shipments.

Figure 4: Volume of Worldwide Shipments



Data Source: IDC

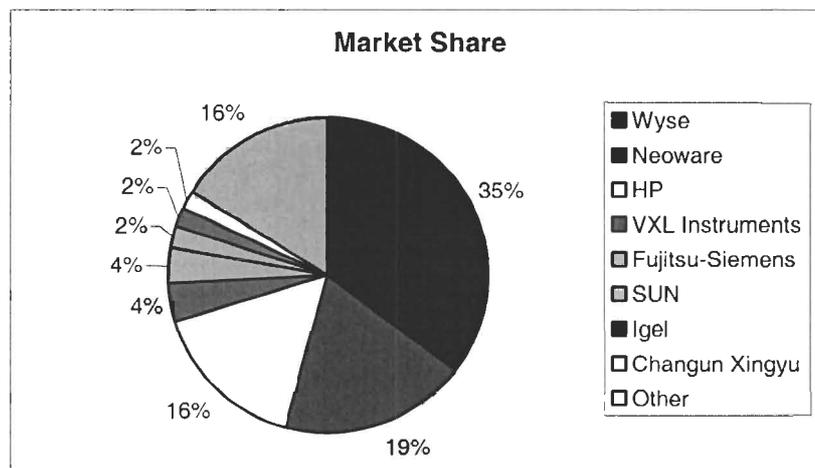
Figure 5: Dollar Value of Worldwide Shipments



Data Source: IDC

The top three vendors of the thin client market Wyse, Neoware and Hewlett-Packard (HP) own 70% of the market. Figure 6 shows the market share breakdown for each of the thin client vendors IDC identified.

Figure 6: Market Share of Thin Client Vendors



Data Source: IDC

3.2 Porter's Five Forces

To understand the competitive landscape of thin-client computing the paper analyzes the external market using *Porter's Five Forces* and the force of the government.

3.2.1 Rivalries

PMC-Sierra's two major competitors in the thin client industry are VIA Technologies Inc. and Advanced Micro Devices (AMD). Both competitors are fab-less semiconductor companies who specialize in x86 microprocessors. VIA Technologies, based in Taipei, Taiwan, was founded in 1987 and is the number one PC motherboard manufacturer for the Intel chipset. AMD is based in Sunnyvale, California, was founded in 1969 and is well known for its microprocessor and Flash memory devices. Both of these companies are leveraging their existing x86 microprocessor expertise to participate in the thin client market.

Thin clients were introduced to the market during the time of the mainframe computer, but it is only recently with the increasing proliferation of the Internet, and the increasing need to reduce total cost of ownership that the market has started to respond to centralized computing. The potential rents of networked computing however are still surprisingly low. According to IDC, the projected number of thin clients shipped to enterprises worldwide in 2008 is 3.5 million units, which corresponds to approximately \$865 million in thin client equipment revenue and approximately \$105 million in thin client microprocessor revenue (O'Donnell, 2004, p. 21). Since the market is relatively small when compared to the PC industry, it is expected that only a small set of microprocessor suppliers will focus on this market. Therefore it is expected that the dominant supplier can emerge early on by being first to market and creating a lock-in at the leading thin client equipment vendors over the next two to three years.

Early market dominance is the best way for any of the microprocessor suppliers to maximize their rents in this market. Desktop computing has become an everyday technology in some parts of the world over the years so as a result, PCs and other desktop solutions are selling at bargain prices and vendors are making minimal margins. So, to be successful PMC-Sierra needs to win the majority of the market, minimize costs, and maximize volumes. Table 2 illustrates the bill of materials (BOM) costs microprocessor suppliers need to have to play in the thin client space.

Table 2: Processor-Based Thin Client PCBs Bill of Materials Comparison

Company	Processor-Based Thin Client PCB	Bill of Material Cost
PMC-Sierra	RM5231A-400	\$70
PMC-Sierra	RM7035C-600	\$85
PMC-Sierra	RM7935C-900	\$100
AMD	GX-400	\$60
VIA	C3-533	\$50
VIA	C3-800	\$65
VIA	C3-1GHz	\$75
Transmeta	Efficeon-1GHz	\$85

From Table 2, one can see that PMC-Sierra needs to reduce their costs by atleast \$20 to be in line with its competitors. PMC-Sierra is aggressively working to reduce these costs. According to IDC, the average selling price (ASP) of thin clients will decline to approximately \$250 in 2008, which will force PMC-Sierra and its competitors to reduce their own costs. To do so, they must have pull with their own suppliers. PMC-Sierra, AMD and VIA are valued customers of their fabrication and packaging partners, therefore they each have a comparable amount of leverage in producing microprocessors. They each also target their microprocessors to different applications, which helps them build enough products to reach minimum economies of scale. A growing number of thin client vendors demand ready to install printed circuit boards (PCB) from their microprocessor suppliers. Neither PMC-Sierra nor AMD are in the business of selling PCBs today, which means if they were to enter these markets they would need to develop

relationships with PCB manufacturers that allow them to be competitive. VIA on the other hand is the number one PC motherboard supplier, so it has already developed a tight supplier network and has the means to squeeze margins and build to economies of scale. Because of this tight network VIA has a strong competitive advantage over PMC-Sierra and AMD in addressing the thin client marketplace.

3.2.1.1 Product Differentiation

There are a number of ways PMC-Sierra, AMD and VIA can differentiate their product offerings. One is based on power. Customers in third world countries, where PCs do not currently have a large installed base, and are most likely to be attracted to the networked computing solution are power conscience and will prefer a power-efficient solution. PMC-Sierra is in a good position to address these customer requirements. The MIPS technology used by PMC-Sierra consumes less power than the x86 architectures that VIA and AMD use. AMD, however is working to close the gap, they recently developed a solution that consumes a similar amount of power as PMC's MIPS architecture.

The second means of differentiation is platforms. PMC-Sierra offers an open-sourced software platform, LINUX, as well as an open hardware architecture platform, MIPS. AMD and VIA also offers a LINUX based platform but their hardware architecture is based on the proprietary x86 architecture. Emerging nations like China and India prefer open source and open architectures which places PMC-Sierra ahead of its competitors.

The final means of differentiation is service. VIA is in a position to ship full PCB solutions to their customers rather than just the microprocessor, whereas PMC-Sierra and AMD are currently positioned to only offer microprocessors and not PCBs. Thin client equipment vendors prefer complete PCB solutions and would likely lean towards VIA rather than PMC-Sierra or AMD if they were to only supply microprocessors.

These opportunities for differentiation allow VIA, AMD and PMC-Sierra to compete in the thin client market on other metrics than price.

3.2.2 Buyer Bargaining Power

Currently there are twelve thin client manufacturers in the industry and 70% of the market belongs to the top three players: Wyse has 35% market share, Neoware has 19%, and HP has 16%, as illustrated in Figure 6 (O'Donnell, 2004, p. 14). The total addressable market (TAM) is relatively small and cannot support this large number of current vendors. Therefore one can expect that the industry will experience some consolidation, resulting in greater market share and greater bargaining power.

The major appeal of the networked computing model is lowered total cost of ownership, so in theory, purchasing costs could vary. Unfortunately, end customers are not educated enough today to look at the long-term savings rather than up-front costs. They perceive thin clients to be a cheaper, short-term and long-term, solution to the PC and if the price is not attractive they will continue with the current PC model. A combination of this perception, declining PC prices, and a high percentage of the cost being attributed to the motherboard is driving thin client vendors to demand lower prices from their semiconductor suppliers. There are few large thin client vendors with significant market share that suppliers want to work with, thus the buyers today have the majority bargaining power.

Once a thin client vendor designs in a microprocessor it will be challenging for them to switch vendors. Designing-in a microprocessor requires learning the product, designing a board, debugging the board, and qualifying the board. This process takes a lot of time, money and energy but if vendors demand that suppliers provide boards rather than just chips, switching costs will drop dramatically, resulting in more power residing with the thin client vendors.

As the industry matures, end customers will better understand the value proposition of thin clients, consolidation will occur and power should become equalized between vendors and buyers, but today the majority of bargaining power lies with the buyers.

3.2.3 Supplier Bargaining Power

Each of the semiconductor vendors has an established relationship and contract with their current fabrication and packaging suppliers, therefore these suppliers' bargaining power should not have any influence over the semiconductor vendors' play for the thin client space. But, if thin client vendors demand that their microprocessor suppliers' move towards offering complete PCB solutions then PCB supplier bargaining power will play a strong role on whether microprocessor vendors continue investing in the market. As already mentioned VIA has an existing relationship with PCB manufacturers and has enough volumes with their other product lines to negotiate competitive prices. However, AMD and PMC-Sierra do not have these relationships and currently do not have the volumes to negotiate competitive prices, making it more challenging for them to compete in the marketplace.

3.2.4 Threat of Entry

The total addressable market for the enterprise thin client is relatively small when compared to the PC market and thus is less attractive to new entrants. However microprocessor companies can simply leverage existing technologies, expertise, and supplier relationships to enter the market, the barriers to entry are minimal. The company that poses the greatest threat of entering is Intel. Intel may choose to enter simply to defend market share from AMD or they may choose to invest because thin client is potentially a disrupter to the PC market. Most likely however, Intel will continue to concentrate its efforts on the larger PC market and the more lucrative server market. Companies such as Texas Instruments, NEC, Toshiba, and Broadcom

that currently license MIPS and ARM processors also pose an outside threat to entering the market, again this is because they have existing products that satisfy the market place and require minimal investments to make an entry.

PMC-Sierra, AMD, and VIA can deter new players from entering by taking advantage of customers' high switching costs and locking-in large customers today. They can use first-mover's advantage to establish distribution channels in developing countries, where thin clients have the greatest potential. It will take time for any other new entrant to establish the same channels if they enter at a later date. The companies can also create a thin client brand that users and thin client vendors associate with proven track record of support, execution and quality. Brand loyalty and recognition can potentially play a large role as it has in the PC market.

3.2.5 Competition From Substitutes

There are currently no devices from other industries that can substitute the microprocessor. However, there is a trend in the graphics industry to offer complete integrated chipsets, which may in the future integrate the microprocessor, therefore becoming a possible substitute (Robertson, 2003, p. 3). The companies offering microprocessors need to be aware of this possible threat and address it by either following the trend or offering a solution that they feel better addresses their customers' needs.

3.2.6 Government

Two recent policies have made thin client computing an attractive alternative to today's decentralized method: Sarbanes-Oxley Act and China's National Project 863. The following sections will discuss in more detail each of these acts and their impacts on thin client adoption.

3.2.6.1 Sarbanes-Oxley

The American Congress passed the Sarbanes-Oxley Act in July 2002 after corporations like Enron and WorldCom misled investors by falsifying financial statements and destroying corporate files. In response, the Sarbanes-Oxley Act requires public companies to archive all business records, including electronic communications, correspondents and documents as well as retrieving them in a timely manner when required by the Securities and Exchange Commission (American Institute of Certified Public Accountants, 2005). This Act is a strong driver for corporations to move towards the centralized, thin client, model of computing. Today's PCs have hard drives that allow information to be stored locally, where it cannot be tracked, retrieved efficiently and not secured, employees have the ability to alter or destroy the documentation. With the networked computing model all of the information is securely stored centrally, it cannot be deleted, it cannot be altered, and IT staff can retrieve it in a timely manner. CIO Randy James of Amerigo Life Inc. has moved his company to the networked computing model and says companies are missing out by not deploying the technology more widely, centralizing desktop applications and data has made it much easier for his company to comply with the Sarbanes-Oxley Act (Mitchell, 2004, p. 19).

3.2.6.2 National Project 863

The Chinese government established the National Project 863 to help propel China into the information age (High-Tech Research and Development Program of China, 2001). China's prestigious Tsinghua University is promoting the Networked Computing architecture to implement China's plans of making the Internet accessible to every child by 2011 (Next Generation Telecom China, 2004). The Kai Yuan (Open Stream) initiative, pioneered by the Tsinghua University, and in partnership with PMC-Sierra, combines open sourced operating

systems with open architecture networked computing to propel Internet access to educational institutes and businesses within China.

The push for open source software as well as an open architecture is a strong pull for PMC-Sierra's solution and puts them ahead of their competitors.

3.3 Political, Economic, Social, Technological, and Legal Analysis

The previous sections discussed the competitive environment and the forces that affect PMC's success in the thin client market. The next sections will discuss the macro-environmental influences on PMC-Sierra's entry in the thin client market space. The combined impact of these influences may change the structure of the industry, which makes them important for PMC-Sierra to be aware of.

3.3.1 Political

It is important for the players in this field to understand existing and future policies of China and India in order to make a play in the Asian market. China's National Project 863 and the Kai Yuan initiative have made open source computing a strong contender to Windows and Intel based solutions. If the National Project initiative is discontinued and government policies change Intel and Windows can enter the market with highly competitive price points and completely change the thin client playing field.

Also, if either India or China ends their government's initiatives to provide Internet access to remote parts of their countries, thin clients will be unaffordable for the villages and schools, therefore dramatically reducing thin client potential in these countries.

3.3.2 Sociocultural Factors

The extreme disparities in earnings and education within India and China have driven both countries to establish mandates to equip their countries with technology access. The disparity has also driven the demand for affordable thin client solutions. Any change to this sociocultural climate will have an influence on how companies position their thin client products.

3.3.3 Environmental Factors

Global warming, the Kyoto protocol and overall environmental awareness are driving businesses to reduce energy consumption and waste in developed and developing countries. This factor is in turn demanding manufacturers to supply energy efficient and sustainable products to the market place.

Thin client manufactures are responding to this demand by producing energy efficient solutions. Companies are responding by deploying thin clients in their workplaces since terminals do not need to be replaced or upgraded as often as PCs, thereby reducing waste.

The strength of environmental influence in different countries may drive how quickly thin clients are adopted and should influence strategic decisions of thin client vendors.

3.3.4 Economic Factors

If the economy experiences a similar recession to the 2001 recession, IT spending will once again dramatically reduce and impact new technology adoption. IT departments may either think twice about replacing their existing fleet of PCs, or will deploy thin clients and aim to heavily reduce long-term spending. Either way, thin client manufacturers and vendors will be impacted and must strategically respond to economic factors.

3.3.5 Technological Factors

If either China's or India's governments increase spending on technology there is a potential threat that they would prefer to cultivate local vendors and manufacturers rather than buy solutions from foreign companies. This threat will cause foreign companies to strategically alter how they enter the Asian markets, possibly partnering with a foreign supplier.

Nanotechnology can potentially render semiconductors obsolete. This is a long-term (10-20 years) threat, but is worth mentioning, as it will have an impact on strategic decisions of semiconductor companies.

3.3.6 Legal Factors

China is in the process of putting in place legislation to only allow open technology in the country so its own companies can compete and manufacture products for the country's use. If this legislation passes thin client vendors will have to reassess how they will enter the Chinese market. It will also impact who the lead vendor will be and how market share will be divided.

3.4 External Opportunities and Threats for PMC-Sierra

Chapter 3 has discussed the external landscape and outlines the issues facing semiconductor entrants in the thin client market. Drawn from this analysis, Table 3 highlights the key opportunities and threats facing PMC-Sierra specifically as it strives to become the market leader in this industry.

Table 3: PMC-Sierra's Key Opportunities and Threats

Opportunities	Threats
PMC-Sierra reduces BOM costs to a competitive level	PMC-Sierra cannot lower BOM costs to a competitive level
PMC-Sierra obtains early market dominance, establishes necessary distribution channels and forces competitors out of the market	PMC-Sierra does not achieve early market dominance and AMD or VIA succeed, pushing PMC-Sierra out of the market.
Strong need for energy efficient solutions.	Weak demand for energy efficient solutions.
Strong demand for open source solutions.	Weak demand for open source solutions.
End customers favour total cost of ownership costs over upfront capital costs in their decisions.	End customers favour upfront capital costs over total cost of ownership in their decisions.
PMC-Sierra establishes a competitive supply chain to provide full PCB solutions.	PMC Sierra cannot establish a competitive supply chain to provide full PCB solutions.
VIA and/or AMD decide to exit the thin client market to focus on the larger PC market.	Intel enters the thin client market with price points rivals cannot compete against.
Corporations realize the benefits of thin client management and move from PCs to thin client terminals	Corporations prefer to use locked-down PCs as terminals rather migrate to thin clients
The United States Government adds to the Sarbanes-Oxley act and demands corporations store all documents centrally	The United States Government removes the Sarbanes-Oxley Act, giving corporations less of an incentive to store business documents centrally
China's National Project selects PMC Sierra as the vendor of choice.	China's National Project selects another vendor as the vendor of choice.
IT spending increases and IT departments are looking for ways to save money long-term.	IT spending declines and IT departments cannot spend on new technologies.

4 INTERNAL ANALYSIS

Chapter three provided an analysis of the thin client industry to determine how the industry is structured and what external factors need to be considered when generating strategies for PMC-Sierra to pursue in succeeding in this market. This chapter will analyze PMC-Sierra's culture, organizational structure, current businesses, resources, strengths, weaknesses, and supply chain to determine how they map to succeeding in the thin client industry. The findings from this chapter will help determine the strategic options and recommendations for PMC-Sierra's management team regarding their thin client business in the next chapter.

4.1 Culture

PMC-Sierra is a knowledge-based technology company. Corporate processes, tacit knowledge, physical systems, managerial systems, patents, a library of intellectual property (IP) and employees are the main components that make up the knowledge of the company. PMC-Sierra's competitive advantages and capabilities are directly attached to these key components. Therefore, for PMC-Sierra to be successful in the thin client industry, it will need to leverage these components and develop new ones for this market. Based on PMC-Sierra's culture of openness to evolve and history of innovating to enter new markets, the company should be able to meet this challenge.

PMC-Sierra's culture is one of teamwork, learning and dialogue, which keep employees stimulated and challenged. PMC-Sierra's flexible infrastructure is centred on System Vision Teams (SVTs), Customer Management Teams (CMTs) and Project Management Teams (PMTs),

which enables everyone to benefit from shared knowledge and ideas. PMC-Sierra will need to use these vision and management teams to help it focus and succeed in the thin client market.

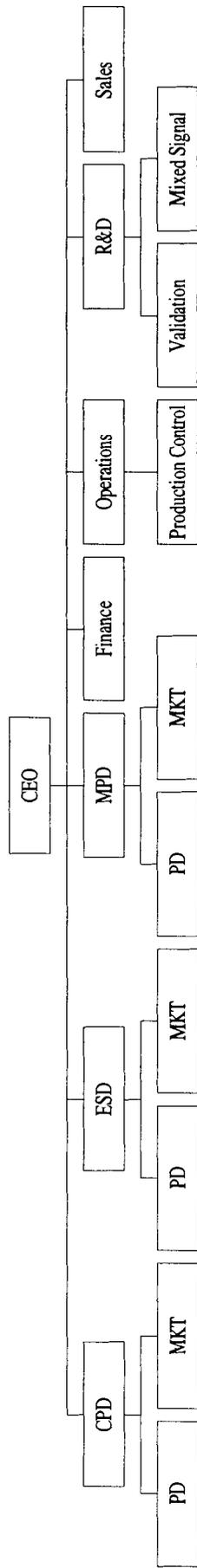
PMC-Sierra enables and encourages career growth. They provide a full range of professional support and learning opportunities, from an integrated mentoring program, to an on-site education. Full tuition reimbursement for education courses and degree programs are offered to all its employees. They also have a full-time employee education specialist on staff to assist employees in developing and attaining their career development goals. The company can position the thin client market initiative as a career growth opportunity to attract top employees to learn and study this market for the company. The knowledge gained can help the company build competencies and knowledge needed to succeed in this market.

PMC-Sierra offers an industry-competitive compensation rewards package, as well as a full range of incentives linked to each employee's performance and the company's success. These incentives include PMC-Sierra's individual incentive plan, share purchase program, stock options, group insurance plan, retirement savings plan, employee referral program, and patent award program. The company can use its industry leading compensation packages to help it attract top thin client industry talent. This talent will equip the company with customer relationships, market and technical knowledge; thus increasing the corporation's chances for success in the thin client market.

4.2 Organizational Structure

PMC-Sierra is comprised of three end market-driven product divisions: Communications Product Division (CPD), Enterprise Storage Division (ESD) and Microprocessor Product Division (MPD) and multiple centralized matrix functional units as shown in Figure 7.

Figure 7: PMC-Sierra Organizational Structure



Each division has their own product development, applications technical support and marketing departments and are responsible for their own profit and loss. The functional units are comprised of finance, sales, operations, research and development. These units support the activities of each of the divisions and the overall corporation. It is critical to understand the makeup of each of these business units to determine how they resemble or differ from PMC-Sierra's thin client business.

4.3 Existing Businesses

All of PMC-Sierra's existing revenues and business are driven from its three product divisions. Each of the divisions' primary business is designing and selling highly complex integrated circuits into telecommunications, data networking, and enterprise equipment. This differs from the thin client business where PCBs will be designed and sold. The below subsections provide a brief overview of each of the divisions and their businesses to highlight their differences and similarities with the thin client business.

4.3.1 Communications Product Division (CPD)

CPD is PMC-Sierra's largest division from many perspectives. It generated the most revenue with approximately \$200M in 2004, sells the most number of products with 150 different integrated circuit products offered in 2004 and employs approximately 250 employees. The division also has the highest gross margins in the company ranging between 70% and 80%. The ASP of a typical product from this division is approximately \$150. The development cost of producing a typical device in this division is roughly \$8M; it takes from a year and a half to three years for customers to get their products into production with the product life lasting between seven to twelve years. The unit's largest customers are Cisco Systems, Lucent Technologies,

Alcatel, Juniper Networks, Fujitsu, Huawei and ZTE. The company was founded around this business unit.

4.3.2 Enterprise Storage Division (ESD)

ESD is PMC-Sierra's newest division, established in mid-2001 and thus is the smallest division from many perspectives. It generated the least revenue with approximately \$15M in 2004, sells the least amount of products with about 15 different integrated circuit products offered in 2004 and employs approximately 100 employees. The division's gross margins range between 65% and 75%. The ASP of a typical product from this division is approximately \$30. The development cost of producing a typical device in this division is about \$6M; it takes half a year to a year and half for customers to get their products into production with the product life lasting between three to six years. The unit's largest customers are Cisco Systems, Brocade, Hewlett-Packard and Fujitsu.

4.3.3 Microprocessor Product Division (MPD)

PMC-Sierra acquired a MIPS™ microprocessor company called Quantum Effect Devices in 2000 that formed MPD. The division generated approximately \$75M in 2004, offered 20 different integrated circuit products in 2004 and employs approximately 150 employees. The division's gross margins range between 50% and 60%. The ASP of a typical product is \$30. The development cost of producing a typical device in this division is around \$12M; it takes a year to three years for customers to get their products into production with the product life lasting between three to seven years. The unit's largest customers are Cisco Systems, Hewlett-Packard, Ricoh, Lexmark, Juniper Networks and Fuji-Xerox. The thin client business group currently resides in this division.

4.3.4 Thin Client Business Group

PMC-Sierra started the thin client business group in November 2004. This group comprises of two product managers, one development manager, and two development engineers. The bulk of the design work is outsourced to third party design houses located in India. The business group did not generate any significant revenues in 2004 but expects to start generating revenues towards the end of 2005. Unlike PMC-Sierra's product divisions, this business group will not only sell integrated circuits but also complete PCBs. The margins for both these offerings will vary between the 20% to 25% range. The ASP of a thin client chipset will be \$35 and approximately \$60 for a thin client printed circuit board. The development cost of producing a thin client PCB is estimated to cost \$0.5M; it will take customers a quarter of a year to a full year to get their products into production with the product life lasting between a year and half to three years. The group's target customers are Wyse, Neoware, Hewlett-Packard, HCL, Lenovo, BOE, VXL, IGEL, and Sun Microsystems. Table 1 summarizes the business traits of each of the divisions and the thin client business group.

Table 4: Summary of PMC-Sierra's Product Divisions and Thin Client Business Group

	Communications Product Division (CPD)	Enterprise Storage Division (ESD)	Microprocessor Product Division (MPD)	Thin Client Business Group
Main Type of Products Offered	<ul style="list-style-type: none"> ▪ Integrated Circuits (ICs) 	<ul style="list-style-type: none"> ▪ Integrated Circuits (ICs) 	<ul style="list-style-type: none"> ▪ Integrated Circuits (ICs) 	<ul style="list-style-type: none"> ▪ Integrated Circuit Chipsets ▪ Populated Print Circuit Boards (PCBs)
End Products	<ul style="list-style-type: none"> ▪ Multi-Service Switches ▪ Networking Routers ▪ Metro Transport ▪ Wireless Infrastructure 	<ul style="list-style-type: none"> ▪ Storage Systems ▪ SAN Networking ▪ Networking Routers ▪ Gigabit Serial Backplanes 	<ul style="list-style-type: none"> ▪ Laser Printers ▪ Networking Routers ▪ Advanced Consumer Applications 	<ul style="list-style-type: none"> ▪ Simple Enterprise Thin Client Terminals ▪ Intelligent Enterprise Thin Client Terminals
Estimated 2004 Revenues	\$200M	\$15M	\$75M	\$0M
Number of Products in Production	150 ICs	15 ICs	20 ICs	3 IC chipsets

	Communications Product Division (CPD)	Enterprise Storage Division (ESD)	Microprocessor Product Division (MPD)	Thin Client Business Group
Average Selling Price of Typical Product	\$150	\$30	\$30	\$45
Average Gross Margins	70%-80%	55%-65%	50%-60%	20%-25%
Typical Product Development Cost	\$8M	\$6M	\$12M	\$1M
Customer Time to Production	1.5 to 3 years	0.5 to 1.5 year(s)	1 to 3 year(s)	0.25 to 1 year
Product Life	7 to 12 years	3 to 6 years	3 to 7 years	1.5 to 3 years
Number of Employees	250	100	150	5
Customer Examples	<ul style="list-style-type: none"> ▪ Alcatel ▪ Cisco ▪ Fujitsu ▪ Huawei ▪ Juniper ▪ Lucent ▪ Nortel ▪ Samsung ▪ ZTE 	<ul style="list-style-type: none"> ▪ Brocade ▪ Cisco ▪ Dot Hill ▪ Fujitsu ▪ Hewlett-Packard ▪ Hitachi ▪ Infortrend ▪ Storage Tek ▪ Sun Microsystems 	<ul style="list-style-type: none"> ▪ Cisco ▪ Epson ▪ Fuji Xerox ▪ Hewlett-Packard ▪ Juniper ▪ Lexmark ▪ Ricoh ▪ Samsung ▪ Sony 	<ul style="list-style-type: none"> ▪ Wyse ▪ Neoware ▪ Hewlett-Packard ▪ HCL ▪ Lenovo ▪ BOE ▪ Fujian Start ▪ VXL ▪ IGEL ▪ Sun Microsystems

Comparing PMC-Sierra's existing businesses with their thin client business group's business, there are several items that need to be highlighted when considering strategies for the thin client business:

- Thin client business requires selling printed circuit boards and integrated circuit chipsets while the existing businesses only sell integrated circuits.
- Thin client business gross margins are significantly lower than all existing businesses.
- Cost of product development for thin client business group is much lower than developing a product for the existing businesses.
- Customers ramp into production much faster than existing businesses' customers.
- Product lifecycle of the thin client business' products are half the timeframe of existing businesses.
- The number of employees in the thin client business is a fraction of the other businesses.
- Thin client customers vary greatly from existing businesses' customers.

4.4 Strengths

4.4.1 Brand Awareness and Recognition

Over the last ten plus years, PMC-Sierra has built a strong brand name for itself as a leading semiconductor supplier of high performance microprocessors and of complex integrated semiconductor solutions for telecommunications, data networking, and enterprise equipment. Existing customers and industry analysts view PMC-Sierra as a proven, high-quality and leading supplier of semiconductor solutions. This reputation has led to receiving many awards and accolades from customers and analysts. PMC-Sierra must explore leveraging this brand strength and awareness to penetrate the thin client market. One possible way to do so is to get testimonials and references from existing customers and industry analysts into target thin client customers and see how they value them. At the same time, management must ensure not to harm the PMC-Sierra brand name in its existing businesses when targeting this space, as it is very possible that a new type of brand can hurt the existing brand.

4.4.2 Superior Technical and Customer Service Support

PMC-Sierra has achieved many customer accolades and awards for providing superior technical and customer service support for their devices used in customers' telecommunications, data networking, and enterprise equipment. Superior technical and customer service support are emphasized in the company mission statement:

To provide enabling technologies used to capture, process, store, and transmit information to drive the Digital Age. We will achieve this by anticipating our customers' requirements and by integrating our high-speed microprocessor, mixed-signal and communication systems technologies to deliver semiconductor solutions with superior quality, service and technical support. (PMC-Sierra, 2005)

Customers have validated this strength by informing PMC-Sierra that they specifically chose to use PMC-Sierra's products over competitors because of their superior technical and customer support. Management must determine if and how they can leverage and build the same strength in the thin client market. This can be determined by getting detailed feedback from thin client target customers.

4.4.3 Financial Stability and Long-Term Viability

PMC-Sierra is a profitable corporation with a strong balance sheet. The company's net cash position as of December 31st, 2004 was greater than \$320 million. The majority of PMC-Sierra's main competitors are not currently profitable and have weaker balance sheets. PMC-Sierra's strong financial position has allowed it to win business over its competitors because customers are selecting suppliers who have financial stability and that are viable long term. Management must examine potential competitors in the thin client market to see if this is a strength that it can leverage over them to be successful in this market. PMC-Sierra can also use their strong position to acquire weaker and depressed competitors who have technology that can make the company successful in the thin client market.

4.4.4 Broad Product Offering

PMC-Sierra currently offers over 180 integrated circuit products to customers. Many of these products interface and work together to provide a complete architecture chipset solution that satisfies the majority of customers' needs. This complete architecture solution enables PMC-Sierra to offer "one stop shopping" to customers. Customers view this very positively as it allows them to deal with only one vendor and they are assured the devices will work together given they are coming from one supplier. Management needs to see if they can provide complete architecture solutions for the thin client market and if customers would value it.

4.4.5 High-Speed Mixed Signal and System-on-Chip Design Expertise

PMC-Sierra is one of the world's leading suppliers of high speed mixed signal system-on-chip semiconductors. The company has been providing these types of solutions to customers for close to a decade. By integrating high-speed analog with digital circuitry into a single system-on-chip device, PMC-Sierra has been able to lockout competitors who only provide discrete devices. The company has been able to leverage this expertise into the telecommunications, data networking and enterprise equipment markets. Management must determine if this is a strength that they can use into the thin client market. Based on industry trends where higher integration is the norm, one can expect that the thin client market will require high-speed functionality integrated into the microprocessor. Once validated by customers, PMC-Sierra can potentially build an integrated device that addresses this requirement.

4.4.6 High Performance MIPS Microprocessor Design Expertise

PMC-Sierra acquired a company named Quantum Effect Devices (QED) in 2000. QED was the industry's leading provider of high performance MIPS microprocessors and was founded by the original design team of the MIPS processor architecture. This original MIPS design team is still employed at PMC-Sierra and provides the company with industry leading MIPS microprocessor knowledge and intellectual property. Management must determine how this expertise can be leveraged into the thin client market. Given that PMC-Sierra's thin client market push will most likely revolve around its MIPS processor, this will be a strength it will need to use effectively to be successful.

4.5 Weaknesses

4.5.1 Limited Internal Software and Firmware Expertise

PMC-Sierra's roots and competences are in hardware development. Over the last year and half, the company has started to invest in developing software and firmware expertise to remove this weakness but still has room to improve. Thin client products are becoming more and more complex with providers seeking complete solutions comprising of both hardware and software from their suppliers. Management must be aware of this requirement and how the company's weakness will affect the strategy they select to pursue.

4.5.2 No Internal Thin Client Industry Expertise

PMC-Sierra is currently a leading supplier of integrated circuits for the telecommunications, data networking, and enterprise equipment manufacturers. The company has been able to build this position by leveraging its key personnel's system knowledge and expertise of these industries. However, PMC-Sierra currently does not possess any internal expertise of the thin client market. This is a significant weakness that management must deal with when evaluating strategic options to penetrate and build a position into the thin client market.

4.5.3 No Experience Selling Printed Circuit Boards

PMC-Sierra's core business today is designing and selling integrated circuits. The company does design and sell PCBs for evaluation platforms and validation systems but does not sell these boards in large volume to customers. The company must be able to sell high volumes of these boards in order to be successful in the thin client market. This is currently seen as a

weakness that management must deal with when evaluating strategic options to penetrate and build a position into the thin client market.

4.5.4 Limited External Research Liaisons, Venture Funding and Partnerships

PMC-Sierra has for the most part developed all of its products internally with limited help from external research facilities and other companies. There have been occasions where the company has obtained new product lines or technologies by acquiring companies. However, PMC-Sierra has not forged many partnerships in the past to help with innovation and product development. The company has and continues to fund start-up new venture companies but to date has not been successful in leveraging these investments into incremental revenue, new technology or product gains for the company. Given PMC-Sierra's history to mainly rely on internal developments, the company's performance and innovation may have been limited for lack of exposure to external technologies, knowledge and expertise. This is seen as a weakness and could limit the strategic options the corporation can pursue for the thin client market.

4.5.5 Thin Client Software Application Support

PMC-Sierra's microprocessors are based on the MIPS architecture. The MIPS architecture currently does not support all of the required thin client software applications. The non-supported applications would need to be ported onto the architecture. This porting function would cost approximately one million US dollars. The processors of PMC-Sierra's competitors, VIA and AMD, are based on the x86 architecture. The x86 architecture currently supports all of the required thin client software applications. PMC-Sierra's lack of support for these applications is a weakness that needs to be considered when determining strategies for this market.

4.6 Value Chain

All of PMC-Sierra's current product divisions have similar value chains. They only differ from an OEM and end customer perspective. The supply chain comprises of third party wafer fabrication companies, and test and package assembly companies. These suppliers deliver working parts to PMC-Sierra, who in turn sends the parts out to their customers' contract manufacturers. Figure 8 illustrates PMC-Sierra's current core businesses' value chain.

The thin client business value chain for the current North American and European markets is fairly similar to PMC-Sierra's current core businesses described above. However for the Asian thin client market and going forward in the North American and European markets, the value chain differs quite a bit. These markets expect or will be expecting complete PCBs instead of just integrated circuits, as they simply want to put their enclosure plastics around it before shipping it to their end customers. This means that PMC-Sierra must supply complete PCBs instead of only integrated circuits. To do so, the company will have to deal with board component suppliers and contract manufacturers to build these boards. These new suppliers are vastly different from the company's traditional suppliers and thus potentially threaten the corporation's success in this market. In the coming options and recommendations chapters, this subject will be addressed further. Figure 9 illustrates the thin client value chain.

Figure 8: PMC-Sierra's Current Core Businesses' Value Chain

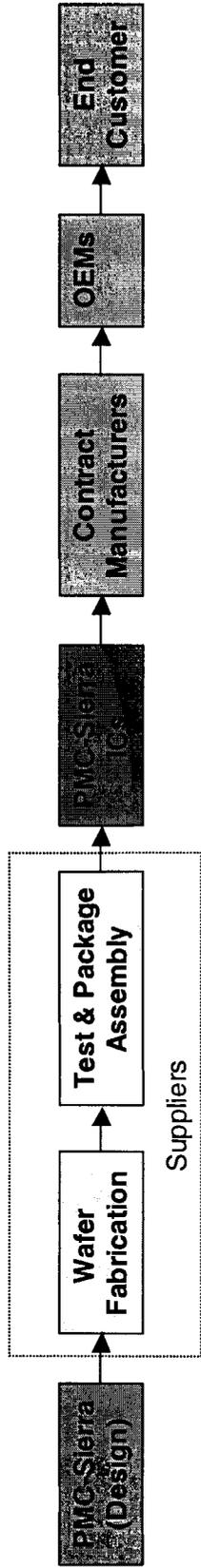
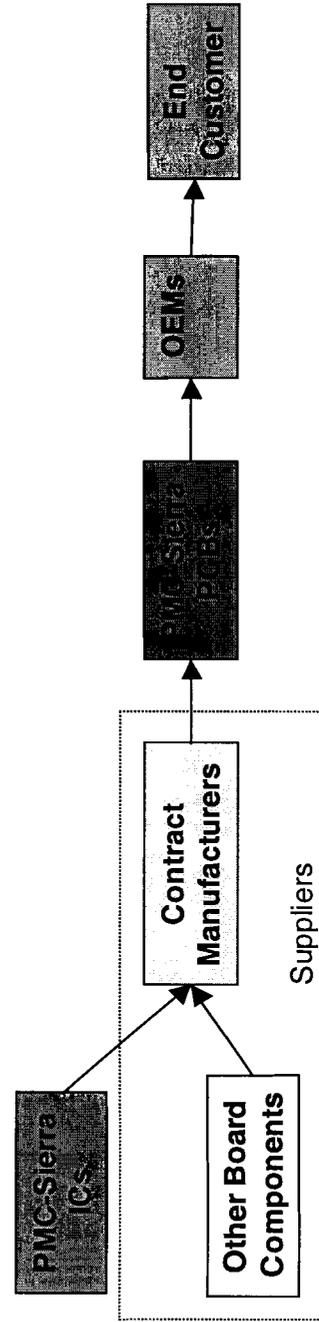


Figure 9: Emerging Thin Client Business Value Chains



Chapter 4 has examined PMC-Sierra's internal environment and outlines the company's culture, organization structure, businesses, strengths, weaknesses and value chain. The analysis shows that the company has the culture and organization structure to be successful in the thin client marketplace but needs to address its lack of resources, lack of a viable value chain, and lack of firmware and thin client expertise to ultimately be successful. Chapter 5 will map these findings with the findings from chapter 3 to provide strategic options and recommendations to PMC-Sierra management about this business.

5 STRATEGIC OPTIONS AND RECOMMENDATIONS

The thin client industry is an attractive market for PMC-Sierra to enter since it requires incremental investment and is a potential disrupter to the PC market, therefore lending itself to significant rents. In order to succeed in the industry PMC-Sierra must meet competitive cost targets while offering full board solutions and porting software applications onto the MIPS architecture. Today, PMC-Sierra does not have the necessary supply chain or volumes to be cost-competitive, thus any entry strategy would require addressing this gap. The environment demands cost-competitive solutions as well as energy-efficient and open platforms. PMC-Sierra is in an excellent position to address these requirements with their MIPS-based processors. Internally, the company has the experience of entering new markets, knowing how to explore and grow new investments as evidenced when the company entered the enterprise storage market. The key internal strengths that will help guide the company towards success in this market are its financial stability, proven MIPS products, and the company's proven track record of customer support. The key weaknesses that need to be addressed are its lack of firmware and thin client expertise within the company.

Comparing PMC-Sierra to its competitors AMD and VIA, it is the only player offering a MIPS-based architecture. As long as countries such as China and India are adamant that they want an open-architecture platform PMC can differentiate itself along these lines and make a strong strategic play. Looking at cost metrics and full board solutions VIA is in the best position, it already has the much-needed supply chain to deliver boards and it has the volumes to be competitive on price. If cost metrics and full board solutions become the dominant success

factors PMC-Sierra is in a poor position to attack this market and would need to develop strategies that would address this weakness.

PMC-Sierra allocated a conservative amount of resources over the past six months to explore the market opportunity. It is now at the decision-making stage and the company needs to decide if it will pursue the market, and if so how. The following sections discuss plausible strategic options, the criteria used to evaluate these options, and recommends what action PMC-Sierra should take in the thin client market.

5.1 Strategic Options

5.1.1 Exit Thin Client Networked Computing Business

PMC-Sierra should exit the thin client market if it determines any of the following:

- It does not have a competitive advantage
- The company does not believe the thin client market will disrupt the PC market, therefore it cannot achieve a return on investment (ROI) that meets company requirements
- It cannot establish the necessary supply chain to be successful
- It cannot obtain the necessary expertise
- It cannot negotiate a partnership with a leading vendor

5.1.2 Increase Company's Thin Client Business Investment

In order for PMC-Sierra to compete effectively in the thin client market, the company must increase its investment and implement strategies that will enable the company to build

competitive advantage. Below is a set of strategic choices the company can make to compete in the market:

- *Invest in Porting Required Thin Client Software Applications onto MIPS*

PMC-Sierra must at minimum invest in porting all the required thin client software applications onto the MIPS architecture. This will enable the company to address the applications desired by thin client vendors and even the playing field with its competitors, AMD and VIA.

- *Hire Thin Client Industry Experts*

PMC-Sierra needs to hire individuals who possess thin client industry expertise to help the company build platforms and solutions that address thin client vendors' requirements. These experts should also possess industry contacts and connections to help PMC-Sierra secure new business. The company has successfully implemented this strategy for other new markets it has entered.

- *Partner with a Leading Printed Circuit Board Manufacturer*

PMC-Sierra's biggest weakness for pursuing the thin client market is their lack of experience in selling PCBs. The company does not currently have the supply chain to offer PCBs competitively. Therefore it is critical that PMC-Sierra partner and build a relationship with a leading PCB manufacturer in order to compete effectively in the thin client market. Many leading PCB manufacturers from Taiwan and China such as Evergreen Hitech, Full Years Technology, Shenzhen Tongying Industrial, Zhejiang Tiansn Electronics and Wang's Circuit Board, are seeking to expand their businesses and thus would be open to partnering with PMC-Sierra to build cost-optimized PCBs for the emerging thin client market. These companies have done similar partnerships with other semiconductor suppliers for the cell phone and PC markets.

- *Grow Headcount of Thin Client Business Group to Achieve Critical Mass*

In order for PMC-Sierra to pursue the thin client market effectively, it must increase its headcount to realize critical mass. PMC-Sierra's thin client group currently comprises of five individuals: two product managers, one development manager and two developers. To successfully penetrate and serve the thin client market, the company will need to, at a minimum, double the group's headcount by adding application support engineers and developers. This will enable the company to showcase one of the company's core strengths, technical support, effectively build credibility with these new set of customers, and show them that PMC-Sierra is committed to the thin client market.

- *Seek Collaboration with one of the Leading Thin Client Vendors*

In order to minimize risk and solidify PMC-Sierra's investment into this market, it is recommended that the company seek a partnership with one of the leading thin client vendors or a computer company that has strong sales channels into the Asian marketplace such as Wyse or HCL.

- *Acquire a Competitor's Thin Client Business*

PMC-Sierra's main competitors in the thin client marketplace are AMD and VIA. Both companies are currently the dominant suppliers of microprocessors for the thin client market. However, both companies are currently weaker financially than PMC-Sierra. Therefore one option for PMC-Sierra is to use its stronger financial position to acquire one of these competitors' thin client businesses. The acquisition would provide PMC-Sierra with an instant strong presence in the marketplace while eliminating one of its main competitors. The likelihood of this occurring is relatively low, as both companies believe that the thin client market has strong growth potential for their companies.

5.1.3 Create a New Venture

PMC-Sierra does not have the necessary processes or systems in place today to effectively pursue the thin client market. They need to develop the internal capabilities to produce, sell, and test PCBs. They need to change their gross margin expectations, shorten product development time, and ramp to production PCB solutions in a shorter time frame than they currently do with integrated circuits. The firmware development team, the product validation team and the quality assurance team each need to develop system-level expertise that they currently do not have. To address these gaps, while minimizing changes to the existing infrastructure, PMC-Sierra can create a new venture.

Existing processes, systems and thinking, will not encumber the new venture. The new venture will be in a position to develop its own relationships, supply chain, and attract appropriate talent. PMC-Sierra will be the majority shareholder of the venture and will have the flexibility to either spin the company back into the existing business, keep it as an external entity or sell its shares and no longer have a stake in the market. A new venture gives PMC-Sierra the opportunity to invest in a new market, which has completely different needs than it is currently used to without changing its current way of doing business.

The main barrier that exists to starting a new venture is PMC-Sierra has not been able to successfully integrate ventures into the corporation in the past, so they may move away from this model. If the new venture is successful it would have established the necessary relationships and processes, but integrating the new processes into an existing corporation that works very differently will still be a challenge. However, a new venture still gives PMC-Sierra a low-risk solution to exploring and investing in a completely new market.

5.2 Evaluation Criteria

From PMC-Sierra's corporate strategy and the internal and external analysis, it is apparent that the company needs certain attributes to succeed in the business. Each of these attributes provides a criterion to evaluate the strategic options:

- *New investments should be in disruptive technologies*

This criterion comes from PMC-Sierra's corporate strategy. The company seeks to invest in disruptive technologies so it can maximize its potential rents and receive a large return on its investment.

- *PMC-Sierra must have a sustainable competitive advantage over its competitors*

For a PMC-Sierra to successfully pursue any new markets it requires a sustainable competitive advantage. There must be a compelling reason for a customer to choose PMC-Sierra's product over a competitor's for the company to even capture minimal rents.

- *PMC-Sierra must adopt a PCB supply-chain*

As indicated in the internal analysis, customers in the thin client market space require full-board solutions and PMC-Sierra does not have the necessary supply-chain to support this requirement today.

- *PMC-Sierra must have the necessary firmware and software expertise*

Customers need an array of software ported onto the MIPS architecture as well as upper-layer software applications supported by the overall thin client ecosystem. The internal analysis highlights that PMC-Sierra lacks the necessary firmware and software experts to provide these functionalities.

5.3 Evaluation

Using the criteria outlined in Section 5.2 the strategic options are evaluated in Table 5

below:

Table 5: Evaluation of Strategic Options

	Disruptive Technology	Competitive Advantage	Supply Chain	Firmware/Software Expertise
Exit the Business	√	√	√	√
Port MIPS software	√	X	X	√
Hire Thin Client Experts	√	X	X	X
Partner with PCB Manufacturer	√	X	√	X
Grow Headcount	√	X	X	√
Collaborate with Leading Thin Client Vendor	√	X	Possible	Possible
Acquire Competitor's Thin Client Business	√	Possible	Possible	Possible
Create a New Venture	√	X	Possible	Possible

The technology is disruptive and remains so with every option, this is in agreement with the company's corporate strategy to seek investments in disruptive markets. PMC-Sierra can possibly establish a competitive advantage if it can acquire a competitor's thin client business and the competitor has a compelling advantage over its competitors. It is absolutely necessary for the company to establish a competitive advantage to be able to compete effectively in the market. If the company can establish a compelling differentiator it still needs the right supply chain to compete. It is possible to obtain the PCB supply chain by partnering with a PCB manufacturer, collaborating with a thin client vendor, acquiring a competitor's thin client business or creating a new venture. The company would have to partner with a vendor who has relationships with PCB manufacturers or it would have to acquire a competitor's thin client business that produces board

solutions today, for example VIA instead of a company that doesn't, such as AMD. A new venture may be able to establish the right supply chain, but PMC-Sierra would still be challenged to integrate the supply chain with its existing business. Finally, the company also needs firmware and software expertise. Collaborating with a vendor may give it access to the right experts and as long as the company acquires a business that has the right experts today and buys those resources it can also obtain the expertise. The new venture may be able to attract the right talent and PMC-Sierra would need to ensure that the talent is kept and integrated into its overall business if the venture is spun back into the company.

5.4 Recommendations

After analyzing the strategic options it is apparent that the fundamental requirement to compete effectively in any new market is a compelling advantage over the competitor's solution. It is highly unlikely the company will be able to acquire a competitor's thin client business to establish a strong competitive advantage, for this reason it is recommended that PMC-Sierra exit the thin client networked computing market. While the company has many of the necessary competitive strengths, it lacks the most important competitive advantages for securing a competitively strong position. The company's value proposition is solely based on open-source, open-architecture platforms and providing an energy efficient solution. These features of differentiation are not sustainable for long-term success in the market. There are numerous companies today that produce MIPS processors and with the low barriers to entry, they can enter the market and offer the same solution PMC-Sierra is today. This differentiation strategy is highly dependent on the assumption that India and China will require open-source and open-architecture solutions. If an entrant were to offer a highly cost-competitive solution, which VIA is in a strong position to do, China and India will likely value reduced cost over open platforms. Also, as stated earlier AMD has already developed a solution that is as energy efficient as PMC-Sierra's

solution, even further minimizing PMC-Sierra's competitive advantage. The company should analyse other markets that thin client technology is used in, however, the company does not have a strong enough value proposition for the networked computing market.

PMC-Sierra also has numerous internal hurdles to overcome to be successful in this market. Their internal processes existing today are tailored for success in the semiconductor market. Product development, product validation, quality assurance, production control all have processes specific to developing, validating and producing integrated circuits. To enter the thin client market the company needs to sell fully populated PCBs, which means each of these groups needs to develop PCB expertise. This gap could be addressed by a new venture, however PMC-Sierra does not have a track record of successfully launching new ventures.

PMC-Sierra lacks the necessary supply chain, relationships and expertise to address this market. Increasing investments may possibly help the company acquire these needs, but without a compelling value proposition the company may not be able to adopt enough market share to receive a return on their investment.

6 CONCLUSIONS

This chapter provides an overview of the implementation plan of the recommended strategic choice and concludes with the learning of the strategy process that PMC-Sierra has practised in pursuing the thin client market.

6.1 Implementation Plan

The strategic recommendation to exit the thin client computing business should be implemented gradually to ensure PMC-Sierra does not negatively impact customers, jeopardize its partnerships and risk shareholder confidence. Outlined below is an implementation strategy aimed at phasing out of the thin client computing business over the next four to five months:

- *Reallocate resources into MPD, keep one resource from development and one resource from marketing on the thin client project*

Reallocate the product manager, the product development manager, and one product development engineer into the MPD team. Keep one development resource on the thin client project to fully investigate whether technically the company can develop a competitive advantage. Keep one product manager on the thin client project to explore other thin client opportunities outside of enterprise computing. Reallocating the remaining resources into MPD will allow PMC-Sierra to still support the MIPS processors and manage existing customers until they get to production.

- *Inform the sales force PMC-Sierra is no longer seeking new thin client computing opportunities*

Discontinue seeking new thin client computing customers. The company needs to focus on managing existing relationships, but not supporting new customers.

- *Continue the relationship with Tsinghua University*

Continue to help fund the Tsinghua University to find new ways for PMC-Sierra to innovate and play a large role in the Asian market.

With the above implementation plan PMC-Sierra will not jeopardize its existing relationships and still have the opportunity to leverage its existing products and strengths in the overall thin client market space.

6.2 Learning from PMC-Sierra Thin Client Business Strategy Process

As PMC-Sierra has experienced a slowdown in growth over the last few years and in 2004, it decided to aggressively pursue a growth strategy that focused on penetrating emerging disruptive markets that the company believed its technology and competencies had strategic fit with. The thin client computing market was one of the first markets that the company believed was disruptive and there was strategic fit; therefore the company entered this market in November 2004 with a small team of five individuals. The entry was made without any prior analysis to determine if thin client computing is indeed disruptive and if strategic fit exists between the market and the company. However, the company decided shortly into the process that these analyses must be completed to determine if the assumptions are true and that the company is pursuing the correct strategic choice, resulting in the generation of this paper.

This new strategy process that PMC-Sierra has performed is one that will be repeated for other new disruptive markets that the company seeks to enter, therefore understanding the key learning from this process is important to PMC-Sierra's management.

This paper has shown that if these analyses were performed before PMC-Sierra entered the market, the company would have likely not entered. However, one can argue that the company would have not been able to perform this analysis effectively without first entering the market to understand its environment. Therefore, the key learning from this process is that the company should first seek to determine if the market or technology it is pursuing is indeed disruptive. If so, the company should then move to the next step of testing the market to get a good understanding of its environment and requirements while in parallel completing a strategic analysis to determine fit. This new process is very similar to the one completed for PMC-Sierra's thin client business except that it starts the analysis earlier to reduce the amount of time and investment required for the company to make a strategic choice about pursuing a given disruptive market.

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