A Methodology of Aligning Product Development Teams with Business Level Goals in a Changing Business Environment

by
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Bachelor of Science in Electrical Engineering
University of Vermont, 1991

Submitted to the Sloan School of Management and the
Department of Electrical Engineering and Computer Science
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Management
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ABSTRACT

Today's competitive business environment requires organizations to develop products in the shortest time possible that provides the greatest value to the customer. This super competitive environment is the result of the world's financial markets putting pressure on businesses by rewarding organizations that meet forecasted financial goals and penalizing those that do not. The pressure is intensified as businesses defend their market share or try to grow. In order to be successful in this environment, it is essential that product development teams be aligned with the organization's business level goals. Management teams are responsible for setting the business goals and ensuring that processes are in place to ensure that development team's efforts are aligned with the established financial goals.

This thesis identifies three different methodologies designed to align development teams with business level goals. Each methodology is described in detail and followed with an evaluation of the feasibility of implementation within the product development organization of the company that sponsored the research. This research reaches the conclusion that the organization's current business processes prevent all of these methodologies from being implemented as defined. Nevertheless, the key concepts behind the methods can be included into the organization's business processes to create the desired alignment. The thesis concludes with a set of recommendations to the sponsored organization that will ensure the alignment of product development teams to the business level goals.

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1. Introduction

The United States stock market has experienced extraordinary growth over the last several years, fueled by an increase in the amount of money invested in securities and mutual funds. The increase in total dollars invested has come from an increase in first time stock market investors and an increase in the portion of stock related retirement plans. Superior past performance, as unpredictable of future events as it is, leaves a certain expectation with today's investors. Extended periods of gains makes it easy to forget that things may not always be so fortunate. Wall Street and investor expectations directly affect the way today's businesses are managed.

Wall Street analysts value securities based on present and future financial performance. More specifically, analysts set specific quarterly revenue and income goals and continually monitor a firm's profit margins. Deviations from expectations alert the investment community and are used to adjust the price of the security. As one can imagine, extreme pressure resides on today's senior managers. They are held responsible for meeting financial expectations and providing growth for the future.

To complicate matters further, managers responsible for meeting the financial goals are far removed from the decisions made in developing new products. Senior managers typically are concerned with financial measures where as engineers developing products are more concerned with product requirements and schedules. It is difficult to make the bridge between the business level financial goals and the design tradeoffs considered when developing a new product. In other words, the impact product development decisions have on the organization's financial goals is difficult to determine. Therefore business processes must be put in place that will ensure alignment between product development teams and the financial goals. This thesis recommends a set of business processes that aligns product development teams to business level goals.

The research in this thesis was completed during a six month internship within Intel Corporation's Mobile and Handheld Products Group (MHPG) in Santa Clara California. Chapter 2 is designed to provide a brief background of Intel and of the changes that have occurred in the computer industry over the last twenty years. Chapter 3 focuses specifically on the mobile computer industry by describing the market environment and discussing the challenges of designing products for this industry

Chapter 4 describes MHPG in detail. This chapter will provide the reader with a sense of how MPHG is organized and the products they develop. In addition to describing MHPG's general business model, this chapter identifies a set of conflicting goals within MHPG. This chapter concludes by building a case for the need to align development teams to business level goals.

Chapter 5 discusses the three methodologies that were evaluated for aligning development teams to business level goals. Each methodology includes a description and an analysis of the feasibility of implementation within MHPG.

Chapter 6 includes a detailed description of MHPG's current business planning processes and an analysis of processes' weaknesses. This chapter concludes with a set of recommended modifications for MHPG to ensure that development teams are aligned with the business level goals.

2. Background

This chapter is structured to provide the reader with a basic understanding of the evolution of the computer industry. A brief description of today's computer industry and of Intel will set the stage for the research completed in this document.

2.1 The Computer Industry

Prior to the advent of personal computers, the computer industry consisted of mainframes and mini-computers. These systems were large and complex, and were designed to meet the computing needs of larger corporations. As of 1980, the computer industry was dominated by a few organizations that were vertically integrated. Figure 2.1 illustrates what the computer industry looked like in 1980. As can be seen, the industry players developed and manufactured everything from the semiconductor chips all the way up to the application software. In addition, these firms used a direct sales force to interface with the customer and often controlled their own distribution through shipping and handling.

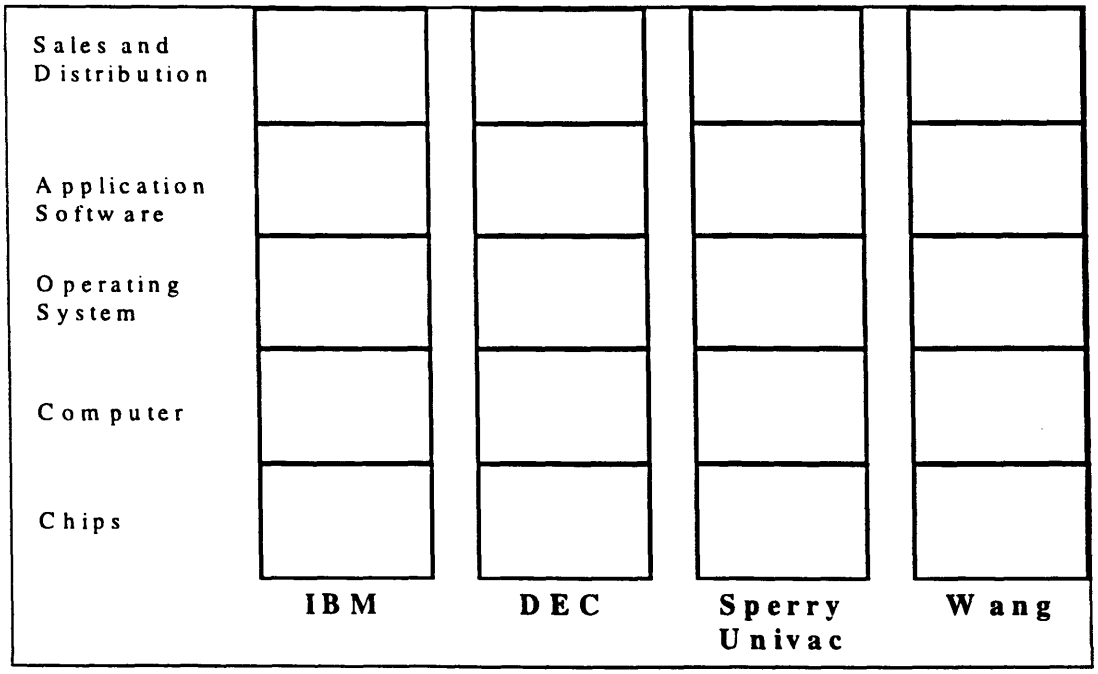

Figure 2-1. 1980 Vertical Computer Industry [1]

The vertical business model was successful because no computer standard existed at the time. Therefore companies developed proprietary solutions to meet customers' specific needs. Problems with integrating different vendor's equipment resulted in high switching costs for the customer. Computer vendors benefited from this through repeat business as the customer's needs changed or expanded. Considering that business with a vendor is a long term relationship, companies put extra emphasis on establishing the first sale to a new client.

Although the first micro-computer (later termed the personal computer) was introduced in the early 1970's, the market remained fragmented with no clear industry leader for some time. It wasn't until 1977 that the micro-computer industry started to take off and change the marketplace. Improvements in four technological areas contributed to the rapid growth of this industry. The four technological improvements were the: [2]

- development of 8-bit microprocessors with significant improvements over Intel's 8080 chip
- development of a standard operating system, CP/M-80
- development of the first disk drive, thus eliminating the need for cassette tape drives
- decrease in cost per bit of Random Access Memory (RAM)

Although Intel introduced its first industry standard microprocessor, 8080, in 1974, it wasn't until 1981 when IBM introduced the first "personal computer" powered with an Intel 8088 microprocessor. At this time, large computer companies such as IBM, Hewlett-Packard and DEC were unclear about the potential size of the personal computer market. These firms did not see the personal computer as a threat to their mainframe and mini-computer businesses. To IBM's surprise the personal computer market started to grow more than expected. IBM, as one of the pushers of the personal computer, had captured close to 40% of the market share by 1983.

IBM's strategy for the personal computer segment was very different than that of its mainframe and mini-computer segments. The strategy was to out-source the supply of the hardware and software, and to adopt an open-architecture standard. The benefit of open architecture is that software firms were now encouraged to develop applications and to burden the cost of development. In addition, IBM adopted Intel's 16-bit architecture, the 8086 chip, which gave software developers the ability to create more powerful applications. At the same time, IBM was working with Microsoft to create a new operating system standard, PC-DOS, that would be available to all personal computer manufacturers. Soon came the emergence of the IBM compatible personal computer and the forming of a new type of industry.

The acceptance of this new standard of computing led to increased competition amongst computer manufacturers and allowed software developers to create applications for mass markets. Skipping ten years into the future, the horizontal computer industry, as seen in figure 2.2 was fully established. The horizontal computer industry worked much differently than the vertical industry. In this new industry, computers could be created with components from several different vendors throughout the horizontal segments. This created extreme competition amongst vendors within the same horizontal segment and less amongst competitors offering complete vertical solutions.

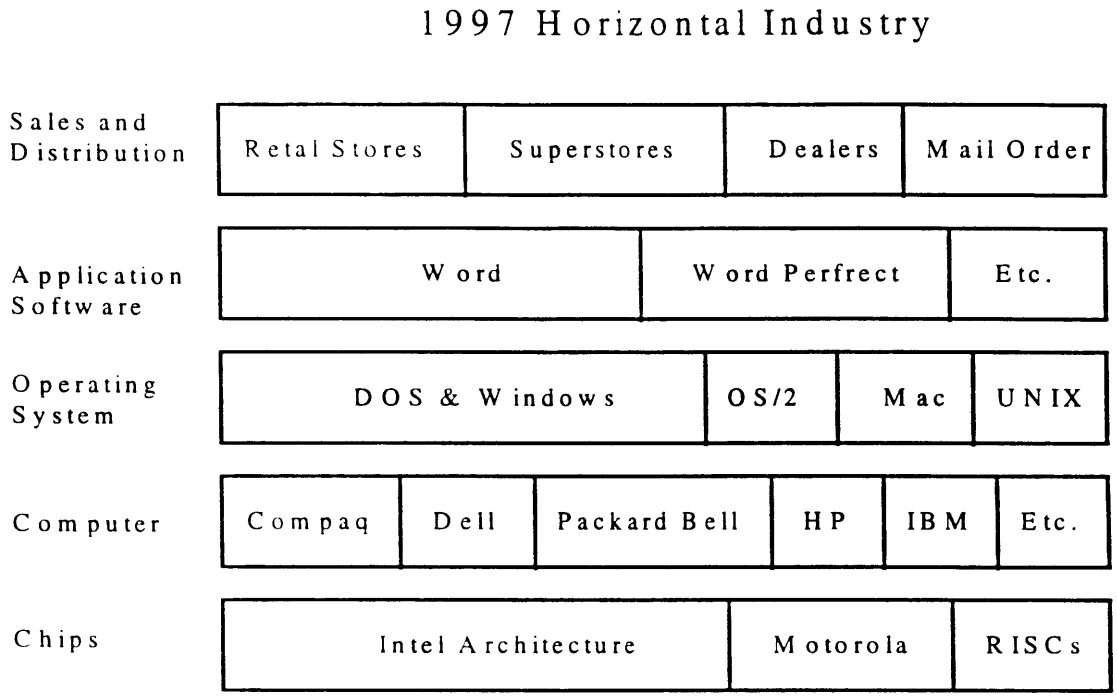

Figure 2-2. 1997 Horizontal Computer Industry

2.2 Intel

Intel, as most people are aware, were the pioneers of the microprocessor. As of 1997, it was estimated that 89 percent of the world's personal computers were powered by Intel microprocessors. Two of the reasons for this success are that IBM chose to out-source the microprocessor and operating system[3] in its personal computer strategy and that Intel has continually developed and manufactured state of the art microprocessors ahead of its competition. Through superior designs, efficient product development and a clear focus on manufacturing, Intel has been able to both help grow the personal computer market and to meet the needs of the consumer.

Intel, founded in 1968 by Gordon Moore and Robert Noyce, originally competed in the memory business. It wasn't until 1985, as profits from the memory business were declining, that Intel decided to exit the memory business all together and to focus on its microprocessor products. In order to meet the needs of the microprocessor market, Intel structured itself as a matrix organization as seen in figure 2.3. Today, Intel's vertical

business units are organized to meet the needs of the specific market segments. In addition, business units are managed as profit centers with each reporting its own profit and loss statement. Research for this thesis was conducted in the Mobile and Handheld Products Group (MHPG) vertical business unit.

Horizontal organizations at Intel are responsible for supporting each of the product line business groups. One benefit Intel receives from this type of organization is the economies of scale that are realized using the horizontal support groups. More specifically, key design talent (such as in the Microprocessor Products Group (MPG)) can be leveraged by sharing designs throughout the vertical segments.

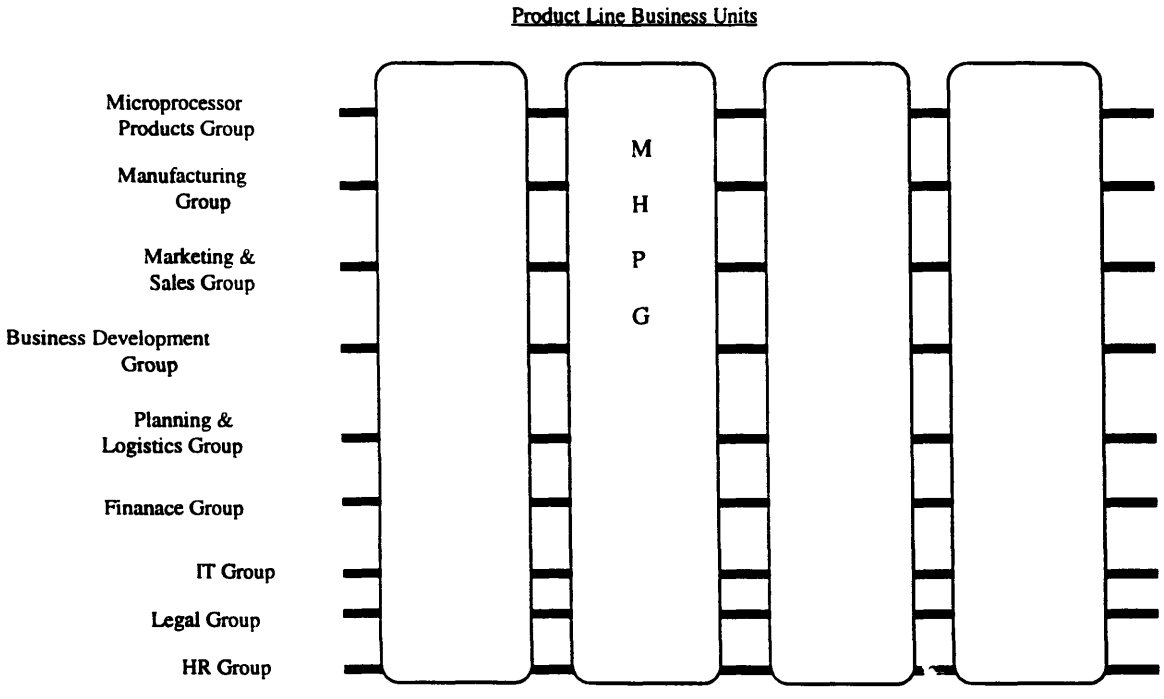

Figure 2-3. Intel Matrix Organization

A drawback of the matrix type organization is that it is difficult to allocate resources amongst the vertical product groups. For instance, MPG is responsible for designing all of Intel's microprocessors products (i.e. mobile computers, desktops, workstations and servers). Although certain features are common between the different products, design criteria are often in conflict with each other. This presents a challenge as one team tries

to design a microprocessor to serve two or more markets. In this situation, the lower volume market segment typically receives a design that is not optimized for its marketplace. Although this does not equate with failure for Intel, it makes the job of the vertical business unit that much more difficult.

Although the vertical business units are organized differently, they share the same goals: to develop and market microprocessor products for the specific business segment. MHPG, for example, develops products that are designed for all mobile personal computers. The challenge MHPG faces is to meet the needs of the mobile computer marketplace with the drawback of the matrix organization described above.

The following chapter describes in more detail the mobile computing industry, and the challenges that MHPG faces in this industry.

3. The Mobile Computer Industry

3.1 Market Environment

The first mobile computer was assembled by Osbourne in the early 1980s but did not receive much success. These devices weighed over 20 lbs. and were often referred to as "luggables". It was until 1982 that Grid introduced a 10 lb., battery powered mobile computer. Companies such as Hewlett-Packard, IBM, Toshiba, Compaq and Apple followed suit and by the late 1980s industry analysts were predicting the mobile computer market to experience rapid growth. [4]

The success of today's mobile computer industry can be credited to the contributions from both Intel and the mobile computer OEMs. Intel's MHPG has contributed to the industry's success by continuously developing and delivering microprocessor products designed for the mobile market. A detailed discussion of MHPG's contribution is included in the following section.

Mobile computer OEM's contribution has been just as significant. Typically mobile computers command higher prices than desktop equivalent (performance) computers and provide OEMs with higher margins. This phenomenon led to an increase in the number of OEMs developing mobile computers and a decrease in the average selling price. Appendix 1 includes a list of the mobile computer OEMs currently developing mobile computers that use an Intel microprocessor product.

End users benefit not only from a lower average selling price but from a large selection of mobile computers to chose from. OEM's differentiate themselves by offering products with different sets of features in order to allow end users to chose a product that meets their specific computing needs. The lower price and greater variety has contributed to the growth of the mobile computer market. Figure 3.1 forecasts the number of mobile computers through the year 2000.

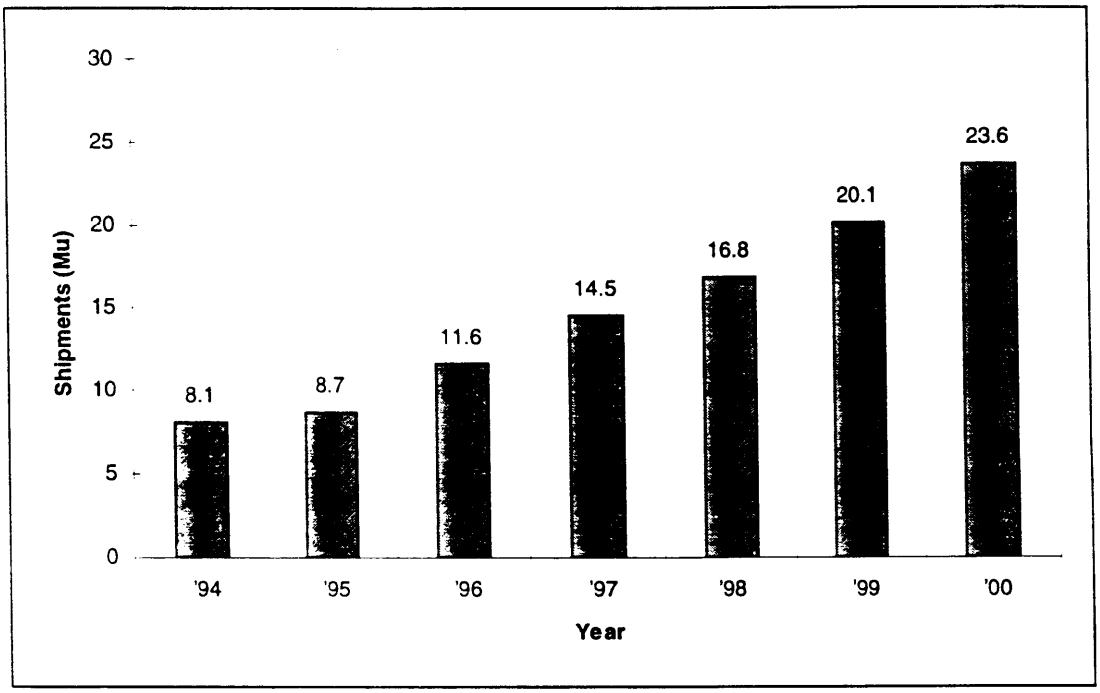

Figure 3-1. IDC Mobile Computer Forecast [5]

3.2 Mobile Computer Design Challenges

Until the early 1990s, mobile computers were large, heavy, and had a very short battery life due to the fact that they were designed and built with desktop parts. Up to that point, no group existed within Intel that designed and developed microprocessors specifically for mobile computers. Intel's microprocessors and chip sets did not include mobile features and component packaging was designed for desktop computers. As a result, the end product was a large device that actually resembled more of a desktop than what one today would call a mobile or laptop computer.

As the demand for mobile computers started to grow, different usage models started to emerge and the future of the portable industry started to take shape. As semiconductor processing technology improved and component vendors manufactured smaller parts, the

size and weight of the mobile computer started to decrease. It wasn't until microprocessors and packaging was designed and built specifically for the portable computer that customer's true needs could be met.

The mobile computer became accepted as a tool to increase the productivity of the business professional. Whether preparing a presentation on an airplane to a customer's site or checking email from a hotel room at night, the business professional became the target end user and would ultimately define the needs of future mobile computers.

As the industry matured, the three most important characteristics of the mobile computer became the form factor, performance and battery life. These characteristics still present both Intel and mobile OEMs with the biggest design challenges of today's and future mobile computers.

The remainder of this chapter describes the technical challenges relating to form factor issues and the balance between performance vs. thermal and battery life issues.

3.2.1 Form Factor

Form Factor in the mobile computer industry is related specifically to the size of the computer. When mobile computers were first introduced there was very little differences in form factor between one vendor and the next. They were large heavy devices that required desk or a table to rest on. This machine could not comfortably rest on one's lap or fit onto an airplane tray. The large form factor was due to many different factors including the keyboard and internal components such as the hard drive, the display, the battery and the microprocessor itself. At that time, OEMs were using many desktop products in the design of the mobile computers. The tradeoff between using desktop parts vs. designing parts specifically for the mobile computers favored using existing parts because of the market uncertainty with mobile computers.

As technologies advanced and component sizes decreased, mobile computer OEMs were able to make smaller form factor products. It was between 1993 and 1994 when the form factors of mobile computer started to become noticeably smaller. The smaller size device of these times led consumers to realize the true benefits of these devices. For instance, a mobile computer could be used to write a memo on an airplane or while sitting on the bed in a hotel room. In addition, the mobile computer started to resemble more of an accessory than a separate piece of luggage while travelling. Advances in technology combined with the demand for the smaller devices helped drive the industry to design different form factor products for specific applications or uses.

As the demand for smaller, thinner and lighter computers grew, the minimum size of the product was controlled by the physical limitations of internal components. For example, CD-ROM technology has experienced major performance improvements and has become a standard feature in mobile computers. As consumers have been demanded CD-ROMs in the mobile computers, they have also continued to demand smaller and lighter mobile computers. Consumers' desire for smaller and lighter mobile computers has changed quicker than the physical dimensions and weight of CD-ROM drives. This phenomenon posed significant design challenges for both the mobile computer OEMs and Intel.

Intel contributed to the adoption of CD-ROMs as a standard feature in mobile computers by utilizing a special packaging technology for its mobile microprocessors. Figure 3.2 shows the difference between a conventional desktop microprocessor housed in a Standard Pin Grid Array (SPGA) package and a mobile microprocessor in the Tape Carrier Package (TCP). Using a TCP requires two-thirds less space and one-twentieth the weight of the conventional microprocessor package. The space and weight savings can then be devoted to a CD-ROM player within the small form factor.

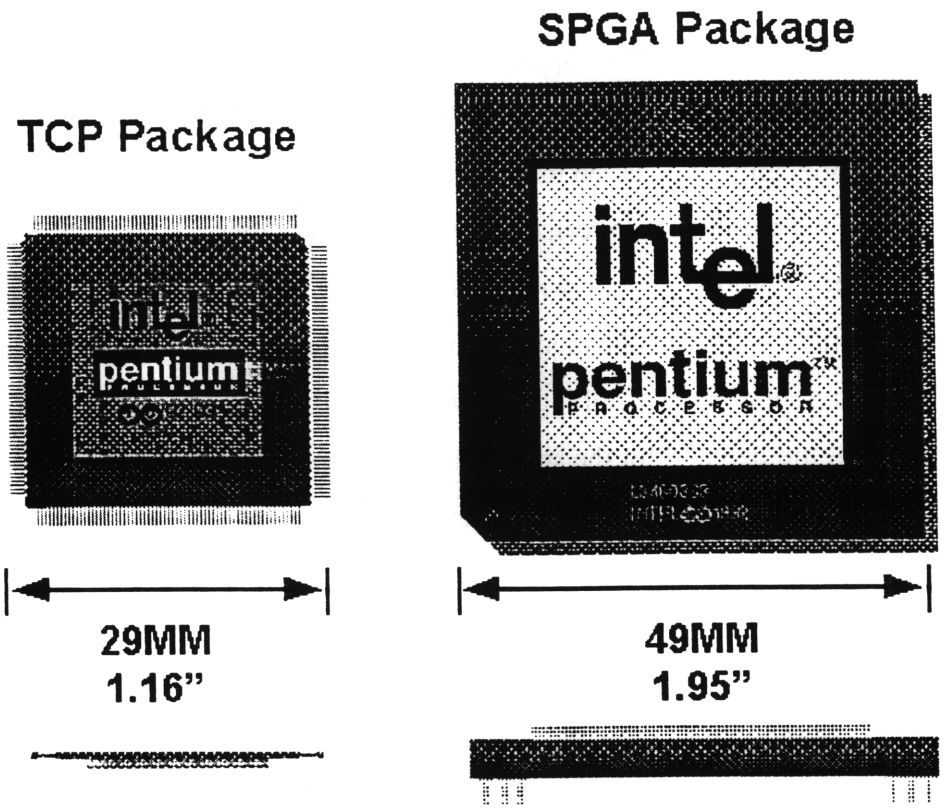

Figure 3-2. Intel Mobile Microprocessor Packages [6]

The Tape Carrier Package is a thin piece of film that looks similar to the film used to take photographs and it is produced through a process called Tape Automated Bonding technology. The TCP package is constructed from a base polymide film that has copper foil laminated to one side. The copper is photo-imaged and etched to leave traces or leads which make the electrical connection from silicon to the system circuit board. The traces are gold plated and then bonded to a gold bump that is placed on the silicon die. Once the traces are bonded to the die, the silicon is covered with a polymide siloxane resin. The devices are then fully tested and shipped to the OEMs for integration into the mobile computer.[7] This package has been a key contributor to the form factor mobile computers currently on the market.

The decision to develop the TCP was determined and developed well before this research took place. The author can only imagine the tradeoffs that were considered in developing this new package. The author believes that the decision to create this new type of

package was to increase the demand for mobile computers leading to an increased demand in mobile microprocessors and more revenue. Therefore the motivation for developing the new package was to meet revenue growth targets set forth by Wall Street and senior management.

Based on the issues identified in the introduction chapter, a process needs to be in place to ensure that development teams develop a package that meets the business level goals (revenue growth). Realizing that revenue growth is a financial measure that has little value by itself, the author also believes that consideration to gross margins also should have be considered when developing the package. The challenge then comes from taking the high level business goal (revenue increase and gross margins) and translating this into information the design team can use to develop the product.

A process needs to be designed to balance the increase in demand due to the smaller form factor and the cost of designing and producing the new product. In this specific case the process would consider the cost of the new package along with the yield losses associated with producing a smaller processor and with connecting the close proximity contacts to the motherboard. The additional microprocessor sales generated by offering new package would be weighed against the expected gross margins and then compared to the business level goals. Although this product has been very successful for MHPG and has helped them meet their business level goals the business case can clearly be seen for the need to align product development teams to the business level goals early in the development process.

3.2.2 Performance vs. Thermal and Battery Life Issues

With the growth of the mobile computer market, users have started to demand products that have comparable performance to the desktop computers presently on the market. As expected, an increase in the performance of the microprocessor (speed) and other mobile features (i.e. faster CD-ROM drives) increases the power consumption of the entire

system. Decentralized power consumption decisions made by component vendors would lead to the mobile computer system running into thermal and battery life problems. Since the microprocessor is the largest source of power consumption within the mobile computer system, MHPG acts as the centralized decision maker to provide guidance to the component manufacturers and mobile OEMs.

As discussed earlier, one of Intel's, and MHPG's, business level goals is to grow in sales volume and to maintain a specific gross margin. In order to achieve these goals, MHPG must continue to develop higher performing microprocessors. In order to keep the overall mobile power system as low as possible, MHPG uses its own power reduction methods and urges component vendors to do the same. MHPG uses its own microprocessor power roadmap to determine the requirements for next generation mobile computers. These figures are used to set targets for the remaining components in the system.

MHPG has taken a proactive role to ensure that the highest performance microprocessor and the most features are added to the mobile platform while still meeting the thermal requirements dictated by the form factor and battery life desired of the mobile user. The battery life of a portable computer has become very significant as many users demand access to the information on their mobile computers at times when AC power is not available.

MHPG's approach to address the thermal and battery life issues while continuing to improve the performance of mobile microprocessor was to launch the Mobile Power Initiative. This initiative provides mobile computer OEMs, component manufacturers and software publishers with products, tools and the resources to develop high performing power efficient mobile computers. [8]

MHPG's Mobile Power Initiative is divided into three areas. Each of the these areas will be discussed:

- The Computer System
- Operating System Power Management
- Software

3.2.2.1 The Computer System

The computer system portion of MHPG's Mobile Power Initiative focuses on the hardware components that make up the mobile computer. This portion of the initiative can be broken down into two areas; the microprocessor and chip set (Intel controls directly) and the 3rd party vendors that make the remaining components for the mobile computer. Since Intel only produces the microprocessor and the chip set it must influence the third party vendors to minimize component and subsystem power consumption.

Left on its own, the power consumption from all the components would quickly escalate and cause thermal design issues for the mobile OEMs. In addition, since improvements in battery technology lag that of components, this trend would lead to a shorter and shorter battery life for the mobile computer.

Figure 3.3 depicts the unconstrained system power projections for a mobile system. This graph illustrates how the system power is greater than the thermal limit (25 Watts) for mobile systems in 1998. The 1998 system power number represent current performance vs. power measurements and the addition of components expected to be added to mobile computers.

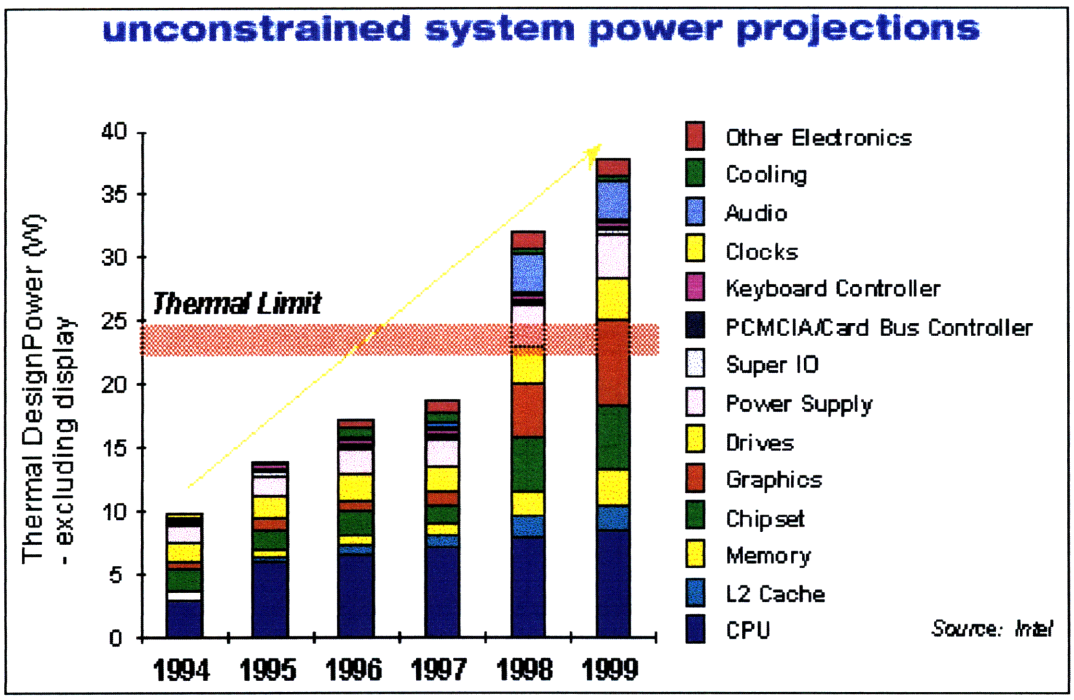

Figure 3-3. Unconstrained Mobile Power Projections [9]

A major portion of MHPG's efforts on the Mobile Power Initiative Intel has been in developing the Mobile Power Guidelines. This document, published by Intel in 1997, addresses the system level power issues faced by the industry. The Mobile Power Guidelines provides guidelines for reducing component and interface bus voltages along with setting power targets for different components in the system. The system power projections shown in figure 3.4 are a direct result from the Mobile Power Guidelines. The system power consumption level for 1998 is at the thermal limit but decreases moving forward. It is important to note that the systems in 1999 will be higher performing products than 1998 products and still consume less power.

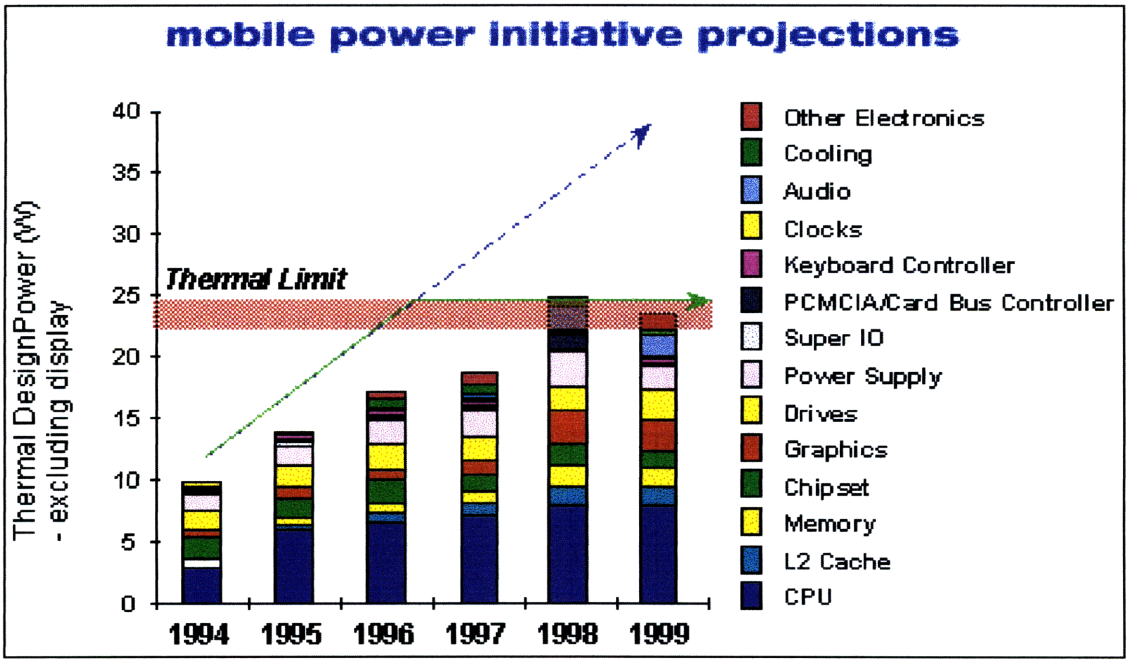

Figure 3-4. Intel Mobile Power Projections if Guidelines are met [10]

3.2.2.2 Operating System Power Management

The operating system power management portion of Intel's Mobile Power Initiative is designed to increase the battery life of mobile computers. How well the operating system manages the power of the mobile computer partly determines the length of mobile computer's battery life. Intel, with the help of Microsoft, mobile computer OEMs and battery manufacturers, has developed technologies that improve the Operating System Power Management and increase the battery life. The three technologies are: Advanced Configuration and Power Interface (ACPI), Smart Battery System (SBS) and the Intel Power Analyst.

ACPI

ACPI is a hardware system specification that allows the operating system to have control over the power management of the mobile computer. Before ACPI, power management typically resided in the Basic Input Output System (BIOS). The limitations of having power management reside in the BIOS is limited flexibility. Power Management was

limited to turning off devices after a predetermined period of device inactivity. ACPI is designed to address the limitations of BIOS controlled power management by allowing the operating system to control the power to all devices in the computer as it is required.

As mobile computers continue to evolve, all operating systems and computer devices will soon contain ACPI functions. Once systems of this sort are built they will have the following characteristics that are not present in today's non-ACPI compliant systems[11]:

- The OS will lower the microprocessors' clock speed when it determines the applications that are being run do not need the CPU to run at full speed.
- The OS will turn on devices only when they are required to be running.
- The OS will regulate an applications activity by continuously monitoring demand of the running software.
- The OS will modify the power management policies listed above depending on battery level.

SBS

SBS is an Intel and Duracell joint venture that calls for advanced circuitry to be placed inside the battery to provide more accurate battery energy level readings to the operating system. SBS was initiated because of a problem that exists with present battery reading technology. SBS is a result of the many complaints describing how the mobile computer system tells the user there are 30 minutes left in the battery and then shuts down within 5 minutes.

SBS is an open (shared with all battery manufacturers) specification between the battery system and the computer interface. It will allow for 98+% accuracy on remaining battery energy level readings. This accuracy will allow the operating system to better control system power when the battery life is getting low.

In addition to a more accurate reading of the remaining battery life, SBS will allow battery chargers to control the charge to the battery cells and in turn increase the battery

life and decrease the number of battery replacements. Another important feature Intel included in the specification is that computers containing SBS must be compatible with all types of batteries. This will ensure that as battery technologies improve, these new batteries will be able to be used in same computer.[12]

Intel Power Analyst

Intel Power Analyst is a tool designed for both operating system and mobile computer vendors. This tool provides real-time power consumption measurements for the different subsystems and components within the computer such as the microprocessor, memory, hard disk, video and audio.

In addition to a graphical reading of the subsystem, the Intel Power Analyst also provides a real-time power consumption reading of the entire computer system. This feature allows 3rd party vendors to test the use of specific applications while the computer system is being designed. As unexpected high power consumption scenarios are determined, the system can be redesigned real time to address the problem areas. [13]

3.2.2.3 Software

The final component of MHPG's Mobile Power Initiative is Software. This area is very important to Intel and mobile computer OEMs. In order to sell higher performing systems, software packages must be designed to take advantage of the latest microprocessors. As expected higher performing software packages require more computations from the microprocessor and thus require more power.

For obvious reasons Intel would like to motivate software vendors to develop powerful but efficient applications. Intel accomplishes this by providing software developers with the tools needed to develop programs that both perform well and conserve battery power. Intel has provided the following tools to software developers: the Intel Power Monitor (IPM) and the Mobile Software Guidelines.

IPM

IPM is a software tool for both application and device driver developers. IPM monitors system activity and will alert developers where portions of their code are either redundant or consume excessive amounts of system power. The information generated from IPM allows developers to modify their code such that it is more efficient and power friendly. [14]

Mobile Software Guidelines

The Mobile Software guidelines were written because many developers were switching to Windows 95 for their software development efforts. These guidelines provide developers with specific facts about the Windows 95 power management system. This information allows developers to write code that allows the Windows 95 power management system to operate as it was designed.

This chapter provided a background of the mobile computer market and discussed some of the design challenges involved in developing mobile computers. It served the purpose of highlighting Intel's roles in helping the industry develop better mobile products.

The next chapter describes the organization in which this research took place. The purpose of the chapter is to identify the products this organization develops and to describe its overall business model. The chapter concludes by identifying MHPG's goals that are in conflict with each other and sets the stage for the alignment methodologies that are evaluated in chapter five.

4. MHPG

Business in the 1990s is about increasing shareholder value, or in other words about increasing the stock price. To increase shareholder value companies can take two traditional approaches; grow the business or increase profitability. The belief shared by Intel management is that if each division can continually grow revenues and make the firm more profitable, then the value of the stock will continue to increase. Unfortunately this is easier said than done, especially for firms that are already very profitable and have been growing for many years. Nonetheless, this is what drives many businesses.

Growth can be achieved by growing the overall market or by increasing one's market share with each type requiring a different strategy. Similarly, profitability can be achieved by increasing the price per unit or by decreasing the cost to make and sell the product. Although these statements appear to be simplistic, they contain the underlying goals of any organization.

MHPG, managed as a profit center, is concerned with the same basic principles listed above. The purpose of this chapter is to give the reader a sense of how these principles drive the organization. After describing MHPG's business model and key business metrics, the chapter will conclude with the evaluation of a recent product development project that sets the stage for following chapters.

4.1 The Organization

MHPG is a business unit that develops and markets microprocessor products for mobile computers. As seen in figure 4.1, MHPG's work can be broken down into three basic areas: mobile platforms, mobile products and mobile initiatives.

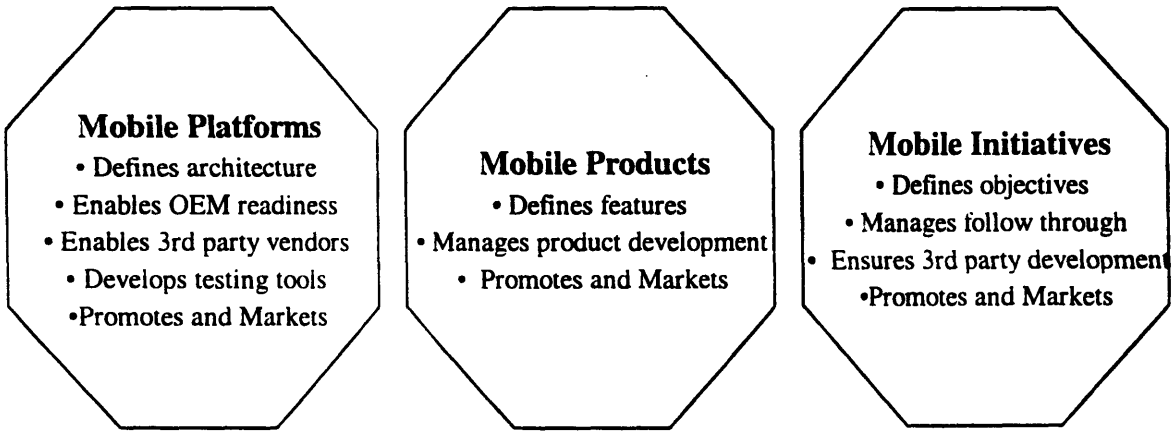

Figure 4-1. MHPG Business Areas

While revenues are only generated from selling mobile products, the platform and initiative work is just as critical to MHPG's success. Without compelling platforms or mobile initiatives the demand for mobile products would not what it is today. Examples of initiatives that MHPG manages are the Mobile Power Initiative described in the last chapter, mobile security, and a mobile data initiative. An example of platform management is that a team is responsible for defining the mobile platform for the year 2000 and ensuring that everything is in place for MHPG to sell its microprocessors into mobile computers.

Product development occurs within MHPG for all mobile products. As discussed earlier, Intel's MPG organization is responsible for designing all microprocessors. MHPG designs and develops the electronics that support the microprocessor for the defined mobile platform. As expected interaction between the microprocessor design (MPG) and

mobile platform definition and product development is critical. Figure 4.2 highlights the mobile product development flow and illustrates the interactions between MHPG and Intel's horizontal matrix organizations on new product development efforts.

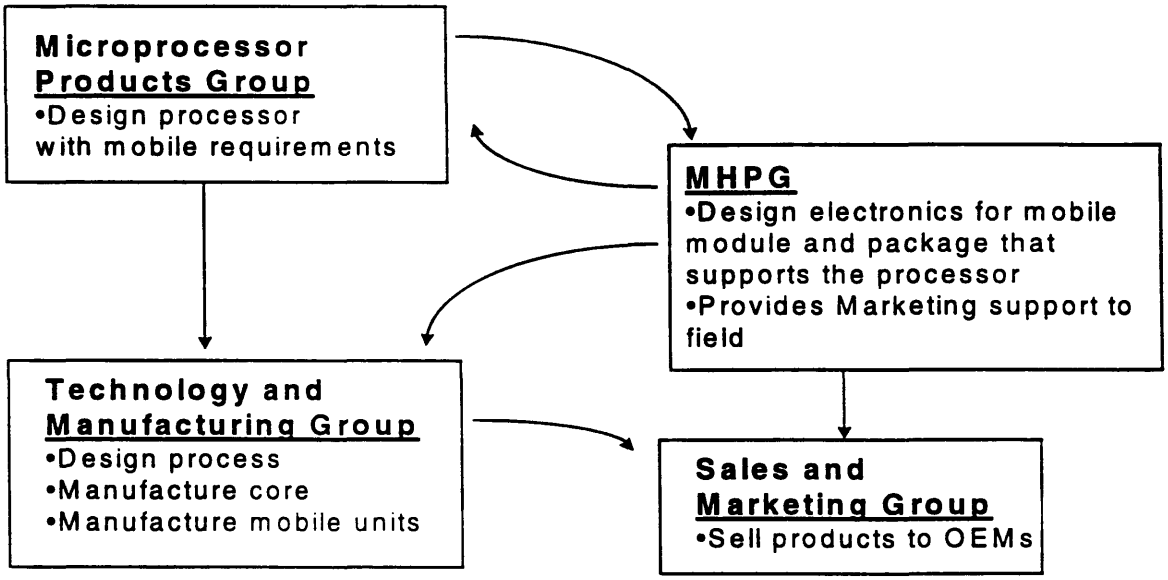

Figure 4-2. Mobile Product Development Flow

MHPG effectively uses a comprehensive process to develop new products and monitor their progress. This standard process begins once the product has been defined and is used on all new product developments. Appendix 2 describes the business processes MHPG uses to manage new product development.

4.2 The Business Model

MHPG's revenue stream comes from developing and selling microprocessor products to mobile computer OEMs. As with other Intel vertical business units, MHPG is expected to grow and improve its profitability.

Fortunately for MHPG, the mobile computer market has been growing since its inception. The growth rate can be attributed to many factors, but most importantly to MHPG's product development efforts. In order to sustain this growth, MHPG basic business model is to continually develop products that cannibalize its present offerings. If you think about it, if MHPG always gets new products to the market (before its competitors) that cannibalize its current products, it will forever stay ahead of its competition. MHPG, and Intel as a whole, has been successful because they have been able to execute to their business model.

MHPG's business model includes introducing new and more powerful products into the market place quarterly. Although it takes Intel around two years to develop a new microprocessor, modifications are made to incrementally increase speeds or features on a quarterly basis. Staggered product introductions allows for substantial price reductions on older products, while maintaining a price premium for the newest products. MHPG's total product offering at any point in time provides products for all types of users. Products are available for users that want the latest and greatest systems, and for new, more price sensitive users that are looking for slower machines at a lower price. Although this does not entirely explain the mobile computer industry, it does provide some background for future discussions.

MHPG's challenge of continually developing new products for the marketplace is complicated by the fact they do not make a product that is sold directly to the end user. MHPG is situated early in the computer supply chain and try to ensure that other players (computer OEMs) are all ready to introduce their new products when MHPG is ready to

introduce its product. MHPG's business model relies on the computer OEMs keeping pace with its new product introductions. It takes OEMs around two years to develop a new platform so there is a lot of pressure to keep the microprocessor and platform schedules in synch with each other.

A subtler assumption of the business model is that the success of new products depends on the number of computer OEMs introducing similar products at the same time. The objective is to have as many computers with the latest microprocessor on the shelves at the same time. This will ensure healthy competition amongst computer OEMs (keep costs down) and thus increase the demand for the latest products. In addition, more computer OEMs introducing the same microprocessor product allows Intel to better utilize its manufacturing capacity as it prepares for full scale production.

Another challenge for MHPG is that mobile computer system designs have increased in complexity with each generation of microprocessor product. To ensure that smaller computer OEMs, with weaker design capabilities, can keep up with larger OEMs, MHPG started to offer two different types microprocessor product. The two products (processor product & mobile module) utilize the same microprocessor core but are packaged differently and include different levels of integration. The microprocessor product is smaller in size and includes less integration. This product is typically used by larger OEMs, with strong design capabilities, in unique mobile form factors due to the size of the product. The mobile module, on the other hand, is larger and includes more integration. This product is ideal for smaller OEMs because it minimizes their system design effort and allows them to compete with larger OEMs that typically can get products to market more quickly. In practice, the mobile module has been adopted by larger mobile computer OEMs (2 of top 6). Although these firms have strong design teams, they also see the value in using the higher integrated product to also decrease their time to market.

Figure 4.3 illustrates the introduction of MHPG's higher integration product. Starting with the mobile Pentium ® generation processor. MHPG offered two microprocessor products. Due to the complexity of computer system designs and the intense competition amongst mobile computer manufacturers, the volume of higher integrated product has increased as a percentage of total mobile microprocessors with each generation product. It can be implied from this figure that the increased sales of the higher integrated are a direct result from MHPG's efforts to help smaller OEMs get their product to the market sooner by simplifying their design.

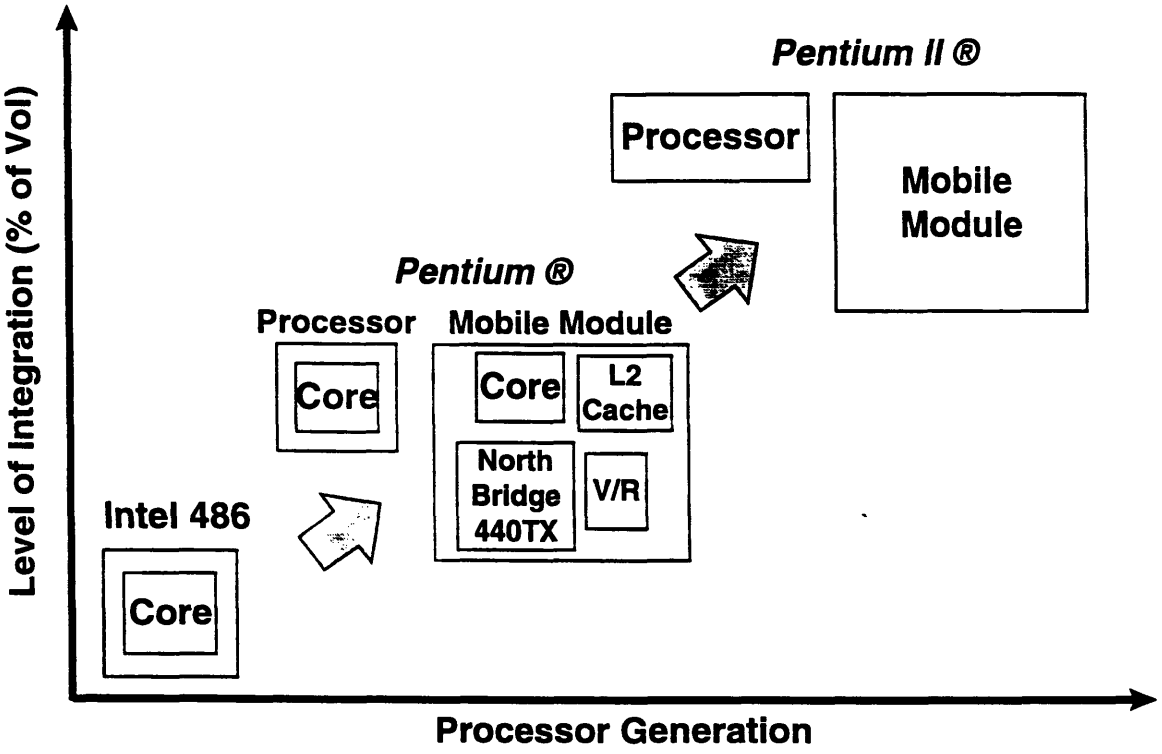

Figure 4-3. MHPG Product Line Integration Levels

Core – Microprocessor
L2 – Cache Memory
North Bridge – Chip set
V/R – Voltage Rgulator

4.3 Conflicting Goals

Using the basic principles of business discussed in the chapter introduction, MHPG goals are to do the following:

- Increase Profitability by
    - Decreasing product costs
    - Providing more value to the customer and thus receiving a higher selling price
- Continue Growth by
    - Providing more highly integrated products to ensure more competition and greater end-product availability
    - Providing higher integrated product to ensure many OEMs are ready to introduce mobile computers when MHPG is ready to introduce a new microprocessor product

The introduction of the low priced (sub $1000) personal computer has changed the computer industry forever. Its success to date has put extreme price pressures on both the microprocessor suppliers and all the mobile OEMs in the industry. The low price computer has had the effect of making MHPG's two goals conflict with each other.

More specifically, in order for MHPG to grow it must continue to provide highly integrated products so OEMs can keep up with new processor introductions. At the same time, computer OEMs are demanding lower prices on microprocessor products because end users have demanding lower priced mobile computers. This in turn prevents MHPG from receiving a selling price that is representative of the value added by the integration in the product.

Thus, in order to increase its profitability, MHPG must reduce product costs. The change in the marketplace has caused MHPG to focus on significant cost reduction efforts with its present products. Unfortunately, product lifecycles are so short that the benefits to cost reduction efforts have a limited window of opportunity. In the long term, MHPG

needs not only to focus on current cost reduction efforts but also on ensuring that new development efforts are aligned with the business level goals.

As MHPG moves forward, business processes must ensure that product development efforts will provide both the growth and level of profitability that is desired. After evaluating current business processes, it was determined that MHPG does not have a comprehensive set of business processes that ensures that product development teams are aligned with its business level goals.

The lack of a comprehensive set of business processes was the basis for the following research. The next chapter identifies three different methodologies of aligning development teams with business level goals, and evaluates their feasibility of implementation in MHPG. The final chapter includes a recommended set of business processes that will help development teams with MHPG's business goals.

5. Methodologies of Aligning Development Teams with Business Level Goals

It would appear at a first glance that aligning development teams to business level goals would be an easy feat. After all, the object of any business is to sell products and make the most profit possible. Without any specific alignment process, a development team may interpret this as "if we design the best product, marketing can price the product to maximize our profits". The problem is that when business goals are not clearly defined development teams can not focus their efforts on meeting the goal.

Figure 5.1 illustrates difference between misaligned and aligned product development teams. As shown, the marketing, design and production teams are all working toward their own goals within the space of business metrics. Not only are these teams misaligned with each other, but they are also misaligned with the key business goals of the organization. This goal of this chapter is to describe three different methodologies that are designed to provide the alignment of development teams to business level goals.

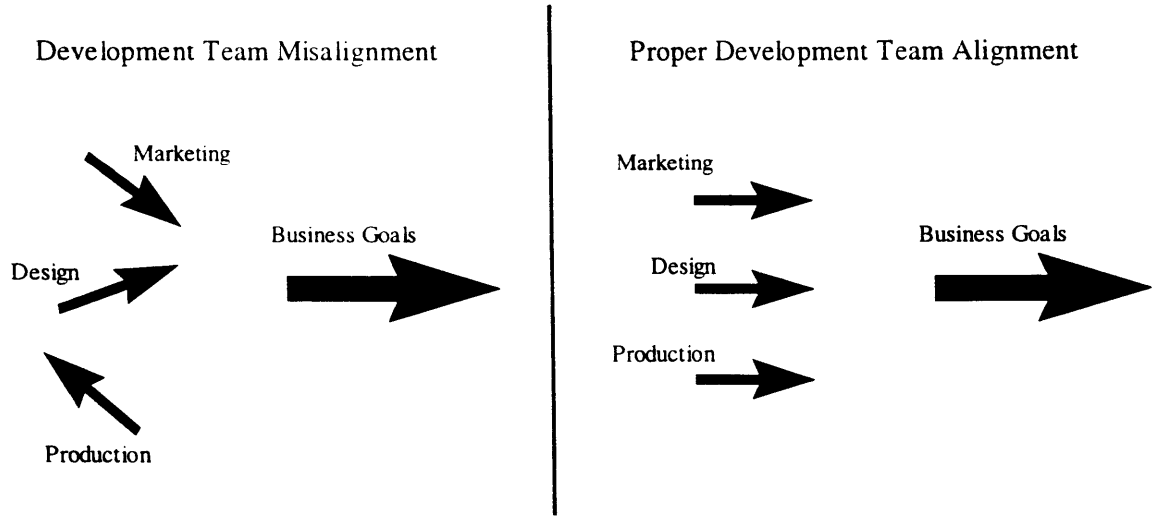

Figure 5-1. Functional Alignment to Business Goals [15]

Clearly defining the business goal is the first step to aligning the development teams. Once this goal is identified, different methodologies can be used to align the development teams. This chapter proposes three different methodologies and discusses the feasibility of implementation within MHPG.

5.1 Hoshin Management

5.1.1 Description

Hoshin management is a way of aligning individuals or teams in order for the company to reach its key goals and to react to changes in the business environment. [16]. A hoshin is defined as a one-year plan for achieving objectives developed in conjunction with management's choice of specific targets and means in quality, cost, delivery, and morale.[17]

In addition to aligning employees with business goals, hosin management is also designed to align job functions and tasks within in the organization in order to help create breakthroughs that are aligned with the business goals.

Hoshin management is a systematic way of accomplishing the alignment described above. This systematic approach can be broken down into three areas: Proactive, Reactive, and Control.

Proactive

The proactive stage of hoshin management is a form of strategic planning. Under Hoshin management a long term vision is used to help drive a mid-term plan, where the mid-term plan clearly defines the successful organization of the future. The successful organization could be defined by financial measures or by offering specific products or services. Included in the mid-term plan is an analysis of the organizations past performance and a

view of the current competitive environment. Together, the leaders formulate the future direction of the organization and the desired business level goals.

Reactive

Once the mid-term plan is clearly defined with specific goals, hoshin management reaches the reactive stage. At this point annual hoshins are identified and then deployed. The annual hoshin is a statement of a desired outcome for the upcoming year. The goal of hoshin management is to create a process that ensures that employees are aligned with business level goals. Hoshins originate from the leader of the organization and are then passed down to each level of the organization. Figure 5.2 displays the different levels of hoshins that would be required if MHPG chose to use hoshin management.

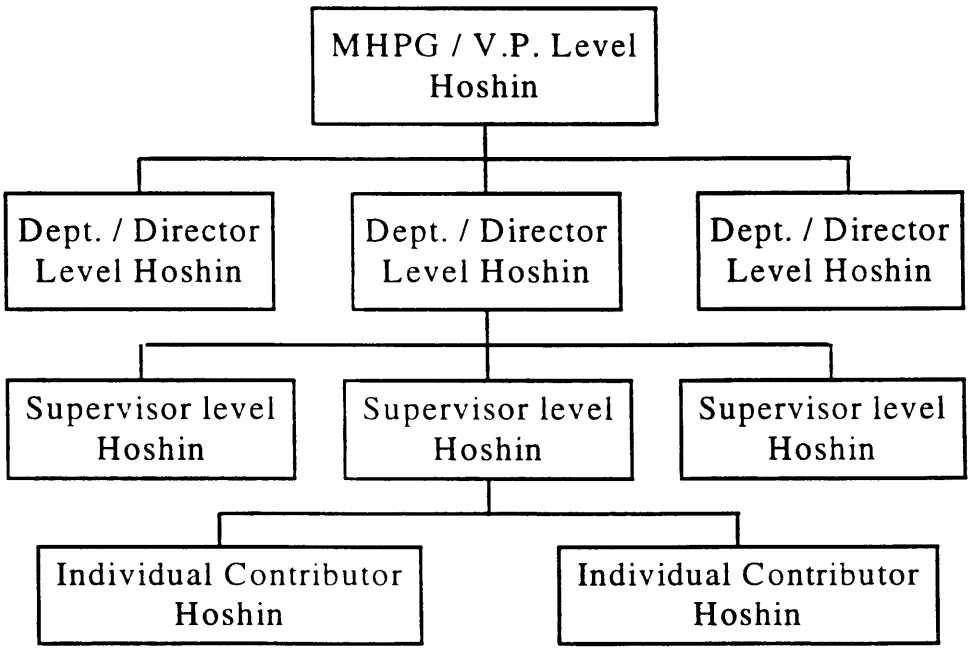

Figure 5-2. Hierarchy of Hoshins

The highest level hoshins would be determined by the Vice President and Directors of MHPG, and would be selected such that the organization will meet its mid-term plans including its business level goals. Organizations identify several high level hoshins that need to be completed in order for the organization to be successful.

Each annual hoshin is composed of the following:

- A Statement of desired outcome for the upcoming year
    - focused means
    - metric to measure progress
    - target value for metric
    - deadline date

Once the highest level hoshins have been determined, department/director level hoshins must be created. Together each director with his/her supervisors would determine their department hoshins for each of the top-level hoshins using the same structure as described above. In order to determine this level of hoshin, the director and supervisors would start by determining what is it about their department that prevents MHPG from meeting the desired outcome of its hoshin. This detailed analysis is required to determine the department level hoshin along with the proper means and appropriate target values for the metrics. This process creates alignment between department level and MHPG business level hoshins.

This process continues down the different levels of the organization until specific tasks are identified for employees. If this process is followed throughout the organization, there will be alignment between individual work and the business level goals. The individual hoshins will be a detailed means for the employee to help contribute to the organization level goals.

Control

The final phase of Hoshin management is that of control. This section of hoshin management determines how each of hoshin will be monitored and compared against its target values. As described earlier, each hoshin must include both a metric and a desired target value. Metrics and targets are identified at the same time the hoshins are developed for each level of the organization.

A benefit of using hoshin management is that it not only allows one to monitor the desired results, but it also the group the ability to carry through with the planned means. During each measurement period the desired outcome is first measured. If the there is a discrepancy between the desired and the actual measurement then the group must ask itself how well it did in carrying out the planned means. In other words, was the desired result not met because of a malfunctioning of the planned means or because the group failed to carry out the planned means? Completion of this analysis will help the group focus its efforts on areas of improvement. [18]

The frequency of measurement depends on the specific task at hand. It should be noted that the selection of the proper metrics is critical. Metrics serve the purpose of 1) determining the value of a project, 2) evaluating people, objectives, programs, in order to allocate resources, and 3) motivating engineers and managers making product decisions.[19] Metrics should be carefully selected and only chosen if the data is readily available. In addition, metrics that can be gamed should not be chosen. Employees will take advantage of such metrics and will prevent the proper alignment from occurring.

As the hoshins are monitored, corrective actions are be taken when the actual results differ from the desired results. Since hoshins typically determine annual targets, pre-specified limits should be determined for the measurements throughout the year. These updates help the groups determine whether they are on course to meet their annual hoshin. Corrective actions are taken as measurements are found outside the limits for a given measurement period.

In order to be prepared to take the proper corrective action, the groups may develop a document that identifies actions to be taken for specific results. This type of document is often referred to as a measurement implementation plan or a control by measure plan. [20]

5.1.2 Feasibility of Implementation

Assuming that gross margins are of significant importance, listed below are examples of MHPG level hoshins that could be used to align its employees to the business level goals.

Examples of possible MHPG Level Hoshin:

- Make X% gross margins on new products for 1998 by decreasing bill of material (BOM) costs
- Make X% gross margins on new products for 1998 by decreasing product development costs
- Make X% gross margins on new products for 1998 by increasing product prices through improved product value

Each of the possible hoshins described meet the criteria discussed above. Each includes a deadline and a focused means of meeting the desired gross margin goal. The focused means are specific actions in which the organization can take in order to meet the goals. The next step would be for each of the marketing, strategic planning, support, design engineering, manufacturing, logistics and finance groups to create department hoshins that are aligned with each MHPG hoshin.

Implementation of hoshin management is not recommended within MHPG for the following two reasons: 1) the way Intel is organized and 2) it would be difficult to get buy-in from top management.

In order for hoshin management to be successfully implemented, organizations must have direct control of all the factors that affect the business level goals. Therefore implementing hoshin management in a matrix organization like Intel's, with shared control, would be very difficult. As discussed in chapters 2 and 4, new product development at Intel is managed within the different vertical business units (i.e. MHPG) and meeting the business level goals depends heavily on the success of its new product development. However factors such as manufacturing capacity and microprocessor

design, which directly impact the success of a product, are not controlled directly by the vertical business units.

In a matrix organization, individuals are linked to others according through a project and a functional area. Individuals typically work for two different people; the project manager and the functional department manager. However, the individual shows up only one group's budget and therefore has a stronger link to this group. This group will be responsible for direct supervision conducting performance appraisals. Matrix organizations can be classified two different ways. The classification depends on the strength of the link between the individual to the project and the functional area. A lightweight project organization is one in which individuals report directly to the functional areas. In this situation the project manager becomes more of a coordinator and schedule manager and at times can have limited control over team members. On the other hand, a heavyweight project organization is one in which project manager has direct control over each individual on the team. Here, the project manager is heavily involved in performance appraisals and has complete budget authority.[21]

MHPG development teams can be classified as lightweight project organizations because only a few member of the product developments team report directly to the project manager. This creates specific problems in trying to implement hoshin management. The problem is that the vertical business units have limited control over certain aspects of a product's success. MHPG's project manager is responsible for making product level decision but has limited control over key team members. The project manager has limited control over individuals from manufacturing, finance and logistics because each one report to a manager in their respective functional organization. The project manager has to influence individuals in order to accomplish project related tasks and therefore has limited control over some of its business level goals. Since the goal of hoshin management is to align employees with business level goals through control and monitoring it doesn't make sense to use it in a situation where the project manager has limited control over team members.

For example, suppose the MHPG level hoshin was to reach X% gross margins by decreasing BOM costs. BOM costs can be reduced by either redesigning the system with lower priced parts or by renegotiating present supplier contracts to get better rates. Supplier contracts are negotiated by the planning and logistics groups therefore limiting MHPG's control over the product cost. Therefore the highest level hoshin is part controlled by a group that reports to a different organization.

The limited control over some business goals does not make hoshin management the best planning process for MHPG. In addition the structure of the matrix organization creates a natural tension between the vertical business units in regards to desired microprocessor features and specifications. To maximize sales of its products, each vertical business requires a unique set of product attributes designed to satisfy its specific customer's needs. Since a microprocessor is often designed to meet the needs of more than one market segment, design trade-offs are made between different organizations and the microprocessor is not optimized for any single vertical business unit. This results in vertical business units having limited control over some significant business level goals. For example, product features directly impact revenues. By limiting the selection of product features, the result is that the vertical business units have limited control over its business goals. A fundamental part of hoshin management is to influence employees to meet pre-defined business level goals. The goals not only must be realistic but they also must be able to be controlled within the organization.

Based on the results observed, one may conclude that hoshin management would not work in any matrix organization. However, the author believes there is some hope for hoshin management within a matrix organization. The probability of successfully implementing hoshin management in a matrix organization is directly correlated with the influence selecting the product features and specifications. Unfortunately, compared to other vertical business units, MHPG has limited control over product features and

specifications. Therefore hoshin management would be better suited for a vertical business unit that has the most control over microprocessor features and specifications.

The second reason hoshin management would be difficult to implement within MHPG is because of its structure. Hoshin management is a very structured process and will only successfully implemented if the leader of the organization embraces it. In order for a leader to embrace this type of process, he/she must be process oriented and have a strong belief that the process will work.

Based on the author's experience with MHPG during the six month internship, hoshin management is not appropriate for this organization. The leader of MHPG is not very process oriented and is very critical of enforcing to much structure into the organization. Criticisms of this methodology are that it is time consuming and it inflexible. The current business environment requires MHPG to react quickly to changes. Hoshin management is viewed as an obstacle to making quick decisions. The process would be overlooked the fiorst time MHPG was presented with a crisis that required quick action. In addition, MHPG senior management has very little faith that the process would work in the first place. Until these barriers (leader needs to be process oriented, process is streamlined to consume less time, and there is faith that the process will work) are overcome hoshin management should not be used to align MHPG product development teams to its business level goals.

5.2 Hierarchy Of Indicators

Indicator - One that serves as a sign, symptom, or token of; one that signifies[22]

Effective Indicators

Indicators, if chosen correctly, can be an effective way of influencing employee's behavior in order to get desired results. In order for an indicator to be effective it must meet the following three criteria: 1) the results must drive decisions within the organization 2) success in meeting target goals must be linked to personal evaluations 3) the data must be readily available.

The first criterion for choosing an effective indicator is that results must drive decisions within the organization. For example suppose an organization promotes on-time deliveries to its customers. In order to monitor the organization's performance it would create an indicator relating to product deliveries. A possible indicator for this could be the percent of deliveries that meet the commit date and could be measured on a monthly basis. The first criterion for an effective indicator states that results must drive decisions within the organization. If this indicator showed that the percent of on-time deliveries was lower than the target value then decisions should be made to either improve the present process or to modify the commit dates provided to customers. If senior management would not take action when target values are missed then this is not an effective indicator.

The second criterion for choosing an effective indicator is that success in meeting target goals must be linked to personal evaluations. Employee behavior is often aligned with the system against which they are measured. Therefore, the employee evaluation process should include the organization's performance relative to the target values of the indicators. In the example of on-time deliveries, employees that have control over product deliveries and commitments should have the performance of the indicators as a portion of their overall evaluation. This will help drive the behavior aligned with the indicators identified.

The final criterion for choosing an effective indicator is that data must be readily available. This may seem like an obvious comment but is often difficult to meet in practice. For example, suppose that on-time delivery is important but the organization's information system is not designed to keep track of delivery complaints filed by the field sales group. In this instance measuring the percent of on-time deliveries would be tedious and time consuming and would make this a poor candidate for an indicator. In situations where the data isn't available but the information is crucial to the business, the organization should invest resources to create systems to acquire the data. The cost/benefit tread-off should thorough be evaluated prior to making any investments.

5.2.1 Description

A second method used to align employees with business level goals is to generate a hierarchy of indicators for the organization. This methodology has many similar characteristics to hoshin management but contains much less structure. Figure 5.3 illustrates the concept of a hierarchy of indicators. The object is to identify effective indicators at each level that is aligned with the business level goals. Using indicators to measure a development team's performance will create alignment with the business level goals. This methodology was evaluated and proposed to the director level of MHPG. Director feedback is be discussed in the feasibility of implementation section.

In order to align the development teams with the business level goals MHPG would need to create three different levels of indicators. The frequency of measurement would differ for each level of indicators with the Critical Success Factors (CSF) measured at the end of a two year period, the Strategic Objective level indicators be measured once a quarter and the Program level indicators measured on a monthly basis.

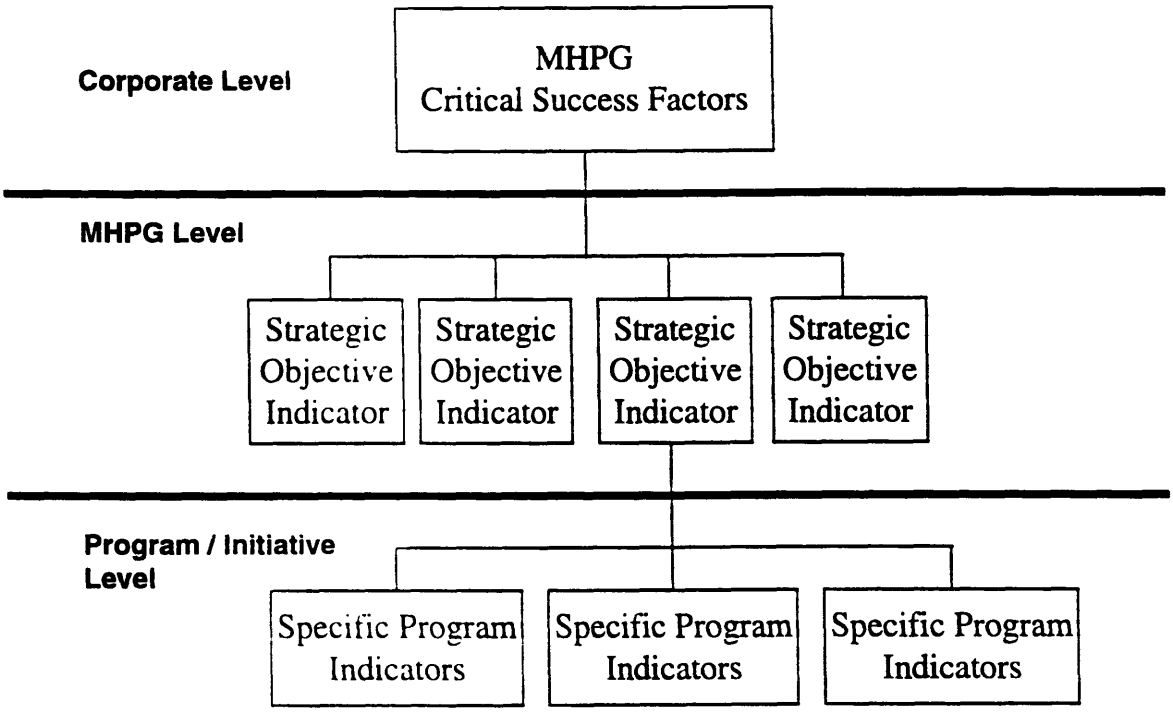

Figure 5-3. Hierarchy of Indicators

The CSFs in this case are MHPG's business level goals. During the internship, a one day off-site meeting with the Vice President and Directors was used to determine MHPG's future direction and identify the CSFs. The decision to measure the CSFs at the end of a two year period was made at the off-site meeting. In essence, the CSFs define MHPG's mid-term plan as described in the hoshin management section. The purpose of the CSFs is to establish a distant ending point for which the organization can move toward. The thought is that if MHPG meets all the target CSF values at the end of two years, then it is successful.

One level down from the critical success factors is the Strategic Objective level indicators which are measured on a quarterly basis. In the past, indicators at this level were also determined during the annual off-site planning meeting. The 1997 Strategic Objective indicators that were in place at the start of the internship were not being utilized. The writer believes the indicators were not being tracked because they did not meet the indicator criteria described earlier. In order to test the feasibility of the hierarchy of

indicator methodology during the internship, a new set of Strategic Objective indicators needed to be selected. Part of this research included identifying a set of effective indicators that met the alignment of this methodology.

The indicator selection criterion described earlier was used to select the 1998 Strategic Objective indicators. In addition to using the effective indicator criteria, the writer had to ensure that alignment occurred with the CSFs. The selection of Strategic Objective indicators was simple because they simply turned out to be a decomposition of the information that required to measure the CSFs. For example if a CSF is to have X revenues, then the Strategic Objective indicator would be product sales volumes and the average selling price.

The next step was to determine Program level indicators. In addition to having trouble identifying indicators that met the indicator selection criteria, it was difficult to identify indicators that had direct alignment with the Strategic Objective indicators and the CSFs. Each Strategic Objective contains several programs thus requires indicators for each of the key programs.

The problem arises by trying to separate the contributions of key programs to each of the Strategic Objectives. In many instances it was difficult to determine the specific measure to track at the lower level that would ensure that the business level goals would be met. It was easy for financial measures but was difficult for less tangible measures.

5.2.2 Feasibility of Implementation

Implementing the hierarchy of indicators methodology in MHPG was not successful. A presentation was put together for MHPG directors that summarized the concept and made specific recommendations for indicators at the Strategic Objective and Program levels. The writer identified the problems with past Strategic Objective level indicators and made a case for using Program level indicators. The purpose of the presentation was to get feedback and to gain acceptance of the proposed methodology.

Feedback from MHPG directors was mixed. On one hand, all of the Directors agreed that there was a problem with the past set of indicators, but a few of the directors were hesitant about using three levels of indicators for the organization.

The reluctant directors pointed out that a third level (program specific) of indicators added too much detail to the measurement process. One director commented that more time would be spent monitoring the different projects than actually working on them. Another director said that MHPG needs a process that is simple and easy to follow, and the hierarchy of indicators does not meet those criteria.

One suggestion was that instead of creating indicators for each program and initiative, each program goal should be graded on a single data point during MHPG's quarterly updating period. More specifically the director responsible for the program would identify the upcoming quarterly goal (i.e. production samples of product X ready in Q1). At the end of each quarter the performance would be measured against tne target goals. In essence this would be the program level indicator but with less structure and more flexibility.

The writer expected this type of reaction based on other interactions with the management team. The result of the presentation was that both CSFs and Strategic level indicators would be used and specific programs would be measured on a pass/fail basis at the end of

each quarter. The writer continued to work with the different departments to finalize the Strategic Objective level indicators for MHPG.

5.3 Target Costing

The final methodology evaluated for aligning development teams with business levels goals is called target costing. This methodology is specifically designed to align the development efforts with financial business goals such as gross profit margins. Wall Street analysts base their company ratings, therefore making this methodology pertinent to this research. For example a company enjoying a net income growth rate of 10% with shrinking margins will be viewed poorly from Wall Street's perspective.

To increase margins, companies can either charge higher prices or they can decrease the cost of the product. Assuming the market determines the price and it is decreasing due to competition, companies are left with controlling product cost to keep the same margins. Companies have the choice of reducing product cost once it is in production through process improvements or by defining the product in the definition stage and selecting cost targets that will ensure margin targets. The first method is sometimes called Kaizen costing and is practiced by most companies.[23] The motivation for practicing this type of cost reduction efforts comes from the increasing pressure on a product's time to market. An HP executive put more precisely: 1) the value of being one month earlier to market is worth more than the entire engineering and development cost of the product 2) being six months earlier to market impacts the profitability of that product by one third over the products entire life.[24] On the flip side senior managers often find out that as much as 70% to 80% of a products cost can not be reduced once it has left the design phase.[25]

5.3.1 Description

The second method of controlling product costs is known as target costing. Figure 5.4 illustrates the key concepts of target costing.

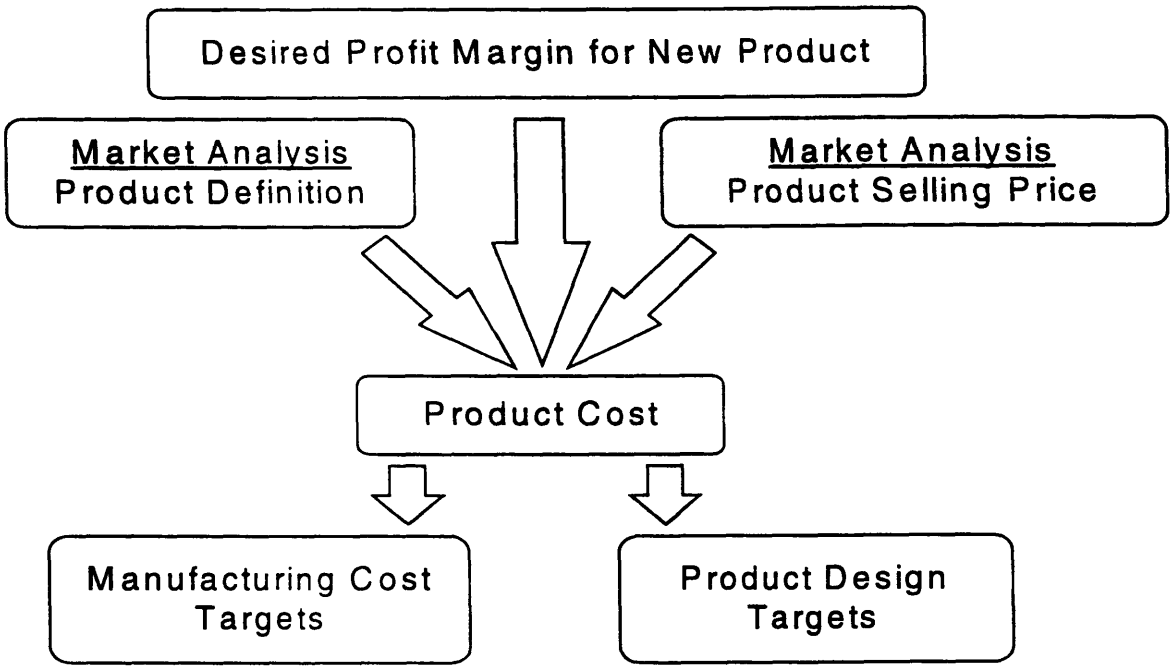

Figure 5-4. Target Costing Framework

Business Level Goal

This process is started with senior managers identifying a set of financial goals for the organization. These goals will serve as the basis for all new product decisions. Product decisions are made based on the product's ability to contribute to the established financial goals.

Suppose an organization determines that investors are expecting 50% gross margins for the specific level of risk. This 50% gross margin figure would be used to make new product decisions. As new products are identified, the following analysis must take place in order for the project to be accepted.

Market Analysis

The second step of target costing is completing a detailed market analysis. The goal of the market analysis is two-fold as seen in the illustration in Figure 5.4. The analysis should not only define the product features but should also determine the ideal selling price for the product given these features. This type of analysis should involve senior level managers. Senior managers understand the business level goals and will be able to communicate the importance for this type of analysis to the different functional areas of the organization.

It is not as simple as determining the ideal selling price for the product. Managers that understand the customers buying habits will have to determine the feasibility of the customers paying the ideal price for the product. The appropriate analysis will include complete product life cycle issues including the introduction of imitator products with lower prices. The feasibility of the selling price acts as a checkpoint before continuing with the analysis.

The market analysis requires an in-depth understanding of the marketplace, customers and competitors. A detailed market analysis will force the development team to pay close attention to how the product is defined. It will cause the organization to look out and observe the marketplace around them. The following questions should be considered before adding different features to a product:

- Which customers require this feature?
- Are the customers willing to pay more for the product because of this feature?
- What is the incremental cost of adding this feature to the product?
- Will the competitors offer this feature?

By completing a detailed market analysis and answering these types of question, the team will have more confidence that the product they introduce will meet the customers requirements and that they will pay the ideal selling price.

Product Cost Targets

The next step of target costing is to determine the product's specific cost targets. A simple calculation using the desired margin value and the the selling price will determine the overall cost target of the product but does not distinguish between production and design costs.

At this point of the target costing methodology organizations need to evaluate the overall product cost determined from the simple calculation. The purpose of establishing the target cost is to identify the cost that must not be exceeded in order for the product to receive the desired margins. If the target cost computed from the margin target and the ideal selling price seems too low, then the organization will decide whether to continue with the project and take the risk of not meeting the initial profit margin goals.

Assuming a project is accepted, the next step in the process is to break down the overall target cost into both manufacturing and development target costs. This type of analysis and thinking is typically done after the development work has already begun. The benefit of the target costing methodology is to create the discipline to compute the costs up front and to clearly identify to management what is required to make the projects be aligned with business level goals.

Clearly the purpose of this process is not just to let management know what is required for a project to be successful. The true value comes from providing guidance to the design teams that develop the product. While the financial information is helpful to senior managers to make a go/no go decision on a new product, the specific cost targets help align the development teams to the business level goals.

In order to complete the alignment of the development teams to the business level goals, the team will conduct a detailed analysis of the product cost structure and divide the product cost target up amongst production and design. Typically each functional group will first estimate its specific cost target before getting together as a complete team.

From a manufacturing perspective, the team would create a (or use an existing) cost model of the manufacturing process for the life cycle of the product. Financial data from past products will be used to understand how the manufacturing costs will change over time. In addition, this cost model will include the use of existing capacity and the purchase of capital equipment to increase capacity needed to meet the assumed volumes.

In addition production yield assumptions and supply chain relationships will be included in this model. Historic data will be used to make assumptions for the expected yields as the new manufacturing process is ramped to full scale production. Including supply chain issues will require the team to understand its relationships with its key suppliers and make the difficult make/buy decision early in the process. Expectations included in the model should be shared with the suppliers in order to ensure that they can the expectations.

Similarly a design estimate would be completed based on past designs, technological improvements, and today's material costs. It should be noted that supply chain issues (make/buy decisions) are made in both the design and manufacturing groups. Upon completing the initial estimates, design and manufacturing will get together to share assumptions (make/buy) and to combine their results to determine the overall cost estimate for the new product. Assuming the estimated actual cost is higher than the cost target from the margin calculation, the difference leaves the team with the gap that must be removed from the product in order to meet the margin goals. The team as a whole is then tasked with determining the areas from which cost can be removed. This will not be as simple as reducing a percentage of the cost from each area but will most likely require a more detailed analysis of the product, the process and the supply chain design.

Once the cost targets for both manufacturing and design have been determined, the design team will break its cost target down into more detail. The overall design target will be used to determine subsystem targets and the subsystem targets will be used to determine cost targets for specific components where necessary. This type of detailed analysis will

ensure alignment between the development team and the business level goals. An engineer designing a component to a specific cost target will be aligned with the subsystem target and the overall design target. This in turn aligns the engineer on the development team with the business level goals.

An important aspect of the target costing methodology is keeping the overall product cost target constant since this number directly affects the business level goals. Typically the desired product features change throughout the development process as more information about the customers is determined. In this situation the target costing methodology would require the entire development team to evaluate the impact of the changes to the cost structure of the product.

Unless a higher price can be charged for the additional features, the overall cost must remain the same to ensure the business level goals are met. In order to add additional cost in one area (design), another area (manufacturing) must be willing and able to reduce its cost the same amount. Keeping this in mind, target costing will do one of two things. First of all it will cause the development team to properly evaluate any modifications to new products during development. The team will be forced to prioritize new features and to determine the true benefit of adding them to the product. A business case will have to be identified for all changes and will have to clearly define the needs and the costs associated with them. If it is determined that a feature is required by the customer then the team will have to determine where the additional cost will come from. This will force the team to work together and come up with a solution. It will also allow members of the team to get a better sense of the product and the development process as a whole instead of focussing strictly on their specific subsystem.

In addition to having the development team properly analyze any changes to the product definition, this methodology also encourages the team to determine creative solutions that meet the design targets. Once the initial subsystem or component targets are set designers must use their creativity to identify solutions to meet these goals. Simply put, if each of

the subsystems and components meets its targets, then the business will meet its business goals.

5.3.2 Feasibility of Implementation

It would be difficult to implement the target costing methodology successfully in MHPG for the following two reasons: 1) product definition is not defined from one specific organization 2) their business processes are not set up to perform this type of analysis.

The first reason it would be difficult to implement the target costing methodology in MHPG is that the microprocessor product definition occurs outside of its organization. As discussed in earlier chapters, MPG designs the microprocessors and MHPG designs the electronics that support the microprocessor. MHPG influences MPG by identifying specific mobile features required in new microprocessor designs.

Although the microprocessor design group tries to include all of the desired features into new products, features desired from vertical groups are often times not included. The specific design of the microprocessor impacts the design of the electronics surrounding it, therefore making it difficult for MHPG to control all of its costs. For example, suppose a microprocessor is designed with a specific power target in mind. If the power target is a compromise between the mobile and desktop groups, the power will likely be higher than MHPG desired and lead to extra design challenges for MHPG. Design challenges such as additional heat sinks will cause the design cost structure be out of MHPG's control. If MHPG could have control over the entire microprocessor design this methodology would be more feasible.

Even if MHPG had control over the entire microprocessor design, it would still be difficult to implement the target costing methodology. Currently MHPG's business processes are not set up to complete this type of analysis. MHPG's established business processes range from making high level decisions and setting strategic directions to

monitoring the status of its development projects. The problem is that implementing the target costing methodology would make changes to many of MHPG's processes. The author believes that it is difficult to make changes to many business processes if the organization is not at a crisis point. MHPG is a very well managed organization that is not at a crisis point and therefore would unlikely change all of its business processes at once. This type of change needs to take place in stages.

Although the three methodologies, as defined in this chapter, are not feasible to implement within MHPG, key concepts can be incorporated into some the current business processes. The major reason these methodologies are not feasible to implement in MHPG is because Intel is structure as a matrix organization. The inherent lack of control experienced in a matrix organization limits MHPG's abilities to effectively use these methodologies. However, there are many benefits of matrix organizations that outweigh the issues raised here. These topics are beyond the scope of this thesis.

Although these methodologies cannot be implemented as defined, specific concepts can be incorporated into specific MHPG business processes. The concepts in the target costing methodology are simple and very applicable for any organization. Concepts have been selected from this methodology to implement into MHPG's business processes. The next chapter focuses on modifying MHPG's business processes to ensure alignment between development teams and business level goals. The chapter describes the business processes, discusses its strengths and weaknesses and recommends the changes needed to include the concepts of the target costing methodology.

6. Improved Business Processes to Align Development Teams with Business Level Goals

Today's computer industry is driven by technological advancements that fuel the introduction of cheaper and higher performing products. The prediction made by Intel co-founder Gordon Moore in 1965 was that the speed of chips would double every 18 months.[26] This famous quote became known as Moore's Law and still holds true today. In order for a company to be successful in this type of environment they first must be able to determine what products the market is demanding and secondly have an efficient development process to make the new products.

A successful business planning process allows an organization to determine what products to offer and provides a framework to design and deliver these products to the market. The planning process is essential in ensuring that an organization is flexible to change over time and to stay competitive.

This chapter describes Intel's and MHPG's current product life-cycle planning process. This chapter includes weaknesses of the current process and concludes with recommended modifications to the business process to ensure that development teams are aligned with business level goals.

6.1 Current Business Planning Processes

Intel's business planning process is designed to continually evaluate the its position in the marketplace and to provide flexibility in changing its strategic direction. Intel does corporate wide business planning on a quarterly basis. Quarterly planning events alternate between corporate wide product planning and strategic direction planning. This process provides Intel with enough flexibility to modify its product line as changes occur in the marketplace.

Vertical business units present product strategies at each of these planning process events. The result of the quarterly events is either the acceptance of the proposed vertical product line plans or recommended modifications from corporate. These events serve the purpose of evaluating Intel's strategic position as well as adjusting the direction of the different product groups.

Once MHPG's direction has been set, an internal planning process must address the issues of determining the details of the different products and initiatives. Figure 6.1 illustrates how the corporate direction setting feeds into the MHPG planning process.

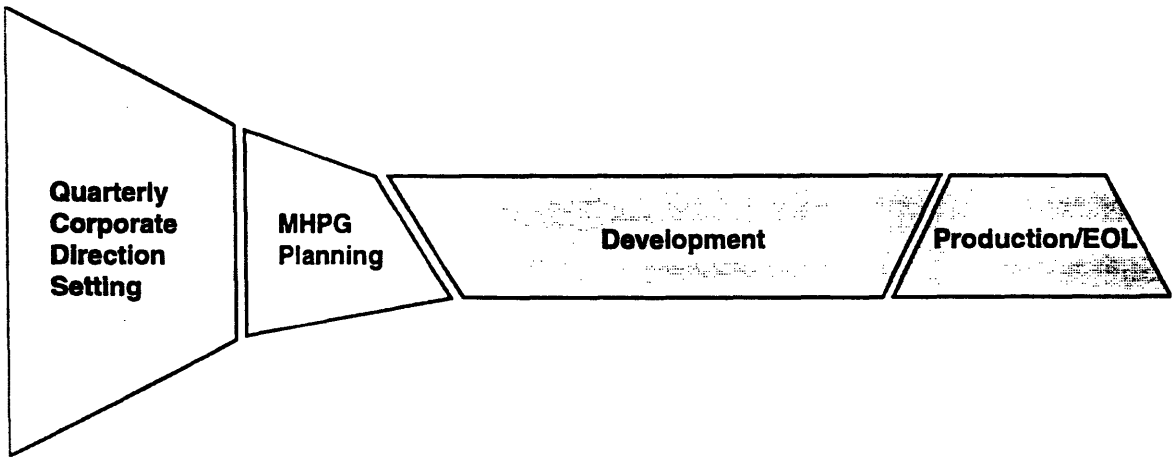

Figure 6-1. MHPG Product Life Cycle

The MHPG planning process must be designed to provide the alignment of the development teams to the business level goals. MHPG planning feeds into the development efforts and therefore must properly define the specifics of the products and initiatives.

MHPG currently uses an annual planning process. The goal of this process is to identify the products and initiatives that will be completed over the next fiscal year based on the budget provided by corporate. Budget constraints force the organizations to identify and

evaluate the tradeoffs between the different products and initiatives. Figure 6.2 illustrates the structure of MHPG's planning process. As illustrated, the first portion of the planning process is to revalidate the Mission Statement. MHPG's Mission Statement defines the organization's purpose and what it aims to accomplish. The next step in the planning process is to define the Critical Success Factors which define MHPG's two year goals. These factors provide MHPG with tangible goals to work toward and define success criteria for the organization.

Figure 6-2. MHPG Planning Levels

The Strategic Objectives are statements that define specific areas of focus MHPG. These objectives are aligned with both the Mission Statement and the Critical Success Factors.

After the Strategic Objectives are finalized, specific programs for each objective are identified. This step includes defining annual deliverables for each of the programs and prioritizing the programs. The determination of the annual deliverables is one of the most

critical parts of the planning process because they are used by each department to determine headcount and resources needed to meet the deliverables.

Following the determination of program specific annual deliverables, the entire list must be prioritized. The method used to prioritize programs is to categorize the programs based on a designated criteria. The details of the criteria can not be discussed but ranged from the program being essential to sell additional products, to the program improving the base platform, to the program would being nice to do if resources were unlimited. Within each category the programs are then prioritized resulting in a complete list of prioritized programs.

The next step in the process is for each director to go their respective departments and to determine what they will do to contribute to each program annual deliverable. Each department identifies the following:

- Department deliverables required for MHPG to meet its annual deliverable
- Department headcount required to meet the MHPG annual goal
- Department dollar resources required to meet the MHPG annual goal

Data from each department is combined to give a total headcount and budget figure for MHPG. Department deliverables are reviewed with senior management to identify any gaps or overlaps between the department deliverables and to determine if MHPG's annual deliverables will be met. It is natural for each of department to overload on its headcount and resource requirements. This process is designed to eliminate overloading by requiring the departments to defend their requests for resources.

The prioritized list of programs with headcount and resource requirements is then used to determine which programs will be funded for the upcoming year. Using the budget from corporate, MHPG determines which programs will be completed and the headcount allocation for each department. This output becomes MHPG's annual plan. The annual plan is revisited on a quarterly basis. Once the quarterly deliverables are identified and

revalidated amongst the team of directors, owners are assigned and held accountable. Key deliverables are measured and scored at the end of each quarter. Identifying the key deliverables on a quarterly basis allows MHPG to be flexible if corporate changes Intel's strategic direction or product line.

Included in the MHPG planning portion of figure 6.1 is a business process that addresses strategic issues, ratifies internal product roadmaps and determines the scope and objectives of new programs. New programs are defined as one of the following:

- A product that MHPG will design, make and sell
- A mobile platform that is optimized for MHPG products
- An initiative that will enhance future mobile platforms

This process includes a weekly meeting with all the directors of MHPG. The objective of this process is to make program level decisions that are aligned MHPG's goals. The process is responsible for defining and approving funding for new programs.

The process consists of three different levels of evaluation for new programs. The three approval levels were created to ensure that the organization is in agreement before going to the next step of the development process.
The following is a summary of the deliverables MHPG had identified for each level:

Level 1: Definition of opportunity, identification of key variables, planned approach
Level 2: Precise definition of program, discussion of alternatives evaluated, recommended direction with expected benefits
Level 3: Completed requirements for program, identified goals for program, 1st revision implementation timeline

Once new programs are defined and approved for funding the process enters the development phase of figure 6.1. MHPG has several business processes used to monitor the status of development part of the process. These processes are designed to alert

management of problems and to change the direction of the development teams as necessary. Appendix 2 includes a list and description of these processes.

As the development efforts progress the programs move into the production stage of figure 6.1. The production phase continues to the end of life of each of programs.

6.2 Weaknesses of Current Business Planning Processes

As an intern evaluating MHPG's business planning processes, the author had an outsider's perspective. The author had the benefit of evaluating contingencies of each process and identifying any existing gaps.

Three weaknesses were identified in MHPG's business planning processes. Each weakness is briefly discussed and recommendations are identified in the next section. The three weaknesses are:

- The methodology of approving new programs using the three levels of strategic review is not utilized consistently
- MHPG's annual planning process does not have provisions for adding new programs during the year
- A gap exists between MHPG's program approving process and both Intel's factory capacity planning process and MHPG's profit and loss business processes

The first weakness observed of the current business planning processes is that the methodology of approving new programs using the three levels of strategic review is not utilized consistently. If properly utilized, the three levels of evaluation for a new program would ensure the proper analysis is completed before a new program is funded. This process was new and therefore unclear to many employees MHPG.

Definitions of the three approval levels are posted on MHPG's intranet as a business process. Unfortunately this web site does not clearly articulate the roles and

responsibilities of the departments in completing the approval process. The author spent a lot of time getting employee's perspectives and understanding the different approval levels. It was clear from these discussions that expectations and deliverables for each level were not properly defined. Although approval of new programs took place, it seemed as though the process would vary from one program to the next. If the expectations of the different levels and the responsibilities of each functional area are clearly defined, the process of defining and approving new programs will be much more effective.

The second weakness observed is that MHPG's annual planning process does not have provisions for adding new programs during the year. As discussed earlier, MHPG determines new programs and resource requirements on an annual basis. This process only evaluates new programs and their impact to MHPG's current resources if the new program happens to occur around the time of the annual planning process.

With the current process, a new program can either be funded with existing resources or the funding decisions can be pushed off to line up with the annual planning process. If the program is critical and funded immediately, there is no process to prioritize it and to accommodate the resource shortage in other program areas. In this situation employees are expected to complete both the existing and additional work for the year. A formal process is needed to evaluate the resource impact to the organization as new programs are identified throughout the year.

The third weakness of the current business planning process is that a gap exists between MHPG's program evaluation process and both Intel's factory capacity planning process and MHPG's profit and loss business processes. On a quarterly basis Intel evaluates its factory capacity plans by combining the inputs from the different vertical business units. Long term factory build plans are generated from this process. In addition each product group is required to update its five year profit and loss model which is then rolled up into

a corporate wide model used by Intel's senior management. However, the current process does not ensure product volume assumptions are consistent throughout the business processes.

For obvious reasons, it is essential that the volume predictions used to evaluate a new program also be used by to create the capacity planning and profit and loss models. A new program should not only be evaluated on its own profitability but also evaluated on its impact on the organization as a whole. Unfortunately the different functional areas that owned each of these processes did not have a process to share their assumptions and predictions. Often times this had no impact on MHPG's financial performance but caused several people in MHPG to do the same work. A solution to this is to design a process that ensures that the new program evaluation, the capacity planning and the profit and loss processes all share the same product data.

Each of these three weaknesses may only have a minor impact on the organization but when combined may prevent development teams from being aligned with MHPG's business level goals. The next section provides recommendations to MHPG's business processes such that new development efforts will be aligned with the organization's business level goals.

6.3 Recommended Modifications to MHPG's Business Processes

In order to make valid recommendations the author needed to completely understand MHPG's current business processes and how they were linked to Intel's processes. The author developed this understanding though one of his assignments as an intern. The assignment consisted of managing MHPG's current annual planning and putting into place a more comprehensive process for years to come.

This assignment proved to be both challenging and rewarding. It was challenging due to the fact that the author had to influence the director level of MHPG. In order to complete the 1998 annual plan, a planning process was designed and tested as it was being implemented. Many of the recommendations in this section came from the experience of completing the 1998 annual plan.

The rewarding part of this assignment was that the author was given a lot of liberty, especially as an intern. Although there was a steep learning curve involved in understanding how the MHPG and Intel functioned, the learning process provided insight into potential areas of improvement. In addition, working on the annual planning process exposed the author to all of MHPG's business processes and provided the opportunity to evaluate how new programs go from an idea to a fully funded program.

As a part of this research the author had the opportunity to join a cross functional team made up of Strategic Planning, Marketing and Finance representatives. This team was tasked with looking at the business processes described above and recommending improvements. The following recommendations are a culmination of the author's individual recommendations and the cross functional team's recommendations. The author believes that the implementation and utilization of the following recommendations will provide the alignment between the development teams and MHPG's business level goals. The modifications to the current business processes will address the weaknesses described above.

The first recommendation is to provide more structure to the process of defining and funding new programs. The three levels of evaluation are a good starting point but need to be more defined. The author approached this problem by seeking to define the critical pieces of information required for each level of evaluation. Figure 6.3 illustrates the framework defining the critical pieces of information needed in this process.

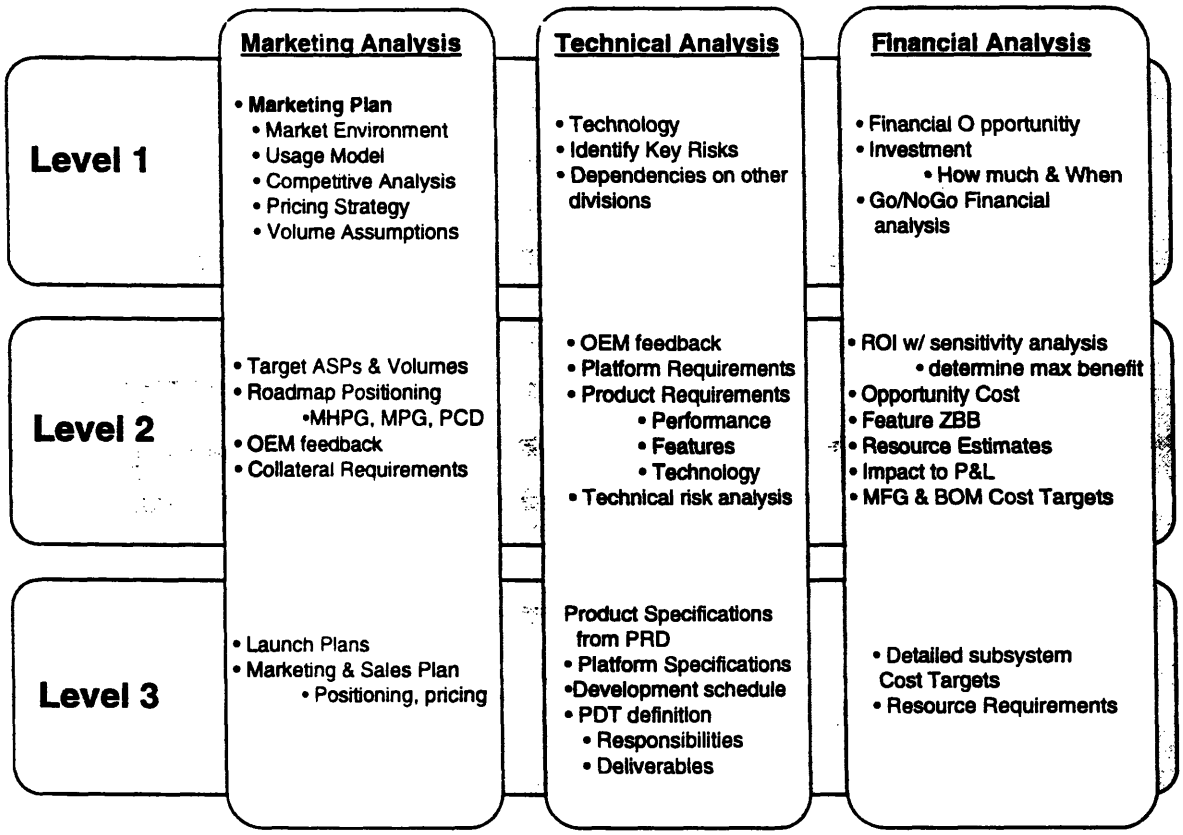

Figure 6-3. Program Approval Framework

As illustrated Marketing, Engineering, and Financial analysis is required for each of the levels. This framework describes the level of analysis required at each level that will ensure development teams are aligned with business level goals. A critical part of determining the details of at each evaluation level was considering the type of analysis is feasible insist upon given MHPG's structure and staffing. This proved to be a challenge because the functional units involved in product development are not staffed to complete this type analysis for each new program.

After evaluating the structure of the organization it was determined that Strategic Planning should own the process of gathering and consolidating the data required at each level. Figure 6.4 shows how Strategic Planning would be interact with the other departments to gather this data.

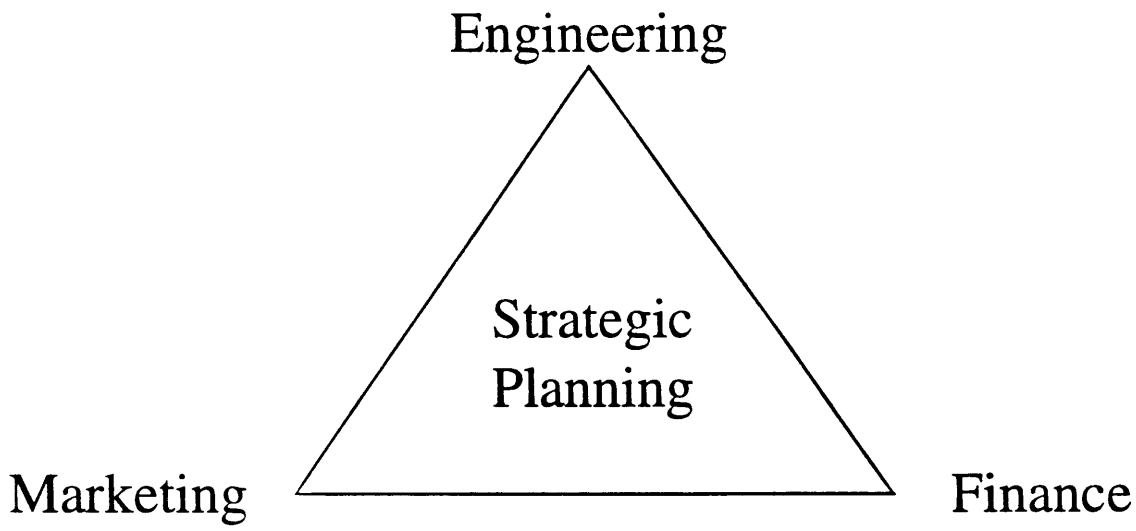

Figure 6-4. Recommended Program Evaluation Team

A challenge of implementing this framework in MHPG was to get buy in from each of the functional areas. This framework was presented to a few of the MHPG directors. Upon the completion of the internship, it was decided to have managers from each of the functional areas work out the details included in the framework. The thought being, managers that have significant development experience can provide better insight into to the type of analysis that is both necessary and feasible. In addition, these managers will be working to the framework and therefore should help create it.

The benefit of this type of framework is that it does not define the type of documentation required at each approval level. It simply defines the amount of analysis that is necessary to properly define and fund new programs. Actual documents such as business plans, product requirement documents, specifications or even power point presentations could be used to actually to the program evaluation.

A critical part of ensuring this framework is successfully implemented is that the directors hold each new product development team to completing and presenting this type of

analysis for each level of approval. Only then will the team of directors will be able to make program level decisions that are aligned with MHPG's business level goals.

The second recommendation to MHPG's business processes is to modify the annual planning process such that new programs can be added to the roadmap on an as needed basis. Management will have the opportunity to judge the impact new programs will have on existing operations. In other, words for an organization that has limited resources, a new program should not be added unless additional resources are provided or funding for an existing program is modified.

This recommendation can be accomplished by utilizing the data collected during the annual planning process. An output of the planning process was a prioritized list of all the programs with their headcount and resource requirements. Management needs to prioritize new opportunities with the existing programs and update the program resources document to determine the effects. The resulting document will identify the impact of adding the additional program to the roadmap. Management will have the choice of canceling the lowest priority programs in order to fund the new one or request additional funding from corporate in order to keep everything on the roadmap.

The benefit of this recommendation is that it will provide MHPG will have a live roadmap and a clear process for making modifications to it. In addition, MHPG will still have the opportunity to revalidate its directions and the entire roadmap during the annual planning session. The annual planning session can then be used to identify future programs and to revalidate the priorities of existing programs in order to be better aligned with the corporate vision.

The final recommendation to MHPG's business processes is to link the program approval process to the capacity planning and profit and loss processes. In evaluating this link, it became apparent that product volumes are essential elements to each process. However, after several discussions with different functional areas it was observed that often times

the product planning, capacity planning profit & loss processes used different assumptions for product volumes. A formal process did not exist to share volume predictions or assumptions. This created a lot of redundancy and was a clear area for improvement.

In order to solve this problem the team determined the type and timing of information required for both the capacity planning and profit and loss business process. This data was combined to create a timeline that clearly showed where the processes overlapped. It became clear that the same information was required in each of these processes but at different times. The challenge was then to create an MHPG process that would allow the sharing of information. This was a challenge because MHPG was constrained by the timing of both Intel's capacity planning and its profit & loss processes. The goal in designing MHPG's process was to minimize the amount of redundant work done between functional areas and to ensure that both its capacity planning and profit and loss processes included the same assumptions.

The solution was to develop an MHPG preparation process that is consistent with the corporate processes. This process included a list of required MHPG meetings with the required attendees. In addition deliverables of the functional areas were identified along with the desired outcome of each meeting. This process was clearly mapped out in a flow chart form and was presented to the MHPG directors of approval. Feedback from the directors was positive suggesting minor modifications. Upon the end of the internship, this process was being finalized with plans of implementation being outlined during the following quarter.

Although the process addressed issues between the capacity planning and corporate profit and loss calculations, it did not include the new product approval framework. The next step was to determine how the new product approval process fits with the process described above. It makes sense that new products should not be approved unless their impact to the capacity planning and profit and loss planning is understood. In addition to

understanding the impact volume and pricing assumptions have on product economics, the impact to Intel and MHPG as a whole must also be understood.

Figure 6.5 illustrates the links between all the processes. This figure includes the specific names of documents associated with MHPG's product development process. Level two of the approval process triggers an evaluation of the new program's impact on the capacity planning and profit and loss models. Referring back to the analysis described in the approval framework, one notices that both pricing and volume assumptions must be completed for a level two approval. This is crucial because the volume and pricing information must be shared with the other processes and it ensures the data is consistent throughout MHPG and Intel. New products will be funded only after its impact on capacity planning and MHPG's profit and loss calculations have been completely understood.

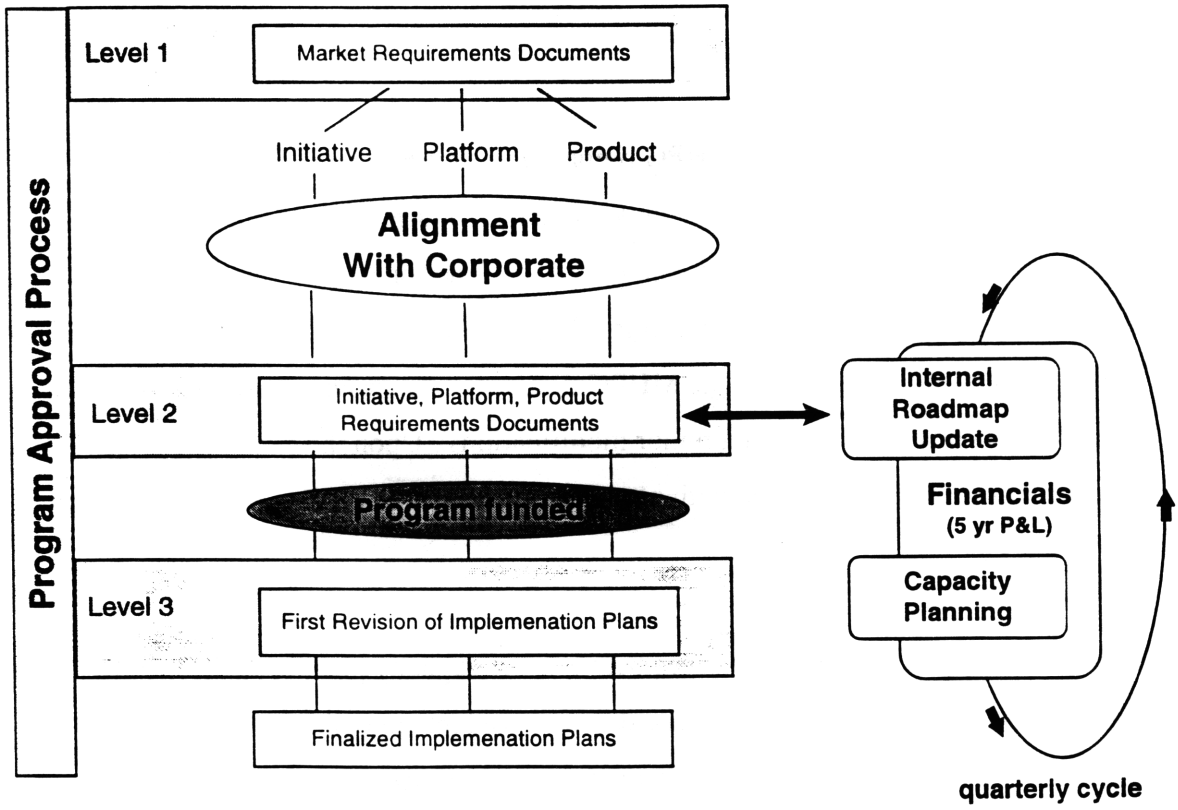

Figure 6-5. Recommended link between approval process and business processes

The benefit of this overall process is that it clearly defines the roles and responsibilities of the different functional areas and it provides MHPG management with an effective decision tool. Following this process, MHPG management can clearly identify the overall financial impact of new product decisions. In addition, MHPG can redefine products as necessary in order to ensure development teams are aligned with the business level goals. It will also force MHPG to determine which new products are strategic versus those that improve their current financial measures.

Once the overall process is in place, alignment of development teams to business levels goals will be able to occur. Referring back to the approval framework in figure 6.3, levels two and three include the determination of specific cost targets. At level two, general manufacturing and development targets should be identified. If the product is aligned with the business level goals (check point with capacity planning, profit & loss), it will be funded and make it to a level three analysis. At this level, implementation plans are generated which include specific subsystem cost targets. This analysis includes the details described in the target costing section and creates the alignment of development teams to business level goals. The process for identifying the cost targets should follow from the target costing section of this paper.

To summarize, these process improvements include the following three modifications:

- structured use of the MHPG's three levels of new product approvals
- annual planning process includes a process of funding new products throughout the year
- linking the new product approval process to business level processes to ensure proper alignment

The combination of the three modifications provides the structure to ensure that development teams are aligned with business level goals. Unfortunately, evaluating the current business processes and managing the annual planning process took up most of the

author's time during the internship. For this reason, and the fact that the author was only an intern, the modifications were not fully implemented. The status of the modifications are:

1) The approval framework was presented to MHPG directors and its contents were being validated by the line managers who will be responsible for the type of analysis described in the framework.
2) A recommended annual planning process was provided to MHPG that includes the changes described above.
3) The link between the approval process and the capacity planning and profit and loss processes was being finalized to present to MHPG directors.

It should be noted that these are not simple changes for an organization to make. These modifications affect many of MHPG's business processes and will take time and persistence for them to be accepted and implemented. Through the internship, the author came to the realization that it was not feasible to create and implement a whole new set of business process. Product development alignment to business level goals would only come through modifying current business processes such the key concepts from chapter 5 were included. The author believes that MHPG is an organization that is looking to improve itself and is ready to make the changes discussed in this thesis. In addition, the team that was assigned to look at these issues is dedicated to improving the current business processes.

The author had two key learnings from this internship and research. First of all, one person, except if he/she is the leader, cannot expect to make large changes in an organization. The modifications presented here affect all parts of the organization and therefore must be accepted by everyone involved with them in order implemented. Line management and engineering involvement with refining the analysis in the framework should allow these modifications get closer to implementation.

The author also learned of the importance of a complete set of comprehensive business processes. As organizations grow and change it is often difficult to ensure that the business processes are modified to balance this growth. It was helpful as an intern at MHPG to look at such issues. As an intern, the author could step back from the day to day activities and provide an impartial analysis of the situation. In addition an intern typically does not have any hidden agendas and can provide a solution that optimizes the organization as a whole and not for a typical functional area.

Appendix 1.

1996 Market Share of Mobile Computers[27]

OEM	Market Share (%)
Toshiba	19.5
IBM	11.3
NEC	8.9
Compaq	8.6
Texas Instruments	5.0
Other	46.7

Appendix 2.

Time to Money (TT$) Meeting

Audience/Purpose

This is the highest level meeting that Intel holds regarding new product development efforts. The program status is presented to the CEO of Intel and the Vice President of MHPG.

Frequency

TT$ meetings are held once a quarter. The topic of products discussed in the TT$ meetings change each time. The author had the opportunity to attend one of these meetings relating to the mobile Pentium® II products.

Typical Agenda

The agenda for this level meeting is to provide a program summary at a high level and to discuss hinge factors for the product launch.

Area	Item	Trend	Status/Issues/Plans
Schedule	Alpha samples by X	⇑	Done!
	Engineering samples by X	⇑	on schedule
	Product Certification by X	⇒	Need more data
Technology	Microprocessor core	⇑	healthy, etc.
	Connector	⇒	
Manufacturing	Capacity	⇒	
CPU & Chipset	Mobile features	⇒	
	Production Worthiness	⇒	
OEM enabling & Marketing	Thermal enabling	⇑	
	Technical Readiness	⇑	

The table above illustrates the format and type of information used during these meetings. Shaded areas would represent hinge factors to the target product launch date and are

discussed in detail. In addition hinge factors identified during previous TT$ meetings are also discussed to report on any changes and updates. Each hinge factors is assigned a risk rating which provides management a tool to aid resource allocation.

Management Operations Review (MOR) Meeting

Audience/Purpose

This meeting is at the business unit level. The program status is presented to all interested MHPG stakeholders and the Vice President of the business unit.

Frequency

MOR meetings are held once a quarter.

Typical Content

The contents of this meeting are very similar to that of the TT$ meeting. The difference is that technical issues are discussed in more detail in an MOR. The MOR meeting typically will be planned just before the TT$ meeting thus making the presentation of the two very similar. The author noticed that the MOR was often used to discuss any discrepancies and risks relating to the program hinge factors before presenting to the TT$.

Management Review Committee (MRC) Meetings

Audience/Purpose

This meeting is at the department level. Department level managers and key development team members attend this meeting to discuss weekly program level issues. This meeting is the forum where program level decisions are made. The engineering department manager is the chairman of this meeting.

Frequency

This meeting is held once a week for two hours.

Typical Content

This meeting is typically broken down into several sections, They typically are:

- Product 1 (Penitum® II module) health
    - Issues relating to the products technical performance, quality, availability, and adherence to schedule are presented. Issues that have a high risk of impacting

the launch date are discussed in detail. Product decisions will be made if the risks impact the program as a whole

- Product 2 (Pentium® II processor) health
    - Same issues are discussed as product 1
- OEM Readiness
    - The status of OEMs and design wins are presented. This time is used to summarize whether OEMs will be ready to launch their notebooks PCs when Intel is ready to introduce its product.
- Platform subsystem readiness
    - The status of key technologies relating to the notebook platform are presented. The platform readiness manager reports on IHV's progress relative to the planned program launch date.
- Core Manufacturing/Demand update
    - An overview of the availability of the microprocessor cores is presented. In addition the allocation of cores between engineering samples, product 1 and product 2 are presented and discussed.
- Launch Update/Scheduling
    - This part of the meeting is used to overview the scheduling and targeted launch date. It is at this point that the two product development teams are synchronized with each other to make sure they are both on track for the same launch date.

Product Development Team (PDT) Meeting

Audience/Purpose

This meeting is at the development team level and consists of all cross functional team members. The purpose of this meeting is to track product schedules and to discuss risks and technical issues. The Mobile Pentium® II product line consisted of two products and thus had two separate PDTs. The processor PDT was located in Santa Clara, CA and the module PDT was located in Portland, OR. Due to the separation of the two items I was

only able to attend the processor PDT and thus the description below refers to this PDT in particular.

The PDT typically consists of the following disciplines: materials, manufacturing, components, new product planning, quality and reliability (QRE), product marketing, design, product engineering, validation, technical marketing, finance and scheduling members: This meeting is conducted by the PDT leader who is typically a first level supervisor in the organization.

Frequency

This meeting is held once a week for two hours.

Typical Content

The structure and the content of the PDT meetings is decided upon by the PDT leader. The structure of the Mobile Pentium® II processor product PDT the author atteneded changed formats during development effort. These formats and the time spent in each of the areas changed as the design started coming into place.

The table below shows the two different formats that the PDT leader used to manage the development process. As seen, once the design reached a certain point, the PDT leader restructured the team to refocus the meetings on different parameters that required more attention.

Original format	Redesigned format
Project Scheduling	Design/Validation/Qual Status
Elec. -Logic, Power, Decoupling; Connectors	Material Status
Mech. -Form Factor, Thermals, Connector	Tech Certification Status
Marketing	Availability/Demand/Allocation Status
Validation	Production/Demand/Availability Status
Test	Cost Status
Qualifications	Customer Enabling Status

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