THE COMPUTER INDUSTRY:
STRATEGIC ANALYSIS OF DEC AND IBM

by

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Submitted to the Sloan School of Management on May 15th, 1987 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

This thesis is a study of Digital Equipment Corporation (DEC) and International Business Machines Corporation (IBM) who compete in the $100 billion computer industry. The study is performed to determine the reasons behind the recent dramatic changes in performance of each of these companies and to understand the fundamentals which will determine the future strategies of these companies.

The computing industry essentially started in 1960 when the advent of the silicon chip made electronic computing equipment a cost effective solution to data crunching oriented business problems. Since then, the performance per dollar for computing power has doubled every three years steadily and the industry has grown to be one of the largest in the world second only to the oil industry. Most computing equipment today is used at the operating level of companies, to automate various standard, routine functions such as payroll and accounting. However, these traditional markets are beginning to show signs of maturity and the industry is shifting toward new kinds of applications. Many of the new applications give individuals tools which they operate from their desks. As applications become more and more decentralized, increasing numbers of employees will have access to computers either on their desks, or very close by. A natural compliment to this distributed systems approach is networking, or linking computers together. Networking allows users to communicate with one another and allows computers to share resources and data. This capability is becoming an essential feature in the computer business. Other trends indicate increasing expenditure in software which makes the computer more user friendly.
IBM, started in 1924, has traditionally focused the large data processing, mainframe markets and has grown to be a $50 billion dollar company in 1985. It offers products and services throughout the computer industry, with most of its profits coming from high end computer sales. IBM has traditionally been recognized as a premier marketer; a reflection of IBM serving its customers with a great deal of assistance in understanding complex computer problems. IBM has relied on its long standing strategy and its dominant market position for too long. 1986 revenues were almost flat at $51 billion, earnings dropped more than 25 percent, stock price is down and IBM is scrambling to figure out how to come back.

DEC, started in 1957, has grown to be the second largest computer supplier, yet still only one seventh the size of IBM. DEC has traditionally focused on the scientific, engineering, and manufacturing markets and has historically relied on technically strong products to sell themselves. DEC, still under the direction of its original founder, Ken Olsen, has recently focused its attention on networking, integrated systems and a stronger marketing presence. DEC's strategies are beginning to pay off as it displaces IBM market share in many areas. Its stock market valuation has doubled over the last year. Revenues and profits have never been higher. DEC must understand what it is doing right in order to maintain its strong growth.

A final comparison is made between the two companies in the areas of products, markets, technologies, organization, and financial position. Reasons for the differences are found to be due to the history and cultures of the companies. Each company has its own unique strengths and weaknesses to take advantage of in the marketplace. Proper understanding of rival's strengths and weaknesses, the industry environment and the complexity of the market provide the basics to fine tune each company's strategy for the future.

Thesis Supervisor: Dr. N. Venkatraman
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CHAPTER 1
INTRODUCTION, PURPOSE, ORGANIZATION

1.1 Introduction

Historically, International Business Machines Incorporated (IBM) has been the leader in the multi billion dollar computer industry. IBM currently dominates most segments of this very profitable industry and generates many times greater revenues than its nearest competitor, Digital Equipment Corporation (DEC.)

However, during the last several years, DEC has proven it also has the capability for being a dominant player in the industry. Three years ago, in 1983, DEC's revenues were fifty times smaller than IBM's. In 1986, the ratio was only seven times smaller.

The stock market has perceived changes in these companies and has adjusted valuation to increase DEC by 137% and reduced IBM by 2% during 1986 (Business Week, April 18, 1986, pp.62-65 & April 17, 1987, pp.46,47.)

An important reason the companies changed so much in position is that their strategies were different. Business strategy, otherwise known as long term business planning is the single most important factor in determining the future competitiveness of a business. Strategies determine the
focus of the resources of a company. Changes in strategies can have significant effects internal as well as external to an organization. (Porter, M. pp.ix-xx.)

1.2 Purpose of This Study

The purpose of this study is to determine the strengths and weaknesses of both DEC and IBM, to evaluate their current strategies, and to determine what factors contributed to the changes in the perception of these two companies during the last two years. From this analysis, the two companies are compared along significant strategic dimensions, and reasons for the differences between the two companies is determined.

This analysis will assist companies in the computer industry, specifically DEC and IBM, as well as securities analysts to better understand the mechanics of a strategic analysis in planning and evaluating the future of their businesses.

1.3 Organization of This Thesis

To accomplish its purposes, this thesis has been divided into eight additional chapters. Chapter two summarizes the history of the computer industry and
highlights the events which are relevant to this study. It also examines the broad trends in the computer industry to date. Chapter three examines the trends within the industry. Chapter four analyzes the industry from a strategic point of view using Porter's framework. Chapter five summarizes the previous three chapters by highlighting the critical success factors in the industry and in the emerging market segments. Chapters six and seven examine IBM and DEC respectively in great detail. These chapters examine the internal strengths and weaknesses of each company, the financial performance of each company, and the position each company has in the industry. Chapter eight compares the strategies of the two companies, and examines the reasons for their differences.

1.4 Sources of Information

Information for this study was compiled using predominantly industry periodicals, trade magazines, and securities analysts reports. Conversations with managers within DEC and IBM as well as other industry observers also helped gain insight on this analysis of the industry. For a complete listing, a bibliography is included at the end of the thesis.
CHAPTER 2

COMPUTER INDUSTRY BACKGROUND

2.1 Industry Definition and Growth

The computer industry consists of information handling electronic hardware, software and services. Information handling hardware is defined to be physical part of computer equipment. It includes the central processing unit, where the actual computations are performed; the input and output devices including keyboards, printers, displays, card readers, bar code readers; storage devices, which include magnetic tape and disk drives and recently laser disk drives; and communication links, which tie computers at different locations together.

Software is better understood as computer programs. It instructs the computer exactly how to interact with its storage devices, its input and output devices, what functions are to be performed on which data, and what to do with the result of each computation. The operating system is the layer of software which interacts directly with the computer hardware and is dependent on the physical architecture of the computer. Higher level software communicates with the operating system which in turn talks with the computer hardware.
Services are the educational, consultative, and repair services associated with the industry. Services is a large and growing segment of the industry as more users are paying for customized software to perform increasingly complex tasks. Managers need assistance making computers useful to their organizations both from a technical standpoint and from an implementation standpoint.

2.2 Domestic and International Trends

Naturally, the more industrialized nations were the first to take advantage of computers. All markets, domestic and international have been penetrated in this industry. Current revenues are approximately 50% international and 50% domestic.

2.3 Performance per Dollar Trends

One of the reasons for the tremendous growth in the computer industry is that performance per dollar has improved on the average by a factor of two every three years. With the computer industry in existence for 27 years, performance per dollar has increased over 500 times. Along with the increased performance per dollar, there have also been significant gains in reliability and reduction in
size. All of the changes are primarily due to technological advances in silicone chip technology. Today, the power in a desk top personal computer is equivalent to the power of a room full of electronics twenty five years ago.

2.4 Open System Approach to Encourage Growth

During the early years of the industry, systems were left open to encourage the development of all possible applications and hence accelerate business and industry growth.

In recent years, manufacturers have changed their point of view and on the large part have closed their products due to increased competition and copying of products.

2.5 History of Applications

Early Applications were predominantly in the areas of payroll, inventory control, and accounting. These applications are known as "transaction" oriented and require little interaction with the users. The high power, mainframe computer evolved directly from these intensive data processing applications.
Scientists and engineers also found the computer to be an invaluable tool to solve many types of science related problems. The scientific and engineering markets were much smaller and required much less computer power than the transaction oriented markets, but were also significant. Today, applications are present in all functional areas of a business.

2.6 Segmentation by Function

As time progressed, performance per dollar of computers improved rapidly and computers were being used in numerous ways. Applications were evolving in every imaginable area. Just about anywhere that there is a repetitive task, a computer can be instructed to perform it.

The industry has exhibited segmentation not only by product, but also by market function. Banking, Retail and Government applications emerged as segments which provided enough opportunity that separate companies were able to specialize in each of these markets.

2.7 History of Use: Batch, Interactive, Distributed

The way computers were being used was also changing.
At first, computers were designed to read a stack of cards, process calculations, and output the results. This process is known as batch processing. Though computers proved to be a useful tool, users were often frustrated with the slow turnaround and feedback time.

Interactive computing was given a very warm welcome. It allows the user to "interact" with the computer at much more frequent intervals. A single computer would have many users and time sharing systems were developed to allocate computer time to numerous users. The input / output devices changed from cards and printers to keyboards and displays. Printers were also used for hardcopies. Time sharing of a single computer allows for some data sharing and communication between users, but limited to the users on the system.

The next movement in the computer industry is in the direction of distributed processing. Users have a local mini computer, connected by communications links to an unlimited number of other users who he can share data with and communicate with. This allows for interactive use, computer matched to individual needs, and unlimited communications.
2.8 Complexity Leads to Dependence on Consultation

The computer is a very complex technical product. It can intimidate even the most confident manager. Computers can also be used as a very powerful strategic weapon with the ability to transform entire industries. Often companies are required to rely on computers in order to remain competitive. Businesses must understand and use the capabilities of computers if they are to remain competitive.

2.9 Distribution Paths

Distribution by the manufacturers of computers has typically been through either direct channels or through a third party. The former technique allows much better control over the customers' perceptions of the manufacturer, yet is extremely costly. Distribution through value added resellers and original equipment manufacturers is less expensive in the short run, but there is little control over the vital link to the customers.

2.10 Lease vs Buy Trends

During the early years of the industry, computer manufacturers provided lease arrangements for the computer
equipment. This allowed customers to afford the costly equipment and also insured the customers against technological obsolescence. If a new product came out which provided greater performance / cost, the customer could replace his equipment with little expense. However, during the 1980's, the leasing arrangements are slowly disapearing. The customer either buys the equipment outright, or leases it from a third party. The switch from leasing to selling has forced the financial statements of the industry better reflect the current conditions of the market.

2.11 Generic Computer Equipment

As the markets of certain segments of the industry become more mature, and customers feel more comfortable with the technology, opportunities have opened for no-name brand compatibles to penetrate this enormously profitable marketplace. In the late 1970's, Plug Compatible Manufacturers (PCMs) shocked IBM several times by taking away significant market share by offering identical hardware at lower prices. During the mid 1980's, there are more than ten companies which offer IBM Personal Computer clones and compatibles.
Certain segments of the industry are mature enough to foster this fierce competition. Manufacturers have been finding other ways to differentiate their products. Reliability, and service are examples.
3.1 Life Cycle of the Computer Industry

Characteristics of the computer industry indicate that it is at the beginning of the maturity stage in the product life cycle. Commercial applications have existed for almost thirty years. The technology and applications have been around long enough to be well accepted and in fact depended upon. The leaders in the industry enjoy tremendous profits; competition is intense. Segmentation of the markets has occurred according to type of business the computer will be used in as well as size of computer needed. Markets are being segmented along other dimensions as well. Users of computers are becoming much more sophisticated and aware of their true requirements. Product improvements and cost reductions have been significant.

Continuous life cycle extensions have maintained strong growth due to rapid improvements in technology and ever increasing applications. In addition to existing companies, new companies have also been forming to exploit the new technologies and markets. The overall industry continues to grow at an incredible twenty percent per year.
This growth depends on continuing new applications and new technologies. Presently, there is no end to these trends in sight. Advances in silicone technology, materials, software design tools, and computer architecture as well as new applications of computing technology continue at an unprecedented rate.

Most of the trends in the industry are a direct result of the advances in technology and reduction in prices. The time sharing, mainframe systems are in less demand since smaller groups of users can now afford his or her own mini computer. Data as well as computing power is shared between users at remote locations as a direct result of communications and networking technology.

3.2 Segmentation by Computer Power

The demand for the unsurpassed data crunching power of the mainframe will never go away as there will always be transaction oriented, pure data crunching applications. This high end segment however is showing signs of saturation and has the lowest growth rate of the segments, predicted to be only five percent over the next several years.

On the other end, the fastest growing segment of the
hardware market is mid-range systems networked to communicate with each other. These systems allow their users more control over their own, smaller computer system. Typically, the system is shared between a smaller group of users, usually a single department. These systems do not require expensive raised floor computer rooms and other costly overhead; thus offer significantly reduced operating expense and increased accountability. These mid range systems, are also being networked together to offer the flexibility of communication across departmental or even geographical lines. Sharing data throughout an organization has shown to provide significant gains in productivity and sometimes even used for significant competitive advantage.

The personal or micro systems segment also had tremendously high growth rates several years ago. This group of computers offers the same advantages of the mid range systems, but even more so: increasing control of computer power for even smaller groups of users, with the ability of being interconnected together. This segment includes all personal computers as well as the more sophisticated workstations. Growth in this segment was greater than 50% several years ago.
Growth in Hardware Sales
(Business Week, January 12, 1987, p.89)
* - estimated

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3.3 Applications of Computer Technology and Trends in Software

Software is the vital link between computer hardware and its applications. Any repetitive numeric task can be performed by a computer, but software must be written to instruct the computer exactly how to do it. The bottleneck for computer applications is not the availability of computer power, but rather the availability of software to make computer power useful in specific situations.

Software is also the critical link between the computer and its users. As computers become increasingly interactive, ease of use becomes more and more important. Software directly controls the user interface, thus determines overall productivity of an interactive system.

The development of software is extremely time consuming and expensive often representing several times a
user's investment in hardware. Early software packages were developed in the areas of highest demand: generic payroll, accounting, and inventory control systems. Early packages were also quite difficult to use causing large investment for training and maintenance.

Over the years, software has come a long way resulting in much easier to use and a huge number of applications. Also, the market has become segmented in numerous directions. Applications are now being developed specifically designed for a specialized task within a single industry. Success of an application is determined not only by its functionality, but also by its ease of use and ease of learning how to use.

Software is also becoming much less costly to produce. In fact there are software packages which help write software, known in the industry as CASE - Computer Aided Software Engineering. These packages assist the programmer in writing the computer programs including the user interface. Maintenance, or changing programs after they have been written, is also much easier since the CASE packages force programmers to use an easily understood format for their programs.

Recently, software has been one of the fastest growing
segments in the industry with predicted annual growth rates in the range of 30 to 45 percent over the next several years. Most of the recent developments have been for the distributed, intensive data processing systems, or the mid range and high end micros. Examples include Mechanical Computer Aided Design, Printed Circuit Board Layout, Integrated Circuit Layout, Architecture and Construction Engineering, Electronic Publishing and Computer Aided Software Engineering mentioned earlier.

Multitasking or windowing is another feature increasingly demanded by computer users. Windowing allows a user to run multiple programs at a single time and interact with each. One example is if a user wants to write a program, receive and send computer mail, test subroutines, monitor the time, and monitor the usage of his CPU all at the same time. This is possible all on one screen and one CPU with windowing.

Most applications of computing technology are to improve the existing operational effectiveness of a company. More importantly, strategic applications of computers can have substantial impact on a company. In some cases computer systems have transformed entire industries. The common link in these cases has been either to extend a
company's value chain and reduce the power of its suppliers or customers, or to provide key marketing information. The primary examples of this type of application are the airline industry's flight scheduling and ticketing systems and American Hospital Supply's automatic order entering system. Both of these systems provided a sustainable link to the customer of the industry. The link increased the ease of ordering the parent company's products, and also provides key marketing information about which products are currently in demand.

Knowledge representation is another area which shows significant promise to extend applications of computing technology. This technology hopes to effectively replicate the thought processes of a human expert on a computer. In situations where the benefits are substantial, these specialized systems, otherwise known as expert systems have proven to be effective. Most of the applications of expert systems today are to solve diagnostic type problems.
CHAPTER 4
STRATEGIC INDUSTRIAL ANALYSIS

4.1 Industry Analysis Overview

An analysis of the computer industry gives a better understanding of the environment which IBM and DEC are competing in. It will highlight the key characteristics of the industry and will identify the areas of competitive advantage and disadvantage which any company in this industry has to deal with. This information, when coupled with the background and market trends in the industry will provide a framework to determine the critical success factors for businesses in the computer industry.

Porter's Framework, which examines buyer and supplier power, threats of substitution, threats of potential entrants, and rivalry among existing industry firms is used to analyze the industry.

Concentration in the business is very high illustrated by few companies holding the majority of market share as well as the anti-trust litigation prominent in this industry. The high concentration is an early indication of the power of firms in the business.
4.2 Bargaining Power of Suppliers

Suppliers to the computer industry have relatively low bargaining power due to their large numbers and dependence on the computer industry. The largest value material purchased by the computer industry is integrated circuits (ICs.) Most of the ICs used in a computer are available as standard components, manufactured by several companies. In these cases, the suppliers compete on low cost, high quality products. Among the major players in the IC industry are the Japanese who have contributed strongly to maintaining a low price for parts in this industry.

Technology is the other product characteristic important to the computer industry. IC manufacturers have developed their technology extremely rapidly over the last three decades to provide ever increasing performance per dollar. The demand for superior technology and low cost product has made the suppliers extremely competitive.

Labor is the other significant input to the computer industry. The labor pool with experience in electronics has never been larger. Unions do not have power in the computer industry. Thus the power of labor as a supplier is also relatively low.
4.3 Bargaining Power of Buyers

First time buyers of computer equipment have a moderate amount of power. There are several computer manufacturers who compete intensely for new customers. Also, as more people become educated and fully understand computer technology, there is less dependence on the computer companies to provide expertise. Computing equipment is extremely expensive, often exceeding several million dollars for higher power equipment, and thus it is expected that as these consumers become more educated, the consulting services are less important and the raw performance per dollar is increasingly valued. An increasing number of "compatible" equipment manufacturers who provide equipment at low cost and little or no consulting services is making the industry more competitive.

However, the buying power of the upgrade buyer is severely diminished. Typically, the software investment is several times larger than that of the hardware and is dependent on the operating system written for. Once a customer has made the decision to use a certain type of operating system, then the customer's software investment is locked into that specific type of operating system,
significantly reducing his buyer power.

In the past, operating systems have been offered by only one computer manufacturer thus taking away a significant amount of buyer power after the initial operating system has been chosen. In recent years, several companies have been manufacturing "compatible" equipment thus returning some of the buying power to the customers.

4.4 Threat of Substitute Products

The only substantive threat in the computer industry is that of technological obsolescence. The field is moving so quickly from a technical standpoint that new product introductions are necessary at very frequent intervals to remain competitive. Additionally, there are a number of new technologies which may revolutionize the industry.

For example, the Japanese are investing a lot of money in researching multiple processor architecture. Other rapidly emerging technologies include Reduced Instruction Set Architecture (RISC) and the use of high speed Gallium Arsenide Transistors. Any of these technologies may ultimately emerge as the best technology for specific applications or possibly as overall superior to existing technology. Any company which is not ready to take
advantage of any of these technologies would be at a distinct disadvantage if one of them proves to be dominant.

As mentioned earlier, a customers software investment is tied to his operating system. Since most new technologies require a new operating system to operate efficiently, the switch to a new technology will be much slower than one might think.

Specially designed computers for specific applications do pose threats in specific market segments. The tremendous size and maturity of the industry offers significant opportunity for segmenting the market. A new computer, specifically designed for an application is a serious threat to any product which is not as well suited to the customers needs. Companies with the resources and willingness to segment and specialize have a distinct advantage and substitutes are possible in specialized segments of the market.

4.5 Threat of New Entrants

Entrants have entered to exploit small niches and to specialize on certain segments of this industry. Apollo Computer is an example of this which had sales of $1B million in 1982 and has grown to $600 million, 1/1000th the
size of IBM in 1986.

The other avenue of new entrant is to provide identical hardware at lower costs. The hardware is relatively easy to develop and replicate, thus the advent of the "compatible" manufacturers. However, perceptions of quality and reliability are much harder to replicate. Reliability is extremely important since computers are often the main component used in the most critical applications. When a company is truly dependent on their computer, and that company's computer goes down, the company will also essentially stop business until the computer can be repaired. This dependence on reliability and service is the differentiating factor which allows the larger computer companies to maintained their tremendous market dominance.

Economies of scale is a very difficult hurdle to overcome for potential new entrants. The existing leaders in this industry are among the world's largest in any industry. Economies of scale exist in every function of the business from manufacturing to marketing. Additionally, the leading companies have developed significant brand identification and customer loyalties. Reliability of equipment and customer service are important considerations
to a customer, thus name brand is important.

New entrants do not pose a threat to the players in the computer industry. Entry barriers are numerous, and if a new entrant proves a particular segment to be profitable, it won't be long before the large companies throw their weight at the segment and immediately claim tremendous market share.

4.6 Rivalry Among Existing Firms

Peaceful coexistence are terms of the past for this industry. IBM typically had 40 to 60 percent market share of most product markets it competed in. DEC, the next largest competitor typically had 5 to 15 percent. Last year, IBM lost 3 to 4 points market share in each of the mid size system markets while DEC gained roughly an equivalent amount.

Marketing efforts have become stronger by both companies. New product introductions are directed to offset advantages of the other's products. It is clear that IBM is taking clear steps to retaliate against these recent advances by DEC.
4.7 Industry Analysis Summary

The computer industry is an attractive industry for many reasons. There are few threats to a firm in the industry. Buyers and suppliers do not have significant power. There is little threat by substitutes or potential entrants. It is not surprising that the industry has historically been extremely profitable.

Rivalry among existing firms is the most significant competitive force on the industry. Emerging technologies and new market demands have to be well understood and carefully monitored. Strategic planning and implementation is increasingly important as is maintaining perceptions of service and reliability of the products.
CHAPTER 5
CRITICAL SUCCESS FACTORS

5.1 Background of Critical Success Factors

There are numerous success factors in the computer industry. Recent trends have caused the necessary emphasis on each factor to change in position. In fact the ability to readily adapt to these changes has become a dominant critical success factors in the industry.

Most of the success factors have evolved over time. At first a single company may have been using a single success factor to provide a competitive advantage. Over time other companies implemented the same factor thus nullifying the competitive advantage, but making it necessary for survival.

5.2 Sales and Marketing

Computers are extremely sophisticated pieces of equipment. Most companies do not fully understand the complexities of the current hardware nor are able to keep up with current technologies and latest equipment in the industry. Computer equipment represents large portions of a company’s budget, thus it is important to make correct purchase decisions.
Sales consulting has historically played a large role in the education of the customer. A computer company representative typically evaluates a client company’s current and future information processing needs, combines this information with their expertise of computer equipment and makes recommendations.

This type of consulting requires not only strong training in computer equipment, but also a good understanding of the client companies and business practices in general. A sales/marketing person playing this information systems consultant role requires extensive training.

5.3 Reliability of Equipment

Users of computer technology become absolutely dependent on it to perform their work and often to run their business. When the computer goes "down," all activities which depend on it stop until the computer is up and running again. There are numerous examples of this problem: the computer at the bank is down so you can’t get your balances; the computer at the department store is down and slows the check out process; the computer at the airline check in is slow and causes long delays; the
computer at work is down and you can't retrieve that urgent memo you wanted to deliver today; the computer on the space shuttle isn’t responding properly and delays the launch.

This extraordinarily high level of dependency causes reliability to be an absolutely critical factor when purchasing computer equipment. Companies with strong name recognition leverage off their name to position themselves in a significantly favorable position.

5.4 Service

Service is also very important in this business for the same reasons that reliability is important. When the computer does go down it is important to get it back up and running as soon as possible. Computer companies must have excellent service organizations to take care of problems that do occur. Guaranteed response times to service calls are often less than three hours in this industry.

5.5 Performance per Dollar

The performance of a computer determines how much data can be processed during a given length of time, usually measured in MIPS, million instructions per second. This measure is the most direct indication of how much work the
computer can perform, or its overall possible contribution to the organization where it is employed.

5.6 Keeping Abreast of New Technologies

Rapid changes in technology have caused performance per dollar to rapidly and continually improve over time. Companies must have the flexibility to quickly incorporate these advancing technologies rapidly to take advantage of them. The best way to ensure fast adaptation of new technologies is to invest heavily in research and development. When new technologies do breakthrough, internal resources either will have developed them or will be able to quickly understand the implications and applications.

5.7 Economies of Scale

From manufacturing to distribution to service, costs can be reduced by economies of scale. Competition is increasingly intense in all areas of the industry. However, it is important to balance taking advantage of economies of scale with maintaining the flexibility necessary to adapt to changes in the market and technologies.
5.8 Short Product Development Cycles

Rapidly moving technologies, fast moving markets, new software applications every day, and increased competition all lead to the increased necessity of fast product development cycles. Windows of opportunity are very short and the industry is becoming increasingly complex.

Companies must easily adapt to these changes at an ever increasing rate. Change management and business flexibility is critically important to success in this industry.

5.9 Support of Specialized Software Products

There are thousands of software packages on the market today, each representing some useful application of computer technology. There are also thousands of companies developing ever increasing numbers of specialized software packages. Often the sale of computer hardware is dependent on how well a certain software package is supported.

Hardware companies must take special effort to carefully analyze the demands of the markets and work with the software companies to support the most critical
applications. This is especially true with the trends toward distributed processing where a system may be purchased for the exclusive support of a single software package.

5.10 Ease of Upgradability

Upgradability is the ability to take a user's existing software and implement it on a more powerful machine. This feature is important to a user who wishes to eventually upgrade his computer system with minimal expense and headaches. Recent trends in the markets indicate that upgradability is an extremely important feature.

Compatibility of architecture and operating systems between low, medium, and high performance systems determines ease of upgradeability. If the system architecture and operating systems are incompatible, significant changes in the software or entirely new software will be required to change systems. These changes are expensive and time consuming.

Learning to run a new software package can also be quite time consuming and frustrating. Often the largest investment in running a computer is not the hardware or the software, but rather the time invested to learn how to use
the software. Systems which offer upgradability do not require learning a new set of software packages.

5.11 Networking

Networking is the ability of computers at remote locations to communicate with each other. It is a fairly recent technology and its applications are growing at a tremendous rate. Applications are in every area of the economy from automatic teller machines to the transmission of satellite weather maps to television stations. Other uses include tying research and manufacturing computers together and inventory control of a merchandiser over its many franchises. Recent applications of computers are relying increasingly on networking.

Communication of computers with each other is another feature dependent on the compatibility of the architecture and operating systems involved. A good way to understand this dependency is that if two computers speak the same language internally, it is much easier to get them to understand foreign computers who also speak the same language.
5.12 Distributed, Medium and Low Range Systems

Centralized, mainframe computing is being replaced by distributed computing, often networked together. Because of the advances in price performance of computer technology, small groups of users have recently been purchasing their own computer equipment. The decentralized trends of computing equipment gives the smaller groups of users increased control over their own computing power. Additional advantages of distributed computing include accurate computer cost allocation and the reduction in expensive raised floor computer rooms. Data bases can still be shared through networking the distributed systems together.

Personal Computers and workstations are the most prevalent examples of distributed processing. Trends toward distributed processing are quite strong thus it is important for computer manufacturers to offer products in this segment of the market.

5.13 Highly Profitable High End Systems

Though most of the action is occurring in the medium and low end of the markets, the high end, though slower in growth is still the most profitable segment of the
business. It is definitely the cash cow of the industry and it is important for capable manufacturers to maintain market share in this segment.

5.14 Diversification into Other Information Technologies

Networking and distributed processing are playing a large role in the computer industry today. Control over communications technology is becoming increasingly important. Players must either invest heavily in R&D or acquire communications companies to understand and implement this increasingly important technology.
CHAPTER 6

IBM BACKGROUND, STRENGTHS, WEAKNESSES, AND STRATEGIES

6.1 History of IBM

IBM was originally the Computing, Tabulating-Recording Company (CTR), a maker of time clocks, butcher scales and mechanical tabulators. Thomas John Watson, Sr., formally a National Cash Register Executive was hired to run CTR in 1914 and in 1924 renamed the company to International Business Machines. In 1933, an antitrust suit revealed that IBM has 80% of markets for keypunches, sorters, and tabulators. By 1939, IBM's earnings surpassed that of its four main competitors combined.

Watson Jr. was appointed president in 1952 and the company introduced its first commercial processor. During 1955 IBM sold its first commercial computer, based on vacuum tube technology. Transistor based computers shipped in 1959. IBM focused on large, mainframe end of the computer market. The IBM 360, the revolutionary mainframe, was ready for shipment in 1964 and represented 70% of installed value by 1969. An antitrust suit in 1969 caused IBM to release its monopoly on the peripheral business.

By 1977, Apple, Wang, Commodore, and Tandy were selling personal computers. During 1984, IBM introduced
several personal computer products with the PCjr being their first visible failure. Later, IBM captures dominant market share in this explosive market.

By 1985, IBM had started to diversify into communications. IBM acquired stake in several companies including Intel, Rolm, and MCI.

In many ways, the history of the computer industry is the history of IBM. Except for small niches, the industry can not be discussed without bringing up this industry giant. Currently, IBM brings in 40 percent of the industry's revenues and claims 70 percent of its profits.

Key Financial and Operating Data
(Dollars in Millions Except per Share Data)
(IBM Annual Reports)

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<td>Per Share</td>
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<td>6,430</td>
<td>5,473</td>
<td>4,330</td>
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At Year End:

| Assets | 57,814 | 52,634 | 42,808 | 37,461 | 32,541 |
| Net Investment in Plant and Equipment | 21,268 | 19,680 | 16,363 | 16,142 | 17,563 |
| Working Capt’l | 15,006 | 14,637 | 10,735 | 8,168 | 5,010 |
| Long Term Debt | 4,169 | 3,955 | 3,269 | 2,574 | 2,851 |
| Stkholdr Eqty | 34,374 | 31,990 | 26,489 | 23,219 | 19,960 |
Sources of Gross Income
(In percentage of Gross Income)
(IBM Annual Reports)

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<td>65%</td>
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<td></td>
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<td>Other Services</td>
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<td>11%</td>
<td>17%</td>
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<td>35%</td>
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<td>Services</td>
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<tr>
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<td>11%</td>
<td>8%</td>
<td>7%</td>
<td>6%</td>
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General Information and Ratios
(IBM Annual Reports)

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<td>120-160</td>
<td>90-125</td>
<td>85-125</td>
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Major Product Information

- Large Systems: 3090-Sierra Mainframe Series, System/36 and System/38
- Mid Size Systems: 9370 - extension of 370 Series
- Mini & Micro Systems: 5080 Workstations, PC, PC-XT, PC-XT, PC-RT
- System/2 PCs (80386 based), Portable PC Convertible
- Network Equipment: Token Ring, PC Networks, SNA Protocol, OSI Protocol
- Peripheral Equipment: 9332, 9335 Disc Drives, Tape Drives, Printers, Displays, Terminals
- Software: Comprehensive Set of Applications
- Maintenance: Comprehensive Services
- Telecommunications: Rolm Products
- Other: Knowledge Based Systems, Development Support, Computer Integrated Manufacturing Support, Typewriters
6.2 STRENGTHS

6.2A 1986 Sales of $51 billion

IBM has a lot of strengths, and size is certainly one of them. 1986 revenues for IBM were more than $51 billion dollars with earnings almost $5 billion. Its next nearest competitor had revenues of only $7.6 billion, barely topping the earnings of IBM! IBM is almost seven times the size of its next nearest competitor.

Being such a giant lends itself to numerous advantages. Economies of scale can be leveraged off of in all functions of the business. Very strong brand recognition allows for premium pricing. Seemingly infinite resources allow the giant to explore any and all emerging markets.

6.2B Uncontested Sales Force and Service Network

Second to none is IBM's sales and marketing forces. Watson Sr. led the company from the beginning with a strong culture of emphasis on sales, service, and customer relationships. IBM is known today as one of the world's leading marketers. This emphasis was particularly well suited for IBM during the early days of computing. Managers at customer companies were not familiar and often
intimidated by sophisticated computer equipment. IBM sales and marketing people assisted, free of charge, helping these customers implement computer technology into their firms. However, as MIS managers slowly became more sophisticated, they were more willing to purchase a competitor's product at a lower price.

During the early 80s, IBM went through a cost cutting binge and much emphasis was removed from the marketing efforts. Recently, the focus has returned to the marketing focus as thousands of employees have been deployed from technical, internal positions to field positions in marketing.

Recent restructuring has also created a single IBM representative responsible for the recommendations for each account. This salesperson is responsible for IBM's entire product line and has reduced conflicts within IBM when different salespeople made recommendations for the same account.

6.2C Quality and Reliability

IBM has been in the market longer than any other company and has always stressed quality and reliability in its products. This feature is absolutely critical to
customers who invariably depend heavily on their computing equipment.

6.2D Leader in Mainframe Markets

Mainframes are IBM's traditional products. Starting with the 360, IBM has been extremely successful in the mainframe markets, with dominant market share. The mainframe market has the least amount of competition and the greatest amount of profits of the entire computer industry.

Though this segment of the market is growing the slowest, IBM can leverage off its strong position and high profitability to generate funds for investments in other areas.

6.2E Technology Development

IBM invests heavily in R&D, over $5 billion for 1986. It is one of few companies which can afford to invest in primary research. Advances in the computer business are driven by technology. New technologies such as superconductive materials will lead to even faster integrated circuit technology will cause significant change in the industry. IBM, having one of the largest research
budgets in the world is ready to take advantage of any of them.

IBM's Research Budget (millions)  
(IBM 1986 Annual Report)

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<td>1982</td>
<td>$3000</td>
</tr>
<tr>
<td>1983</td>
<td>3550</td>
</tr>
<tr>
<td>1984</td>
<td>4150</td>
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<td>1985</td>
<td>4750</td>
</tr>
<tr>
<td>1986</td>
<td>5200</td>
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6.3 WEAKNESSES

6.3A Size

Size is not only a strength, but also a weakness. It is very difficult to manage a company of this vast size. How could anyone maintain 20% growth rate with 20% earnings based on $50 billion dollars of sales? The large size also leads to a lack of focus. Several years ago, IBM operated rather successfully as several separate operating units. Each unit offered a different product successful in their own market segments, but incompatible with other IBM products. Now the market is demanding compatibility among all products.

Lack of flexibility is also derived from the large size of the company. Today's markets change extremely rapidly. IBM has been historically slow in moving into new
market areas. This better safe than sorry tactic has protected investments, but also has given up significant leads in important new markets.

The lack of flexibility may also be due to IBM's attention on the mainframe segments. IBM has grown to what it is today based on the mainframe computer and will take a long time to adjust its focus into other segments. Recently, computer markets have been changing very quickly, with increased demand outside of the mainframe segments.

6.3B Threatening Emerging Technologies

The technologies demanded by today's market in the computer industry are those if networking, upgradeable product lines, and distributed processing. Due to IBM's lack of focus on a single architecture and operating system, it is difficult to provide efficient networking or compatible systems. Without networking, distributed systems are limited in capability. IBM is caught between a rock and a hard place in this situation. The networking that IBM does provide is significantly inferior to product offerings of other companies and is believed by many to be a band aid fix rather than a real solution.
6.3C Increasing Commodity Nature of Major Product Lines

Competition in the Computer Industry has never been greater. The products are becoming more commodity like. The market will no longer demands products which don't have standard interfaces. Numerous foreign competitors have entered the markets particularly in the low end PC markets.

Though IBM and other US firms have historically been technological leaders in the computer industry, Japan is now also making a major investment in computer research and development, particularly in the field of parallel processing. Foreign countries have proven to be effective low cost competitors. If Japan takes the technical lead, IBM could be in trouble. IBM must maintain its technical lead and work closely with the markets to develop new products in order to remain competitive.

6.4 Current Strategy

Strategy is often best reflected by current product announcements. Recent announcements by IBM have included the 9370, a mid range system, supposedly compatible with high end systems. This product had immediate initial success, but reports indicate that it is not as compatible as the market would like.
A second announcement is that of the new, more powerful, Series-2 Personal Computers. These systems provide more power than existing PCs, will support networking, and will contain a larger percentage of IBM proprietary parts thus reducing the ability to copy the product. The negative effect of "closing" the new PC will be that third party vendors will not be able to produce accessories for it, without special agreement, thus the proliferation of this new product line is limited.
CHAPTER 7

DEC BACKGROUND, STRENGTHS, WEAKNESSES, AND STRATEGY

7.1 History of DEC

Digital Equipment Corporation was originally founded thirty years ago (1957) as a spin off from MIT. Ken Olsen, one of three founding members, continues to lead DEC as President and Director of the Corporation. The company's original focus was to provide the computer as a tool to solve engineering and scientific problems.

DEC grew in the engineering and scientific community over the years, and is currently very strong in manufacturing applications. DEC sold its systems based on strong technical performance primarily to an OEM market (a second group of companies which would purchase DEC’s computer to be used as a part of their product.)

In 1965, DEC introduced its first minicomputer, a market segment which had been ignored by IBM. This segment proved to be extremely valuable to DEC.

During the late 1970s, Digital strived to please its customers with customized systems specifically tailored to the customer’s situation. DEC later developed a highly specialized computer application to maintain accuracy of orders and improve customer satisfaction. Though this
system has provided strategic advantage in the past, DEC is now moving toward more standard configurations.

In 1977, Olsen declared a single technical direction for the company to focus its scarce resources. He directed the development of a single, long standing, 32 bit architecture with a single operating system and instruction set, eventually came to be known as VAX/UMS. The plan has taken nine years to complete. During 1986, DEC introduced an entire line of new VAX/UMS based products. This technical foresight has provided DEC with the long term strategy which has helped it develop the strengths it has today.

During the early 1980s, DEC reorganized to adjust to the rapid change environment brought on by new technologies. Response to market was emphasized. Power as well as profit and loss responsibilities were moved to the field organizations. Additionally, generous stock options, now worth millions, were given to its key engineers.

During the last few years, DEC has recognized that future opportunities will be increasingly commercial and that DEC will have to compete directly with IBM.
Key Financial and Operating Data  
(Dollars in Millions Except per Share Data)  
(DEC Annual Reports)

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<td>and Equipment</td>
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<td>At Year End:</td>
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<tr>
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Sources of Gross Income  
(In percentage of Gross Income)  
(DEC Annual Reports)

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<tr>
<td>Equipment</td>
<td>65%</td>
<td>68%</td>
<td>69%</td>
<td>67%</td>
<td>72%</td>
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<tr>
<td>Service and Other</td>
<td>35%</td>
<td>32%</td>
<td>31%</td>
<td>33%</td>
<td>28%</td>
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General Information and Ratios  
(DEC Annual Reports)

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<td>3.9</td>
<td>4.1</td>
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<td>.155</td>
<td>.100</td>
<td>.026</td>
<td>.028</td>
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<td>Days A/R Outstdng</td>
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<td>75</td>
<td>83</td>
<td>82</td>
<td>73</td>
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Major Product Information

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<td></td>
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<td>Displays, Terminals</td>
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<td>Software</td>
<td>Large Set of Applications</td>
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<tr>
<td></td>
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<td></td>
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<td>Maintenance</td>
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<td>Development Support</td>
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<td>Computer Integrated</td>
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<td>Manufacturing Support</td>
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</table>

7.2 STRENGTHS

7.2A VAX/VMS: Compatibility, Upgradeability, Networking, and Clustering

Digital's main strengths are possible because of the standard VAX/VMS architecture and operating system of Digital's products. VAXs were 5% of DEC's hardware revenue in 1985, 34% in 1986 and estimated 52% for 1987. These new products are not only technically first-class, but also extremely profitable.

Software used on a VAX/VMS, DEC system today can easily be transported to a future model or higher
performance system. The user's software investment is protected by the compatibility of Digital's product line. Software no longer has to be repurchased and/or relearned every time customers change their equipment. Also, DEC can introduce new equipment with immediate support by a large base of software. For example DEC's new workstations leverage off a huge installed base of applications already written for VAX/VMS architecture.

Another advantage of upward compatibility is that 3rd party software vendors can develop software for all machines on the smallest, least expensive VAX based system.

Standard architecture and operating systems throughout the product line have also allowed DEC to network its products together. Networking provides communications between computers at remote locations. Systems of any size can be networked together to share data, communicate, and increase performance. DEC has also demonstrated the ability to network to non-DEC equipment. This capability allows DEC to sell into companies which have an installed base of non-DEC equipment.

Digital has the largest network in the world which currently includes 29 countries, 250 locations, and 60,000 users!
Digital offers the capability to connect its products together in order to significantly increase performance. Several computers work on any given task at the same time. Overall performance is increased significantly resulting in some cases with applications running as fast on a VAX cluster as on a mainframe. However, there are applications which can not be easily divided among several processors. In this type of application, which is sometimes called transaction oriented or pure data crunching, the mainframe still outperforms the VAX.

7.28 Flexibility

Three years ago, DEC dropped some strong product lines in order to devote its full attention on the VAX/UMS technology. A few distressed employees left, but overall, the company stood behind the change in direction. Flexibility is a requirement for success in any rapidly changing industry, especially the computer industry.
7.2C Totally New Product Line

Last year (1986) DEC introduced a completely new set of products which not only suit the market extremely well, but also offer significantly increased profitability to DEC. The result is profitability increased 15 points over the last eighteen months bringing the total to 52 percent!

DEC's new products leverage off DEC's strong VAX/UMS technology and are targeted directly at IBM's weak spots. As mentioned earlier, because the products are compatible with earlier products, there already exists a large base of software for the new products.

DEC is also supporting important software packages. For example, DEC recently introduced its "All in One" office automation package. This package simplifies computers and makes them extremely easy to use for standard office personnel. DEC has already captured 20% of this market.

7.2D Increased Sales / Marketing Muscles

DEC has increased its sales staff by 30% over the last year. Increased emphasis on sales and customer relationships demonstrates that DEC knows what it takes to go head to head with IBM and move into the markets necessary for further growth. DEC offers consulting
services in areas of specific strengths. Also, it is focusing on the top 600 computer accounts hoping to gain some business away from IBM.

In order to help its sales and marketing, DEC has always offered absolute quality in conjunction with competitive price/performance. It also has a top service program, with guarantees that a serviceman will be on site within two hours of a service call. Additionally, DEC is also willing to service non-DEC equipment.

7.2E Protection From Peripheral Manufacturers

DEC has used its proprietary VAXBI bus on its recent products. This bus effectively closes the systems to outside manufacturers making compatible equipment. The down-side is that capabilities of the systems will not be developed by outside companies as quickly, but the protection from compatible manufacturers is necessary in today's environment.

7.2F IBM Trying to Look Like DEC Adds Credibility

In many ways, IBM has shifted its focus and strategies to be quite similar to what DEC has been doing all along. Examples of this include using non-direct channels for
marketing and interest in the scientific and engineering markets.

7.3 WEAKNESSES

7.3A Momentum will be Difficult to Maintain

DEC's position in the market has increased dramatically over the last eighteen months. This trend will be extremely difficult to continue. Much of the growth has come about due to DEC's new product line and increased profitability. Also, IBM has awaken to DEC's tactics and is vigorously protecting their market share.

7.3B Limited Software

The current breakdown of existing software is as follows: 50% manufacturing, 25% distribution, financial management, health care, earth resource areas, 25% other. There are few software applications in insurance, transportation, utilities, and other service industries. There are numerous firms developing new software applications for the VAX, but time is needed before a good selection will be available.
7.3C No Mainframe Product

For some applications, where tasks can not be split up among several processors, the mainframe is a much superior performer. There will always be a market for a mainframe for heavy data crunching or transaction oriented processing. Additionally, the mainframe segment is extremely profitable.

7.3D Salesforce Needs Time to Get up to Speed

The recent growth in the salesforce isn’t likely to have a significant impact for some time. The salesforce has traditionally been very technical and separate for different products. It also has to coordinate with the other channels of distribution. Large computer companies need to use the account oriented, single company contact approach.

7.3E Difficult to Penetrate the IBM Shops

IBM has a tremendously large installed base. Most companies with computer systems have already installed IBM equipment. In order to install a VAX into an IBM shop means establishing an entirely new core of expertise in VAX. New learning must occur. Operating managers must be trained.
DEC must convince the customer that the superiority of its products make these high switching costs worthwhile.

7.3F Clustering Restricts Pricing Flexibility

Clustering provides the capability of tying an additional computer into an existing cluster to increase performance. This means that the power of a larger VAX system could be replicated by numerous smaller systems clustered together. Because these now serve as substitutes, price/performance must now be held constant across the entire product line.

7.4 Current Strategy

DEC will leverage off its strong networking and distributed processing capabilities. Its first priority is to develop a fully distributed database management system. There are roughly 1.5 years left of development time on this project. This system will allow significant improvements in distributed processing.

DEC will also be working to enhance the performance of its VAX cluster to bring it on par with the mainframe. The full parallel processing technology required is mostly a software development effort and will require 3 to 5 years
to complete. DEC will probably also develop a faster VAX than the 8800. This will take roughly three years time. Other advanced research includes Reduced Instruction Set architecture (RISC) and enhanced networking capabilities to include transparent access to a system from anywhere.
CHAPTER 8

COMPARISON OF THE TWO STRATEGIES & ANALYSIS
OF THE REASONS FOR THE DIFFERENCES

8.1 Product Characteristics

The computer industry is composed of numerous segments. Both IBM and DEC have full product lines with products in every market segment. The mainframe segment is where IBM has developed as a company. IBM has concentrated on and successfully developed this segment from the early days of the industry. The segment is extremely profitable, and IBM has over sixty percent share. Though this segment is starting to mature, IBM can use the profits from this segment to fund investments in other areas of the business.

DEC's product in the high end segment is the VAX cluster. It allows DEC to compete and also extract the high profits of this segment. However, DEC had less than 3 percent of this segment in 1985. For certain applications, where clustering is inefficient, DEC's VAX cluster can not compete with IBM's mainframe. DEC will make significant improvements in this segment through improvements in the cluster software, but needs time.

IBM also dominates in the mini or PC segment while DEC has very little market share. The mini segment was
experiencing explosive growth several years ago. Even though IBM set the standards, numerous "IBM clone" products came onto the market and eventually outsold IBM. IBM's latest PC line, System/2, is a closed system, designed to be clone proof. Closing the hardware has the drawbacks of limiting third party hardware and software development.

DEC is very strong in other segments. The mid size segment is where DEC has developed as a company. Its products have been traditionally strongest in this segment. IBM's share of this segment eroded by four points during 1986 with most of the gains being claimed by DEC. Also, DEC was faster than IBM to the market with a workstation product in the fast growing segment.

DEC is leveraging off its base of software by using compatible operating system and architecture throughout its product line. All existing and future VAX software will run on any of DEC's products from mini to VAX cluster.

DEC is unquestionably the leader in networking. Its development and use of this technology over many years has put it at the forefront in networking technology. Due to its networking expertise, DEC also offers superior distributed processing capabilities.
8.2 Market Characteristics

In the past, users of computing equipment often did not know exactly what they needed for their particular application. IBM has grown to be what it is today as a result of premier marketing and customer relationships. Watson originally developed IBM in its early days as a premier marketing and selling organization. Many sources consider IBM's sales force as the best in the world. IBM provides premier consulting services to help customers determine which computer products best fit their specific applications. Computer equipment is very expensive and the purchasing decision for computer equipment can be quite complex. IBM has very strong brand recognition and reliability. No one has ever been fired for recommending IBM equipment. Thus IBM has the advantage with non-expert, conservative buyers of computer equipment.

DEC has traditionally relied on competitive pricing and strong technical products to sell themselves. DEC realizes that to continue its strong growth, especially in the commercial markets, that will be competing directly with IBM. As a result, DEC has increased its emphasis on marketing by beefing up its direct sales force by 30% over the last year. It also continues to develop other
distribution channels.

Buyers are also becoming smarter. The markets are beginning to demand features other than what IBM has to offer. The markets are demanding system compatibility, networking and distributed processing. Almost ten years ago, DEC decided that it was important to develop a long standing common architecture across its product line. DEC has products supported by this common architecture in all segments and offers the compatibility IBM does not. DEC machines can be upgraded by simply adding another system and clustering the systems together. Software can be easily transported from one system to another. New systems can be introduced without a large investment in developing new software. DEC has these products now.

IBM is very strong and intelligent. It has perceived the new demands of the market and is moving to develop and introduce products to satisfy them. It continues to claim that its products, though not compatible are each optimized for each particular segment. It claims that its products are better suited for each specific segment which each was designed for. Software is being designed so that the user interface is the same across products, thus eliminating retraining, but the problem of developing and purchasing
software for each segment is not solved. IBM has recently introduced products which begin to offer compatibility in its product line.

IBM feels that DEC must make compromises in order to use the same operating system and architecture throughout its product line. DEC claims that IBM's products may be optimized for each segment, but there is a lot of overhead required to network the systems together. Thus IBM's compatibility, networking and distributed system products remain inferior to DEC's offering.

IBM remains strong in high speed, pure data crunching applications. Growth in this segment has diminished to only 5 percent over the last few years. The mainstay of IBM's business appears to have reached maturity. There will always be a need for the mainframe computer with raw data crunching power, but growth has slowed enough that IBM must look elsewhere for the long term growth of its company.

8.3 **Technological Characteristics**

Users of computer equipment are concerned primarily with capability, ease of use, speed, and cost. Advances in technology determine changes in each of these areas.

IBM maintains a tremendous research and development
effort, including in the areas of primary research. A recent development which has come out of its labs is that of superconducting material at practical temperatures. This technology will allow a quantum increase in circuit density. Significantly increased processor speeds, reduced costs and less space requirements will result from this advance in materials technology. Though IBM played a major role in the development of this technology, it does not hold any competitive edge as a result. Rather, the entire industry will benefit from these advanced, superconducting materials.

As mentioned earlier, IBM does maintain the product with the fastest computation speed or raw data crunching power. It has been the leader in this high end and highly profitable market from the beginning of the business.

DEC maintains a very strong position in the computer markets due to its VAX/VMS operating system and architecture technologies. It took DEC ten years to develop this technology and incorporate it into its products. The result is that DEC is able to offer compatibility, distributed processing, and networking throughout its product line. IBM will have significant difficulty transforming its product line to offer these unique
Ease of use is determined by the software on a system. Software technology has come a long way during the past few years. It is no longer very difficult to develop high quality software very quickly. IBM has a comprehensive base of software for all types of applications. DEC’s software base is concentrated in the areas of manufacturing, engineering and office applications. New software is being developed at an extraordinary pace. DEC will soon fill in its gaps. Software development for DEC’s product line is less time consuming than for IBM’s product line due to the fact that all DEC’s systems are compatible while IBM’s systems are not. Thus software development for the DEC line is much more efficient than and could someday surpass the IBM line.

8.4 Organizational Characteristics

IBM is one of the largest companies in the world. It has, for all practical purposes, infinitely deep pockets. It also has incredibly strong brand and name recognition. IBM can invest and be a substantial player in any market it desires. It has the power to demand premium pricing on any product in any market it so desires. It also has the
resources to cut price in any market to gain share. It has the largest installed base of products and satisfied customers in the industry. IBM is a giant and is difficult to beat in any contest.

One major problem with such a large company is effectively managing its resources. The company has allowed different products to be developed by different groups and the result is non compatibility. Now that the markets are demanding compatibility, IBM is in a tough situation. It has chosen to provide band aid fixes to its existing equipment. The market has shown some acceptance of these fixes. However, good technical solutions will take years to develop.

DEC on the other hand has used its smaller size and flexibility to its advantage. Ken Olsen directed a single technical direction for the company ten years ago. Today, the results of this focus are astounding. This single direction is what made compatibility, networking and distributed systems all possible. DEC's strengths are a result of its technical and marketing foresight and flexibility to adapt to significant changes in direction.
8.5 Financial Characteristics

A summary of key financial values and ratios is summarized in the following table. Adjustments in position and strengths of these companies are clearly seen upon examination of these financial figures.

Comparative Financial Information
(Business Week, April 17, 1987, pp46,47., Business Week, April 18, 1986, pp62-65.)

<table>
<thead>
<tr>
<th></th>
<th>IBM</th>
<th>DEC</th>
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<tbody>
<tr>
<td>Market value (million)</td>
<td>$90055</td>
<td>$21622</td>
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<tr>
<td>Change from 1985 (%)</td>
<td>-2</td>
<td>137</td>
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<tr>
<td>Sales - 1986 (million)</td>
<td>$51250</td>
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<tr>
<td>Change from 1985 (%)</td>
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<td>20</td>
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<tr>
<td>Profits - 1986 (million)</td>
<td>$4789</td>
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<tr>
<td>Change from 1985 (%)</td>
<td>-27</td>
<td>115</td>
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<td>Profit margins - 1986 (%)</td>
<td>9.3</td>
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<td>Profit Margins - 1985 (%)</td>
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<td>5.7</td>
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<tr>
<td>Return on invested capital (%)</td>
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<td>Return on common equity (%)</td>
<td>13.9</td>
<td>13.8</td>
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<tr>
<td>Assets (millions)</td>
<td>$57814</td>
<td>$7966</td>
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<tr>
<td>Change from 1985 (%)</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Recent share price ($)</td>
<td>149</td>
<td>167</td>
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<tr>
<td>12 month high share price ($)</td>
<td>162</td>
<td>167</td>
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<td>12 month low share price ($)</td>
<td>116</td>
<td>76</td>
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<tr>
<td>Price as % of book value</td>
<td>262</td>
<td>345</td>
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<tr>
<td>P/E ratio, end of 1986</td>
<td>19</td>
<td>35</td>
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<tr>
<td>P/E ratio, end of 1985</td>
<td>14</td>
<td>21</td>
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<tr>
<td>Dividend yield (%)</td>
<td>2.96</td>
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<td>Dividend payout (%)</td>
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<td>0</td>
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<tr>
<td>Shares outstanding (million)</td>
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<td>130</td>
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<tr>
<td>Earnings per share 1985 ($)</td>
<td>10.54</td>
<td>3.71</td>
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<tr>
<td>Earnings per share 1986 ($)</td>
<td>7.81</td>
<td>4.81</td>
</tr>
</tbody>
</table>
8.6 **Summary of Each Company's Strengths and Weaknesses**

IBM's most significant strengths are its marketing muscles, its reputation, and its size. DEC's most significant strengths are its networking and its compatibility capabilities. Both companies offer a full line of products, have excellent service, and strong financial positions.

IBM's main weakness is its size. It is too large and inflexible to quickly steer into new marketplaces. DEC's major weakness is also its size. It is smaller than IBM, thus it must spend its resources more wisely. It is also less well known in the marketplace than IBM.

Each of these companies should adjust its strategy which leverages off its own strengths and off its competition's weaknesses. The industry is slowing in growth and becoming increasingly competitive, but remains very profitable.
### SUMMARY OF DIFFERENCES

<table>
<thead>
<tr>
<th>Dimension \ Co.</th>
<th>IBM</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCTS</strong></td>
<td>Full line, segmented</td>
<td>Full line, integrated Strong midrange products</td>
</tr>
<tr>
<td></td>
<td>Strong mainframe products</td>
<td>Strong networking products</td>
</tr>
<tr>
<td></td>
<td>Strong PC line</td>
<td>Product line compatibility</td>
</tr>
<tr>
<td><strong>MARKETS</strong></td>
<td>Very strong reputation</td>
<td>Mid range markets are growing</td>
</tr>
<tr>
<td></td>
<td>Large installed base</td>
<td>Networking demand is growing</td>
</tr>
<tr>
<td></td>
<td>Attractive to conservative customers</td>
<td>System compatibility demand is growing</td>
</tr>
<tr>
<td></td>
<td>Mainframe growth has slowed</td>
<td>Applications strong in manufacturing engineering, and office markets.</td>
</tr>
<tr>
<td></td>
<td>Applications throughout market</td>
<td>New applications will grow quickly.</td>
</tr>
<tr>
<td><strong>TECHNOLOGY</strong></td>
<td>High speed processors</td>
<td>Efficient networking Complete product line compatibility</td>
</tr>
<tr>
<td><strong>ORGANIZATION</strong></td>
<td>Large, somewhat inflexible</td>
<td>Smaller, proven flexibility</td>
</tr>
</tbody>
</table>

#### 8.7 Analysis of the Reasons for the Differences

Reasons for differences between any companies is due to their unique history and culture. IBM and DEC are no exception. Each has grown and developed as a company facing
different types of problems and circumstances. Each has
developed its own particular strengths and weaknesses.
Today, these companies find that they must compete with
each other in order to maintain their historic growth
rates. The only similarity of these two companies is that
they compete in the same marketplace.

IBM developed from the early years of this century as
a premier marketer. IBM has always maintained very strong
relationships with its customers. DEC is a much newer
company, starting only thirty years ago and has always been
very strong in technology. DEC was able to foresee the
demands of today's markets and has worked for ten years to
develop a technical solution to its demands.

Markets do change. The successfully player in the
computer industry is the one who is able to truly
understand and predict the complexities of the marketplace
and leverage off its own strengths and its competitor's
weaknesses. DEC's VAX/VMS solution will not last
indefinitely. IBM has such large resources and reputation, it
will be a dominant player in any market it so desires.
The future will be interesting to watch as DEC and IBM
continue to compete in this complex industry.
BIBLIOGRAPHY

Akers, John F., Chairman of the Board, IBM Corp. Speaker at Sloan Distinguished Speaker Series, Massachusetts Institute of Technology, Cambridge, MA. March 5, 1987.


——. "It All Adds Up to Another So-So Year," Business Week, January 12, 1987, p.88,89.


Cooper, A. C. and Schendel, D. E. "Strategic Responses to Technological Threats," Business Horizons,
February, 1976.


Digital Microsystems and Products Catalog 1986, ED 27915 79/86 02 23 70.0, USA, 1986.


International Business Machines Corporation 1985 Annual Report, Armonk, NY.


"How Long Can This Keep Up... or to Jump In or Not to Jump In? A Perspective on Recent Strength," Investment Research - Minicomputer Stocks, Goldman Sachs, January 19, 1987.


