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Information Technology, Process Reengineering, and Performance Measurement: A Balanced Scorecard Analysis of Compaq Computer Corporation

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**INFORMATION TECHNOLOGY, PROCESS
REENGINEERING AND PERFORMANCE
MEASUREMENT:**

**A BALANCED SCORECARD ANALYSIS OF COMPAQ
COMPUTER CORPORATION**

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CASE STUDY



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ABSTRACT

The personal computer industry is characterized by fierce competition for market share. The pace of technological change results in ever-shorter product lives and a continuous search for enhanced efficiency. To achieve these goals, firms must use information technology insightfully to redesign business processes, improve supply chain management and increase the value provided to the customer.

This competitive environment in the personal computer (PC) industry provides an exceptional laboratory for evaluating how companies use information technology to create business value. Compaq Computer Corporation is one of the most successful PC manufacturers. This case study, based on publicly

available data, provides a comprehensive analysis of how strategic business use of information technology in concert with business process redesign improved the economic performance of this large-scale manufacturing company. Compaq has relied on strategic use of enterprise-wide IT to enhance its competitive position as the number one supplier of personal computers in the world.

This analysis begins with a review of the economics and competitiveness of the PC industry, and the role of information technology. To place Compaq's performance in perspective, we compare it to Dell Computer Company and Gateway Computer Company. We then profile the changes in Compaq's business strategy and its use of process reengineering and enterprise-wide information technology to implement strategic changes.

To understand Compaq's financial success better, we use the Balanced Scorecard [Kaplan and Norton, 1992 and 1996] to develop a causal model of firm performance that highlights the contribution of information technology to four different dimensions of that performance. We conclude that 1) information technology, along with 2) process reengineering, when properly aligned with 3) Compaq's business strategy contributed substantially to Compaq's overall success and market leadership.

Keywords: Balanced Scorecard, Enterprise Resource Planning, Information Technology, Reengineering, Business Strategy, Compaq Computer Corporation.

I. INTRODUCTION

Intensifying global competition and increasingly sophisticated consumer preferences require companies to respond quickly and effectively to market opportunities. In this economic climate, effective implementation of a business strategy depends upon insightful use of information technology to redesign business processes, improve supply chain management, and increase the value provided to the customer. To accomplish these goals, managers need timely and

comprehensive information to make good marketing, production, and distribution decisions. As Porter and Millar [1985] noted, “The information revolution is changing the nature of business and *can* [emphasis added] create competitive advantages for those managers who understand its effects.” Questions remain, however, about how firms should use IT to gain this value.

Michael Hammer [1990] advocated the use of IT to make radical changes in business processes: “We should ‘reengineer’ our businesses: use the power of modern information technology to radically redesign our business processes in order to achieve dramatic improvements in their performance.” Many firms followed his advice; however, Hammer himself admits that the results of these efforts were mixed [Hammer and Champy, 1993]; Davenport [1997] stresses the importance of IT to achieve “information integration,” but he also points out that “true information integration won’t happen without major changes in management approaches and organizational structure.”

Firms use IT to deliver value to their customers, to keep their current customers and gain new ones. Porter [1996] explains: “[A company] must deliver greater value to its customers or create comparable value at a lower cost, or do both.” Any differences in cost, price, or quality of products derive from the execution of business activities that make up the firm’s business processes. While these objectives are clearly desirable, implementing them can be a challenge. How should management combine reengineering or business process redesign with use of IT in a specific organizational culture? What are the cause and effect relationships? What actions must the firm’s management take to derive value from their IT and business process redesign efforts? And, how can they measure the results?

This study provides a comprehensive, detailed analysis of how strategic business use of information technology, in concert with business process redesign, can improve the economic performance of a large-scale manufacturing company, Compaq Computer Corporation. Compaq has relied on strategic use of enterprise-wide IT to enhance its competitive position. The company experienced rapid growth in the 1980s, gaining a well-deserved reputation for producing high

quality (and high cost) computers. In the 1990s, however, Compaq felt the effects of increasingly intense competition: it lost sales and market share. In 1992, its annual revenues dipped by more than \$300 million to \$1.5 billion while its operating costs continued to rise. Earnings per share dropped by over 70%. Compaq's management needed to respond—by developing a new business strategy that would allow the company to compete successfully while remaining financially strong. The success of any change in strategy would depend directly heavily on how wisely Compaq used information technology across, and into, the entire organization. These issues constitute the theme of this analysis. We focus on Compaq's use of IT along with the redesign of their business processes during the period 1992 to 1998.

USE OF PUBLICLY AVAILABLE DATA

Because this study is based only on publicly available data, the depth of what we can achieve is somewhat limited. Also, many of the press articles concerning Compaq are heavily influenced by Compaq's press releases and statements by Compaq executives. An advantage, however, is that we can be totally objective since we are neither constrained nor influenced by having obtained access to internal data and information.

THE COMPAQ TIMELINE

Figure 1 shows the highlights at Compaq Corporation during the 1990's. It is presented here for reference to allow readers to put the events discussed in this case in perspective.

ORGANIZATION OF PAPER

This analysis is organized as follows. The economics and competitiveness of the PC industry, and the role of information technology, are evaluated in Section II. In Section III, we concentrate on changes in Compaq's business strategy and its use of process reengineering and enterprise-wide information technology to implement strategic changes. Next, the impact of the strategy changes and use of IT on the economic performance of Compaq are evaluated

using a Balanced Scorecard causal and performance analysis [Kaplan and Norton, 1992 and 1996]. The final section summarizes our insights and conclusions.

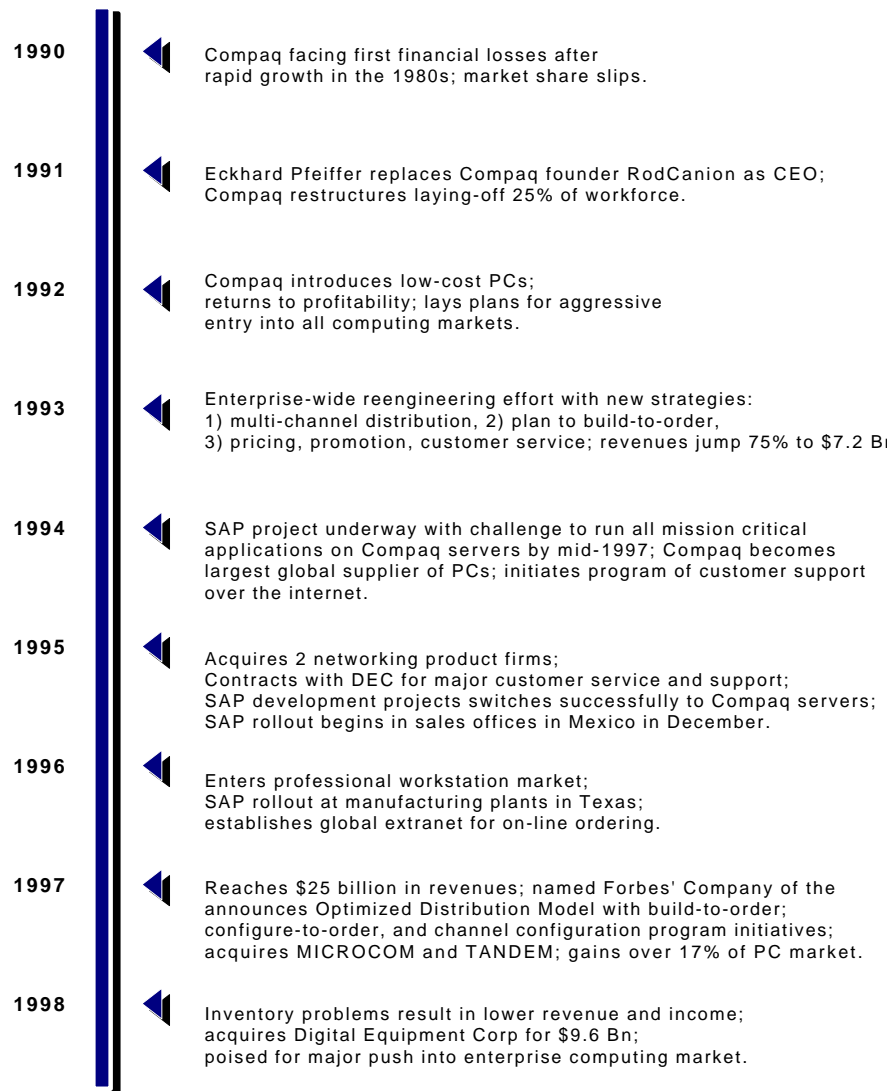


Figure 1: Compaq Computer Corporation Highlights In The 1990s

II. THE PERSONAL COMPUTER INDUSTRY: COMPETITION AND STRATEGIC USE OF IT

OVERVIEW

It is not an exaggeration to assert that rapid and relentless economic Darwinism has prevailed, and continues to prevail, in the PC industry. "Compaq participates in a highly volatile industry that is characterized by fierce industry-wide competition for market share. Industry participants confront aggressive pricing practices, continually changing customer demand patterns, growing competition from well-capitalized high technology and consumer electronics companies, and rapid technological development carried out in the midst of legal battles over intellectual property rights." This statement from Compaq's June 30, 1997 SEC 10Q report accurately describes the highly competitive conditions in the industry [Compaq, 1997b].

These competitive conditions and demands have taken their toll on a number of firms. Companies such as Apple Computer, AST Research and Packard Bell are fighting for survival. Others are leaving the market (e.g., Unisys Corporation) or have been acquired (e.g., Digital Equipment and Tandem Computer, both acquired by Compaq). And some have suffered substantial losses: Dell Computer lost \$36 million in 1994, IBM lost over \$8 billion in 1993, and both Gateway and Micron Electronics reported disappointing financial results in 1997.

Survival in the PC industry requires that firms continuously re-evaluate and improve their business processes, especially their value chains. ERP software, such as SAP AG's R/3, is used to implement changes in business processes. Leveraging this technology enables companies to restructure resources, gain efficiencies, improve market reach, and implement corporate strategies more effectively.

STRATEGIC INITIATIVES BY THE PC MANUFACTURERS

While Hewlett-Packard and IBM are formidable competitors for Compaq, they are large, highly diversified companies; therefore, they are not readily

comparable with Compaq. We will, therefore, contrast Compaq's operations and use of enterprise IT with Dell and Gateway. We note, however, that third quarter 1997 PC industry results indicate that Hewlett-Packard made substantial gains in the PC market, and IBM's inability to compete on price caused it to restructure its PC operations in late 1997.

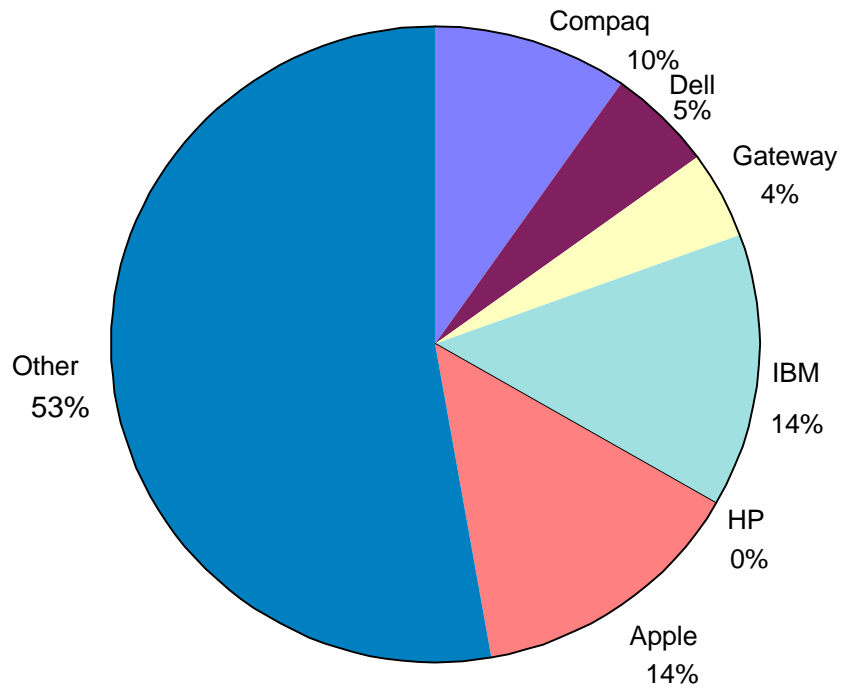
The continued growth and success of PC manufacturers depends on their ability to implement their strategic objectives in a changing market. In the last quarter of 1997, the overall market for PCs increased 15% over the same quarter in 1996. Compaq enjoyed a clear lead in PC market share in both the reseller (commercial) and the retail (consumer) channels. Figure 2 shows the distribution of U.S. market shares for the major PC manufacturers as of the end of 1993 and for the fourth quarter of 1997. Compaq had an 18% market share; Dell was number two with more than 10% of the market, and Gateway was number five with 8% of the market. All three recorded substantial increases in the number of units shipped during 1997. The data are based on various public sources that report findings obtained by International Data Corporation (IDC)

In Tables 1 and 2, we compare the performance during 1997 of Compaq, Dell, and Gateway. At the end of that year, Compaq was two to four times as large as the other two in annual revenues (and prior to its acquisition of Digital Equipment Corporation). From a return on equity (ROE) standpoint, however, Dell had a big lead. Although Dell carried no long-term debt to lever the common equity, it still produced a 76% ROE whereas Compaq's ROE was 23.6% and Gateway's 12.6%; Dell's management has created a formidable competitor.

What aspects of the corporate strategies are driving company performance? The direct marketing and build-to-order strategies employed by Dell and Gateway give them clear advantages in terms of reduced inventories. See Sidebar.

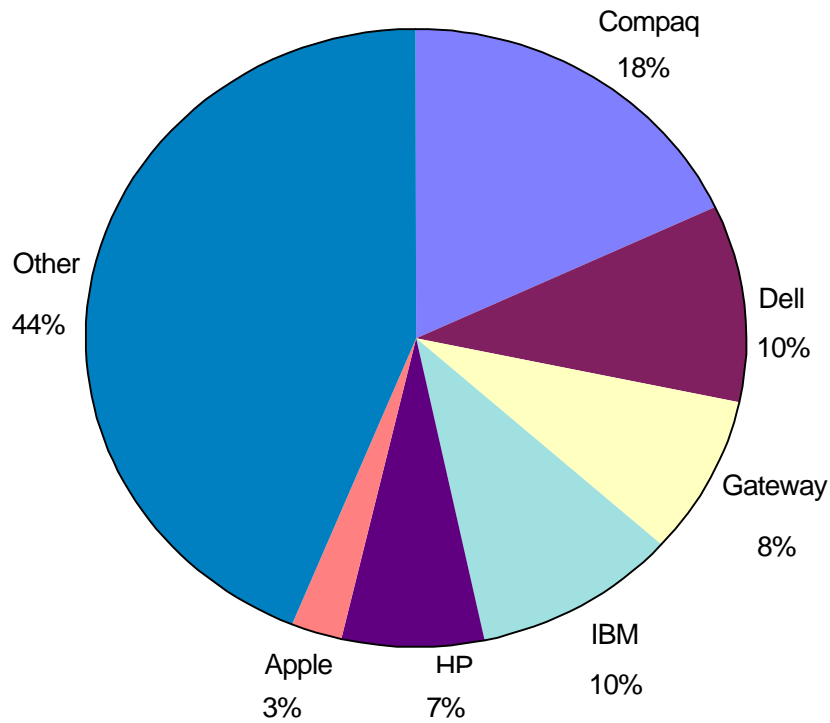
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U.S. PC MARKET SHARES



a. 1993

PC Market Share -



b. 1997

Figure 2. Relative Shares of the PC Market in 1993 and 1997

Table 1 Selected Financial Measures - Major PC Manufacturers

CATEGORY	COMPAQ	DELL	GATEWAY
Effectiveness			
• Market Share (U.S.)	16.6%	9.5%	7%
• Revenue	\$24.6B	\$12.3B	\$6.3B
• Units Sold (worldwide)	10.2 M	4.6 M	2.2 M
• Gross Margin	27.5%	22.1%	17.12%
• Net Margin	7.5%	7.7%	1.8%
• Net Income	\$1855M	\$944M	\$109.8M
• ROA	13.76%	26.03%	5.92%
• ROE	22.2%	90.0%	12.6%
• Market to book value	454%	2468%	551%
• % Revenue -International	45%	31%	16%
Efficiency			
• Operating Cycle Time	77 Days	44 Days	46 Days
• Current Ratio	2.31	1.45	1.54
• Inventory Turnover - annual	12.6 X	39.7 X	19.8 X

B=billion, M=million

Based on annual financial results for year ending 12/31/97 for Compaq and Gateway; 2/1/98 for Dell Computer [Source: Hoovers, 1998; Compaq 1998a and 1998b; Dell, 1998; Gateway, 1998].

Table 2. Comparative Enterprise Performance

	Compaq (1997 vs 1996 4th qtr)	Dell (1998 vs 1997 4th qtr)	Gateway (1997 vs 1996 4th qtr)
1. Effectiveness	Sales increased 23%.	Sales increased 55%.	Sales increased 27%.
	4 th quarter U.S. unit sales jumped 51%.	4 th quarter U.S. unit sales up 67%.	4 th quarter U.S. unit sales up 23%.
	Gross margin increased 85 basis points to 27.5%.	Gross margins held steady at 22%	Gross margins dropped to 3% from 18.9%.
	Net income increased 37%.	Net income increased 51%.	Net income increased 5%.
	Build to order strategy better matched market demands	Build to order strategy better matched market demands	Build up of high-end PC inventory in 3 rd qtr reflects inability to match market demands.
	ROE increased to 29.6%.	ROE increased 76%.	ROE rebounded to 42% after loss in 3 rd qtr.
1.1 Reach	Gained new customers - with under \$1000 computers, new business products, servers, notebook line.	New server and network products aimed at increasing corporate and government customers.	Announced new server products to reach corporate customers; opening retail stores.
	Still leads with 16.6% of U.S. PC market.	Improved market share to 9.5% of U.S. PC market.	Improved market share slightly to 7% of U.S. PC market.
	Uses 7000 partners in channel to reach customers around the world (extranet better integrates supply chain).	Sells direct w/o retail and reseller channel.	Sells direct but uses some resellers and has own stores at a few locations.
	Introduced Compaq On Line to expand market reach.	Web sales exceeding \$3 m per day.	Web sales at \$2 m per day; using channel to reach new business customers.
	Passed Toshiba to become number 1 in notebook sales.	Passed Compaq to be number 1 in sales to medium and small business.	Named number 1 in customer service by major journal.
1.2 Strategic Structure	Acquisitions of Microcom and Tandem enabled new capabilities.	Committed to direct sales model and "Dell-ocity" - short cycle times.	Acquisition of ALR enabled new server products.
	Outsourcing to improve asset utilization. (Close relationship with small group of responsive suppliers.	Announced reorganization to streamline processes.
2. Efficiency	Improved inventory turnover to 12.6 times from 8.8.	Improved inventory turnover to over 39 times from 18.	Rebounded after caught w/obsolescent inventory, turnover increased from 15 to 19.8 times.
	Reduced days sales in inventory from 60 to 30 days.	Only 8 days sales in inventory.	Now, only 15 days sales in inventory.
	Build to order strategy lowered costs.	Leader in build to order strategy.	
	Gross margin increased to 27.5% from 26.4%.	Gross margin increased to 22% from 21.7%.	Price pressures drove gross margin from 18.5% to 3%.
	Operating expenses declined to 12% of sales.	Operating expenses increased 2% to 9.9% of sales.	Operating expenses increased 1% to 10.9%; but down 25% from 3 rd qtr .
	Better utilization of manufacturing capacity by allocating 25% more run time to sub \$1,000 machines.		Build up in high end PC inventory with revenue growth below expectations reflect misallocation of manufacturing resources
	Smaller unit size allowed more units to be shipped per truck.		

[Sources: various - company financial statements, news articles, and press releases].

SIDEBAR: THE EFFECTS OF BUILD-TO-ORDER

Under a build-to-order (BTO) process model, the manufacturer begins to assemble computers only after an order has been placed. Using BTO, Dell averages less than 10 days to sell its inventory; its inventory turnover was over 39 times for its fiscal year ending February 1, 1998. Gateway averages 18 days to sell its inventory, and its inventory turnover was 19.8 times. Because Compaq uses the reseller channel to sell its products, it took over 30 days to sell its inventory with an inventory turnover of just over 12.6 times for the year ending December 31, 1997.

Dell's efficient BTO model gave Compaq a target for its manufacturing and distribution processes. Compaq had relied on "build-to-forecast," an inherently more efficient manufacturing process characterized by large production runs and low unit costs. In the PC industry, however, any unsold product has a very short shelf life. New products are introduced constantly and product lines often have only a life of a few months. Like others in the industry, Compaq had to deal with obsolete products in both its inventory and the inventory held by its retail dealers and resellers. Obsolescent inventory--with lowered prices--competed with new products. In addition, Compaq was faced with substantial product returns each time a new product was introduced. The extra handling and disposition was wasteful and costly.

Compaq

Compaq controls almost 12.5% of the global PC market by designing, manufacturing, and marketing a wide range of computer products, including desktop and portable computers, and network servers. From 1994 to 1997, Compaq averaged 33% growth in annual revenue and 51% growth in annual net income. This growth was accomplished by leveraging its strategic use of information technology. Also, Compaq increased its reach (product offerings) by

acquiring both Microcom Corporation and Tandem Computer in 1997. These acquisitions allowed Compaq to compete more aggressively with Dell Computer and Gateway. Its acquisition of Digital Equipment Corporation in 1998 should allow it to confront HP and IBM in the market for large-scale enterprise networks and service.

Compaq is the leader in the reseller channel with over 35% of unit sales. While Dell and Gateway enjoy significant sales to businesses, they were not major players in the reseller market in 1997 for two primary reasons:

- Dell and Gateway are direct retailers and, therefore, they do not typically use the reseller channel;
- Until 1995, Dell and Gateway focused on selling workstations and individual computers, rather than servers and completely bundled network hardware.

Compaq has also done well in the retail channel. Compaq leads there as well with over 25% of the market [Infobeats, 1998]. Intense price competition and other factors have caused several PC manufacturers to lose market share and then regain it in late 1997 as they brought out competitive models that sell for less than \$1000. For example, Packard Bell's share dropped from 29% of the retail market to 20% and then rebounded to over 25% with substantial gains in the under \$1000 segment. But both Acer's and Apple's share declined significantly because of their small share of the fast growing sub-\$1000 market [Computer Intelligence, 1997]. Dell and Gateway avoid the retail channel with their direct marketing strategy; they did not join the competition for desktops priced under \$1000. (However, Gateway began offering a limited selection of computers for under \$1000 in 1998). Their ability to price their products without a retailer markup, however, allowed them to market high performance (Pentium II™) systems for well under \$2000, and this contributed to their strength in the consumer marketplace.

Dell Computer

Dell continued its success in the commercial (business) marketplace in 1997, actually passing Compaq in sales in the second quarter of 1997. The world's leading direct marketer of computer systems, Dell's 1997 sales growth rate is double that of Compaq and Gateway (Table 2). Dell's ability to leverage information technology fueled its growth in an industry characterized by declining prices. Dell maintains lower costs by bypassing distributors and other resellers. Dell was the first to use a build-to-order (BTO) methodology to manufacture and distribute computers according to specific customer orders. They have focused their organization and their use of IT to implement their business strategy: to minimize inventories and more effectively manage their supply chain. In fact, Dell's newest factory converts customer orders into desktop PCs ready for delivery in an average of 8 hours [Goldstein, 1997].

Gateway

Gateway, the second largest direct marketer of computer systems, is also responding to competitiveness in the industry. In 1997, it acquired Advanced Logic Research (ALR) and announced its entry into the corporate network server market. At the same time, Gateway modified its distribution model to increase the use of channel resellers. It continues to sell most of products directly, but uses VARs when large corporate clients need specific services [Bliss and Rosa, 1997]. Gateway also announced expansion of its own chain of retail stores, Gateway Country, building on the success of its store in Great Britain [Ferguson, 1997].

BUSINESS STRATEGIES AND USE OF INFORMATION TECHNOLOGY

In the PC business, sagacious use of enterprise-level IT is essential to implement business strategies and be fully competitive. Moreover, Mata, Fuerst, and Barney [1995] suggest that managerial IT skills are likely to be the only source of sustained competitive advantage using information technology. They define managerial IT skills to "include management's ability to conceive of,

develop, and exploit IT applications to support and enhance other business functions” [Mata, Fuerst, and Barney, 1995, p. 499].

The following excerpt from Dell’s 1997 SEC 10K report, although addressing only the customer awareness aspect, highlights the importance of IT in implementing business strategies. Great emphasis is placed on customer service and understanding of market trends--and use of the enterprise software that provides the necessary information.

“Dell’s information systems enable the company to track each unit sold from the initial sales contacts, through the manufacturing process to post-sales service and support. Dell is able to track key information about many of its customers and target marketing activities specifically to particular types of customers by using its database to assess purchasing trends, advertising effectiveness and customer and product groupings. This database, unique to Dell’s direct model, allows the Company to gauge customer satisfaction issues and also provides the opportunity to test new propositions in the marketplace prior to product or service introductions” [Dell, 1997].

Gateway’s annual reports indicate a similar emphasis on tracking customer satisfaction and sales [Gateway, 1997]. Since Compaq has used, and continues to use, resellers as intermediaries, Compaq obtains customer-oriented information that is both less complete and less timely.

More generally, their uses of direct marketing and build-to-order strategies permit Dell and Gateway to enjoy strategic advantages over Compaq. The two companies are able to reduce the relative size of their inventories, obtain more direct and timely feedback from their customers, and, with comprehensive sales tracking systems, are able to obtain immediate information regarding changes in customer preferences. The continued growth and success of these PC manufacturers depends on their ability to improve and implement their strategic objectives in a changing market. Wise use of enterprise software is an essential tool. Compaq is now deploying enterprise software to obtain the information and logistical advantages enjoyed by its competitors.

III. COMPAQ: BUSINESS STRATEGY AND USE OF INFORMATION TECHNOLOGY

In Section II, we profiled the intense competition that prevails in the PC industry--and why effective use of IT is a competitive necessity. In this Section we investigate how Compaq's use of IT permitted the firm to change its corporate strategy, transform several critical business processes and compete more successfully.

COMPAQ IN 1997

In 1997, headlines in the business press extolled Compaq's accomplishments: "Compaq Announces Record Third Quarter Sales, Earnings, and EVA," "Compaq Scores with Cheaper PCs," "Dataquest, IDC Q3 figures put Compaq atop of PC sales heap," "Domination – Compaq and Dell surge" [NewsEdge, 1997; Wong, 1997; Kane, 1997]. At the same time, some of Compaq's competitors were not faring as well. For example, Micron Electronics, Inc. announced on November 24, 1997 that its quarterly earnings would be lower, Gateway reported a third quarter 1997 net loss of \$107 million, and Apple Computer was just returning to profitability. These different results are surprising since there appears to be little to distinguish one PC from another--each uses almost the same components often from the same vendors. The prices are similar; so is the performance of the products. Why, then, was Compaq doing well when many others were not?

COMPAQ'S HISTORY

Before we address that question, some understanding of Compaq's history may be helpful. Founded in 1983, Compaq presents a model for a growth company. In 1983, it reported first year sales of \$111 million. By 1984, Compaq had subsidiaries in Germany, France, and the United Kingdom. By 1985, its stock was trading on the New York Stock Exchange. Compaq reached \$1 billion annual sales by 1987. Compaq introduced the first business-class laptop computer in 1988 and a PC-based multiprocessor server in 1989. By 1990,

international sales exceeded North American sales. The Compaq Presario line of personal computers for the home was launched in 1993. Compaq became the largest global supplier of PCs in 1994 and the fifth largest computer company in the world in 1995 [Compaq, 1997a].

Growth in the 1980s, however, caught up with Compaq in the early 1990s. Compaq experienced its first quarterly loss in 1991; essentially, the company had outgrown its ability to manage its growth. In addition, responding to competitive pressures had become more difficult. More specifically, Compaq's information system lacked the process integration necessary to provide management with timely information. Its organizational structure was no longer applicable or efficient.

1993: COMPAQ CHANGES ITS BUSINESS STRATEGY

Compaq seemed to manifest the common problem that: "processes have not kept pace with the changes in technology, demographics, and business objectives" [Hammer, 1990]. When CEO (and Compaq founder) Rod Canion failed to develop a comprehensive plan to reengineer the corporation, the board of directors replaced Canion with Eckhard Pfeiffer. In 1993, based on Pfeiffer's new business strategy, Compaq began an enterprise-wide reengineering effort that encompassed changed business processes, a more effective organizational structure, and a comprehensive, integrated enterprise information system. The before and after process flows are shown in Figures 3 and 4.

Three major strategic objectives were emphasized:

- *Build-to-order manufacturing.* Before this objective could be fully implemented, however, Compaq needed to reengineer its processes to reduce cycle time (the time from receipt of an order until the products fulfilling that order are shipped) from two weeks to 5 days.
- *Multi-channel distribution.* Compaq planned to add additional sales channels, such as mass-market retailers, but the success of this

strategy hinged on not alienating the computer retailers and resellers with whom Compaq already had highly productive relationships.

- *Pricing, promotion, and customer service.* Compaq began implementing this initiative immediately by cutting prices an average of 30%, increasing advertising by 60%, offering on-site installation, extending warranties, and building remote diagnostic capability into its PCs [Planning Review, 1994].

1993-1997: COMPAQ'S REDESIGNED BUSINESS PROCESSES

Compaq's management identified three major business processes that were critical to its strategy implementation:

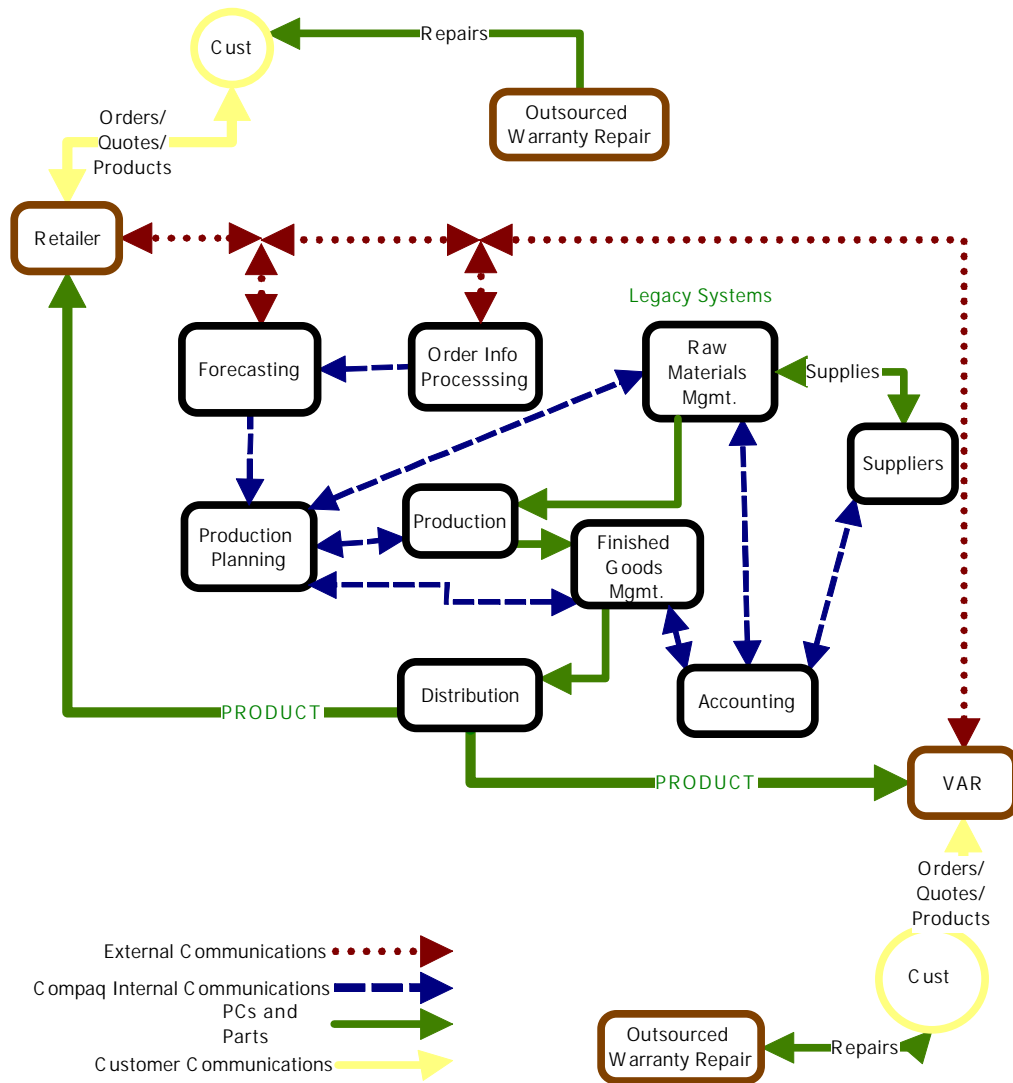
- 1) product design and development,
- 2) manufacturing and distribution, and
- 3) pricing.

These processes not only had to be improved; they had to be completely redesigned.

Product Design and Development Process

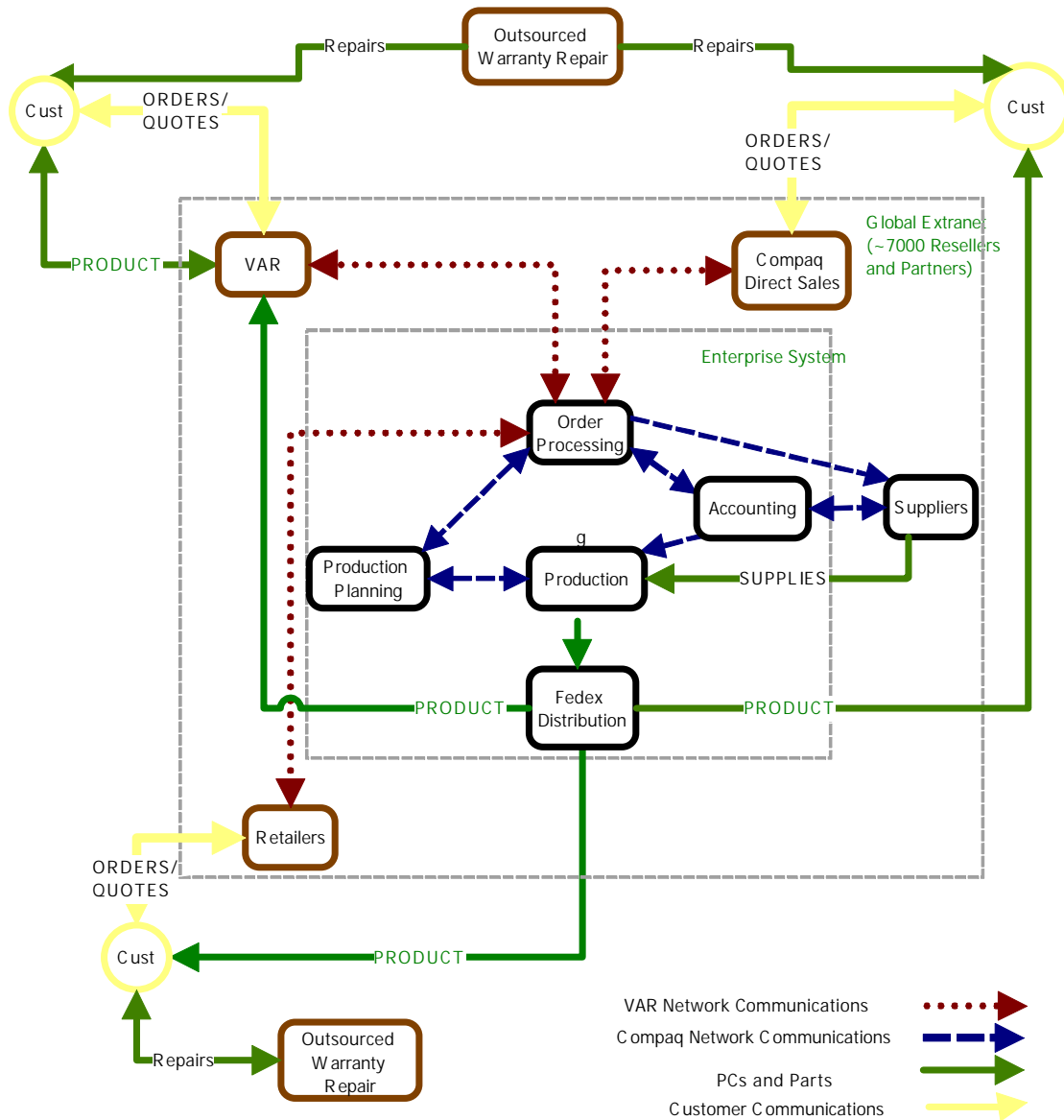
Compaq already excelled in product design and development. In 1993 it began to design products to specific price points--price targets that would position the company's products favorably in the market. In addition, its goal was to be, if not the first, among the first to market with products based on the latest technology.

Good business practice demanded a cross-functional process. Designers and engineers needed market information on both market requirements (e.g., interoperability of systems components, reducing cost of ownership, typical uses, and configuration preferences), and on competitors' innovations. Also needed were data from suppliers and manufacturing information to design-for-manufacturability. A "best practice" team approach dictated that the marketing



BUILD TO FORECAST	
Orders Entry (phone, fax, mail, web) VAR provides customer service	Production Larger batch sizes increase economies
Purchasing Greater Parts Inventory Demands	Configuration VAR configures PC More inventory required Greater chance of obsolescent inventory
Production Planning Easier to manage communications	Distribution Fewer, less frequent larger shipments Requires Finished Goods Inventory -4 Weeks Price Protection

Figure 3: Compaq's Build to Forecast System



BUILD TO ORDER

Orders (phone, fax, mail, web)
 Compaq receives order Direct+ or WWW
 Compaq provides customer services
 VAR receives order - Provides service

Purchasing - Goal: No Inventory
 Requires vertical integration of communications

Production Planning
 Requires extremely efficient supplier linkages
 Requires extremely efficient production processes

Production/Configuration - Goal no Inventory
 Smaller batch sizes diminish economies of scale
 Compaq or VAR configures PC for customer
 Goal no Inventory
 Far more demanding logistics and turnaround

Distribution
 Extremely frequent small/single item shipments

Figure 4. Compaq's Build to Order System

members of the team specify the product requirements and the manufacturing members set the production constraints.

Manufacturing and Distribution Processes

To compete with Dell, Compaq needed to improve its inventory management. Build-to-order should eliminate these problems by reducing inventory levels. Build-to-order, however, requires a much higher level of supply chain integration and management: Physical inventory must be replaced with information. Suppliers must know their delivery requirements almost as soon as Compaq does. If the flow of products were to be delayed, Compaq would not have the parts and subassemblies necessary to assemble complete PCs, and the build-to-order process would break down. Also, Compaq works with multiple suppliers and operates assembly plants around the world, placing further demands on management to balance supplier capabilities while keeping the manufacturing facilities operating smoothly and efficiently. In 1994 Compaq began developing a SAP-based total order planning system (TOPS) that could meet its global information requirements and allow it to convert to build-to-order (see Figures 3 and 4).

Pricing Process

Compaq's pricing objectives are ambitious: It wants to set the prices for the market. At the same time, it also wants to create value for its customers in ways that will differentiate its products. In this highly competitive industry, achieving these pricing goals requires detailed and timely sales information. The agile company that can adjust to changes in the volatile marketplace is the one that succeeds. In the retail channel, Compaq wanted sales information on a daily basis to price its products correctly without compromising its profit margins. In the reseller channel, Compaq needed more timely information about its end customers' requirements so that it could develop solutions that would add more value than competitors' products at a lower total cost of ownership.

One aspect of pricing is product quality, i.e., does the product meet all of the customer's requirements. Compaq's success in the major corporate market

hinges on its ability to deliver complete enterprise-wide solutions. Its customers typically seek to avoid dealing with multiple vendors, and they do not want to struggle to integrate potentially incompatible products. They want Compaq to provide complete solutions and then price the products appropriately. Consistent with these objectives, to add the necessary expertise and product lines, Compaq acquired both Microcom Corporation and Tandem Corporation in 1997 (and Digital Equipment Corporation in 1998). Also, Compaq formed alliances with major software vendors such as SAP AG, BAAN, PeopleSoft, and Microsoft.

1994-1996: COMPAQ RESTRUCTURES

Ultimately, the performance of any business process depends on the both the abilities and knowledge of the people that perform that process, their incentives and management's practices. Reengineering efforts align decision-making with operation of business processes. Consequently, management becomes both cross-functional and cross-process in scope, with decision making assigned to "put the decision point where the work is performed and build control into the process" [Hammer, 1990].

The success of any organizational change depends on the culture at the process level, the degree of centralization of common processes, and the nature of information sharing. Unless the organization is committed to operational excellence, there is little hope of achieving best in class performance [Porter, 1996]. Hammer's 1990 article advised companies to "organize around outcomes," and Compaq sought just that. In July 1996, Compaq announced a new organization consisting of three groups: [Frank, 1996]

- PC Products Group - desktop and mobile computing businesses, a new communications business, and products for the small to medium business market;
- Consumer Products Group - personal consumer market;
- Enterprise Computing Group - enterprise software solutions, especially customer use of SAP AG's R/3 software.

This new structure was designed to align the organization along its value chains and give Compaq's managers an integrated view of the company's critical business processes. At the same time, Compaq's alliances and acquisitions allowed it to increase the scope of its services, broaden its markets, and expand its level of expertise in the enterprise computing business. However, these structural changes also created greater demands for information sharing. Compaq's managers more than ever needed to communicate, collaborate, and coordinate their activities around the world.

1994-1997: COMPAQ'S NEW ENTERPRISE INFORMATION SYSTEM

Restructuring an organization around new business processes requires an enterprise information system that can capture and integrate information across the entire value chain. As an organization seeks to assign decision rights at the process level, the timeliness and accuracy of the decisions becomes dependent on access to necessary information. Therefore, successful implementation of Pfeiffer's strategy depended critically on the ability to deliver information in a timely, reliable, and usable manner. One recurrent theme among Compaq's process improvements was the role of information, integrated enterprise-wide, to support and measure process performance.

To obtain the required technology, Compaq tapped both its own resources and those of its major partners. Compaq became its own customer. The solutions that it was developing for its largest corporate customers were also applied within Compaq itself. First, Compaq committed early to use of its own servers and the Windows NT™ operating system software. Second, it further developed relationships with the major vendors of enterprise-wide information systems. To some degree Compaq's success in the business market depended on whether its servers running Windows NT™ could support enterprise-wide implementation of SAP R/3 and other systems; this was its opportunity to demonstrate that its products could provide a complete solution for its largest customers.

TOPS and Compaq On Line

During the period 1994 to 1997, Compaq designed and began implementing an enterprise-wide computing solution--the Total Order Planning System (TOPS)--based on SAP R/3 software and Compaq's own Windows NT-based ProLiant™ servers. The R/3 system implementation was a major effort, with at times over 100 concurrent users performing programming, configuration, and testing [Compaq, 1997c].

As a part of its enterprise system, Compaq was also building an extranet--Compaq On Line--to serve its distribution and reseller channel across 80 countries. Rolled out in 1996, On Line allows channel members to configure, price, and order products online. Compaq On Line's planned integration into TOPS was intended to create links spanning the entire value chain, from suppliers to customers, and to employees (see Figure 4). Sales force automation and electronic commerce engines will be provided. Figure 5 depicts our estimation of the information flows that these systems should achieve. Compaq eventually will be able to match orders with manufacturing and distribution in real time, allowing Compaq to adjust manufacturing plans and schedules every eight hours at plants in North and South America, and at distribution centers in Europe [Girishankar, 1997].

The extranet and SAP R/3 systems are critical to Compaq's achieving its build to order strategy (called the Optimized Distribution Model – see Sidebar) and thereby reducing production costs by up to 20%. “A customer in Paris could access Compaq On Line from a browser and indicate the company's requirements. Based on the geographic location and needs of the customer, that call will be automatically sent to the most appropriate dealer. The system will then automatically configure and price the customer's requests” [Girishankar, 1997]. Compaq expected over a million transactions per day over the extranet by the end of 1997. (We have been unable to confirm whether they reached this goal.)

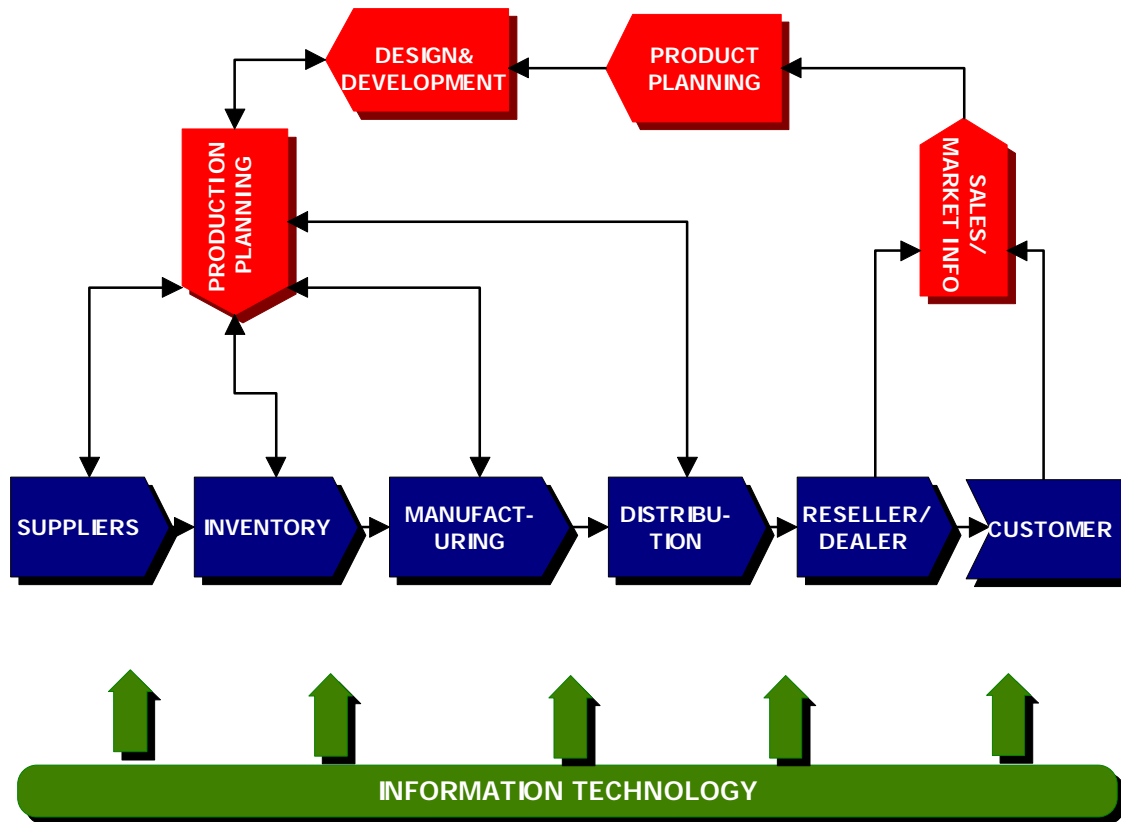


Figure 5: IT Impact on the Value Chain Role of the Extranet

SIDEBAR: COMPAQ'S OPTIMIZED DISTRIBUTION MODEL

Compaq announced its Optimized Distribution Model (ODM) in 1997 to be implemented in three phases. The initial phase of ODM is build-to-order (see sidebar 1), already implemented for its Deskpro line. The second phase is configure-to-order (CTO) where Compaq will configure products to customer specification and deliver to resellers (e.g., Radio Shack, CompUSA) to fulfill the order. The third phase is the Channel Configuration Program (CCP) where Compaq delivers configurable (partially assembled products) to resellers who will then customize those products to meet specific customer requirements.

Compaq also announced that it would certify resellers before those resellers would be authorized to participate in the CCP. With the ODM, Compaq plans to integrate business processes spanning the supply chain from suppliers to final customers [Cunningham and Scannell, 1997].

Expected Enterprise Wide Capabilities

Compaq's IT architecture is designed to gather information on worldwide demand and customer preferences, and respond accordingly (see Figure 6). This enterprise-wide system will allow it to:

1. Monitor supply and demand factors around the world on a daily basis, and better understand customer requirements. Compaq's senior management sees--in real time--a global representation of the market and can respond promptly to market changes.
2. Implement the Optimized Distribution Model to reduce inventory levels and improve productivity: "We can shift resources rapidly to respond to changes anywhere in the world, making our planning process much more agile" [Compaq, 1997c].
3. Automatically make necessary foreign currency translations and provide the necessary currency information to reduce risk.
4. Make Compaq employees more aware of their roles and responsibilities--and how their actions affect others. For example, the marketing people can share information with members of the design and manufacturing team, resulting in products that are more consistent with customer preferences. Compaq will then be able to respond rapidly to any competitive pressures [Compaq, 1997c].
5. Share information across its supply chain. A leaner, more focused organization is created given the electronic commerce capabilities, improved inventory management, and automated processes such as the "configurator" applications that allow customers to configure, price, and order systems (see Figure 6). By sharing information electronically with suppliers, Compaq can effectively outsource many of its component assembly processes. These changes have already resulted in a steady increase in Compaq's sales per employee [Girishankar, 1997].

Compaq began implementing its SAP R/3 system in 1995. The R/3 rollout began with sales offices in Mexico, then Europe, and finally the U.S. The manufacturing modules of R/3 were scheduled for implementation in an opposite sequence. The implementation began at plants in Texas in 1996, and full implementation was scheduled to occur in 1998 [Girishankar, 1997]. (We have been unable to confirm that implementation has been completed as scheduled.)

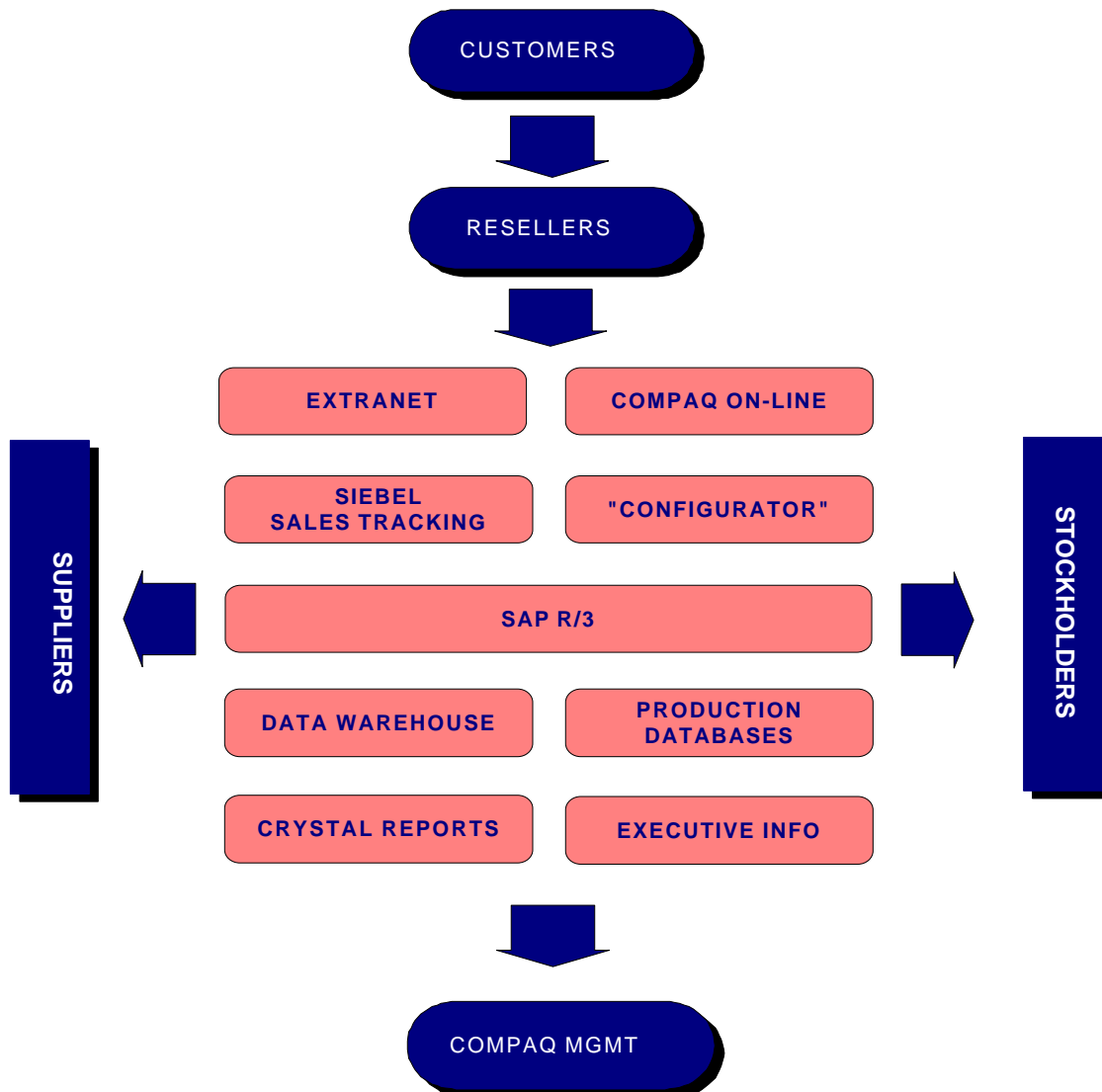


Figure 6 Compaq's Information System Relationships

1997: IT Initiatives

In October 1997, Compaq announced new IT initiatives aimed at its goal of being first in customer satisfaction. The firm enhanced its Compaq On Line system to form a new Internet-based system called COLinqPlus (Compaq On Line Linq). This tool allows resellers and retailers to order and track parts movement electronically in real-time. It eliminates paperwork requirements for processes like warranty labor reimbursements and saves time. At the same time, Compaq announced an automated “My Voice” on-line customer satisfaction tracking systems. This system collects customer responses after service calls to measure satisfaction and evaluate the level of service provided [Compaq, 1997d].

IV. A BALANCED SCORECARD ANALYSIS OF COMPAQ’S PERFORMANCE AND USE OF IT

OVERVIEW

In Section III we described Compaq’s new business strategy and the technology-enabled changes Compaq made, and is continuing to make, to its business processes. But how do we *measure* the payoff from its investment in information technology? The literature suggests that the payoff from IT should be evaluated in terms of the business objectives that it supports. For example, Mooney, Gurbaxani, and Kraemer [1995] recommend measuring IT value against its support for intermediate process goals that form a firm’s overall strategy; Brynjolfsson and Hitt [1997] indicate that “[t]echnology must be aligned with the core competencies of the company to deliver true value.” We adopt this perspective. We address the impact of improvements in both the efficiency and effectiveness of the affected business processes. Most important, we consider not only past results but also implied future benefits.

FINANCIAL ACCOUNTING MEASURES OF ENTERPRISE PERFORMANCE

Executive management needs performance measurements that indicate the extent to which the company is achieving its strategic objectives. While they

are used extensively, traditional financial accounting measurements do not reveal adequately the benefits of investing in information technologies. Financial accounting measurements do inform management of historical outcomes but do not indicate why those results were achieved or what management must do to improve future results. Excessive reliance on financial accounting performance measurements is inadequate at best, and can be very misleading, due to the following limitations:

1. Financial accounting provides very little indication of why results were (or were not) achieved or how to improve the firm's strategy;
2. Only ill-defined linkages are revealed between the effectiveness and/or efficiency of business processes and financial results;
3. Long-term assets are reported at historical cost, which may be unrelated to current value;
4. Management treats economic events subjectively by selecting among feasible accounting methods.

A BALANCED SCORECARD VIEW OF EVALUATING ENTERPRISE PERFORMANCE

Kaplan and Norton [1992 and 1996] developed the Balanced Scorecard (BSC) to link a firm's strategic objectives to performance measurements. BSC theory:

1. Suggests measurements that guide a firm towards its strategic objectives.
2. Integrates measures of the causal determinants of financial outcomes.
3. Concentrates on operation of business processes to permit more accurate capture of the benefits that result from investments in information technology.

The BSC aligns business process measurements with a firm's strategic objectives. Cause and effect linkages are identified from the execution of daily activities to eventual results. Consistent with this theme, performance measurements are considered from four perspectives (Figure 7):

1. *Learning and growth for the organization and its members.* The focus is on the firm's employees, their skills, satisfaction, motivation, innovation and productivity. These attributes precondition process improvements, customer satisfaction, and ultimately financial success;
2. *Operation of internal business processes.* The focus is on optimizing costs, quality, throughput, and time attributes of each process;
3. *Satisfaction of customers.* The focus is on customer satisfaction and the resulting changes in market share, new customer acquisition, customer retention, and customer profitability;
4. *Financial results.* Based on the above three perspectives, the focus is on outcome measures of revenue growth, cost reduction, and asset utilization. Clearly, innovative new products that are accepted enthusiastically by the market and are produced efficiently will result in superior financial performance.

The first three perspectives yield sets of performance measurements that are directly implied by the firm's strategic objectives. However, corporate stakeholders ultimately want to see results in a language they understand-- financial results.

Both financial and non-financial performance measurements are essential in a BSC analysis. Measurements are also identified as being either leading or lagging indicators. Leading measurements motivate future action to improve the firm's business processes. The leading indicators are linked to future results; in contrast, the lagging measurements represent the firm's *effectiveness* in achieving its objectives. Since the lagging measurements document past results, they may also be studied to achieve more efficient use of the firm's resources.

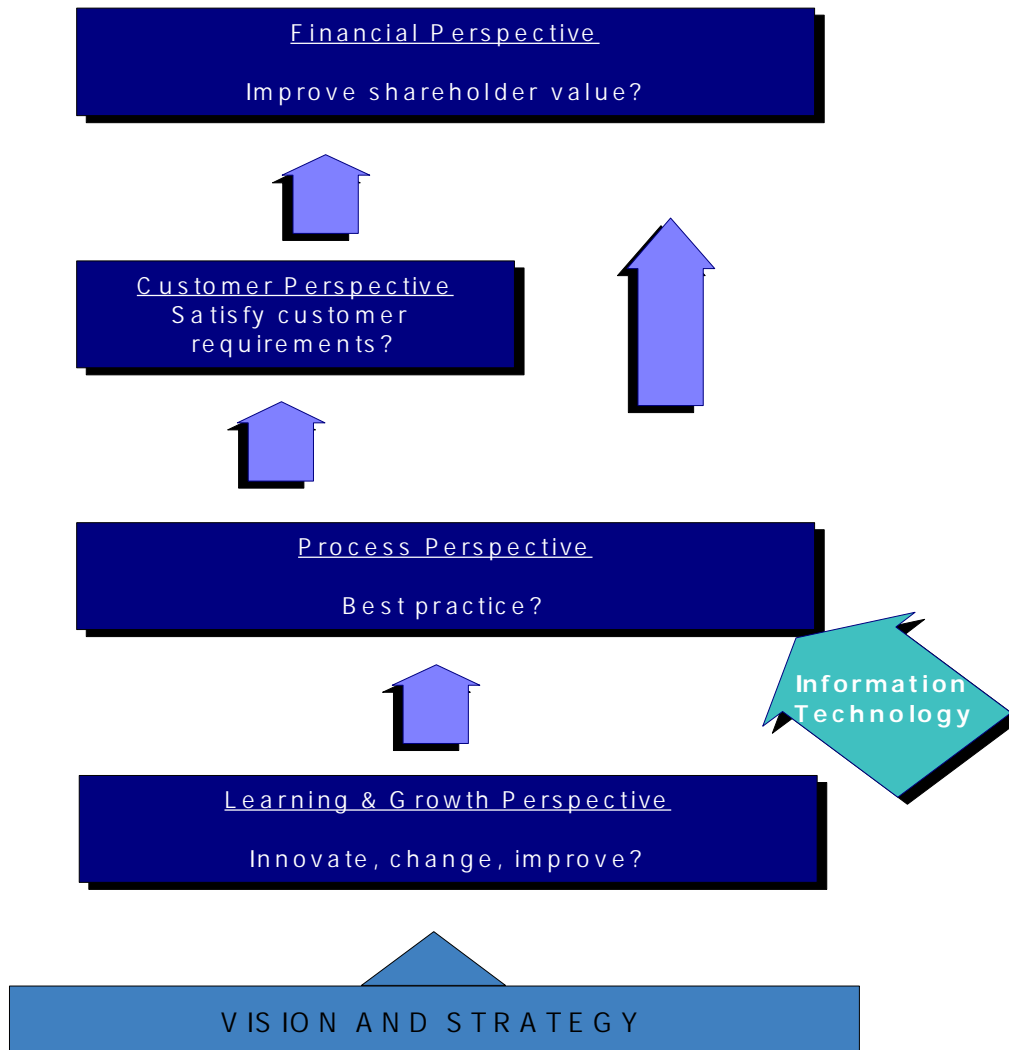


Figure 7 Balanced Scorecard Representation of Causes and Effects

The BSC analysis also facilitates understanding of the economic impact of IT investments. The BSC's emphasis on the performance of business processes (Figure 8) permits the impact of IT investments to be direct. The impact of IT induced improvements will eventually be manifested in measures of customer satisfaction and financial performance. More generally, strategic business initiatives may require IT innovations (such as use of ERP software) to be feasible.

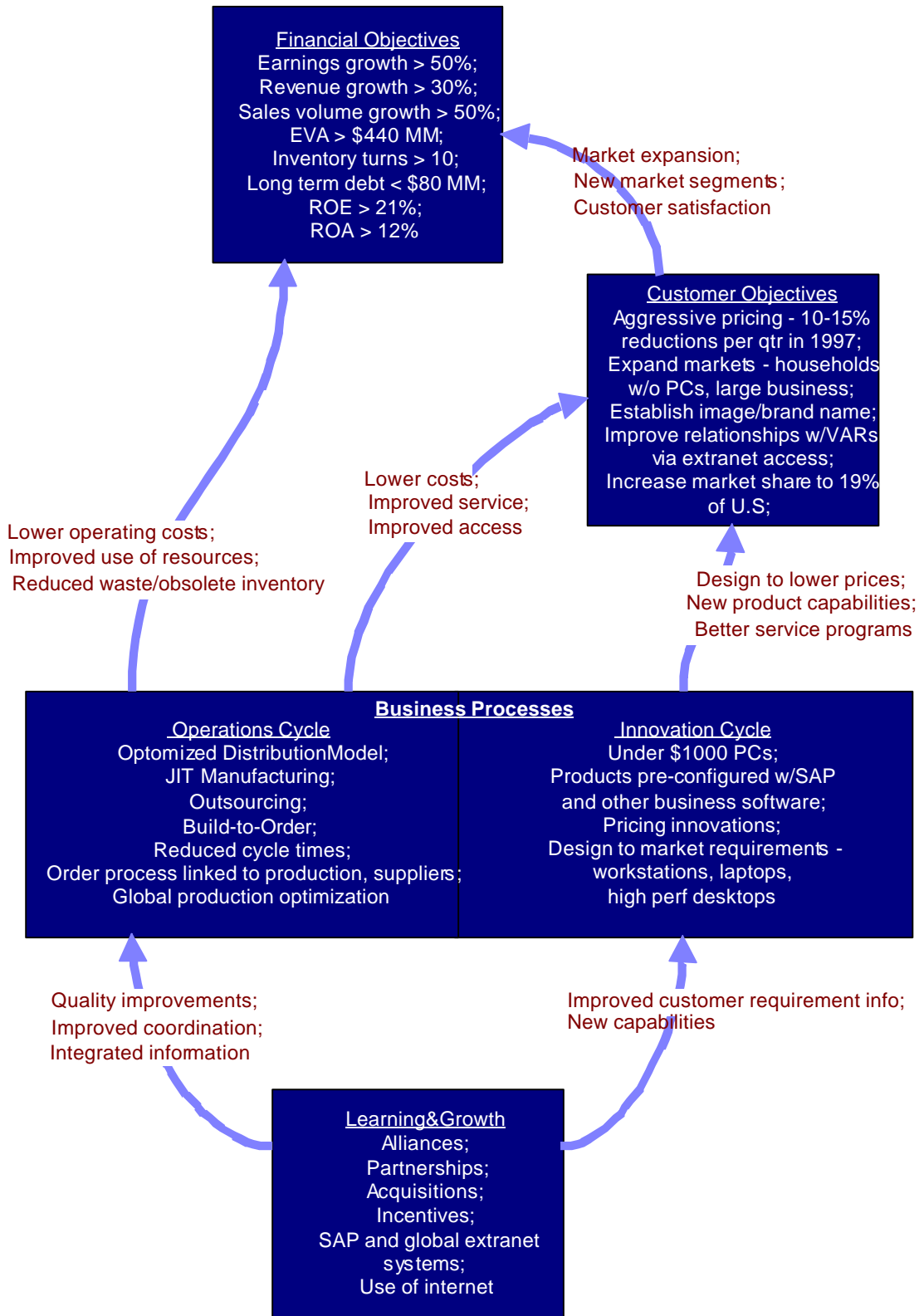


Figure 8 Compaq's Balanced Scorecard Objectives

1997 Performance Results: Financial Outcome Measures

Tables 1 and 2 in Section II measured Compaq's performance compared to that of Dell and Gateway. The results depict the success of Compaq's changed business strategy and the benefits achieved from its use of enterprise-wide IT.

From 1992 to 1997, Compaq's net sales rose from \$4 billion to over \$24 billion. The firm sustained a revenue growth rate of over 31% over 60 months [Hoovers, 1998]. Annual net income increased from \$213 million to over \$1.8 billion over the same period, while inventory turnover almost doubled (Figures 9, 10, and 11).

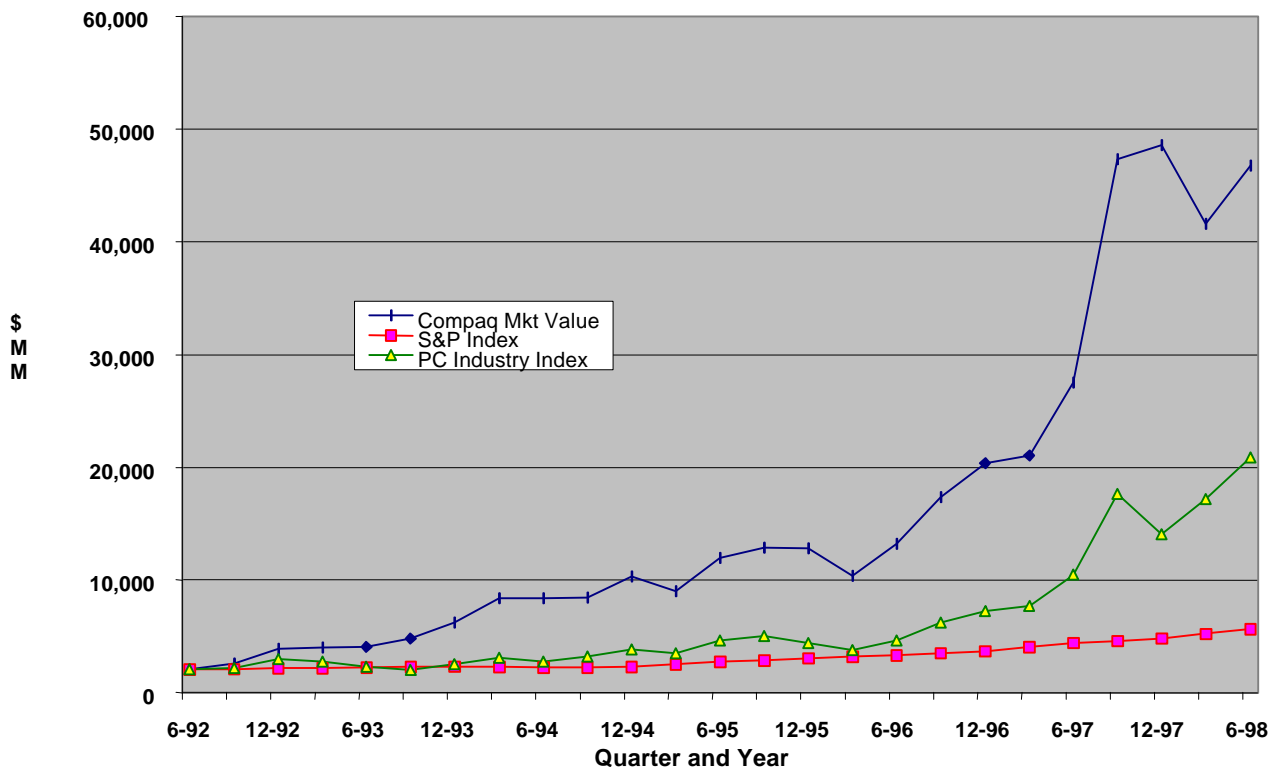


Figure 9 Compaq Financial Indicators 1992-1998;
Market Value, S&P, and PC industry Indexes
(Source: CSI Inc., via Microsoft Investor)

Compaq Financial Performance and (not including 1998 2nd qtr)

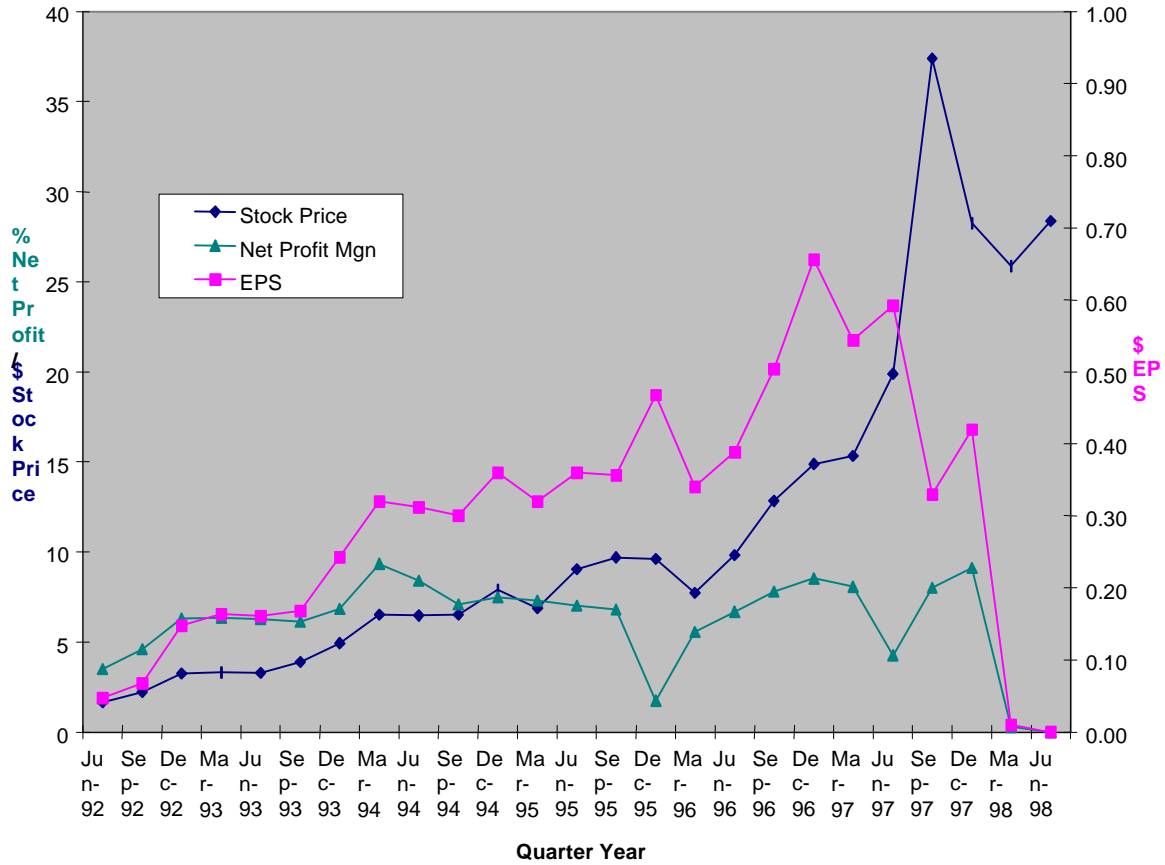


Figure 10. Compaq Financial Highlights 1992-1998

COMPAQ COMPUTER COMPANY
Financial Performance Indicators

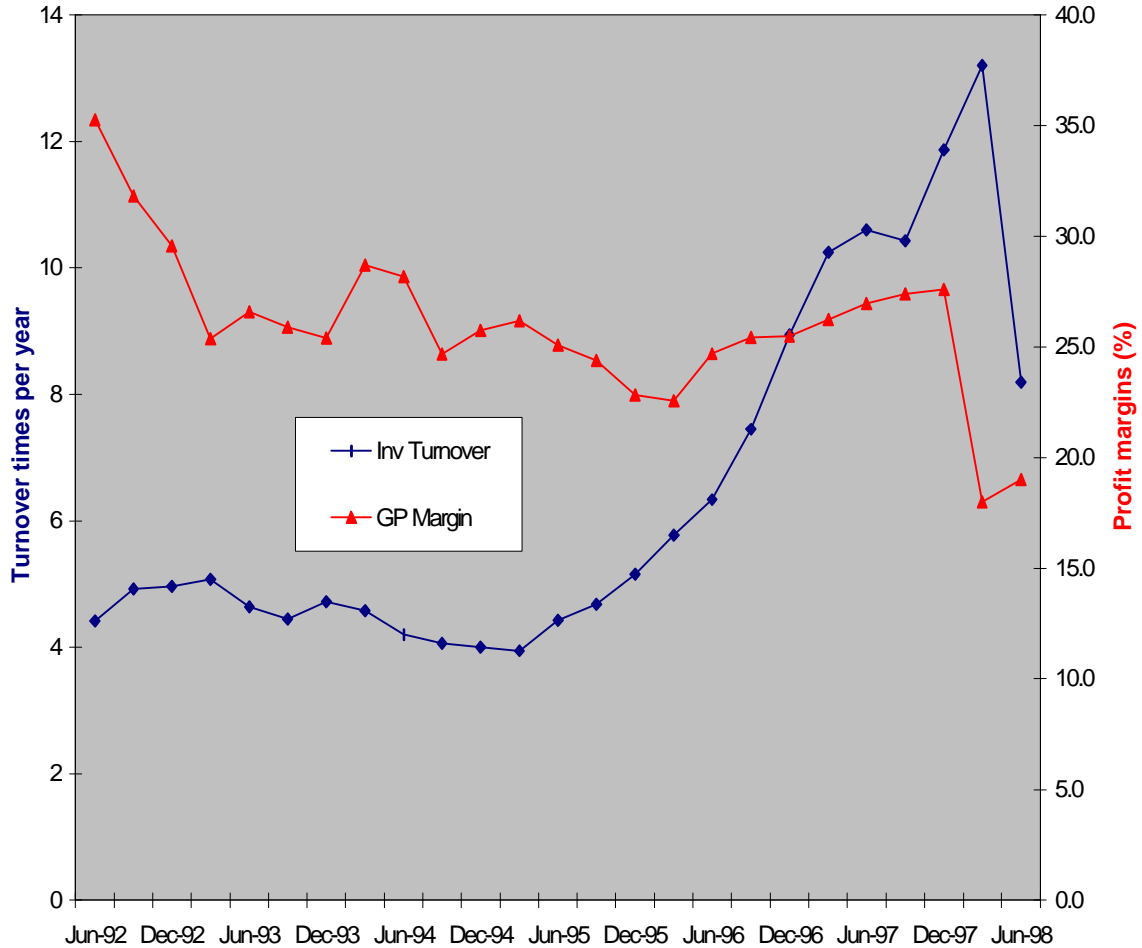


Figure 11. Compaq Inventory Turnover 1992-1998

During the fourth quarter of fiscal 1997, Compaq’s unit sales jumped 52% versus fourth quarter 1996 [Waurzyniak,1998]. Over the same time period, Compaq’s gross profit margin edged up to 27.6%, and inventory turnover increased from 7.1 to 12.6 times. Compaq’s cash balance improved to \$6.8 billion (up \$3.8 billion in the nine months since the end of fiscal 1996), and the Economic Value Added (EVA) grew by over 150%. The \$300 million long-term

debt balance at the end of fiscal 1996 was eliminated early in 1997; Compaq was essentially free of long-term debt [Compaq, 1998a].

All of these results occurred in a competitive environment where prices for PC products were decreasing as fast as 15% per quarter. Consistent with one of its strategic objectives, Compaq itself drove some of the price reductions, yet it was able to maintain one of the highest gross profit margins in the industry. Compaq's use of IT to improve its processes and implement its strategic objectives contributed to its economic success in a very competitive market.

Kaplan and Norton [1996] argue for a comprehensive approach to business strategy. Firms should choose the market and customer segments the business unit intends to serve, identify critical business processes that must deliver value to those customers, and select the individual and organizational capabilities that are required to meet these objectives. Using this approach, we examine the cause and effect relationships that drive Compaq's performance, as presented in Figure 8.

Customer Objectives

Ultimately, a company must deliver value to its customers. Kaplan and Norton describe value as a function of product attributes (e.g., functionality, quality, price, and timeliness), company image, and customer relationships. Compaq tries to deliver value through its pricing, promotion, and customer service initiatives to increase market share. As was shown in Figure 1, Compaq steadily improved its market share from 9.3% of the U.S. market in 1993 to 18.1% in the fourth quarter of 1997 [Waurzyniak, 1998].

Market share provides one important measure of customer satisfaction; it reflects marketplace acceptance of the price and performance of Compaq's products. It also clearly indicates the effect of the effort that Compaq made to create a positive image and develop relationships with its customers. Hanspeter Eiselt, Compaq senior business manager for desktop PCs, described the company's high ranking in the 1996 annual VARBusiness Magazine Report Card: "In the past year, Compaq made a conscious effort to work and

communicate with its reseller community - an effort that paid off in first-place scores for both support and partnership” [Jordan, 1996]. While the firm continues to excel at product quality and functionality, Compaq slipped in the 1997 VARBusiness Magazine Report Card, in terms of product availability and profit potential for value added resellers (VARs) [Melymuka, 1997].

Compaq competes in a dynamic marketplace. Customers’ requirements change. Relationships can be short-lived. Therefore, retaining a customer can be difficult. Compaq is betting that it can create and sustain value by expanding its product lines and increasing its service capabilities, combining the resources of Compaq, Tandem, and Digital to “deliver the best computing solutions and innovative products and technologies, all backed by global services and support” [Compaq, 1998c].

Business Process Objectives

As shown in Figure 8, Kaplan and Norton describe two process cycles that span the gap between identifying and satisfying customer needs. First, during the first innovation cycle, products are designed and developed. Then, during the operations cycle, products are made, marketed, and serviced. The performance of these two cycles creates value for the customer and for the business itself. Suitable use of information technology can profoundly improve these cycles.

Innovation Cycle

The causal links between the innovation cycle and customer value are shown in Figure 8. According to Kaplan and Norton [1996], “[t]he innovation process, the long wave, of value creation, is for many companies a more powerful driver of future financial performance than the short-term operating cycle.” For Compaq, the innovation cycle is focused on speed. “Compaq thrives on speed--speedy revenue growth, speedy market share gains, speed in entering new business, speed in manufacturing” [Kirkpatrick and Curry, 1996]. John Rose of Compaq summed it up: “The environment is changing, and you’d better be innovative--not just in your products but in every part of your business” [Kirkpatrick and Curry, 1996].

Compaq's product innovation focuses on specific market objectives and price points, reducing time to market, and designing products to match customer requirements while considering component availability. A recent example is the under-\$1000 PC. Compaq was first to offer significant PC performance at that price. Compaq's PCs quickly captured almost 40% of the under-\$1000 retail market in 1997, attracting buyers that had previously been unable to afford PCs [Zlotnikov, 1997]. Most importantly, Compaq was able to design and develop this product at a price point that allowed them to maintain their gross profit margin.

Compaq's reengineering efforts reduced the time-to-market of its new products. These new products emphasize enhanced functionality, or price advantages, which in turn improve customer satisfaction and product image [Jordan, 1996].

Operations Cycle

For Compaq, the operations cycle encompasses sourcing parts and components, manufacturing, configuring, marketing, distributing, and servicing products after the sale. The operations cycle has been a major focus of Compaq's reengineering efforts since 1994, when CEO Pfeiffer stated, "Reengineering of the business process is our No. 1 priority. The reorganization brings us a higher level of customer focus" [Damore and Gillooly, 1994]. The reengineering projects included expansion of the company's distribution center, the implementation of a new inventory tracking system and an overhaul of the company's information management system.

Compaq's ongoing reengineering efforts continue to emphasize process efficiency. At the end of 1995, Vice President of Compaq's North American Operations Ross Cooley said, "I've been asked what worries me at night; one thing is our ability to reengineer Compaq for the size it is today and will be tomorrow. And the reengineering effort is a long effort. It requires changing our business processes first and then our information systems to support the new business process" [Farre, 1996]. In 1997, CEO Pfeiffer announced the Optimized Distribution Model (ODM) (see Sidebar). He also described the objectives for

any cost savings that would result: “All those cost savings will not end up on the bottom line. They will flow back into our prices being more competitive, pushing our market share...to get the inefficiency out and refunnel the money into those things that really create success and customer satisfaction” [Farre, 1997].

Compaq relied heavily on enterprise-level information technology to achieve reengineering gains. It pushed the envelope on emerging technologies. Its own IT system includes 15,000 nodes with 2,000 servers in more than 30 countries. Originally running UNIX-based systems, Compaq committed to the use of Windows NT before it was fully proven in such an environment [Gillooly and Thyfault, 1994].

By 1997, Compaq was using SAP R/3 software to integrate its business processes and sales information while it completed its systems implementation schedule. It was building a global extranet (Compaq On Line) to provide customers with “configurator” applications to automatically configure and order PCs and servers [Girishankar, 1997]. In mid-1997, Compaq opened its Internet shopping service, allowing customers to order Compaq products directly from Compaq’s At Home website [Kanellos, 1997]. These innovations allow Compaq to achieve process efficiencies, including the following:

- * Linking orders electronically with production and suppliers, improving cycle time; facilitating just-in-time manufacturing, and making production status information available so that customers can track their own orders;
- * Sharing information with suppliers allows them to anticipate changes in Compaq’s demand and improve their efficiency, thereby reducing costs of supplies and improving on-time delivery;
- * Exchanging information on parts and component availability with suppliers allows products to be configured with the most economical and readily available components, reducing costs and improving cycle time;

- * Integrating orders with SAP's financial management and production planning modules, reducing time and cost of orders processing for both Compaq, its resellers, and its other customers;
- * Capturing customer information after a sale to provide individualized service as well as additional marketing based on information about the specific products and configurations ordered by each customer.

These process efficiencies would not have been possible without the large investment in information technology made by Compaq. In addition to creating the systems, Compaq's employees must take on the daunting task of learning the new systems and continually improving them over time.

Learning and Growth Objectives

A company cannot innovate or operate well without creating long-term learning and growth. Organizational learning and growth come from three principal sources: people, systems, and organizational procedures. We have already outlined how Compaq's systems and procedures provide information about business processes, customers, and the competitive environment. Compaq's people must then have the requisite skills and incentives to accomplish its business strategy.

Compaq always relied on its "virtual organization" for the capabilities that it lacked to develop innovative products and deliver superior customer service. Compaq has a "partnership-integrated model" of business [Kirpatrick and Curry 1996]. Because its research and development budget is relatively limited, it uses partnerships and alliances with other industry leaders for mutual benefit. Compaq's Bob Stearns expressed the importance of these relationships: "Our partnerships are part of our research and development budget" [Kirpatrick and Curry 1996].

Compaq, for example, uses alliances with value-added resellers to extend its own capabilities to meet customer requirements and obtain information on customer needs and preferences. For example, large business customers are accustomed to the kind of handholding for which IBM is famous. The VARs provide this capability for Compaq, so “Compaq gets to play in the big-iron business without incurring the costs of running its own services and software business” [McWilliams, 1996].

Partnerships allow Compaq to focus on its core competencies. For example, Compaq management determined that product warranty repairs and service is not a core competency, so it contracted with Digital Equipment as its worldwide service provider [Farre, 1996]. Partnerships also open new markets and create synergistic demand for both partners’ products: for example, the partnership with Siebel Corporation, where Siebel promotes Compaq products and vice versa.¹ Compaq’s extranet and electronic commerce systems are designed to achieve efficient exchange of information to and from its partners. Well before the extranet, Compaq was an early user of Lotus Notes™, placing Notes servers in large customer sites to exchange business and technical information [Gillooley and Thyfault, 1994].

Where capabilities are particularly important to its strategic objectives, making partnerships less desirable, Compaq used its financial strength to acquire them. These acquisitions gave Compaq the expertise in networking and transaction-intensive systems needed for the large business market.

A PERFORMANCE MODEL OF COMPAQ

We described Compaq’s performance prior to 1998 based on the four BSC perspectives and their linkage with Compaq’s strategic goals. In this section, we show how performance along one dimension drives performance along other dimensions.

¹ The Siebel/Compaq partnership includes testing of Siebel software to ensure that it operates properly on Compaq hardware; Siebel then recommends that its customers use Compaq products to ensure proper operation of the software; in return, Compaq preloads the software on machines and promotes Siebel to its customers.

In Section III, we described Compaq's growth strategy, which emphasizes build-to-order manufacturing, multi-channel distribution, and pricing, promotion, and customer service. To achieve growth, any company needs to keep current customers and acquire new ones--it must create customer satisfaction. Compaq focused on the drivers of customer satisfaction:

- price,
- brand image, and
- service.

Price

Compaq determined that the most important driver of customer satisfaction was price. Reductions in prices should be accompanied by reductions in costs. Compaq reduced its costs by achieving process efficiency. As described above, Compaq has been engaged in a series of process reengineering efforts since 1993 that reduced cycle times, increased inventory turnover, and reduced the cost of raw materials. These efficiencies allowed Compaq to reduce prices as much as 15% per quarter during 1997, thereby driving customer satisfaction.

Brand Image

In addition to its aggressive advertising and promotional programs, Compaq reinforced its brand image by improving the functionality of its products and scope of its product line. This is where the innovation cycle and the speed with which Compaq innovates are most important. By reengineering its product innovation processes, Compaq was able to reduce time to market and enhance product functionality while designing products that were less costly to manufacture. Product innovation allowed them to meet changing customer requirements and drives customer satisfaction.

Service

Compaq uses its multi-channel distribution model to increase customer service. Its VAR network allows it to provide the specialized level of customer service that major business customers expect. But, its VARs are also its customers. Therefore, it implemented information systems that make it easier for them to do business with Compaq, for example on line ordering via the extranet (Compaq CoLing). Compaq serves its resellers so they can provide a higher level of customer service and again drive customer satisfaction.

Achieving these process level improvements to enhance customer satisfaction requires organizational learning and growth. Compaq's management had to become even more knowledgeable about customer requirements. It constantly monitored and improved its processes to keep costs down. Its enterprise-wide systems feed Compaq's management with information that should allow them to make better decisions and improve process performance, which in turn drive customer satisfaction.

To meet its growth objective, used process improvements (which are in turn driven by enhanced learning) to achieve more revenue dollars, higher net income, and a greater return on investment for its stockholders. Figure 12 provides an example of how initiatives along one balanced scorecard perspective drive performance at the next, ultimately creating increased customer satisfaction and increased market growth.

COMPAQ FALTERS IN 1998

In 1997, Compaq's financial performance was the best in its history. Their strategy was highly successful, as indicated by their results along all the Balanced Scorecard perspectives. In 1998, however, Compaq's financial performance suffered. During the first six months of 1998, they lost over \$3 billion. Excluding the \$3.6 billion charges attributable to the merger with Digital Equipment Corporation, their net income was barely positive. Revenues grew less than 5% over the same period in 1997. Industry analysts blamed Compaq's problems on its return to the old practice of "channel stuffing" (selling inventory to

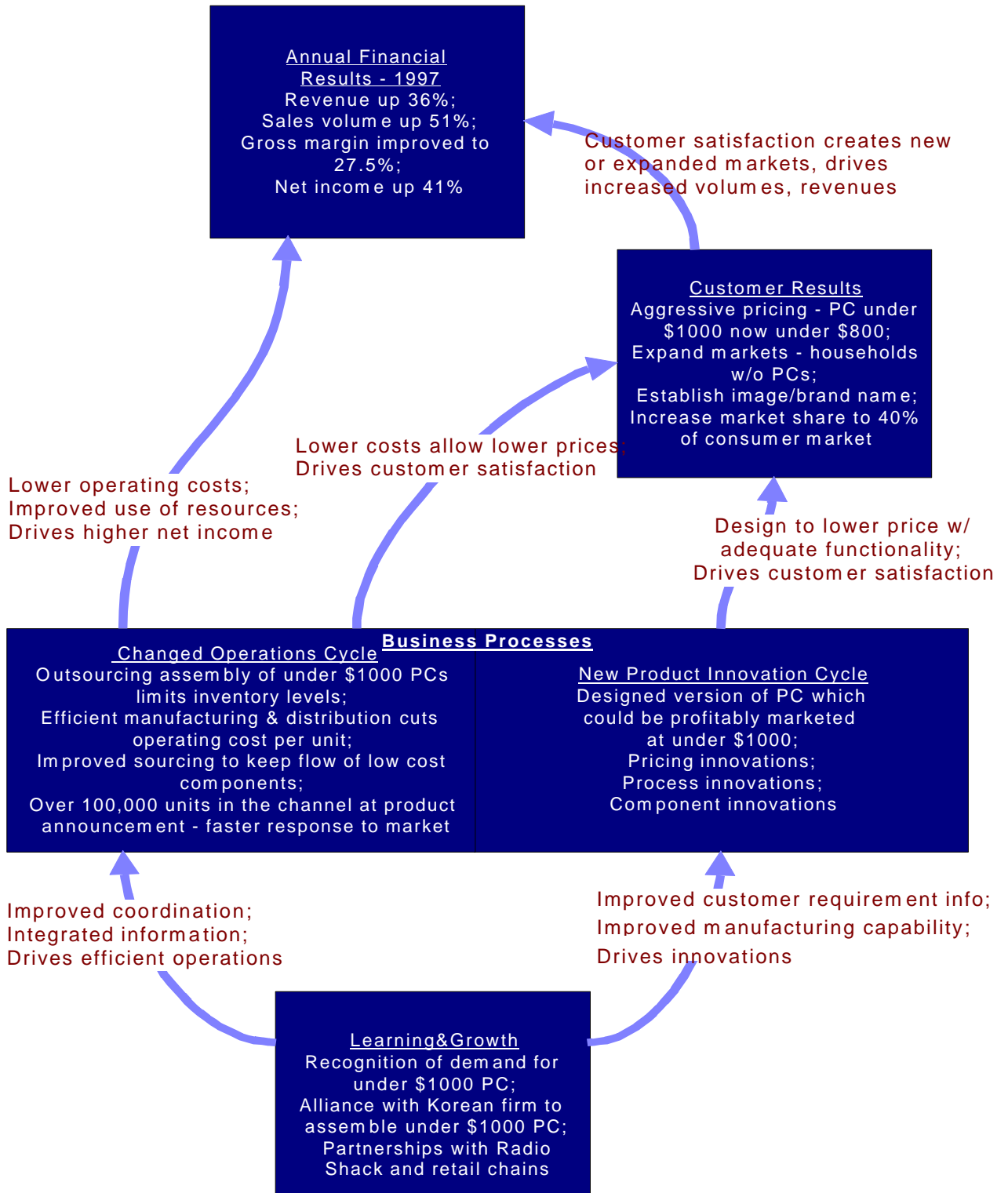


Figure 12. Compaq's 1997 Performance Based on the Balanced Scorecard

channel partners in excess of anticipated end user sales), while intense competition in the industry was driving prices down and sales were slowing.

Just as the Balanced Scorecard presented a performance model for Compaq in 1997, it also provides insights into Compaq's misfortunes during 1998. The four Balanced Scorecard perspectives provide a causal model that allows us to understand some of the complex reasons for Compaq's rapid performance decline in 1998.

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Compaq's performance began to suffer as Compaq pursued the acquisition of Digital Equipment Corporation. The DEC acquisition was much larger and more complicated than Compaq's earlier acquisitions of Tandem and Microcom. Compaq's and DEC's product lines overlapped significantly. There were legal and regulatory issues. There were financial and organizational issues. Addressing these myriad issues competed for management attention at all levels in Compaq.

Although the DEC acquisition gave Compaq the service infrastructure that it needed to compete in the enterprise computing market, overall learning and growth suffered as Compaq's workforce contemplated the impact of the merger. As many as 20,000 workers might be laid-off [Wilcox, 1998]. Some of those layoffs would be within Compaq. Reorganization and planning for the combined company took precedence over improving the old company. Information systems had to be redesigned. Coordination at all levels became more complicated. Formal networks to support the operation of the company were in some measure supplanted by informal networks addressing merger issues.

The consolidation of facilities and business processes was more important than process innovation in the short run. Compaq could not focus on faster cycle times and lower inventory levels until it decided which products it would keep,

which facilities would remain, and how separate workforces would be combined. Compaq failed to follow its own plans for implementing the Optimized Distribution Model. Full conversion to build-to-order was delayed. At the same time, Compaq's growth objectives pushed it to overestimate sales volumes and deliver excess levels of inventory to its channel partners in late 1997. The competition for management attention may have limited its ability to monitor sales and balance inventory levels. Or, the desire to meet growth objectives unduly influenced its actions. In either case, the result was disastrous. Instead of the targeted level of two weeks inventory in the channel, there was five to six weeks inventory in the channel in early 1998.

Compaq was forced to take drastic action to eliminate excess inventory before the products became obsolete. They cut prices and began aggressive marketing campaigns. They shut down assembly lines for two weeks. While these efforts were successful in reducing inventory, they disrupted internal business processes, delaying new product introductions, and actually causing some shortages. Compaq couldn't bring out the latest Pentium II machines without adversely affecting the value of their products in inventory, so Compaq lost ground to companies using build-to-order production. In 1997, Compaq said its goal was to increase inventory turnover to 30 times by the end of 1998, but after the first six months of 1998, inventory turnover dropped to 10 times per year.

Compaq's customers began to worry. They worried that the merger would reduce competition and lead to higher prices. The DEC customers wondered whether their products would be supported or phased out. DEC had been known for innovation in the industry, and there was substantial question whether Compaq would continue that level of research and development. The VARs were upset about high inventory levels, slow implementation of channel assembly programs, and potential competition from Compaq's new service organization [Wilcox, 1998]. In general, customers were concerned about the effect that the merger and its attendant changes would have on them. Compaq's market share dropped to 14.4% of the U.S. market, while Dell's jumped 72% to also record

14.4% of the market in the 2nd quarter. Worldwide, however, Compaq remained the clear leader [Kane, 1998].

In March 1998, Compaq announced that it would accelerate implementation of the ODM and aggressively reduce inventories. By April 1998, those levels were down over \$300 million from 4th quarter of 1997. By July, channel inventory levels had dropped to 3.5 weeks [Compaq, 1998d]. The cost of that success, however, was significant. The price reductions and production cutbacks drove gross profit margins below 20%, down over 8% from 1997. Compaq barely broke even in the 1st quarter, earning only \$16 million versus net income of \$414 million in the 1st quarter of 1997. By the end of the 2nd quarter, Compaq's management claimed that this setback was now behind them. Earl Mason, Compaq's Chief Financial Officer stated that "we are now moving aggressively to achieve targeted levels of performance and growth" [Compaq, 1998d]. Wall Street is not convinced. Analysts predicted that 3rd quarter results will not show much improvement, although earnings were expected to jump up to \$0.36 per share in the 4th quarter. That would bring 1998 earnings per share to about \$.045 (excluding special charges), a far cry from the \$1.17 achieved in 1997 [Jubak, 1998]. Table 3 compares Compaq's 1998 financial results for the first six months with those of Dell and Gateway.

Compaq's performance model in 1998 looks much different than the model for 1997. Figure 13 presents a Balanced Scorecard view of Compaq's performance in 1998. Competition for management attention and the problems of merging two large companies seemed to disrupt performance along every dimension. To return to the performance of 1997, the scorecard indicates that Compaq must rebuild its infrastructure, reestablish high levels of learning and growth, refocus its processes and make new innovations, and win back customers.

Table 3 Selected 1998 (6 months) Financial Measures- Major PC Manufacturers

<u>Category</u>	<u>COMPAQ</u>	<u>DELL</u>	<u>GATEWAY</u>
Effectiveness			
• Market Share (U.S.)	14.4%	14.4%	7.7%
• Revenue	\$11.519B	\$8.251B	\$6.294B
• Units Sold	5.2 M	3.2 M	1.4 M
• Gross Margin	18.5%	22.5%	20.01%
• Net Margin	< 0%	7.9%	4.1%
• Net Income	-\$3616M	\$651M	\$136.6M
• ROA	< 0%	23.4%	12.0%
• ROE	< 0%	81%	24.7%
• Market to book value	235%	1267%	322%
• % Revenue – International	45%	31%	16%
Efficiency			
• Operating Cycle Time	na	na	na
• Current Ratio	1.40	1.62	1.62
• Inventory Turnover (annual rate)	9.6 X	44.4 X	34.6 X

B = billion; M = million; na = not available.

Based on annual financial results for 6 months ending 6/30/98 for Compaq and Gateway; 8/2/98 for Dell Computer [Hoovers, 1998; Lemos, 1998; Compaq, 1998e].

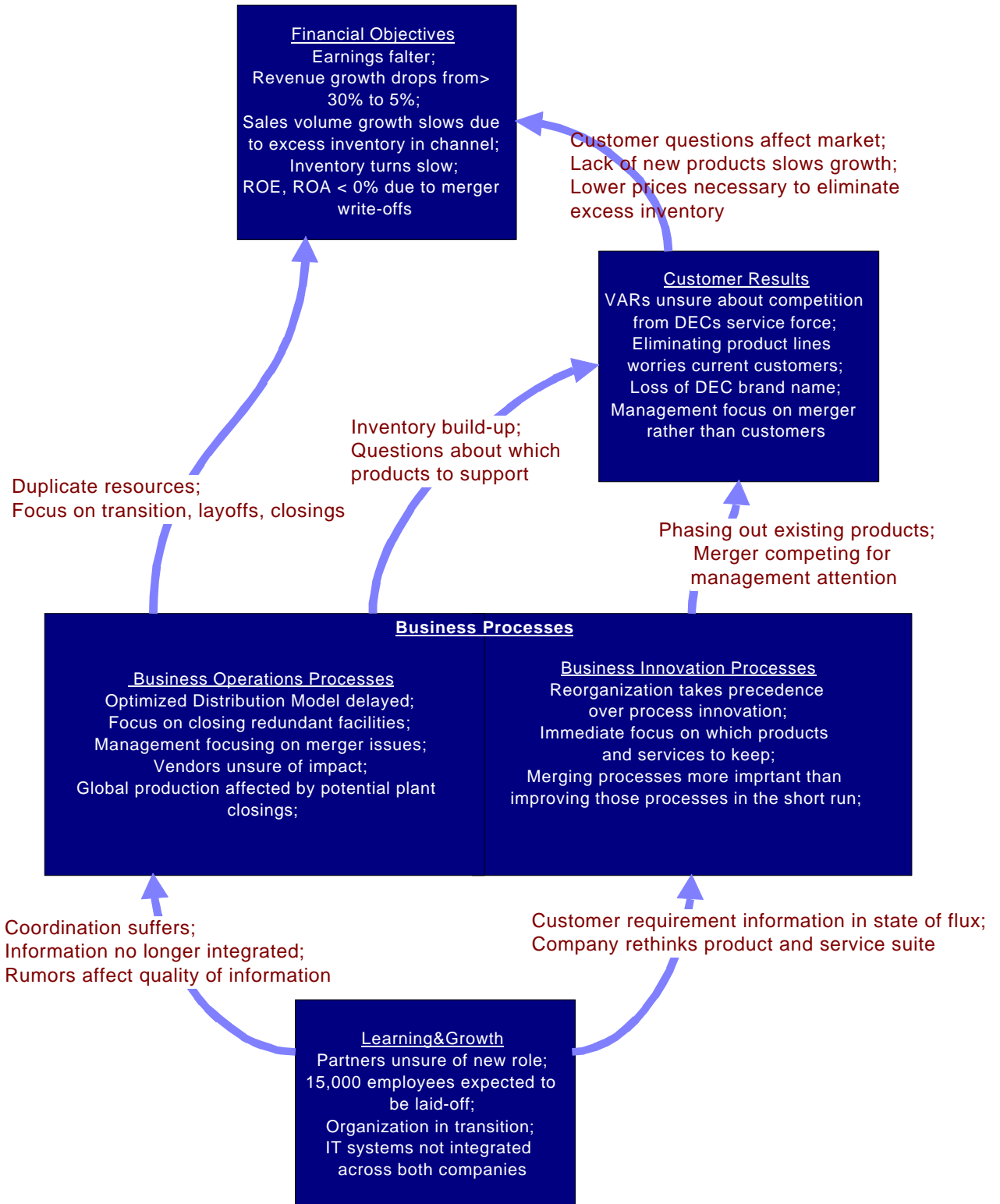


Figure 13 Compaq's 1998 Performance Based on the Balanced Scorecard

V. SUMMARY AND CONCLUSIONS

Better information drives learning and growth and enables more efficient business processes. Better information is necessary if Compaq is to understand and meet its customers constantly changing requirements. Compaq's managers and employees, suppliers, and VARs need enterprise-wide access to that information to coordinate their activities across the value chain and continuously improve company business processes.

The causal linkage among the various Balanced Scorecard perspectives drives the resulting financial measures and market share results. Compaq's improved sales volumes in 1997 resulted from delivering value, increasing customer service, innovating new products, and reducing time-to-market. The growing sales volume more than offset decreasing prices to generate higher revenue. Improved cycle times and decreasing costs enabled Compaq to operate more efficiently in 1997, which resulted in higher net income levels and higher revenue per employee.

As Kaplan and Norton [1996, p. 24] noted, "Financial measures are inadequate for guiding and evaluating organizations' trajectories through competitive environments. They are lagging indicators that fail to capture much of the value that has been created or destroyed by managers' actions". Therefore, we have also emphasized leading indicators, such as pricing innovations, strategic partnerships, and process reengineering efforts, to assess the contribution of information technology to Compaq's economic success.

It is not enough to excel at one aspect of business; successful companies, like Compaq, use IT as an integral part of all aspects of their businesses to gain and sustain a competitive advantage. Our Balanced Scorecard analysis of Compaq indicates that, rather than a single factor, it is the well-managed combination of factors, facilitated by access to--and prudent use--of information, that leads to good performance. For example:

- Business strategy - a clearly defined and communicated business strategy is important. There is a difference, however, between strategy

formulation and strategy implementation. We noted how Compaq formed its strategies, and how it immediately also identified the processes that were necessary to achieve its strategic objectives. It also used these strategies as a basis for prioritizing IT investments.

- Process efficiency - a number of firms succeeded with reengineering or total quality management efforts. However, even Michael Hammer admitted that less than one-third of reengineering efforts succeeds [Slavin, 1994]. Compaq has reengineered several times in a successful search for greater efficiency and/or effectiveness.
- Information technology - many firms implement ERP systems, as is indicated by the impressive growth of ERP vendors such as SAP AG, Peoplesoft, and Baan. Often firms use such comprehensive software applications as a means to achieve reengineering, but the success of the IT investment is then inextricably linked to the success of the reengineering effort. If either the system implementation or the reengineering fails--both of which are risky--firms face the large write-offs such as Gateway reported in 1997.
- Alliances - alliances provide the leverage for firms to extend their own resources to achieve growth and reduce costs. Compaq leveraged its relationships with Intel and Microsoft to establish strong footholds in both the consumer and corporate market. It worked with its resellers to leverage its sales and support resources. In addition, as it grew, it used its size to obtain favorable prices and to ensure availability of components. To manage these important relationships along its value chain, Compaq used IT extensively – the Compaq On Line Linq extranet and the Total Order Planning System are two prominent examples.
- Skilled and motivated workforce - it is obviously the workforce--from the CEO down--which determines how well a firm innovates and

operates. Compaq's culture rewards both innovation and efficiency [Kirkpatrick and Curry, 1996; Nee, 1998].

Thus, a synergistic combination of factors has driven Compaq's success. Processes create innovative products and address customer requirements. Process efficiencies allow lower product prices and improve the return on resources applied. Of course, the better customer requirements are met, the greater the customer satisfaction and the larger the market share. But, the "bottom line" is a firm's profitability. All the other actions must be taken with that long-term financial result in mind. During the period 1992 to 1997, Compaq focused on bottom line results, but it also understood the performance drivers of those results. In 1998 Compaq was facing the challenge of merging two large companies, combining their resources, and linking IT systems. The question remains whether the new Compaq can achieve the same level of performance along all the balanced scorecard perspectives.

During 1997, Compaq CEO Eckhard Pfeiffer announced an ambitious goal of achieving annual revenues of \$40 billion by the year 2000 from \$18.1 billion in 1996 [McGarvey, 1997]. In September 1997, he revised the goal upward 25% to \$50 billion annual revenues by the year 2000 [Schwartz and Briody, 1997]. Compaq's goal is to become one of the three largest, passing NEC and Hewlett-Packard to challenge IBM and Fujitsu [Compaq, 1996]. To accomplish his goal, Pfeiffer must turn Compaq into more than a PC manufacturer. The acquisition of Digital Equipment Corporation is designed to make Compaq a full service information technology company able to deliver complete solutions to the largest companies [Zuckerman, 1997]. Compaq's success, however, will be determined by its use of information and information technology to improve its products and processes to sustain a competitive advantage.

Jim Manzi [1992], former CEO of Lotus Development, could have been describing Compaq when he said, "the key to productivity lies not in the computers themselves but in how they are used. "Use," in this instance, refers to how information technology fits into the overall structure of the organization and how it helps achieve organizational goals. The potential of information technology

is realized only when that technology is integrated into the strategic vision of the organization and when it is used to redefine job structures, processes and lines of authority.”

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REFERENCES

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Bliss, Jeff and Jerry Rosa. (1997) “Waitt Weighs In On Channel and Corporate Battle Plans”, *Computer Reseller News*, issue 757 October 6.

Brynjolfsson, Erik, and Lorin Hitt. (1997) “Information Technology and Organizational Design: Some Evidence from Micro Data”, MIT working paper, October

Compaq Computer Corporation. (1996) *1995 Annual Report*, Compaq Computer Corporation, Houston, TX.

Compaq Computer Corporation. (1997a) *1996 Annual Report*, Compaq Computer Corporation, Houston, TX.

Compaq Computer Corporation. (1997b) *SEC 10K Report*, Compaq Computer Corporation, Houston, TX.

Compaq Computer Corporation. (1997c) "Compaq/SAP Partnership", <http://www.compaq.com/products/servers/partners/sap/>.

Compaq Computer Corporation. (1997d) "Compaq North American Services Furthers Goal of Being No. 1 in Customer Satisfaction", Compaq Computer Corporation Press Release, June 10

Compaq Computer Corporation. (1998a) *1997 Annual Report*, Compaq Computer Corporation, Houston, TX.

Compaq Computer Corporation. (1998b) *SEC 10K Report*, Compaq Computer Corporation, Houston, TX.

Compaq Computer Corporation. (1998c) "Compaq CEO Pfeiffer Unveils Company Strategy". Compaq Computer Corporation Press Release, June 12.

Compaq Computer Corporation. (1998d) "Compaq Reports Second Quarter Results", Compaq Computer Corporation Press Release July 15.

Compaq Computer Corporation. (1998e) "Compaq Outpaces Industry Growth", Compaq Computer Corporation Press Release. July 27

Computer Intelligence. (1997) "Sales of Sub-\$1000 PCs Help Compaq Become No. 1 in Retail", Computer Intelligence, <http://www.compint.com/news/>. November 17.

Cunningham, Cara and Ed Scannell. (1997) "Compaq Executive Brass Tout New, Three-Phase Distribution Model", *InfoWorld Electric*, July 10.

Damore, Kelley and Brian Gillooly. (1994) "Compaq Reorganizes U.S. Operations", *Computer Reseller News*, March 21.

Davenport, Thomas H. (1997) *Information Ecology*, Oxford University Press, New York.

Dell Computer Corporation. (1997) "SEC 10K Report", Dell Computer Corporation, Round Rock, TX.

Dell Computer Corporation. (1998) "SEC 10K Report", Dell Computer Corporation, Round Rock, TX.

Farre, Tom. (1996) "Compaq Pushes Beyond the PC", *VARBusiness Magazine*, issue 1201, January 1

Farre, Tom. (1997) "Compaq Reengineers Again", *VARBusiness Magazine*, issue 1308, May 15

Frank, Diane. (1996) "Compaq Reorganizes, Senior VP Stimac Resigns", *InfoWorld Electric*, July 8. <http://www.infoworld.com>.

Ferguson, Kevin. (1997) "Gateway: Everything's Not So Black And White" *Computer Retail Week*, issue 183, September 22

Gateway Computer Corporation. (1997) "SEC 10K Report", Gateway Computer Corporation, North Sioux City, SD.

Gateway Computer Corporation. (1998) "SEC 10K Report", Gateway Computer Corporation, North Sioux City, SD.

Gillooly, Caryn and Mary E. Thyfault. (1994) "Practicing What They Preach", *InformationWeek*, October 10. <http://www.informationweek.com>.

Girishankar, Saroja. (1997) "Compaq Builds Global Transaction System", *CommunicationsWeek*, August 1. <http://www.communicationsweek.com>.

Goldstein, Alan. (1997) "Dell Computer Founder Looks for Ways to Stay Ahead of Pack", *Dallas Morning News*, September 2.

Hammer, Michael. (1990) "Reengineering Work: Don't Automate, Obliterate." *Harvard Business Review*, Jul/Aug, 68(4), pp. 104-112.

Hammer, Michael and James Champy. (1993) "Explosive Thinking", *Computerworld*, May 3, v27, n18, pp. 123-125.

Hoovers. (1998) "Hoovers Online", Hoovers, <http://www.hoovers.com>.

Infobeads. (1998) "The Sub \$1000 PC Market Meets Its Match". *Computer Intelligence*, <http://www.ci.infobeads.com/InfoBeads/>.

Jordan, Peter. (1996) "Compaq Reengineers Itself Into Top Desktop Vendor", *VARBusiness Magazine*, issue 1217, October 15

Jubak, Jim. (1998) "Dell vs. Compaq", *Jubak's Journal, Microsoft Investor*, August 25. <http://investor.msn.com/prospect/articles/jubak>.

Kane, Margaret. (1997) "Domination – Compaq and Dell Surge", *ZDNN* October 27. <http://www.zdnet.comn/zdnn>.

Kane, Margaret. (1998) "Inventory Woes Don't Slow PC Growth", *PCWeek Online*, April 27. <http://www.zdnet.com/pcweek>.

Kanellos, Michael. (1997) "Compaq Tests Web Sales Waters", *CNET*, October 16. <http://www.cnet.com>.

Kirkpatrick, David and Sheree R. Curry. (1996) "Fast Times at Compaq", *Fortune Magazine*, April 1.

Kaplan, Robert S. and David P. Norton. (1992) "The Balanced Scorecard – Measures That Drive Performance", *Harvard Business Review*, Jan/Feb, pp. 71-79.

Kaplan, Robert S., and David P. Norton. (1996) *The Balanced Scorecard*, Harvard Business School Press, Boston, MA.

Lemos, Bob. (1998) "Compaq Clear No.1 In Q2", *ZDNN*, July 26. <http://www.zdnet.comn/zdnn>.

Manzi, Jim. (1992) "Productivity: Faith Isn't Enough", *Computerworld* May 4, v26, n18, p. 29.

Mata, F.J., W.L. Fuerst, and J.B. Barney. (1995) "Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis", *MIS Quarterly*, 19, 4, December, pp. 487-505.

McGarvey, Joe. (1997) "Compaq Thinks Big", *ZDNN Interactive Week*, July 9. <http://www.zdnet.com/zdnn/content/inwk/>.

McWilliams, Gary. (1996) "Compaq at the Crossroads", *Business Week*, July 22.

Melymuka, Kathleen. (1997) "Hewlett-Packard Wins And Digital Falls To Back Of The Pack", *VARBusiness Magazine*, October 15.

Mooney, J.G., V. Gurbaxani, and K. Kraemer. (1995) "A Process Oriented Framework for Assessing the Business Value of IT". *Proceedings of the 16th International Conference on Information Systems*.

Nee, Eric. (1998) "Compaq Computer Corp.", *Forbes Magazine*, January 12.

NewsEdge Corporation. (1997) "Compaq Announces Record Third Quarter Sales, Earnings, and EVA", *NewsEdge Corporation*, <http://www.newspage.com>.

Planning Review. (1994) "Compaq Computer", *Bell PubliCom for the North American Society for Corporate Planning*, v22 (Jul).

Porter, Michael E. and Victor E. Millar. (1985) "How Information Gives You Competitive Advantage", *Harvard Business Review*, v63, n4 (Jul/Aug), pp. 149-160.

Porter, Michael E. (1996) "What is Strategy?" *Harvard Business Review*, v74, n6 (Nov/Dec), pp. 61-78.

Slavin, Roy H. (1994) "Re-engineering: A Productivity Paradox", *Quality* v33, n6 (Jun), p. 18.

Schwartz, Ephraim and Dan Briody. (1997) "Compaq CEO Sets Goal Of \$50 Billion In Sales, *InfoWorld Electric*, October 2. <http://www.infoworld.com>.

Waurzyniak, Patrick. (1998) "IDC Reports Healthy 14 Percent PC Growth", *Electronic Buyer's News*, January 27.

Wilcox, Joe. (1998) "Compaq Cuts 5,000 in Facilities Consolidation", *Computer Reseller News*, June 26.

Wong, Wylie. (1997) "Dataquest, IDC Q3 Figures Put Compaq atop of PC Sales Heap", *Computerworld Magazine Online*, October 28. <http://www2/computerworld/com/home/>.

Zlotnikov, Vladim. (1997) "PC Sales Growth Remains Down", *Electronic Buyers News*, November 3.

Zuckerman, Laurence. (1997) "Compaq: We're No. 1, but We Can Change", *New York Times – CyberTimes*, June 16, <http://www.nytimes.com>.

LIST OF ACRONYMS

BSC	Balanced Scorecard
BTO	Build-to-order, a manufacturing strategy that builds products only after receipt of an order for those products
Channel	Sales and distribution network, e.g., Compaq sells to subsequently sells to end users.
DEC	Digital Equipment Corporation
ERP	Enterprise Resource Management, describes large-scale, integrated software systems designed to manage all or a large portion of a company's operations and support functions.
EVA	Economic Value Added, a measure of profitability that identifies net income beyond that which provides a market return to the shareholders.
IDC	International Data Corporation
IT	Information Technology
JIT	Just-in-time, an inventory management technique which attempts to time receipts of raw materials to make them available when needed for production but not earlier.
JIT –ODM	Compaq's Optimized Distribution Model program as described in the Sidebar
PC	Personal computer
ROA	Return on Assets (Net Income plus Interest Expense divided by average total assets).
ROE	Return on Equity (Net Income divided by average shareholders' equity).
SAP	Systems Applications Programs, an ERP software product of SAP AG
S&P	The Standard and Poor's listing of 500 largest companies
VAR	Value Added Reseller, a channel firm that takes products from the original manufacturer and adds its own service or integrates other products and then markets a more comprehensive product to the end user.

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