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We All Want to be Like Mike: The Internet and the Personal Computer Value Chain

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By

Martin Kenney

Professor

Department of Human and Community Development

University of California, Davis

Davis, California 95616

[mfkenney@ucdavis.edu](mailto:mfkenney@ucdavis.edu)

and

Senior Research Associate

Berkeley Roundtable on the International Economy

University of California, Berkeley

James Curry

Profesor-Investigador

El Colegio de la Frontera Norte

Tijuana, Baja California, Mexico

US Mail: P.O. Box L

Chula Vista, CA 91912

[jcurry@colef.mx](mailto:jcurry@colef.mx)

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"We're in a fashion industry where there are several product turns a year" Ed Jurica, vice president of information service for CompUSA (RosettaNet 2000a).

## **Introduction**

E-commerce was expected to transform many industries and permit the disintermediation of various segments of the value chain. This paper explores the impacts of the E-commerce on the PC industry. The PC is particularly appropriate for study for a number of reasons, but most important because it has been the device linking most persons to the Internet. Also, the PC industry played a significant role in exploring new business models that were later adopted by other industries. The most prominent of these experimenters with new business models is Dell Computer. Not only PC firms, but nearly every other firm involved in producing and selling a product evinces interest in the Dell model. Dell Computers was successful in an industry characterized by cutthroat pricing, rapid technological change, foreign competition, global value chains, and changing consumer tastes. Not surprisingly, the PC industry was an earlier adopter of the Internet as a business tool. For these reasons, the PC industry can provide insights into what might prevail in other industries.

These first two sections of this essay describe the structure and configuration of the PC value chain prior to the adoption of the Internet. The focus is upon the advantages of the direct marketers particularly Dell Computer, which allowed them to rapidly increase their market share at the expense of the traditional assemblers. The third section describes the rapid response by Dell to the competitive potentials of the Internet. The fourth section describes the responses by the constituents of the non-direct marketing value chain and the new entrants into the PC value chain that used the Internet to market

PCs directly to customers. The fifth section examines the efforts by an industry consortium and a private firm to transfer the value chain extending from the assemblers through the Channel online. The sixth section examines the various devices that have been touted as driving a coming Post-PC era. The final section discusses the impacts of E-commerce on the PC industry.

### **The PC Industry<sup>1</sup>**

In contrast to many industries where a dominant design emerges and then a period of consolidation sets in, in PCs fierce competition and price wars are the norm. Since its introduction by IBM, large global players such as Compaq, Dell, Hewlett Packard, and IBM have dominated the PC market. And yet, at least 30 percent of the market remains controlled by no-name brands (or, in industry parlance, white boxes). In the retail segment cost continues to be a major differentiating factor, but even in institutional market sales price is significant. In 2000, nearly twenty years after the introduction of the PC, no single business and distribution model was entirely dominant. Moreover, due to the low barriers there have been a constant stream of new entrants; some of which have sufficient capital and a compelling enough new business model to become significant players.

The roots of this competitive dynamic can be traced to IBM's decision to purchase the microprocessor and the operating system software from outside vendors

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<sup>1</sup> This article only considers the situation for PCs, by which we mean desktop computers that use the Windows operating system and a compatible microprocessor. Niche products such as the Apple Mac, Playstation, Nintendo, Atari, and Amiga exhibit different dynamics. Also, the notebook and handheld computer sectors have a different structure.

(Langlois and Robertson 1992). The unexpected result for IBM was a loss of control of the PC standards. The providers of the microprocessor and operating system, Intel and Microsoft, were free to sell to other vendors; thus unleashing a slew of "clones." The result was that, no one company was able to integrate the entire value chain, and with the exception of operating system software (Microsoft) and, to a slightly lesser degree, microprocessors (Intel and AMD), there is competition at every link of the chain. The market availability of all components combined with the extreme ease of assembly made the PC a quintessentially modular product.

The availability of components on the open market combined with its modularity has meant that in nearly every stage of the value chain there is intense competition. Bresnahan and Richards (1999) described these dynamics as "vertical competition," an environment in which firms at each stage of value chain encourage competition at the other stages. So, for example, Microsoft certifies microprocessors made by other firms as Microsoft compatible; even while Intel develops microprocessors to work with the Linux operating system. Price competition is continuous and even acquiring a dominant position cannot entirely protect a firm (with the possible exception of Microsoft).

The pace of change, both technically and economically, is driven by PCs various components and customer usage because of the general-purpose nature of the PC. Constant dramatic improvements in performance for roughly the same price is explained by the fact that two of the most valuable components in a PC, semiconductors and hard disk drives (HDDs), are subject to rapid technological improvement. The first and most famous improvement dynamic is described by Moore's Law, which states that the

performance of semiconductors will double roughly every 18 months.<sup>2</sup> Moreover, the new chip can be sold at roughly the same price as a chip with one-half the capability sold for 18 months earlier. Intel, the leading microprocessor producer, has made the rapid development of new product generations and sub-generations a cornerstone of its business model (Clark 1995).<sup>3</sup> Similarly, in the 1990s the per-megabyte cost of HDD magnetic storage experienced a rapid decline as the areal density of data storage doubled every 17 months (McKendrick 1997).

The persistent tendency for the price of the most technology-intensive components to drop for any specified performance level is difficult enough to manage. There are also periods of extreme price instability due to factors such as overcapacity in certain components or to increased competition in a particular component segment. For the PC value chains this means that inventory problems extend far beyond simply having capital in process and storage costs. They expose the inventory's owner not only to a persistent depreciation, but also to the risks associated with more unpredictable price declines.<sup>4</sup> The PC value chain is conditioned by the loss-the-value dynamics, which means that making the supply chain from component producer through to the consumer more efficient is an overriding concern. Any strategy decreasing the holding period for

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<sup>2</sup> Gordon Moore is one of the founders of Intel, the world's most valuable semiconductor company and most important producer of microprocessors for the PC.

<sup>3</sup> Intel's strategy was to sell its newest and fastest microprocessor at high prices. As faster models are introduced, the prices for earlier models are significantly reduced. However, in 1999 this strategy came under significant pressure due to the introduction by AMD of an entirely compatible family of microprocessors of comparable speed at lower prices.

<sup>4</sup> Examples of crisis vary. One example is the 1997 collapse of the Korean currency and economy that prompted Korean firms to flood the world economy with DRAM chips at devastatingly low prices. Also, any event that slows consumer purchasing affects

inventory makes an immediate and significant contribution to profitability (Kenney and Curry 1999).

### **The Value Chain Prior to the Internet**

The PC value chain is a complicated network that is presented in highly simplified form in Figure One. The value chain never was fully integrated. Even with the first PCs, SCI and Avex, former NASA contractors from Huntsville, Alabama won contracts to assemble motherboards and add-on cards (respectively) for the original IBM PC in 1981 (Sturgeon 1999). The IBM sales channel consisted of IBM salespersons and computer stores it qualified such as Businessland. Almost from its introduction, demand for the IBM PC outstripped supply, and nearly immediately there was a flood of fully compatible or almost compatible clones, legal and illegal. The cloners could purchase the operating system from Microsoft and the MPU from Intel; all they had to copy was the BIOS. IBM's head start, brand name, and control of the BIOS was sufficient until 1985-1986 to control the industry and restrain new entrants, however there was a business opportunity.

### **Figure 1 About Here**

In 1985 Compaq emerged as the first creditable competitor to IBM. With the cloning of the BIOS chip, any firm anywhere could now enter the marketplace, and, particularly, in Taiwan a number of firms began subcontracting for the large U.S. firms and various retailer (Kraemer and Dedrick 1998). As the premium brand throughout the

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assemblers with PCs in the pipeline because turnover slows, but the PC's value

1980s, IBM still was the dominant force in pricing and was able to extract a rent from customers in the form of 18 percent net operating margins (*Business Week* 1992). Compaq established itself as a competitor with comparable quality, but slightly lower prices (Whiting 1989). However, a market for components was maturing under the IBM/Compaq price umbrella. This was assisted by the improving quality in components and the assurance of compatibility simplified market entry for second-tier producers, especially in the low-end market. These clones were offered at significantly lower prices and still were profitable because Compaq had a 67 percent price premium over a comparable Gateway 2000 computer (*Business Week* 1992).

The strength of the IBM and Compaq brands offered them much pricing protection, and thus there was little stress on optimizing the value chain. This set the stage for the entry of still more low-cost vendors. At that time, parts and completed machines could remain in inventory or in the channel for relatively long periods because there was no important time-based competition. Components and even finished PCs could be sourced from abroad with little profit penalty. This provided Taiwanese OEMs with the headroom for their market entry.

As Figure Two indicates in 1990 the PC market was in transition, five of the top ten firms in unit sales were Japanese or European and, if IBM is included, seven of the top ten positions were occupied by existing firms. In 1990 it appeared that the established computer firms were poised to control the industry. However, the industry was actually at an inflection point.

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inexorably declines.

## Figure 2 about here

In 1990 there were three important sales channels: computer company sales persons, computer superstores, and local computer stores or vendors (white box vendors and valued-added resellers). However, the dominant firms, IBM and Compaq were experiencing market share loss to direct sellers such as Dell and Gateway 2000, Taiwanese firms, and no-name clones; all of whom undercut the market leaders on price (Cortino 1992). In 1992 Compaq responded to its low-cost competitors by dramatically lowering its margins and engineering costs out of its value chain. As a relic of the earlier period when Compaq integrated most production to protect quality, as late as 1992 Compaq was still building its own power supplies, even though high-quality power supplies made in Taiwan were available on the market for a fraction of Compaq's cost (Business Week 1992).

The industry growth combined with the downward pressure on prices to convince PC assemblers to purchase even more Taiwanese parts and even finished computers. U.S. contract manufacturers continued to manufacture PCs and related products, but moved to diversify their customer base retreating from the lower-margin PC business. According to Sturgeon (1999) Taiwanese quickly became more adept building motherboards, peripheral devices, and later finished computers, than U.S. producers. Initially, these parts were for the generic "clone" market and later for branded companies such as Dell and Packard Bell. IBM and Compaq were forced to follow suit. One Taiwanese assembler, Acer, went further and designed and sold PCs under its own name.

Even while Compaq was cutting margins in an effort to recover sales; the small, but rapidly growing direct sales firm Dell abandoned its efforts to enter the retail chain.

Their unsuccessful experience of selling into the retail channels taught Dell the advantages of their order-taking model. Because Dell operated on a true supermarket system, in which the customer "pulled" the merchandise through the system, it had far less inventory in process and reduced risk because it only built computers that already had been sold (Dell 1999c). This permitted Dell to sell computers at a lower price and/or have higher margins. The result was that Dell grew significantly faster than its competitors thus increasing its market share (Curry and Kenney 1999; Dedrick et al. 1999).

Direct marketers had two significant advantages over their competitors. First, they need not be concerned by value erosion, because inventories reflected only immediate real need. Since distribution was direct, minute changes in demand were registered immediately and losses attributable to faulty demand forecasts were virtually nonexistent. Even better, because Dell's suppliers essentially managed input inventory, Dell was nearly free of exposure to declining prices. Second, machines were built upon receipt of payment so there were no losses from inventory waiting to be sold. In other words, the direct marketing model permitted Dell to manage both upstream and downstream inventory.

The traditional PC firm adopted two basic responses to Dell: The first response was to develop ancillary services, system integration services for businesses or a bundle of software and services for the home consumers. In the business area this approach was probably best exemplified by IBM, which provided a wide range of services including pre-configured internet and e-commerce server systems, business service software (including electronic data interchange-type services such as Lotus Notes), systems

installation, and information systems consulting. In 1997 to expand its service-related offerings and diversify its product offerings in the higher value server market, Compaq acquired Digital Equipment Corporation (Ramstad and Auerbach 1998). In the consumer and small business market PCs were offered bundled with additional services, most importantly, Internet access. To maintain or expand market share, particularly among first-time computer buyers, most PC assemblers offered Internet service as part of the purchase of a PC -- usually in the form of rebate. For the least expensive PCs, the strategy was to charge full price of Internet service and essentially give away the PC. The recognition here was that the killer application was the ability to surf the Internet, not the other PC applications. This created opportunities for low-cost PC marketers such as E-machines to create alliances with Internet service providers such as AOL's CompuServe. The ISPs would rebate approximately half (\$400) of the cost of an E-machines PC in exchange for a long-term service contract with the customer. This approach became less popular in 1999 time frame, as various Internet firms particularly the portals began giving away Internet access.

The second major approach has been to offer extremely inexpensive PCs through the retail channel. These machines experienced less value erosion than did more expensive machines. The direct marketer's overhead mitigates against high profit margins in these extremely inexpensive machines. E-machines, a startup, is now the number three retail brand in the U.S. because it was able to import completed PCs from

Korea (CNET 1999).<sup>5</sup> In effect, E-machines created a space at the low end of the market that was not sufficiently profitable for the direct marketers to attack.

Ultimately the difficulty for the non-direct marketers was an inability to abandon their existing channels. Quite naturally, the Channel resisted efforts on the part of manufacturers to develop direct sales particularly for corporate accounts. Consider the situation for the traditional firms and their markets channels as represented in Figure One. The PC value chain is quite complicated and contained three different demand chain elements: assemblers, distributors, and a polyglot group of resellers, value-added retailers, integrators, and retailers. For the manufacturers the status quo is dangerous given the easy availability of parts. Any constituent in the value chain could change brand name manufactures and begin to assemble their own white boxes.

The highly disaggregated sales system was vulnerable to disruptions. Consider, the assembler's decisions on which computers to make was done by forecasting demand six months in advance on the basis of demand information that came upstream from the channel. The assemblers' factories and their suppliers were building for supposed future demand. This was fine so long as demand was constant and predictable, but, of course, demand was subject to the vagaries of the market. If a firm overbuilt, since the value of PC was a rapidly wasting asset, it would use measures such as rebates and price protection to push the product into the channel. This became known as "channel stuffing." This led to periodic bouts of gross excess capacity that continued until the manufacturers and their suppliers ramped-down production. This would appear to be

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<sup>5</sup> Two Korean firms, TriGem Computer and Korea Data Systems Co. and the Taiwanese firm, Jean Company manufacture E-machine's computers. TriGem Computer also

advantageous for the channel because prices would fall and they could collect their rebates, but, in fact, the inefficiency, excess inventories, and extra effort associated with returning product disrupted everyone's profitability.

The traditional system had still other vulnerabilities, which centered on its ability to interchange and process information. The actual information interchanges were idiosyncratic and the descriptors of products varied among firms. This was curious because the products were highly standardized. However, there was no one set of agreed upon criteria for comparison. As important as the information and its format, the interfirm communication media varied, but for the most part were based on phone and fax. Often large paper catalogs were used and most transactions were registered on paper. Only the larger vendors had expensive, hard-to-use proprietary EDI systems. Information flowed haltingly through convoluted, error-prone channels, which injected much noise into the system. In summation, by 1996-1997, the traditional assembly-to-channel marketing system was at a competitive disadvantage. Inventory problems, slow responses, and faulty forecasts led to massive financial losses and eroding market share as the direct marketers particularly Dell computers grew far more quickly than the rest of the industry.

In summation, Figure One captures the value chain structure in the mid 1990s. Compaq, IBM, and others still sold PCs through the traditional channels, either to the computer superstores and value added resellers or through direct sales to large corporate customers. The white box remained the largest single "brand," because it cost less than

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outsources some manufacturing to a facility in Xiamen, China and another facility in Shenyang, China.

those of the majors did. However, both the white box makers and the traditional assemblers were losing market share to the direct marketers.

### **Welcome to the Internet**

The widespread diffusion of the Internet would create opportunities in nearly every segment of the PC value chain. Already in the late 1980s Gopher was available for PCs. However, it was not until the Mosaic browser for the PC was released in Spring 1993 that the Worldwide Web began its dramatic increase in use. The enormous PC-installed base was what made the WWW such a fast growing phenomenon and powerful new tool (Jimenez and Greenstein 1998). Conversely, the WWW became the new “killer application” that drove the PC industry. It was not surprising that PC firms recognized the significance of the Internet earlier than most firms and moved to adapt it to their business plans.

### Direct Marketing

Dell, almost immediately, understood that the Internet might be significant for its business. This prescience not entirely surprising because their business was predicated upon the use of communications technologies, both telephony and mail order catalogs. Interacting with customers through a telephone made the step to the Internet very short, it was a natural progression from the telephone. As with some other early adopters such as Federal Express, once a firm established an online presence, customer demand and suggestions led to next steps.

The commercialization of the Internet created new opportunities and new threats for every firm in the PC value chain. It created space for new entrants, even while it provided opportunities for existing firms to create new connections to their customers. It also created opportunities to reorganize the existing value chain to allow disintermediation of various intermediaries. Despite the disruption and confusion among the various constituents, it is clear there is neither a final resolution nor certainty about the ultimate impacts of the Internet on the value chain. In the following sections, we summarize a few possible impacts.

In the late 1980s Dell established an FTP site so its customers could download technical bulletins and other information. In 1994 Dell was the first personal computer firm to launch a commercial web site ([www.dell.com](http://www.dell.com)). Initially, the site provided only technical support information and an e-mail link for support. Then, 1995 online configuration and pricing options were introduced, though the actual sale was still consummated on the telephone (Dell 1999c). With the introduction of the Secure Sockets Layer in the browser and increased confidence in online credit card purchasing Dell transferred the entire transaction online.

Dell confronted a unique opportunity, since it had already given up on selling PCs through the channel, it had no legacy distribution channel to consider. For Dell replacing telephone operators who were simply conduits for entering orders into a computer with an Internet-based interface was not a great technical and business strategy leap. Internet-based sales grew dramatically. In December 1996 Internet-enabled sales were \$1 million per day (Dell 1999c: 93). By February 2000 Dell reported average web-related sales of \$40 million per day or 50 percent of total sales. Dell's savings from moving transactions

to the Internet were substantial. For example, Dell estimated that order status calls, which can cost up to \$13 each, can be handled over the Internet for essentially no cost at all. Dell estimated its savings through avoided order status calls were more than \$21 million in 1999. Each online purchase transaction produced an average of 40 percent fewer order status calls for Dell, and 15 percent fewer technical support calls, at a savings of \$3 to \$8 per call (Dell 1999a).

In 1996, with the introduction of the Premier Pages program offering a password-protected, Dell-developed web page, its largest customers such as Ford Motor and Shell Oil these customers could order directly from Dell. Each page is uniquely designed for each customer and contains account team information and procurement and purchase-order processes unique to the customer (Dell 1998). The efficiency of this well-based ordering system allowed one global customer, Shell Oil, to save 15 percent of its annual PC purchasing costs. Another firm was able to reduce its procurement staff from 15 to four (Dell 1999b). These webpages create a link with these customers and provide Dell a pipeline for the introduction of new IT products. There are also benefits for the customer. Control and tracking is simplified because all PC purchases and billing were centralized. Dell could even put the corporate property numbers on the computer in the factory eliminating the necessity of having someone find and place the property tags on the machine after it is put into service. The Internet permitted Dell to increase the service it provided its corporate customers.

Dell has also created "valuechain.dell.com," which connects the company with its largest suppliers. Through this site, the suppliers can find out Dell's requirements for their incoming materials, receive statistics from Dell's manufacturing lines, and data on the

reliability of their components. This permits Dell and its suppliers to monitor each other in real time. An illustration of the transparency the systems creates is Dell's ability to observe inventories passing through their supplier's operations (Dell 2000).

The efficiencies of the direct sales model were accentuated by the diffusion of the Internet. The edge the direct marketers experienced prior to the Internet translated nicely into still further advantages. In contrast, for those using the channel and those in the channel the situation would only become more dire, even though the Internet also provided them with opportunities to become more efficient.

### **Trying to Score on Mike**

The commercialization of the Internet created challenges for all the PC firms and allow the entrance of some new players whose business models were predicated upon using the Internet. Competing with the direct marketers was difficult enough, even when the direct marketers were limited by their dependence upon catalogs and labor-intensive telephone ordering. With the introduction of Internet-based ordering the cost advantages (combined with the other advantages) became overwhelming. Recognition of the problem was simpler than fashioning a credible response. On the one hand, a dramatic move to direct-sales methods meant alienating the existing sales channels. On the other hand, remaining with the push system, no matter how sophisticated meant that the direct sellers would retain their advantage. This problem faced not only manufacturers such as Compaq and IBM, but also distributors such as Ingram Micro and Tech Data, value-added resellers such as Compucom and General Electric IT Services and the retailers

such as CompUSA and Fry's Electronics (VARs and the retailers are combined in Figure Three).

### **Figure 3 about here**

#### The New Entrants

The possibilities for marketing PCs created by the Internet were not lost among entrepreneurs. Quickly, the Internet attracted a number of startups, which meant to sell PCs from their websites, these are represented by the shaded boxes in Figure 3. Moreover, one failing bricks and mortar retailer, Egghead Software, closed its stores and transferred its operations entirely to the Web. Creating an electronic storefront was quite simple from two dimensions: The first dimension was the ease with which a retail engine can be implemented on the web. The second dimension pertains to the ease of organizing fulfillment. In the PC sector the existence of distributors such as Ingram Micro simplified entry; in much the same way as Ingram Books facilitated the establishment of Amazon.com. The Internet storefronts had significant advantages, namely they carried no inventory, they required no sales staff, most of their orders were handled electronically, and they operated 24/7.

The Internet retailers also had weaknesses. The first of these was their dependence upon distributors for fulfillment. So, for example, in fiscal year 1998 Cyberian Outpost ([www.outpost.com](http://www.outpost.com)) purchased 38% and 10%, respectively, of its products through two major distributors, Ingram Micro and MicroAge. Buy.com had an even closer relationship with Ingram Micro, Inc., which was contracted to provide all of

its computer hardware and software products (Buy.com 2000). Buy.com was completely dependent upon Ingram to provide timely and accurate order fulfillment. The core competency of the online retailers was the attraction of customers and the development of their brand name. These "virtual stores" were not dependent purely on computer revenues as their strategy appears aimed at becoming "online Walmarts." Their long-term viability was uncertain, because these computer products were commodities profits may prove elusive.

Another methodology was a referral system, whereby an Internet firms such as a portal referred customers to an assembler or distributors. Leaders at this were Yahoo! and CNET. For example, CNET claims that in fourth quarter 1999 it was the top referrer of traffic to the online transaction areas of Dell, Gateway, IBM, Acer, and Apple Computer (CNET 2000). The significance of these referral programs for the PC industry is difficult to gauge, however they offered yet another channel from the manufacturer to the end user and could outflank the bricks and mortar channels. CNET has made a major advertising commitment in an effort to raise the visibility of its site, and make it the premier technology-related reference site.

The PC industry is nothing, if not innovative. Another strategy for selling more PCs is to launch "affiliate" sales programs. A San Francisco start-up, PeoplePC, pioneered affiliate buying last year, when it announced deals to provide PCs to employees of Ford and Delta Airlines (Konrad and Kanellos 2000). PeoplePC teamed with HP and Uunet to offer a PC and Internet access at \$5 per month for three years. The company sees this as a way it can communicate more regularly with its employees, and the UAW supported the program as a way to communicate more effectively with its

members (Wilcox 2000b). These affinity programs seem to be increasing as Intel and American Airlines also announced these programs.

In contrast to the experiences in some other retail sectors where E-commerce startups captured significant market share, in computers the startups have had difficulty capturing a profitable market space. This is, in part, due to the difficulty nearly all participants have in achieving sustained profitability. Moreover, in contrast to other sectors such as books and CDs, in PCs the established leaders such as Dell quickly implemented WWW-based sales and other activities. In such a fast changing industry it is always difficult to predict success, however it could be that the referral-based model will be more successful than the retail model. The new entrants did not unleash a wave of creative destruction, rather they formed a new pipeline to the customer.

#### Traditional Assemblers: Compaq, IBM, and Hewlett Packard

The Internet reinforced the competitiveness of the direct marketers and increased the difficulties for the traditional assemblers. The late 1990s were difficult for the traditional assemblers as they lost market share, and were slammed by component price decreases, which devalued their inventory. The Internet posed a powerful dilemma. If they decided to sell direct, then they would be directly competing with their channels. If they did not begin direct sales, they would likely continue to lose market share. This was not an idle threat, major firms such as Packard Bell/NEC and AST Research/Samsung had already been driven from the market. Moreover, the channel could always switch their efforts to selling white boxes. To top it off, it was estimated that Compaq's profit on each consumer PC sold was as little as four percent (Wilcox 2000a).

The chaos among the traditional assemblers was profound. For example, after online retailers began selling Compaq PCs, in February 1999 Compaq responded by forbidding such sales, because it undermined their offline retailers. Consider the difficulty of the situation, the direct marketers were constantly increasing their market share, and the assemblers were wrestling with the impacts of the Internet on their business models. Having said that, reaction by the assemblers was slow. From an analysis of Compaq's press releases, it appears that only in October 1996 was there any announced reaction to the potential of the Web, and then it was only the creation of a WWW-based intranet. This is approximately two years later than Dell.

Only in July 1997 does Compaq truly respond to the threat. The most important measures in this response can be seen in Figure Four. This first response is to develop a channel assembly program. Even this measure can be seen as a response to the threat of the mid 1990s, and not the looming new competitive disadvantages posed by E-commerce. Only in November 1998 does Compaq unveil a line of computers meant to be sold on the web. In January 2000 Compaq bought one of its distribution partners, Inacom so that it could control the value chain. But perhaps most telling was the striking admission in 2000 by the Compaq president that it did not have "the ability to take an order, do the configuration online, and be able to track the order and fulfill it (Popovich 2000).

Figure 4 about here

Compaq was not alone. IBM's experiences in the retail channels were, if anything, worse. The difficulties were so overwhelming that as of January 2000 IBM

withdrew the Aptiva from the retail market (Wilcox 1999). This decision freed IBM to enter the direct market. To distinguish itself, from Dell and Gateway where customers can wait for weeks to receive an order, IBM.com promised that if a customer placed an order online or over the phone by 3:00 p.m. EST, the system would be shipped the very same day ([www.ibm.com](http://www.ibm.com) 2000).<sup>6</sup> It is too early to see whether its direct operation will be successful, but exit from the difficult retail market was probably inevitable.

In contrast, to Compaq and IBM two companies, Hewlett Packard and E-machines have done quite well gaining market share. The greatest beneficiary of IBM's withdrawal from the market was Hewlett Packard, which managed to capture most of its channel-based market share.

In the business sector, IBM's competitiveness was based upon its ability to deliver total systems' solutions. In these cases, IBM could build to order and the cost of the PC was hidden in the cost of the entire solution. One method for more effectively attacking the SMB business space would be to develop Internet-based problem solving for these customers. The small firms are too small to justify and afford sophisticated and expensive maintenance contracts, but in aggregate the market is huge.

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<sup>6</sup> Curry and Kenney (1999) found that at the University of California, Davis customers waited an average of 19 days from the date the purchase order was faxed from the university to when the purchaser received the computer.

## The Distributors<sup>7</sup>

The early literature on E-commerce posited that through using the Internet it should be possible to make direct links between manufacturers and end users, thus disintermediating distributors. Of course, this is what the direct model already did. In the PC value chains, distributors such as Ingram Micro, Tech Data, Avnet, and CHS have been critical players.<sup>8</sup> The breadth of their offerings is staggering. For example, Ingram has more than 280,000 SKUs, which range from the smallest passive component through finished system and software. These distributors are fully capable of assembling and delivering a finished PC directly to the customer. To facilitate their operations and expedite delivery each firm has built a network of warehouse/logistics facilities enabling them to deliver orders the next day in most of the contiguous U.S.<sup>9</sup>

For the assemblers such as IBM and Compaq, the distributors were critical players in the channel. Though, in some cases, the distributors and assemblers were linked by EDI systems, for the most part the relationships were relatively arms length. The traditional method was to simply ship as many computers as possible to the

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<sup>7</sup> Profits are elusive in PC distribution. Most of these firms distribute a wide variety of IT products, and PCs, though large volume, are quite low in profitability. Distribution has great difficulty extracting profits from its sales. For example, in full fiscal year 1999, net sales at Ingram Micro topped \$28.1 billion and grew 27 percent over 1998. However, net income was only \$183 million versus \$245 million for 1998. Tech Data, though smaller having \$11.5 billion in sales, was able to earn nearly \$192 million in fiscal year 1999 (Tech Data 1999). For the distributors the problem is that their suppliers can open a website and sell directly to consumers capturing the distributors profits and removing time from the value chain.

<sup>8</sup> Ingram Micro is interesting because its sister companies include Ingram Books, which is the world's largest book distributors, and Ingram Entertainment, which is a major distributor of entertainment products. Amazon.com could quickly enter the book market because it could out source fulfillment and logistics to Ingram Books. Though publicly traded, the Ingram family still has a substantial ownership position in all of these firms.

distributors and, give them price protection, and then hope the Channel could sell the machines. Of course, this distribution methodology led to bouts of excess inventory, and too much handling when compared with the direct marketers. The disadvantages of the traditional value chain were obvious.

In response to a severe inventory crisis in 1997-1998 the large assemblers and the distributors introduced a new business model "channel assembly," which meant to divide the assembly of a PC into two segments: The first segment was where the box, the motherboard, floppy disk drive, and other components whose value was decreasing only slowly would be undertaken. The final assembly segment, the addition of the parts most susceptible to value erosion, the DRAMs, the microprocessor, and the hard disk drive, was completed in the channel immediately before the PC was delivered. The distributors and VARs have been under enormous pressure and the smaller distributors have been either acquired or left the business. The pain has not been confined to the smaller firms, two leaders, CHS and MicroAge filed for bankruptcy in April 2000.

Channel assembly was an aspect of the effort to adopt a "pull" model. Ingram Micro (2000) renamed its business model "demand-chain management" referring to the idea that demand should "pull" the parts through the system. The need to reduce inventory and other costs also has contributed to a consolidation of the value chain. In May 1999 Compaq decreased the number of its U.S. distribution partners from 39 to 4 (Ingram Micro 2000). Another effort to streamline the demand chain was vendor co-location programs, in which the distributor establishes a configuration operation adjacent

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<sup>9</sup> Distributors such as Ingram and Tech Data have sophisticated delivery operations in Europe and are building their networks in Asia.

to or even in the assemblers' factory. Systems reconfiguration and customer shipping occur from the vendor's site resulting in cost and time-to-market efficiencies.

Channel assembly and co-location strategies were not directly related to the Internet. Contemporaneously, in 1998 the major distributors began introduction of electronic commerce tools to migrate their customers to web-based ordering. For example, Ingram's Web site, [www.ingrammicro.com](http://www.ingrammicro.com), is meant to be a Business Center for resellers, i.e. the next tier downstream. The site features real-time pricing and availability, on-line ordering, order status, and an extensive product catalog. Ingram also provides resellers access to real-time ordering, product allocation, order status, product search, and pricing and availability status. This permits downstream VARs etc. to have direct access to Ingram's mainframe inventory systems. These offerings permit retailers to act as a middleman between the customer and Ingram without the customer knowing. Depending upon the product, Ingram can even drop ship the product directly under the VARs' label.

The economics of online sales were as compelling to the distributors as they were for Dell. So by 1999 all of the major distributors had an E-commerce site for their customers. In conjunction with introduction of the site many of their smaller customers were transferred to the E-commerce site in an effort to cut costs. So, in effect, the establishment of an E-commerce site was used by the distributors to rationalize their customer chain.

### **Value-Chain Solutions**

The electronic components and particularly the PC supply chain were rife with incompatible formats for providing product information and no taxonomy for that information. Even parts numbers were not defined in a standardized fashion. Examination of Figure 3 illustrates the difficulties when the players in such a complicated value chain all have different definitions and descriptive parameters for their products. This is particularly true when contrasted to the direct marketers who did not have to depend on this complicated Tower of Babel. What this meant was that the Channel-based value chain was plagued by informational inefficiencies, which in an off-line world were surmounted by a thick web of personal connections and information sharing.

The extremely complicated topography of the PC value chain characterized by its diverse EDI systems, a reliance on phone, fax, and paper purchase orders, and/or varying manufacturers' or distributors' web sites rendered the value chain opaque and inefficient. The terrific growth in the direct marketers in 1997 and 1998 encouraged the firms in the channel and those dependent upon the channel to search for strategies for decreasing costs, speeding information flow, and making the value chain more transparent. In 1998 a group of major PC and other IT firms formed an independent, non-profit organization RosettaNet dedicated to promoting industry-wide initiative to adopt common electronic business interfaces (RosettaNet 2000b). Many of these firms also participated in the formation of Viacore, Inc., which is developing an e-commerce hub to translate RosettaNet information for member top-tier demand chain companies.

Even with a non-profit organization seeking to develop standards, the disaggregated and chaotic nature of the IT industry's value chain created an opportunity for a B-to-B entrant capable of knitting the value chain together and providing

customizable solutions to various participants. The only important entrant specializing in electronics is pcOrder.com (sic). The firm's business proposition is that all of the information in the value chain should be moved online. Ideally, pcOrder.com would link all the firms in Figure 3 into one compatible HTML-based system. However, currently most of its efforts have focussed on the parts of the value chain from the assemblers downstream. pcOrder.com has a multidimensional business model: The first dimension is a modular suite of customizable software applications for any constituent of the value chain. The second dimension is a standardized database consisting of over 600,000 SKUs from over 1,000 manufacturers, which for a fee VARs and resellers can use to compare, configure, and order products online (pcOrder.com 1999). Full implementation of pcOrder's solution would make all of the information flow in the value chain electronic, would dramatically lower inventory, and make the entire system more transparent.

The pcOrder business model does appear to have some apparent contradictions. For example, though Ingram Micro and Tech Data offer products through the pcOrder database, they also have their own website for VARs. It is really not in the distributor's interest to contribute their data to a pcOrder.com type of website, however the fear of losing customers does force them to participate. The pcOrder database, Techbuyer.com, allows the VARs and resellers to compare configurations and prices online and then order online. This could be a valuable option, because reselling hardware has margins as small as 1-2 percent (O'Brien 2000). For the VARs the advantage is ease of use, thereby saving time, which can be better used for value-adding activities.

The use of the system by the resellers and VARs means that the demand chain will become more customer driven. This does not mean that the distributors will be eliminated inventory entirely, however they should be able to dramatically decrease their inventory. Particularly, if this system is combined with complete channel assembly, it might be possible to create a demand chain that is nearly as efficient as that of direct assemblers while retaining the service and close interaction with customers that was the strongpoint of the non-direct system. The ultimate outcome is still quite indeterminate.

### **The Post-PC Era<sup>10</sup>**

There has been a veritable tidal wave of prose announcing the dawn of the Post-PC era. The two technological developments hailed as harbingers of this new era are the Internet and wireless. The claims of the adherents to the "post-PC" position are often difficult to understand. The strong interpretation is that the PC will disappear to be replaced by another device or set of devices. Considering that the current global installed base of PCs is over 200 million, this claim appears dubious. A weaker interpretation is that the PC will become one of many devices connected to the Internet. The crux of this argument is that the PC will gradually lose its status as the only end-user device attached to the Internet -- a more credible argument. The following briefly describes the devices, which will make connection to the Internet ubiquitous.

Any claim that handheld devices will replace the PC as the Internet access device of choice is dubious for both convenience and technical reasons. For small bits of information such as stock quotes, time, weather, or even traffic reports, mobile devices

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<sup>10</sup> This section draws heavily upon discussions with Steve Depp (2000).

such as telephones are a viable option. Even handheld computing devices such as the Palm Pilot provide an only barely adequate viewing experience. For a richer experience full-sized monitors (either flat panel or CRT) are far superior, witness the continued increase in the screen size of notebook computers (10.4, 12.1, 13.1, 14.4 inch). From the technical perspective, there are significant issues about how to shrink web pages from those developed for a computer monitor to ones that are readable on a mobile telephone or even a Palm Pilot (most of which are gray-scale). There seems little likelihood that non-PC mobile devices will usher in the Post-PC world, however they will end the hegemony of the PC as the only Internet on-ramp device.

There are a set of more formidable competitors to the PC, which deliberately use attributes of the Internet in an attempt to dethrone the PC. These have combined with macro-environmental tendencies that will have a significant influence on the viability of the PC. The first tendency is the massive increase in bandwidth and concomitant decrease in cost throughout the telecommunications infrastructure. There can be little doubt that the homes and small- and medium-sized businesses will soon have high-bandwidth service onto the premises, be it through DSL, cable or some other media. The second tendency is for computing power on the desktop to no longer be a limiting factor for the vast majority of applications. The third tendency is that there will be a web-centric solution for nearly every desktop PC application. The harbingers of this are free web-based email, calendars, and photo sharing online. Many office productivity applications may also be done online if latency and bandwidth problems are resolved. The Internet thus may have the paradoxical result of cannibalizing some of the functions of the device most important for its diffusion.

The Network Computer (NC) is the device that has attracted the most attention as a possible substitute for the PC. The NC was first touted publicly in 1995 by Larry Ellison, the CEO of Oracle (Rivlin 2000). The argument for the NC is that corporate MIS managers would have a much easier time managing the computers on their networks, if the PCs were converted into "dumb" terminals. Initially, one of the arguments in favor of the NC was that it would be less expensive than a fully configured PC, which at the time was an average of \$2,500. In the interim the cost of a PC dropped below \$1,000 removing that sales point. The more significant advantage was the lower total cost of ownership of a PC, which is much greater than the cost of the PC. Despite the promise of the NC, it never sold well. For example, in 1999 an estimated 700,000 units were sold in the corporate sector, but projections estimated that sales would increase to 6 million units in 2003 (Rivlin 2000: 183). In 2000 the NC, though gaining market share, has not yet mounted a serious challenge to the PC. There will be a continuing effort to create a NIC or, at least, move the applications software to the web. The most interesting effort in this area was the 1999 release by Sun Microsystems of the office productivity suite, Star Office, which is predicated on networked computing. Given these efforts it would be a mistake to completely dismiss the NC's potential.

Another potential threat to the suzerainty of the PC in the home is the set-top box. The settop box is meant to provide the computing and connectivity and functionality to allow the TV to take the place of the computer. As the cable modem becomes more prevalent, the television, which is really a monitor (though of very low quality) and an electromagnetic wave reception device, could be converted into a networked entertainment and shopping device. When high definition television is available, the

"television" networked to the Internet could become a significant competitor to the PC particularly in the family room. The set-top box also has the potential to connect other home devices to the Internet, if the home has high bandwidth connection to the telecom network, a varied menu of functions including those of a PC could be transferred to the Internet. As an example, one new General Instruments set-top box has an IDE port to which a hard drive can be connected. In the home-computing environment the settop box and the HDTV could be a an alternative to the still difficult-to-use PC.

Another alternative is the "Internet appliance," which consists of a visual output device and an input device such as a keyboard. Normally, these do not have a Microsoft operating system and often have no permanent storage device. Internet appliance offerings have come from Dell, Compaq, and even Microsoft. In April 2000 AOL and Gateway announced an alliance to offer their own Internet appliance (Miles and Davis 2000). Of course, for all these players, the success of the appliance will cannibalize their PC sales, even while the appliance is an inexpensive commodity.

The final threat to the PC is from the game machine. Consider the Sony Playstation 2, which has more graphics power than any PC ever built, and will be equipped with a DVD drive, an IEEE1394 FireWire connector, and at least one PC Card slot. The PC card slot could have a network connection in the form of an Ethernet card or cable television connection. All of this for game machine prices. This machine does not have Microsoft software or Intel-compatible chips. These game machines could banish the PC to the home office. And if web-based productivity applications were offered, the Playstation could absorb the PC's office functions, also. There can be no doubt that both Microsoft and Sony recognize this potential. For example, in late 1999

Sony announced plans to work with Cablevision Systems Corporation to develop and deploy a new-generation digital entertainment and broadband-communications platform throughout the New York metropolitan area. For now this system is being designed to connect with Sony set-top boxes. One potential drawback is that users may find local storage compelling. If the wide variety of other PC functions are unavailable, can the game machine displace the home PC?

It is impossible to predict the outcome of the competition among the various platforms. The handheld devices will gain market share, but they are not a direct threat to the PC. Less predictable is the outcome of competition with devices intending to move much of the computing from the desktop to the network. If these solutions are adopted the future of the PC industry could be dramatically altered. These NCs, set-top boxes, and game machines are not PCs. Should the market turn a response by the PC industry would be difficult, because, quite simply, the reasons for adoption would not be cost, but rather ease of use and lower total cost of ownership. The next decade will almost surely be one in which multiple Internet access devices will compete.

## **Discussion**

The impact of the Internet on the PC industry has been intertwined and contemporaneous with the competitive threat from the direct marketers. This makes it difficult to attribute the attempts to streamline the Channel to one threat or the other. There is no question that the direct marketers such as Dell were able to leverage the Internet to make their operations even more efficient than they had already been. The

willingness of Dell customers to use the Internet permitted the company to achieve significant savings throughout its entire operation heightened its competitiveness.

The dawning of E-commerce did attract some new online retail entrants, but in comparison to a number of other industries such as book and CDs, autos, and services the new entrants were unable to disintermediate existing players, so they became yet another layer of players in the value chain. In this sense, we can say the Internet has had little transformative impact in the PC industry.

From another perspective the Internet will have a dramatic influence on the value chain. The PC industry is a chaotic shambles of incompatible information systems, inadequate and incomparable product descriptions, and non value-adding human involvement in the communications stream. The threat of Dell and the open and non-discriminatory Internet standards create an environment in which market competitors can agree without providing any single firm an advantage -- one of the difficulties that usually emerges when competitors discuss the adoption of an EDI system. The adoption of these standards will have a profound impact on the efficiency of the PC value chain.

The final impact of the Internet on the PC is the dethroning of the PC as the exclusive device for Internet access. Depending on the speed with which greater bandwidth becomes available, it is possible that a networking computing device, either an NC, a game machine, or even an amalgam of one of these and a PC, perhaps without the Microsoft operating system and an x86-compatible microprocessor could challenge the PC for primacy as an Internet access device. During the next decade the center of the computing industry will shift from the PC-centric world to one which will be Internet-centric will allow a "thousand flowers to bloom," in the sense devices connected to the

Internet. This does open the possibility that firms from other industries will compete for the computer users' dollars.

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**Figure 2: Global Revenues and Ranking for PC Sales in 1997 and 1990**

Ranking	Company 1999	Company 1997	Company 1990
1	Compaq	Compaq	IBM
2	Dell	IBM	Apple
3	IBM	Packard Bell NEC	NEC
4	Packard Bell NEC	Dell	Compaq
5	Hewlett Packard	Hewlett Packard	Toshiba
6	Gateway	Gateway	Olivetti
7	Apple	Apple	Groupe Bull
8		Acer	Fujitsu
9		Fujitsu	Unisys
10			Commodore
11			Hewlett Packard
12			Dell
13			Packard Bell
14			Gateway 2000

Compiled for various sources.

**Figure 4. Compaq's Distribution Moves (1997-2000)**

October 1996  
Implements web-based Intranet

July 1997  
Implements build-to-order program  
& Channel Configuration Program  
in which distributors/resellers  
complete final assembly of PCs

November 1998  
Unveils Prosignia line of PCs to be  
marketed and sold by direct order  
only

January 1999  
Compaq.com business division  
formed to oversee Internet and  
direct-sales efforts

May 1999  
Launches Distribution Alliance  
Program. Compaq contracts  
resellers to produce direct-order  
computers

January 2000  
Purchases Inacom, one of its  
distribution partners with four  
assembly and distribution facilities  
in U.S.

Source: PC Week January 10, 2000