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Taiwan's PC Industry, 1976–2010: The Evolution of Organizational Capabilities

The stellar growth of Taiwan's personal-computer (PC) industry over the past three decades represents a paradox. Participating in the global production system, local firms in Taiwan grew in association with established firms in the West. Despite their technical know-how, manufacturing prowess, and size, most leading Taiwanese firms did not develop their own capabilities in branding and marketing. A close examination of the historical evolution of the industry reveals that interactions with established companies in the West, in addition to local competition, decisively shaped capability development among latecomer firms. A few firms in Taiwan that eventually joined the ranks of global PC brands had been investing in marketing early, guided by a strategic vision rather than near-term economic calculation.

Taiwan's personal-computer (PC) industry represents a paradox. Local Taiwanese firms have been participating in the global-production system for decades, growing alongside established companies in the West. Taiwan has seen unparalleled growth in the volume of exports of PC-related products over the last thirty-five years. By 2010, Taiwanese companies had captured more than one-quarter of the global integrated-circuit market share, they had become the biggest producers of flat-panel displays in the world, and they supplied over 90 percent of the global laptop shipment volume.[1] Taiwanese firms operating in China produced close to two-thirds of Chinese information-technology (IT) exports, yet only a few Taiwanese PC companies (most noticeably Acer) have developed a global brand presence, while the others merely

[1] Ministry of Economic Affairs, *Semiconductor Industry: Analysis and Investment Opportunities* (Taipei, 2008). "Greater China IC Foundry Industry Overview," *DigiTimes*, 24 Jan. 2011. Ministry of Economic Affairs, *Taiwan FPD Industry Analysis and Investment Opportunities* (Taipei, 2008); "IT in Taiwan and China: Hybrid Vigour," *Economist*, 27 Mar. 2010.

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continue to eke out an existence as component suppliers or contract manufacturers for Western firms. Why do so few Taiwanese brands compete in the world market?

In *Scale and Scope,* Alfred Chandler posited that a three-pronged investment approach underpinned the successful growth of an industrial enterprise: 1) investment in large-scale production to lower unit costs; 2) investment in marketing, distribution, and purchasing networks; and 3) investment in the recruitment and organization of professional managers.[2] He later extended the argument and observed that both first-movers and latecomers, in order to sustain enterprises within the electronics and IT industry, must develop organizational capabilities based on technical, functional (development, production, and marketing), and managerial knowledge.[3] Consistent with this central thesis, other scholars have repeatedly documented that for a latecomer to grow successfully into a dominant global player (think of Sony, Panasonic, Samsung, or LG), the firm must continue to expand into a wide range of higher value-adding activities, such as research and development (R&D) and marketing, going beyond product assembly and manufacturing.[4]

In the case of Taiwan's PC industry, most local firms did not develop capabilities in branding and marketing despite their technical know-how, manufacturing prowess, and size. As latecomers, leading firms in

[2] Alfred D. Chandler Jr., *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, Mass., 1990).

[3] Alfred D. Chandler Jr., Takashi Hikino, and Andrew von Nodenflycht, *Inventing the Electronic Century: The Epic Story of the Consumer Electronic and Computer Industries* (New York, 2001).

[4] Chandler's analysis is not without its critics. See Richard N. Langlois, "The Capabilities of Industrial Capitalism," *Critical Review* 5 (1991): 513–30, who finds Chandler's approach too narrowly focused on large corporations, underplaying the role of markets in economic growth. See Thomas K. McCraw, "Alfred Chandler: His Vision and Achievement," *Business History Review* 82 (Summer 2008): 207–10 and Marie Anchordoguy, "Chandler and Business History in Japan," *Business History Review* 82 (Summer 2008): 301–9, who discuss criticism of Chandler for overemphasizing older hardware companies such as IBM. On the changing structure of the industry, see Richard N. Langlois, "The Vanishing Hand: The Changing Dynamics of Industrial Capitalism," *Industrial and Corporate Change* 2 (Apr. 2003): 351–85; S. H. Chen, "Global Production Networks and Information Technology: The Case of Taiwan," *Industry and Innovation* 9 (Dec. 2002): 249–65; James Curry and Martin Kenney, "Beating the Clock: Corporate Responses to Rapid Change in the PC Industry," *California Management Review* 42, no. 1 (1999): 8–36; and Jason Dedrick and Kenneth L. Kraemer, "The Impacts of IT on Firm and Industry Structure: The Personal Computer Industry," *California Management Review* 47 (Spring 2005). Chandler's critics notwithstanding, the creation and maintenance of organizational capabilities remains a central issue in the growth of large firms. We therefore take this issue as a starting point for our analysis. See also Dedrick and Kraemer, *Asia's Computer Challenge: Threat or Opportunity for the United States and the World?* (New York, 1998); Jen-shih Lee, *Biomedical Engineering Entrepreneurship* (Singapore, 2010); Terence Tsai and Bor-Shiuan Cheng, *The Silicon Dragon: High-Tech Industry in Taiwan* (Cheltenham, 2006).

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Taiwan successfully occupied top positions as component suppliers and contract manufacturers in the global market.[5] Yet these technologically-driven organizations focused only on a narrow set of business operations and consequently suffered shrinking margins.[6] (In 2010, the net margins of contract manufacturing ranged from −0.9 to 3.7 percent after a long and steady decline since the mid-1990s, when margins exceeded 15 percent.) Taiwanese companies thus saw developing global brands as a means to restore profitability and even a national priority.[7] Meanwhile, continuous outsourcing "hollowed out" international branded PC companies, exemplified by HP and Dell.[8] Most of them have long deemphasized R&D activities, or ceased to manufacture their PCs, retaining little unique understanding of the underlying technologies.

Two questions arise from observation of this phenomenon: What caused leading firms in Taiwan to remain locked in the path of remaining component suppliers and contract manufacturers without successfully developing capabilities in branding and marketing despite demonstrating the intention of doing so? What did exceptional firms such as Acer do differently, enabling them to develop global brands?

The literature that examines the ascendancy of global IT firms from "latecomer countries" is vast.[9] These studies point out the roles the state and local governments played in shaping the entrepreneurial activities carried out by individual firms. Financial, regulatory, and educational conditions—when properly aligned—can provide considerable advantages for local firms from latecomer countries and help them penetrate the global market, even in a highly mature industry.[10] But because in-depth

[5] Alice Amsden and Wan-wen Chu, *Beyond Late Development: Taiwan's Upgrading Policies* (Cambridge, Mass., 2003).

[6] Edward Steinfeld, *Playing Our Game: Why China's Rise Doesn't Threaten the West* (New York, 2010). *CommonWealth,* 15 Aug. 2003, 180–83, and 1 Sept. 2003, 160–65; *TechVantage* (June 2005): 60–66.

[7] We found strong evidence that Taiwanese companies exhibited the strategic intent to forward integrate by developing branding and marketing capabilities to restore their former profitability. This article seeks to understand what external constraints Taiwanese firms faced during the capability building process and why some were able to break away from those constraints while others were not. "Acer Head Stresses Branding at Taipei Business Seminar," *Taipei Times*, 6 Oct. 2008.

[8] Clayton Christensen and Michael Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Boston, 2003). Gary Pisano and Willy Shih, "Restoring American Competitiveness," *Harvard Business Review* 87 (2009): 3–14.

[9] See Amsden and Chu, *Beyond Late Development;* Suzanne Berger and Richard K. Lester, *Global Taiwan: Building Competitive Strengths in a New International Economy* (Armonk, N.Y., 2005); Linsu Kim, *Imitation to Innovation: The Dynamics of Korea's Technological Learning* (Boston, 1997).

[10] See Dan Breznitz, *Innovation and the State: Political Choice and Strategies for Growth in Israel, Taiwan, and Ireland* (New Haven, 2007), a cross-country account of the ways production and innovation are now conducted globally. See also Richard R. John, *Network Nation: Inventing American Telecommunications* (Cambridge, Mass., 2010). For a more

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studies usually focus on a single country, studies have paid less attention to the interactive dynamics of how latecomer firms struggled with established multinationals in the global marketplace.

Therefore two questions remain: What circumstances have allowed established companies to maintain their global dominance despite their lack of unique technical know-how (e.g., HP and Dell)? How can a one-time resource-poor, technologically-deficient firm from a latecomer country overcome the industry status quo?[11] To answer these questions, we need to examine the development path of latecomer firms against the changing influence exerted by established companies that have so far dominated the global market.[12]

The historical evolution of Taiwan's PC industry reveals that interactions with established companies in the West, in addition to local competition, decisively shaped local firms' capability development. Initially, the market environment favored entrepreneurs who had been focusing on production scale and manufacturing efficiency. Rather than succumbing to an inherited cultural aversion to risk-taking, successful Taiwanese entrepreneurs rapidly scaled up their organizations and sought volume orders as component suppliers or contract manufacturers from international branded PC firms—a survival imperative given the absence of a sizable domestic market. But with the standardization of PC-product architecture, the end market consolidated. International branded PC firms then used their heightened bargaining power to exert tighter controls over their Taiwanese suppliers, effectively depriving them of the necessary resources to engage in other nonmanufacturing activities over the long run. Consequently, leading Taiwanese firms continued to grow dramatically but could not develop capabilities in branding and marketing.

The few firms that successfully developed global brands had carefully pursued a dual strategy: distributing their own-brand products while simultaneously providing contract-manufacturing services, thereby seizing the fleeting window of opportunity to undertake an alternative development path before international branded PC firms could exert an overwhelming influence in Taiwan. The strategic vision of these

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focused discussion about the PC industry in Taiwan, see Kenneth L. Kraemer et al., "Entrepreneurship, Flexibility, and Policy Coordination: Taiwan's Computer Industry," *Information Society* 12, no. 3 (1995).

[11] Implicitly, we are adopting the definition of entrepreneurship put forward by business scholar Howard Stevenson that "entrepreneurship is the pursuit of opportunity beyond the resources you currently control." See Howard H. Stevenson and David E. Gumpert, "The Heart of Entrepreneurship," *Harvard Business Review* (Mar.–Apr. 1985): 85–94.

[12] See Walter A. Friedman and Geoffrey Jones, "Business History: Time for Debate," *Business History Review* 85 (Spring 2011): 1–8, which calls for comparative studies among firms or countries.

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firms' top management rather than near-term economic calculation determined the pursuit of this important strategy.

Figure 1 displays the historical evolution of leading Taiwanese companies in their attempt to develop global brands.[13] Beside Acer, the world's fourth largest PC brand in 2010, ASUSTek, MSI, and Gigabyte were the largest motherboard makers in the world.[14] Quanta and Compal were the largest laptop contract manufacturers.[15] Together, they constituted more than half of global shipment volume.

This article is organized into five sections. By examining in detail the historical evolution of leading firms within the motherboard sector, the first section describes how Taiwan came to dominate the component market. The second section examines Taiwan's contract manufacturers within the laptop sector. The third introduces Acer and ASUSTek, arguably the only PC companies in Taiwan to have meaningfully achieved the status of branded PC firms in the global market. The fourth and final sections explain the relationship between industry life cycle and capability

[13] The information on Taiwan's PC industry is fragmented; many materials are written in Chinese. To develop a coherent narrative that goes beyond the existing literature, much of the data used in this article was originally published in *CommonWealth* magazine and *DIGITIMES*, the two leading business publications in the Chinese-speaking region that have covered Taiwan's PC industry continuously since the late 1970s. Moreover, we conducted sixty-eight semistructured interviews (in English or Mandarin) between 2008 and 2010 to understand the strategy process inside each firm. Informants were CEOs or corporate executives; general managers; and operating managers or functional specialists. The authors also consulted numerous books in Chinese on Acer and ASUSTek (including a book-length manuscript that is only distributed internally at the firm).

Some of the sources consulted on Acer include: 施振榮, *全球品牌大戰略: 品牌先生施振榮觀點*, 台北: 天下雜誌 (2005) [Stan Shih, *Global Brand Strategy: Mr. Stan Shih Point of View* (Taipei, 2005)]; 周正賢, *施振榮的電腦傳奇*, 台北: 聯經出版公司 (1996) [Zhou Zhengxian, *Stan Shih: The Computer Legend* (Taipei, 1996)]; 施振榮, *宏碁的世紀變革: 淡出製造、成就品牌*, 台北: 天下文化 (2004) [Stan Shih, *Acer Century Change: Fade Manufacturing, Brand Success* (Taipei, 2004)]; 施振榮, *再造宏碁 (全新增訂版): 開創、成長與挑戰*, 台北: 天下文化 (2004) [Stan Shih, *Recycling Acer (New Updated Version): To Create Growth and Challenges* (Taipei, 2004)]; 王樵一, *施振榮: 逆境再起*, 台北: 新苗 (2007) [Wang Qiao, *Stan Shih: Adversity Renewed* (Taipei, 2007).]

On ASUSTek: 伍忠賢, *華碩馬步心法: 施崇棠的策略雄心*, 台南圖書出版股份有限公司 (2007) [Wu Zhongxian, *Asus Strategy: Jonney Shih Policy Ambitions* (New York, 2007)]; 周芳苑, *華碩傳奇首部曲: 施崇棠與華碩四傑創業兩千億紀事*, 台北: 商訊 (1999) [Zhou Wanfangyuan, *Asus Legend: Shih and ASUS's Four Founders* (Taipei, 1999)]; 華碩電腦財會處: *千年暗室一燈即明華碩大分割* (internal use only, 2008) [ASUSTek Computer Accounting Office, *Asus Large Partition* (internal use only, 2008)].

[14] In 2010, Acer and ASUSTek's laptops ranked fourth and fifth respectively in global shipment volume, surpassing household names such as Sony, Samsung, and Toshiba in the PC sector. Stephen Shen, "Worldwide PC Shipments Increase 2.3% in 2Q10, Says Gartner," *DigiTimes*, 15 July 2010. Ricky Morris, "Taiwan Motherboard Industry Overview," *DigiTimes* (2009).

[15] Nichole Huang, "The Greater Chinese Notebook PC Industry," *Market Intelligence Center* (2008).

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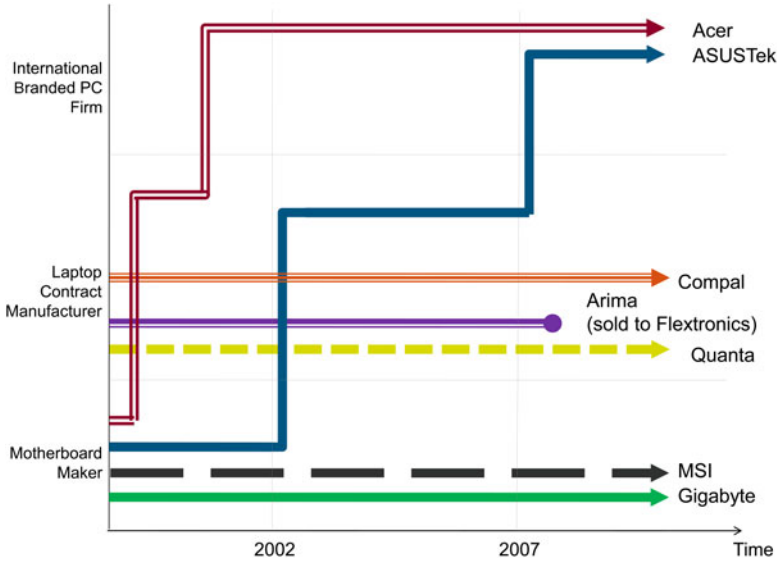

Figure 1. Varying development paths undertaken by leading Taiwanese companies. (Sources: Compiled by authors from annual reports, *Commonwealth*, *DigiTimes*, and interviews.)

development among latecomer firms, highlighting the temporal limit of certain development paths.

The Motherboard Sector

The PC is a remarkably complicated product, yet its assembly process is one of the simplest in modern manufacturing. Standard components include motherboards, connectors, power supplies, optical disk drives (CD-ROMs), monitors, keyboards, and mice. Suppliers of motherboards—the physical and electrical foundations of a PC—exemplify the typical growth path of component suppliers in Taiwan.[16]

There is little consensus on the exact launch date of the first PC.[17] But from the outset, leading PC manufacturers, especially IBM, published technical diagrams and detailed documentation of their machines,

[16] A motherboard is the central printed circuit board of a PC. All other components are connected to it, and its job is to relay information between them.

[17] Arguably, Xerox's PARC (Palo Alto Research Center) developed the first PC in 1973, even though the firm failed to capitalize on its invention. See Douglas Smith and Robert Alexander, *Fumbling the Future: How Xerox Invented, Then Ignored, the First Personal Computer* (New York, 1988). Steve Jobs famously took the graphical user interface that Xerox had pioneered and implemented it on Apple's machines, propelling Apple to a leading PC manufacturer. By the time the first IBM PC was launched in 1981, earlier incumbents such as Tandy Corporation (Radio Shack) had quickly exited the industry.

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which permitted rapid reverse engineering and the replacement of their original motherboards.[18] Most importantly, IBM contracted with two upstarts at the time, Microsoft and Intel, to develop the critical operating system and microprocessors for the IBM PC and allowed them to license their technologies to other companies.[19] While IBM had inadvertently given away control of its own creation, the open standards of the IBM PC architecture also lowered entry barriers, allowing thousands of new companies to enter the computer business, making everything from keyboards to spreadsheet programs.[20] Many third-party motherboards in Taiwan, while compatible with the dominant standard, offered additional performance or product features for upgrading a computer.[21]

Many small Taiwanese firms began producing motherboards in the late 1970s, taking advantage of their low labor costs. Initially, they were only capable of carrying out the most basic job of manufacturing according to specifications, supplying motherboards to international branded PC firms for repackaging or relabeling. This sector was widely known as the original equipment manufacturer (OEM) business. It emerged in the late 1980s and eventually dominated Taiwan's IT industry. Small firms attained the required economies of scale because of the volume orders from international branded PC firms when the rapid growth of the global PC market generated ongoing OEM orders from American, European, and Japanese PC manufacturers.

The ample business opportunities encouraged many new entrants. In 1992, Taiwan's motherboard makers together comprised 68 percent of the global market share in motherboards, making Taiwan the number-one producing country worldwide.[22] However, the steady growth of the motherboard sector came to an abrupt end in 1995 when Intel went public with its plans to scale up its motherboard business.[23] Intel's target was to make 10 million motherboards per year, equivalent to 1994's total worldwide production.[24] At the time, Intel's two major customers, IBM and Compaq, who were still selling computers based on Intel's previous 80486 processor, showed little interest in introducing

[18] Henry W. Chesbrough and David Teece, "Organizing for Innovation: When Is Virtual Virtuous?" *Harvard Business Review* 74 (1996): 65–73.

[19] When IBM solicited Microsoft to develop an operating system, Bill Gates bought out a local software house, put the finishing touches to its operating system, and sold it to IBM as PC-DOS. In what turned out to be its biggest strategic mistake, IBM allowed Microsoft to license DOS to other computer makers as MS-DOS without sharing royalties with IBM. See Dedrick and Kraemer, *Asia's Computer Challenge*, ch. 2.

[20] Dedrick and Kraemer, *Asia's Computer Challenge*, 50–70.

[21] Paul Ceruzzi, *A History of Modern Computing* (Cambridge, Mass., 1998).

[22] *CommonWealth*, 1 Jan. 1994, 191. Chung-Shing Lee and Michael Pecht, *The Taiwan Electronics Industry* (Boca Raton, 1997), 83.

[23] "'Intel Inside' Now Means More Than Just CPU," *Newsbytes*, 3 Nov. 1995.

[24] *CommonWealth*, 1 Dec. 1997, 162–68.

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Pentium processor–based machines. By developing its own Pentium-compatible motherboards, Intel was able to appeal to smaller PC manufacturers, which initially lacked the technological sophistication to work out their own system designs but were eager to secure market advantages by adopting the Pentium processors early on.[25] Other major PC manufacturers, including HP, Gateway, and Dell, subsequently followed suit and sourced Pentium-compatible motherboards directly from Intel in order to introduce the next generation of PCs more quickly.[26]

With deep pockets that allowed aggressive investment in production facilities, Intel became the largest motherboard manufacturer in the world after only one year of operation.[27] This development caused severe stress to Taiwanese motherboard makers, which had hitherto supplied four out of every five motherboards worldwide to companies that did not make their own. Because Intel had already commanded an 80 percent share of the world's PC microprocessor market, no independent motherboard maker could meaningfully switch to an alternative microprocessor supplier. Motherboard makers were forced to take up the new Pentium chips.

Many "mom-and-pop" shops could not keep abreast of the latest technology and disappeared. Firms without technologically savvy top management went under. In 1990, approximately one hundred Taiwanese companies produced motherboards. By 1995, only twenty remained.[28] From a global market share of 80 percent a year before, shipments from Taiwan dropped to 65 percent.[29]

Fortunately for the surviving Taiwanese companies, after one year and a peak production level of 6 million units per year, Intel pulled back.[30] Some observers believed Intel lacked the necessary process engineering and cost advantages to sustain a profitable motherboard business. The industry press reported that Andrew Grove, Intel's former CEO, was surprised by the level of manufacturing sophistication when he visited Taiwan and saw many leading-edge surface-mount technology (SMT) facilities installed in Taiwanese factories.[31] Although making motherboards had never been as profitable as making microprocessors for Intel, its aggressive expansion into the area, albeit temporary, enabled Intel to accelerate the industry transition from 80486 to Pentium. It also ensured the ongoing cooperation of the surviving

[25] Robert Burgelman, *Strategy is Destiny: How Strategy-Making Shapes a Company's Future* (New York, 2002), 219, 253.

[26] *CommonWealth,* 1 Nov. 1995, 142–47.

[27] Ibid.

[28] "Two of Taiwan's Most Hated Words: Intel Inside," *Businessweek*, 9 Oct. 1995.

[29] *CommonWealth,* 5 June 1996, 148–49.

[30] *CommonWealth,* 1 June 1998, 146–52.

[31] *TechVantage* (July 2001): 94–100.

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Table 1
Introduction Dates of Selected Intel Microprocessors

Year	*Generation*	*CPU Clock Speed*
1985	Intel 386™ Microprocessor	16 MHz
1989	Intel 486™ DX CPU Microprocessor	25 MHz
1993	Intel® Pentium® Processor	60 MHz
1995	Intel® Pentium® Pro Processor	200 MHz
1997	Intel® Pentium® II Processor	333 MHz
1999	Intel® Pentium® III Processor	500–1100 MHz
2001	Intel® Pentium® 4 Processor	1.5 GHz
2002	Intel® Mobile Pentium® 4 Processor-M	1.7 GHz
2002	Intel® Pentium® 4 Processor with Hyper-Threading Technology	3.06 GHz
2006	Intel® Core™ Duo Processor	2.0 GHz
2007	Intel® Core™2 Quad	2.4 GHz
2008	Intel® Atom™ Processor	800 MHz–1.7 GHz

Source: Intel Corporation company website, http://www.intel.com/pressroom/kits/quickrefyr.htm, accessed 23 Jan. 2010.

motherboard makers in Taiwan, allowing Intel to fend off competitors (principally AMD) more effectively through rapid product migration. Intel thus gained control of the pacing of new product introduction for its microprocessors.[32] Table 1 illustrates the quickening life cycle of central processing units (CPUs) manifested by this time-paced strategy.[33]

As Intel quickened the pace of technological progression for its microprocessors, leading motherboard makers that focused on technological innovation also did extremely well. When Intel launched its Pentium 4 processor in 2001, industry analysts estimated that profit margins derived from the latest motherboards were as high as 30 percent.[34] ASUSTek, ECS (Elitegroup Computer Systems), Gigabyte, and MSI

[32] For Intel to double the number of transistors on integrated circuits approximately every two years, technical breakthrough was not sufficient. Intel had to induce (or even coerce) its partners within the PC industry to commercialize its technologies. See Annabelle Gawer and Rebecca Henderson, "Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel," *Journal of Economics and Management Strategy* 16 (Spring 2007).

[33] Microsoft's rapid product upgrades met the increase of PC computer power propelled by Intel. Microsoft relied on upgrades to drive profits: Between 1989 and 1994, roughly 32 percent of Microsoft's customers opted to upgrade on interim releases (e.g., 2.0 to 2.1), while nearly 75 percent upgraded on major releases (e.g., 2.0 to 3.0). Windows 3.1, Windows 95, and Windows NT cost millions of dollars each to develop, but the marginal cost of each new copy was just a few dollars. Meanwhile, as more users adopted Windows and more software developers wrote applications for Windows, the marginal value of each new copy of Windows actually grew.

[34] ASUSTek's average profit margin was around 23 percent during the period; "Growing Influence," *TechVantage* (July 2001): 94–100.

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(Micro-Star International) emerged as the "big four." Tellingly, engineers founded all these firms.[35] Many of the founders had even worked with competitors before their personal forays into the industry.

ASUSTek: The Archetypical Motherboard Maker. Four engineers from the pioneering Acer Incorporated—T. H. Tung (童子賢), Ted Hsu (謝偉琦), Wayne Hsieh (徐世昌), and M. T. Liao (廖敏雄)—founded ASUSTek in 1989. The company soon became the world's largest motherboard maker. Aspiring to build a "small but beautiful" company, ASUSTek's founders designed and manufactured motherboards that used the Intel 80386 microprocessor, which represented the high end of the PC market at the time.[36] When Intel announced the 80486, ASUSTek developed its own 486 motherboard without having the processor prototype in hand, using only the technical design data that Intel made available.[37] The four founders later took their motherboard to Intel's Taiwan office for testing. Not only did ASUSTek's design work extremely well, the founders also helped Intel debug its own official design.[38] Within a month of this news, orders for ASUSTek's 486 motherboard flooded in, putting ASUSTek in a market leadership position for almost a year. This collaboration marked the beginning of a long-lasting partnership between ASUSTek and Intel.

The strong technical orientation of top management continued through the second generation. Jonney Shih, who had also worked at Acer for the previous fifteen years, joined ASUSTek in 1992 as chairman and CEO. The original founders continued as vice chairmen of the company. Deeply passionate about technology, Shih regularly taught employees advanced electronics theories and helped design new motherboards.[39] He constantly reminded his executives to go beyond superficial know-how and grasp what he termed "know-why."[40] Shih saw superior technological understanding as the prerequisite for senior leadership in order to elicit cooperation from lower-level managers.[41] Under

[35] In 1986, former Sony engineer Joseph Hsu, along with four other colleagues, set up MSI. In 1989, four former engineers from Acer started ASUSTek. Three years later, Jonney Shih, who had also been working at Acer, joined ASUSTek as CEO and has stayed with the company ever since. At Gigabyte, CEO Danny Yeh and four other founders of the company were engineers by training.

[36] 伍忠賢, *華碩馬步心法: 施崇棠的策略雄心*, 台灣: 達人館 (2006), 90 [Z. X. Wu, *Asus Strategy: Jonney Shih Strategic Ambitions* (Taiwan, 2006), 90].

[37] Chyong Ling Judy Chen and Susan Margaret Belcher, "The Importance of Absorptive Capacity in the Road to Becoming a Giant Lion: ASUSTek Computer, Inc.," *Global Economic Review* 39, no. 3 (2010): 291–315.

[38] Interview with Joe Hsieh, General Manager, Motherboard Business Unit, ASUSTek Computer, Inc., 13 Jan. 2009.

[39] *CommonWealth,* 5 June 1996, 72–74.

[40] *CommonWealth,* 1 Dec. 2001, 64–71.

[41] *CommonWealth,* 1 Feb. 1998, 60–70.

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Shih's leadership, the company dedicated 10 percent of its total personnel to R&D—the highest rate in the industry. New hires typically went through a half-year, three-module training program. Upon completing the formal training, newly minted engineers worked as apprentices on various R&D projects.[42]

Beyond motherboards, ASUSTek also developed other related technical capabilities.[43] For example, while most motherboard makers relied on third-party vendors to supply the basic input/output system (BIOS), a critical piece of software a PC runs when powered on, ASUSTek insisted on building its own, using an in-house development team. The firm expanded its expertise in computer peripherals, multimedia, and silicon-chip design.[44] With the breadth of its knowledge base, ASUSTek possessed flexibility in product customization. The firm routinely introduced additional features on its motherboards, incorporating functions that expansion cards had previously supplied. Therefore, when Intel began its rapid expansion into the motherboard business, ASUSTek was able to maintain product differentiation through its leading technical capabilities.

ASUSTek's corporate slogan, "Rock-Solid Quality," embodied its efforts to cultivate a quality-conscious division with superior understanding of the underlying technology. The firm was so concerned with quality and capability that it reportedly even scheduled a new R&D vice president to attend a year of technical training despite the new hire's personal reputation and technical proficiency. Building on Andy Grove's famous quote, "Only the paranoid survive," Shih once observed, "If you want to be number one, is there any difference between being perfectionist and paranoid?"[45]

Designed in Taiwan, Made in China. To lower manufacturing costs, leading motherboard makers sought to relocate production facilities to China.[46] "Designed in Taiwan and made in China" became the new paradigm.[47] By 2000, top motherboard makers had generally located more than 20 percent of their production offshore. The rising complexity of the production system required companies to pay more attention to the information exchange, organization coordination, and manufacturing processes. Motherboard makers thus invested heavily in

[42] *CommonWealth,* 1 Dec. 2001, 64–71.
[43] *CommonWealth,* 5 June 1996, 72–74.
[44] Interview with Joe Hsieh.
[45] "Jonney Shih," *BusinessWeek*, international edition, 29 June 1998.
[46] "Taiwan Mainboard Makers Increasing Production in China," *DigiTimes,* 18 Oct. 2000.
[47] "Motherboard Makers Accelerate the 'Designed in Taiwan and Made in China' Trend," *DigiTimes*, 4 Jan. 2001.

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information-technology systems, including enterprise-resources planning, order management, and shop-floor automation systems. Many of them also used interorganizational systems and other web-based technologies to communicate with suppliers, customers, and logistics specialists.[48] Intense competition and growing needs for scale-intensive investment drove industry consolidation. By the early 2000s, the "big four" each achieved a monthly capacity of over one million units, claiming a 60 percent share of motherboard shipments produced from Taiwan.[49] These companies not only achieved leading technical capabilities in bringing out the latest products, but also matured in terms of manufacturing capabilities to manage large-scale production systems. Taiwan as a whole accounted for 101 million of the 120 million motherboards shipped in 2000, representing approximately 84 percent of the world market share.[50]

The Laptop Computer Sector

Around the same time, Taiwan also emerged as the dominant supplier for laptop computers. Compaq launched the first "luggable" computer in 1982. It had the same hardware as an IBM PC, but transplanted into a portable case. Compaq sold 53,000 units within the first year and set revenue records for American businesses in its first three years of operation.[51] The firm's success led other desktop PC makers such as IBM, Apple, Toshiba, and Epson to launch their own portable computers.[52] The stellar growth of laptop computers attracted the attention of many new Taiwanese entrants, which initially sought to work with international branded PC companies as contract manufacturers. Among these new entrants, former pocket calculator manufacturers boasted the strongest manufacturing capabilities at the time.

Pocket calculators, based almost entirely on imported components with the exception of plastic housings and printed circuit boards, represented the most assembly-driven electronic product. Early on, local firms often imitated foreign (primarily Japanese) calculator models through

[48] *CommonWealth*, 1 Feb. 1999.

[49] "Analysis of Merger Trend among Second-Tier Motherboard Makers," *DigiTimes*, 29 Nov. 2000, and "First-Tier Motherboard Makers Battle among Themselves for Market Share," *DigiTimes*, 8 May 2001.

[50] "Taiwan's Share of Global Motherboard Market Exceeds 80%," *DigiTimes*, 2 Jan. 2001.

[51] Steve Hamm, *The Race for Perfect: Inside the Quest to Design the Ultimate Portable Computer* (New York, 2008), 52.

[52] Tom Forester, *High-Tech Society: The Story of the Information Technology Revolution* (Cambridge, Mass., 1987), 144–45.

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reverse engineering and sold final products to American importers.[53] In terms of the sheer number of units manufactured, calculators towered over Taiwan's other early (principally electronic) products. By 1987, Taiwan was making 60 million calculators per year, surpassing Japan as the top producer worldwide.[54] Having succeeded against stiff competition, Taiwanese calculator manufacturers mastered the skills of miniaturization—integrating numerous parts and components into a small space. However, rather than competing through their own brands, Taiwan's calculator manufacturers relied heavily on large contracts from Japan to sustain their volume business.[55] To drive down production costs, Taiwanese companies soon moved manufacturing offshore to Southeast Asian countries, such as Thailand and Malaysia.[56]

Like building calculators, manufacturing laptops required specialized skills in design integration and miniaturization.[57] The product architecture of a laptop was much less standardized than a desktop PC, particularly during the early stage of the industry life cycle. The specific performance dimensions of a laptop, such as weight, battery life, and overall system stability, depended as much on proprietary system designs and layouts as on the performance of the individual components. Within a confined space, manufacturers needed to decide how to cram in all the necessary components and control both thermal effects and electromagnetic interference.[58] A deep understanding of the interactions among components within a system was therefore critical.

Quanta, Compal, and Inventec: The Archetypical Laptop Manufacturers. Barry Lam (林百里), the founder of Quanta, and Yeh Kuo-yi (葉國一), the founder of Inventec, both worked at Santron Electronics, a contract manufacturer that produced electronic calculators.[59] At the time, Lam worked as the chief engineering officer, and Yeh worked as the chief financial officer. They later approached a wealthy entrepreneur, C. Y. Hsu (許潮英), for seed money and set up another calculator company, Kinpo Electronics (金寶). In 1975, Yeh left Kinpo and founded a third calculator company, Inventec.[60]

[53] Amsden and Chu, *Beyond Late Development,* 31–32.

[54] *CommonWealth,* 1 Apr. 1991, 168.

[55] Amsden and Chu, *Beyond Late Development,* 32.

[56] Dennis J. Encarnation, *Japanese Multinationals in Asia: Regional Operations in Comparative Perspective* (New York, 1999), 273.

[57] *CommonWealth,* 1 Apr. 1999, 34–38.

[58] *CommonWealth,* 14 Sept. 1999, 248–52.

[59] Amsden and Chu, *Beyond Late Development,* 28–30.

[60] 陳志成, "個人電腦工業垂直分工產業結構之形成: 資源限制假說之驗證," *國立中央大學博士論文,* 2005, 113–15 [C. S. Chin, "The Formation of the Industrial Structure of the PC Industry Vertical Division of Labor: Resource Constraints Hypothesis Verification," National Central University Ph.D. diss., 2005, 113–15].

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Starting in the mid-1980s, calculator giants such as Inventec and Kinpo aggressively built their laptop operations. Kinpo set up Compal as a direct subsidiary to make laptops.[61] Lam left Kinpo shortly after and founded Quanta, which eventually became the largest laptop manufacturer worldwide.[62] The ability to ramp up rapidly and use manufacturing discipline to overcome low profit margins allowed these fledgling laptop companies to land large contracts from international branded PC firms. Using their design and assembly competencies, these contract manufacturers came to dominate the laptop sector, achieving sufficient scale to displace other local incumbents. Contract manufacturers Quanta and Compal emerged as the top two, followed by Wistron and Inventec.[63] Taiwan's laptop industry as a whole went from a 40 percent share of the global market in 1998 to a dominant position of 72 percent in 2004 and 91 percent in 2009.[64]

Because of the close collaboration with international branded PC firms, contract manufacturers benefited from continuous technology transfer.[65] Over time, leading firms gradually transformed themselves from pure contract manufacturers into original design manufacturers (ODMs). In the previous OEM arrangement, international branded PC firms provided detailed technical specifications and drawings and spelled out the exact component requirement as a production specification. When Taiwanese manufacturers became ODMs, they took on additional responsibilities for technical design and component procurement, becoming more involved in the design aspects of the laptops they manufactured. Having offloaded this less profitable side of their operations, international branded PC firms focused on marketing activities and performance metrics for quality control. As epitomized by Dell, leading branded PC firms often invested very little in actual mechanical and electronic R&D, relying instead on contract manufacturers to innovate and design the next generation of laptops.[66] HP, on the verge of shutting down its laptop division in 1999, outsourced the entire business

[61] 今周刊, 退休、紅酒、枕邊人 面板鐵嘴陳瑞聰的三十年職涯夢 4 May 2008 ["Retirement, Red Wine, Three Decades of Dreams," *Business Today*, 4 May 2008].

[62] Interview with Ted Chang, Executive Assistant to the Chairman and CEO, Planning and Program Office, Quanta Research Institute, Quanta Computer, Inc., 15 Sept. 2010.

[63] Wistron was a contract manufacturer spun off by Acer. The subject is covered in the following section. "Taiwan Notebook Industry Overview," *DigiTimes*, 11 Jan. 2005.

[64] Breznitz, *Innovation and the State*, 113. Joseph Tsai, "Taiwan Notebook Industry Overview," *DigiTimes*, 25 Aug. 2009.

[65] Dell, for example, went so far as to send in its corporate consultants to work with Compal for over eighteen months. According to the local managers, "Dell was into our pants the whole time." Interview with Steve Kung, CTO, Senior Vice President, Compal Electronics, 10 June 2010.

[66] Kenneth Kraemer, Jason Dedrick, and Sandra Yamashiro, *Refining and Extending the Business Model with Information Technology: Dell Computer Corporation* (Irvine, 2000).

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operation to several Taiwanese firms. The outsourced services included hardware assembly, software installation, product testing, final packaging, and direct shipment to customers.[67] Similarly, IBM announced in 2002 that it would no longer manufacture any laptops—the only physical relationship it had with the computer was the IBM badge that contract manufacturers affixed to the machine.[68] As international branded PC firms progressively hollowed out and ceased to engage in R&D activities and manufacturing processes, they retained very little unique understanding of the underlying technologies. Meanwhile, contract manufacturers from Taiwan improved both their manufacturing capabilities in managing large-scale production as well as their technical capabilities in developing new products.

The early successes of leading laptop manufacturers and motherboard makers can therefore be attributed to their strong manufacturing and technical capabilities, especially their ability to miniaturize laptops radically or to develop motherboards according to Intel's quickening schedule. Competitive pressures drove companies to allocate increasing resources in areas that would achieve greater scale and efficiency improvements in order to lower production costs. That sense of urgency in Taiwan is vividly expressed in a corporate fable printed on the welcome card that Quanta gave to new hires during employee orientation:

> When the sun rises every morning, a gazelle in the jungle starts running because he knows that he will be breakfast if he cannot outrun the lion. The lion also runs early because he knows that he will starve if he is always late.[69]

As the industry continued to consolidate, firms that lost sight of manufacturing quickly fell behind. Those that still devoted significant resources to marketing activities were exceptional, often guided by a strategic vision rather than being influenced by any near-term economic calculation. Acer and ASUSTek are the rare examples.

Acer and ASUSTek: Developing Global Brands by Pursuing a Dual Strategy

The initial name of Acer was Multitech when Stan Shih (施振榮), his wife Carolyn Yeh, and a group of five developers first established it in 1976. With a startup capital of $25,000 and eleven employees, they set

[67] "Quanta's Quantum Leap," *BusinessWeek*, 5 Nov. 2001.

[68] James Curry and Martin Kenney, "The Organizational and Geographic Configuration of the Personal Computer Value Chain," in *Locating Global Advantage*, ed. Martin Kenney and Richard Florida (Stanford, 2003), 113–41.

[69] *CommonWealth*, 15 Dec. 2003, 98.

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up an office at Hsinchu City, Taiwan. The company started out as a distributor of electronic parts and as a microprocessor technology consultant but quickly evolved into a manufacturer of personal computers. The company incorporated as Acer in 1987, a name meaning "acute" or "sharp" in Latin.

Like other local firms, Acer took advantage of cheap labor and rent in Taiwan. It grew steadily throughout the 1980s, building its reputation as a contract manufacturer for U.S.-based computer makers such as Unisys and Texas Instruments.[70] It also marketed its own brand by manufacturing IBM-compatible personal computers based on the Intel microprocessor.

To overcome its initial capital constraints, Acer created a loose alliance among its employee-owners, supplier-partners, and distributors, allowing it to expand its brand presence in Europe, which received less attention from U.S.-based computer makers at the time.[71] Unlike North Americans, Europeans paid less attention to U.S. brands.[72] Although the diversity of populations and cultures on the continent might have played a role, the scale of the distributors was crucial. Fragmented and smaller in size, European distributors were more receptive to the offerings of Taiwanese companies, and the relatively small size of European countries forced manufacturers to focus on one limited geographical region at a time, pilot market offerings, and adjust their strategy accordingly. In this respect, international leading brands, particularly those from the U.S. such as HP and Dell, were often at a disadvantage when they required tactical maneuvers, local customization, and fine-tuning.[73]

Acer created the "Uniload" assembly system, shipping pallets of snap-together parts and components from Taiwan by air or sea to assembly centers overseas. The final assembly of the PCs took place as close as feasible to the final consumers. Acer sent "perishable" components with short product life cycles, such as motherboards and memories, through airfreight carriers. It shipped "nonperishable" components, such as floppy disk drives and PC casings, by low-cost transport. Acer could therefore react to the changing import duties on high-tech products in various countries and rearrange product configurations quickly according to local market requirements. Local dealers were able to maintain

[70] *Far Eastern Economic Review*, 24 May 2001.

[71] Ernst Dieter, "What Permits Small Firms to Compete in High-Tech Industries? Interorganizational Knowledge Creation in the Taiwanese Computer Industry," DRUID Working Papers 98-3, DRUID, Copenhagen Business School, Department of Industrial Economics and Strategy/Aalborg University, Department of Business Studies (1998).

[72] "Taiwanese Notebook Makers Find Home in Europe," *DigiTimes*, 7 Feb. 2001.

[73] *CommonWealth,* 25 Oct. 2004, 118.

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low inventory levels while meeting customer demands.[74] By 1990, Acer had become the world's thirteenth largest PC maker in terms of production volume.[75]

Acer's dual approach—developing its own brand while providing contract-manufacturing services to other companies—turned out to be a difficult strategy to sustain.[76] Although the company aimed to achieve economies of scale by expanding the contract-manufacturing business and then leveraging its manufacturing base to support the fledgling brand, the day-to-day operations of the two businesses were vastly different, which incurred great organizational costs.

The know-how of contract manufacturing was mostly embedded in the production process. Tight quality controls, rigorous manufacturing disciplines, efficient assembly processes, and short production cycles were critical. Production workflows were highly codified with careful documentation (e.g., project updates or error reports) in order to maximize capacity utilization and minimize production surprises. Developing an international brand, by contrast, required a nuanced understanding of the local markets and meant developing organizational capabilities in branding, marketing, sales, distribution, and customer support. Rather than focusing on manufacturing, Acer needed to discern consumer demand and technology trends by collecting market intelligence on consumer tastes, prevailing quality, and acceptable price points.

A longtime believer in the value of brand building, Acer's founding CEO Stan Shih predicted that industry profits would move away from manufacturing to upstream research and development and downstream sales and marketing. He famously drew the "Shih's smiling curve" to illustrate his own theory at a time when little empirical data was evident (see Figure 2).

To develop an international presence, Acer organized itself along the "client-server" approach. By 1995, Acer was divided into eleven semi-independent business units. Five were regional business units (RBUs) serving Taiwan, North America, Europe, Latin America, and the rest of the world; they acted as profit centers with full autonomy and focused on sales and marketing overseas. The other six were strategic business units (SBUs) located in Taiwan responsible for developing products and providing corporate resources to the RBUs.[77] Under the "client-

[74] 施振榮, *再造宏碁: 開創成長與挑戰*, 台北: 天下文化 (1996) [Stan Shih, *Recycling Acer: Creating Growth and Challenge* (Taipei, 1996)].

[75] Linsu Kim and Richard R. Nelson, *Technology, Learning, and Innovation: Experiences of Newly Industrializing Economies* (New York, 2000), 148.

[76] Up to 40 percent of Acer's output was sold under contract manufacturing.

[77] Christopher A. Bartlett and Anthony St. George, "Acer America: Development of the Aspire," Harvard Business School Case 399-011, 1998.

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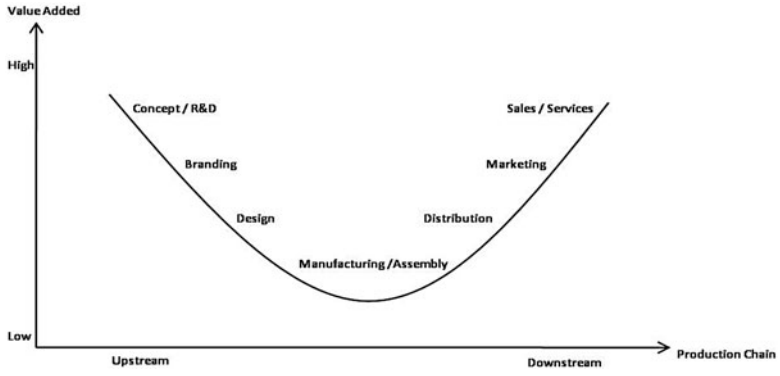

Figure 2. Stan Shih's smiling curve. (Source: Adapted from Stan Shih, *Me-Too is Not My Style* [Taipei, 1996], 202.)

server" model, each unit might buy from another unit at one time and sell to it at another. The idea was to create a network-style organizational structure rather than a hierarchical one. The firm's motto of "Global Brand, Local Touch" focused on creating favorable brand-name recognition around the world by tailoring products, services, and management style to local conditions at the country level.

While this approach allowed Acer to introduce many innovations, including the first multimedia home computer for the U.S. market in the mid-1990s—the stylish charcoal gray Aspire model—the firm's organizational structures and processes were far more complex than those of a pure contract manufacturer (contract manufacturing still represented 35 percent of Acer's revenues). The firm's overall profit margins, after deducting overheads and administration costs, were much lower than those of other leading contract manufacturers. Thus Stan Shih's own vision, which he passionately called the "dragon dream," appeared to be driving the company's persistent investment in brand building rather than tangible, near-term economic incentives.[78] Figure 3 shows the profitability comparison.

Similarly, when motherboard maker ASUSTek diversified into laptop computers in 1997, the firm did not emulate successful examples of other established contract manufacturers that relied on volume orders from international branded PC firms to exploit economies of scale. Rather, ASUSTek continued its emphasis on technological leadership by positioning its laptops for extreme performance, focusing only on

[78] Christopher A. Bartlett and Anthony St. George, "Acer, Inc.: Taiwan's Rampaging Dragon," Harvard Business School Case 399-010, 1998.

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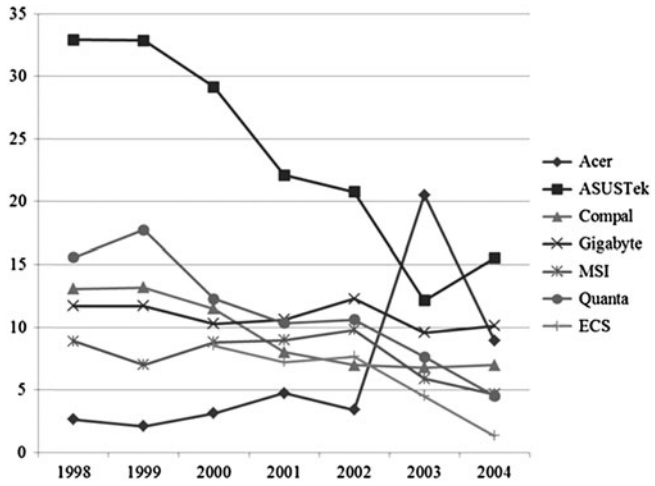

Figure 3. Profitability comparison. (Source: Compiled by authors using Bloomberg terminal.)

the premium segment of the market and distributing laptops under its own brand.[79] This strategy might have reflected the firm's founding principle of "quality over quantity."[80] The firm later became one of the first to integrate fingerprint recognition into laptops. In 1998, the Russian Federal Space Agency selected two ASUSTek laptops for a two-year space mission on the Mir Space Station. The Russians also used other brands on the mission, but only the ASUSTek laptops remained functional the whole time.[81]

ASUSTek, similar to Acer, made Europe its initial training ground to develop its branding and marketing capabilities. Limited by its marketing budget, ASUSTek relied on cultivating close relationships with local distributors. Synnex, ASUSTek's worldwide distribution partner, commended the company's "humbleness" when dealing with smaller clients and commented that it never exhibited any trace of "big-firm arrogance." Europe later became ASUSTek's largest laptop market. The company brand was ranked fifth largest in Eastern Europe, and the company was ranked sixth largest vendor in the Middle East and Africa by 2004. By 2006, Europe accounted for 60 percent of ASUSTek's branded laptops sold worldwide.

[79] "Emerging Markets: The Winners in a Losing Year," *BusinessWeek*, international edition, 1 July 1998.

[80] Interview with Tony Chen, COO and NB BU General Manager, ASUSTek Computer, Inc., 7 Jan. 2009.

[81] Wu, *Asus Strategy*, 94–95.

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Unintended Consequences of Product Standardization

The growing dependency of branded PC firms on suppliers' technology, which undermined the companies' technical know-how, actually increased their bargaining power over component suppliers and contract manufacturers in Taiwan. As most branded PC firms outside the U.S. (primarily European and Japanese companies) resisted outsourcing manufacturing, they were unable to achieve the same cost structure as their U.S. competitors. National champions—such as Olivetti in Italy, Groupe Bull in France, Siemens in Germany, ICL in Britain, and even NEC, Casio, and Hitachi in Japan—successively pulled out of the PC industry. Table 2 illustrates how non-U.S. brands continued to lose global market share. In addition, several megamergers (HP-Compaq, Lenovo-IBM, and Acer-Gateway-eMachines) consolidated the remaining industry into just a handful of giants.[82] This extreme industry concentration significantly raised the leading brands' bargaining power when they chose suppliers.

Moreover, the product architecture of a PC became increasingly standardized. In 1995, Intel introduced the "ATX" mechanical-form factor. The new standard made motherboards, computer cases, power supplies, and every other important component completely interchangeable. The standardization of the peripheral component interconnect (PCI) bus, accelerated graphics port (AGP), universal serial bus (USB), and multimedia extensions (MMX) precluded any meaningful innovation beside those of the microprocessor, rendering irrelevant many of the proprietary research activities of component suppliers.[83] Some industry analysts even predicted that motherboards would one day be reduced to bare, plug-and-play circuit boards.[84] But perhaps most damaging to contract manufacturers was the ubiquitous "Wintel" (Windows and Intel) platform that imposed uniform functionality across all PCs.[85] International branded PC firms saw little value in retaining exclusive relationships with contract manufacturers and component suppliers and could instead pursue business practices that allowed them to extract the remaining margins within the global supply chain.

At HP Labs, economists helped design auctions that exposed industry cost structures and identified the lowest cost vendor under

[82] Arik Hesseldahl, "Acer's Gateway to the U.S. Market," *BusinessWeek*, 28 Aug. 2007.

[83] Interview with Joe Hsieh.

[84] *CommonWealth,* 1 Mar. 1994, 102–10.

[85] In the early 1990s, Microsoft's most important investment was Windows 95, which was designed as a replacement for DOS and Windows 3.1 and only worked with Intel architecture microprocessors. It created a standard that allowed diverse applications to interact simultaneously without crashing and bundled programs such as networking software and Microsoft Mail that previously had been kept separate.

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Table 2
Global Ranking of PC Sales by Units, First Quarter

Ranking	*1990*	*1997*	*1999*	*2001*	*1Q, 2003*
1	IBM	Compaq	Compaq	Dell	Dell
2	Apple	IBM	Dell	Compaq	HP/Compaq
3	NEC	Packard Bell	IBM	HP	IBM
4	Compaq	NEC	Packard Bell	IBM	Toshiba
5	Toshiba	Dell	NEC	Fujitsu/Siemens	NEC
6	Olivetti	HP	HP		
7	Groupe Bull	Gateway	Gateway		
8	Fujitsu	Apple	Apple		
9	Unisys	Acer			
10	Commodore	Fujitsu			
11	HP				
12	Dell				
13	Packard Bell				
14	Gateway				

Source: Martin Kenney and Richard Florida, *Locating Global Advantage* (Stanford, 2004), 127.

different conditions.[86] On the online auction system, component suppliers bid to win business. To fuel competitive tension among component suppliers, the two- to three-hour-long auctions were often extended toward the end to accommodate a few extra rounds. Since these online auctions were usually not contractually binding, HP had room to further negotiate the purchase quantity. At times, online results were simply used as a starting point for further price negotiations with preferred suppliers.[87] By directly negotiating with component suppliers and monitoring the delivery of components used, international branded PC firms essentially eliminated any opportunity for contract manufacturers and component suppliers to hide any profits.[88] Former HP CEO Carly Fiorina even publicly stated that the company was willing to sacrifice the interests of its global suppliers to achieve lower retail prices.[89]

Moreover, leading branded PC firms regularly switched suppliers.[90] When a branded PC firm concentrated its volume orders with one supplier temporarily (say, for one or two years), that supplier would be under pressure to invest in additional production capacity to meet the projected volume.[91] Since it is more difficult to scale back a production facility once it is built (due to labor contracts and fixed long-term investments), regular switching among suppliers resulted in surplus manufacturing capacity in the industry, thereby increasing the buying power of branded PC firms.

An ironic dynamic thus evolved within the PC industry. As component makers and contract manufacturers in Taiwan rapidly scaled up to meet the demands of their U.S. clients, U.S. branded PC firms outcompeted their European and Japanese counterparts who had been reluctant to outsource manufacturing (see Table 2). As a result, U.S. companies had more bargaining power over Taiwanese suppliers, condemning them to razor-thin margins despite their successful business operations. Figure 4 shows the declining margins of pure contract manufacturers and component suppliers in Taiwan. One local manager lamented, "We have been too successful in feeding Frankenstein's

[86] Jamie Beckett, "The Business of Bidding: Reinventing Auctions for Better Results," http://www.hpl.hp.com/news/2005/jul-sep/auctions.html (accessed on 15 May 2009).

[87] *CommonWealth,* 1 Sept. 2003, 160–65. In a high-profile dispute in 2003, ASUSTek refused to fulfill all of the orders from a previous bidding. It was reported that the bid price per motherboard was $7 to $10 lower than the average production cost.

[88] "Dell Aims to Establish a New Model for Notebook Procurement," *DigiTimes*, 1 Dec. 2003.

[89] "HP's Fiorina Upsets Taiwan Suppliers," *DigiTimes*, 11 June 2003.

[90] Interview with Steve Kung, 22 Dec. 2009.

[91] Interview with Ken Kan, Vice President, Notebook Engineering, FlexComputing, 9 July 2009.

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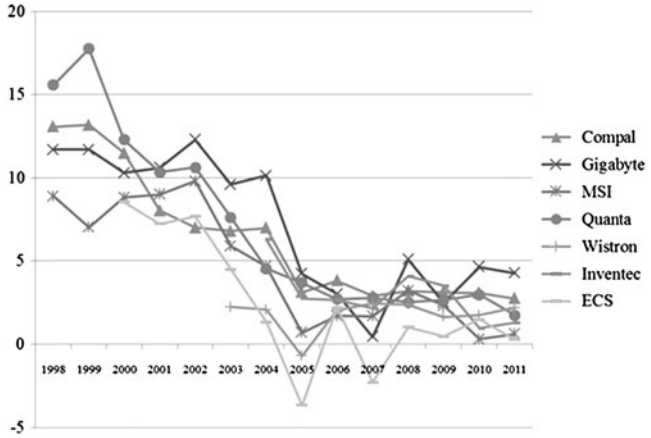

Figure 4. Declining net margins among pure contract manufacturers and component makers. (Source: Compiled by authors using Bloomberg terminal.)

monster."[92] Strapped for financial resources, local firms found it difficult to invest in resource-consuming capabilities or engage in long-range innovative activities. Regardless of the size of these contract manufacturers, they remained captive suppliers for the industry.

Why didn't these Taiwanese companies strike out on their own and directly compete with international branded PC firms in the world market? Although such a strategy may seem logical, the fear of direct confrontation with powerful clients almost always thwarted any contract manufacturer's initiative to launch a new brand. Table 3 summarizes the different attempts made by leading firms to launch new products. When Quanta acquired California-based computer company Q-lity to market its own brand of laptops, other internal business units "often advised" managers at the subsidiary to keep their operations "low profile" to avoid confrontations with contract-manufacturing clients.[93] Approaching retailers such as Best Buy and Amazon could incite clients such as HP and Dell to retaliate by withholding orders, which could put Quanta out of business. Q-lity quickly retreated from the U.S. and focused on Mainland China.[94] Even so, the subsidiary could only market laptops over the Internet and relied on third-party distributors

[92] Interview with Peter Ju, General Manager, NB Vertical Sales and Marketing, FlexComputing, 9 July 2009.

[93] "Quanta to Market Own-Brand Notebook PCs in Taiwan," *Taiwan Economic News*, 4 Nov. 1999.

[94] Quincy Liang, "Quanta Aims for Top Spot in Notebook PC Industry in 4Q," *DigiTimes*, 11 Oct. 2000.

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Table 3
New Products Launched by Leading Firms

Leading Firm	*First Product*	*Year*	*New Products*
Arima	Laptop	2001	Fiber-optic devices, light-emitting diodes (LEDs)
		2001	Own-brand GSM mobile phones
		2001	Own-brand liquid crystal display (LCD) monitors
Compal	Laptop	1999	Personal digital assistant (PDA)
		2001	Own-brand GSM mobile phones
		2002	Optical drives
Gigabyte	Motherboard	1998	Own-brand laptops
		2002	2G fiber channel SAN (storage area network) devices
		2002	Information appliances: Tablet PC, Thin Client
		2003	Own-brand laptops (second entry)
		2005	Mobile phone
MSI	Motherboard	2000	Barebones system
		2000	High-end graphic cards
		2001	Optical drives
		2004	Own-brand laptops
Quanta	Laptop	1999	Optical drives
		1999	Q-lity (own-brand laptops and motherboards)
		2000	LCD monitors
		2001	PDA
		2002	Mobile phones

Sources: Compiled by authors from annual reports, *DigiTimes*, and interviews.

for channel management and to provide after-sales services. Unable to generate consumer awareness, the company's sales figures languished, and eighteen months later, without substantial earnings, Quanta shut down the brand completely.[95]

The example of Arima further illustrates the threat of being forced out of business after losing important contracts from international branded PC firms. Since its early days, Arima worked exclusively for Compaq, which ranked Arima as the best laptop supplier in overall performance in 2001 and 2002.[96] But shortly after Compaq merged with HP, Arima lost its contract. Revenue dropped by 45 percent within one year.[97] The

[95] Samson Yu, "Noah Sauve," *DigiTimes*, 30 Oct. 2000.
[96] *CommonWealth,* 15 July 2003, 114–16.
[97] Sarah Chang, "Quanta Continues Growth Spurt, Other Taiwan First-Tier Notebook Makers Post 'Reasonable' March Revenues," *DigiTimes*, 15 Apr. 2003.

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drop forced top management to divest its laptop operation and sell it to Singapore-based Flextronics.[98]

In short, the standardization of personal computers, an unintended consequence of Windows and Intel's dominance, pressured Taiwan's contract manufacturers to comply with the wishes of international branded PC firms. The accelerating standardization of product architecture made manufacturing processes interchangeable among manufacturers, which dramatically reduced the cost for an international branded PC firm to switch suppliers. Meanwhile, the end market had consolidated to a few leading brands as many European and Japanese PC makers disappeared. Those that remained—primarily U.S. firms—now commanded overwhelming purchasing power in Taiwan. This heightened bargaining power enabled the few branded PC firms to demand minimal pricing, depriving local firms of any extra profit to plow into innovative activities and precluding the Taiwanese companies (directly or indirectly) from investing in branding and marketing.

The Few that Succeeded in Building a Global Brand

As expected, only companies that began developing branding and marketing capabilities early on could continue to make meaningful progress in distributing their own products on a global basis. Acer and ASUSTek seized the window of opportunity during the early cycle of the PC industry, which allowed these technically competent companies to develop their own brands on a global basis. However, the dual strategy—selling products under its own brand as well as providing contract-manufacturing services—had also become impossible to maintain, and competitive pressure forced the companies to shed their former contract-manufacturing services and focus on their own-brand businesses.

Toward the end of the 1990s, it became clear that Acer's own-brand business was hurting its contract-manufacturing services. Although Acer supplied Dell with desktops and laptops, most of the models were confined to the low-end consumer market, which was very different from what other leading contract manufacturers (e.g., Compal and Quanta) produced for Dell, because international branded PC firms were concerned that the Acer brand might copy their cutting-edge designs. In other words, client conflicts severely limited Acer's potential for growth.

In the early 2000s, the technology slump affected PC companies worldwide. Acer's net profit for the first nine months of 2001 fell 90

[98] "Arima to Sell Its Notebook and Server Businesses to Flextronics," *DigiTimes*, 13 Nov. 2007.

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percent compared to the previous year—from $180 million to $18 million.[99] At its shareholders' meeting in June 2001, Acer's management proposed spinning off the contract-manufacturing business, which it did in 2002 by establishing Wistron Corporation. Although Wistron still made most of Acer's machines, the spin-off allowed Acer to place orders outside the company.[100] With an enlarged supplier base, Acer was able to exercise pressure to lower costs (arguably even more so than other branded PC firms) because of the in-depth knowledge acquired from its previous manufacturing operations. This experience helped Acer improve the competitiveness of its product vis-à-vis other international branded PC firms.

The spin-off also set the right context for Wistron to sell its manufacturing services. In the past, when branded PC firms outsourced manufacturing to Acer, they were buying from a competitor. As Wistron repeatedly reassured its clients that it had no plans to sell its own line of machines, it became a more attractive business partner for other branded PC firms.[101] Spinning off Wistron can thus be seen as the logical response to the increasing pressure in the industry. It allowed Acer and Wistron to act independently and exploit market opportunities more aggressively in their respective domains. In 2008, Acer divested Wistron shares to less than 5 percent.

ASUSTek faced the same dilemma. In 2005, it shipped 3.8 million laptops in total, of which 2.3 million were manufactured for others to rebadge. Although total shipments grew to 5.3 million in 2006, contract-manufacturing orders only increased to 2.5 million. Sony and Apple, ASUSTek's two largest contract-manufacturing clients at the time, were worried about the ASUS brand's sales volumes surpassing their own, so Sony awarded ASUSTek only one model for contract manufacturing in 2006, representing about 10 percent of Sony's laptop sales, and Apple announced its intention to terminate its partnership with ASUSTek by 2007.[102]

In July 2007, ASUSTek announced its plan to spin off its contract-manufacturing business into a subsidiary, Pegatron. The parent company would retain the brand-name business. The spin-off was

[99] Michael J. Enright, "Acer in 2001: The Reorganization," University of Hong Kong, School of Business, Centre for Asian Business Cases, 9 Nov. 2001.

[100] 施振榮, *宏碁的世紀變革—出製造, 成就品牌* (Taipei, 2004) [Stan Shih, *Acer Century Change: Fade Manufacturing, Brand Success* (Taipei, 2004)].

[101] Acer also progressively reduced its equity holding in Wistron, signaling to the market that the two firms were truly operating as separate entities. "Acer to Release 70 Million Shares in Wistron," *DigiTimes*, 2 Jan. 2007.

[102] Willy Shih, Howard Yu, and Hung-Chang Chiu, "Transforming ASUSTek: Breaking from the Past," Harvard Business School Case 610-041, 27 Jan. 2010.

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completed by January the following year, a final move that signified ASUSTek's complete transition to a marketing organization.

Acer and ASUSTek demonstrated it was possible to achieve economies of scale and develop branding and marketing capabilities by pursuing both contract-manufacturing services and own-brand businesses simultaneously. Acer's and ASUSTek's contract-manufacturing operations allowed them to achieve the minimum production scale necessary to withstand the increasing competition from other international PC firms that aggressively outsourced manufacturing to Taiwan, but they continued to invest in branding and marketing capabilities, even though this investment limited the expansion of their contract-manufacturing services. The strategic importance of developing branding and marketing capabilities has not always been apparent, however. Managing the two conflicting business models is difficult. For a long time, a simple contract-manufacturing business was more profitable.

But even with the determination of top management, the concurrent pursuit of both contract-manufacturing services and own-brand businesses was only feasible during the earlier days of the industry before international branded PC firms consolidated into a few giants that exercised disproportionate control over their suppliers. The final spin-offs of Wistron from Acer and Pegatron from ASUSTek testify to the magnitude of the competitive pressure and the maturity of the industry, signifying that the window of opportunity for capability development in branding and marketing had closed for other firms in Taiwan.

Conclusion

Chandler and other scholars have noted that the continuing development of a complete set of functional capabilities—development, production, and marketing—must underpin the successful growth of an industrial enterprise. Taiwan's PC industry represents a paradox. Most leading firms in Taiwan remained component suppliers or contract manufacturers and did not develop the complete package of capabilities, including branding and marketing, despite their technical know-how, manufacturing prowess, and size. Held captive by client companies, these leading firms suffered shrinking margins. The context of the local environment alone cannot explain this pathological path of development. Not only did local firms compete among themselves, but international branded PC firms (such as HP and Dell) and other dominant players who defined the underlying technological trajectory (such as Intel and Microsoft) also determined the competitive dynamics of the industry.

Motherboard and laptop sectors succeeded when firms had the right kind of technical competencies to keep them ahead of the competition.

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Faced with the relentless onslaught of technology changes as Intel quickened the pace of technological progression of microprocessors, early motherboard makers lacking sufficient technical knowledge disappeared. Similarly, laptop manufacturers that had mastered design integration and miniaturization due to their earlier calculator operations fared much better than other local incumbents.

Over time, the basis of competition moved toward manufacturing efficiency and production scale. Within the motherboard sector, leading manufacturers were those that successfully evolved to become manufacturing-oriented organizations that could profitably fulfill large orders from international branded PC firms despite the inherent low margins. In the laptop sector, leading manufacturers were those that aggressively pursued the contract-manufacturer model, deploying most of their resources in expanding manufacturing scale. Meanwhile, international branded PC firms were progressively hollowed out, having ceased R&D activities and manufacturing.

Had the industry dynamics stabilized at this point, local firms in Taiwan might have had the opportunity to begin developing capabilities in branding and marketing on top of their existing technical and manufacturing know-how. However, the overall product architecture of a PC rapidly became standardized, heralding the maturity of the industry. At the component level, Intel's ATX mechanical-form factor eliminated any substantial variations in motherboard design. At the system level, the Wintel platform made functionality across all PCs virtually identical. Standardized product architecture meant that manufacturing processes were interchangeable so international branded PC firms could switch suppliers easily and cheaply, which heightened their bargaining power with suppliers. By the time international branded PC firms had consolidated into a few industry giants, Taiwanese companies had no choice but to cut production costs to the bare minimum and give up building their own brands to compete directly with their clients. Ironically, investing in branding and marketing became irrational.

The stories of Acer and ASUSTek speak loudly about the importance of having a long-range strategic vision. Both companies invested in branding and marketing early on, pursuing a complex, dual strategy and sacrificing much of the near-term economic benefits. This strategic choice allowed both firms to take advantage of a fleeting window of opportunity to engage in an alternative learning path in branding and marketing, first in Europe, then in the U.S.

When ASUSTek finally made inroads into the U.S. market, the firm relied heavily on the technical competencies stemming from its former manufacturing operations. In pioneering the netbook (an ultraportable, low-cost laptop), ASUSTek significantly departed from the standard

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laptop architecture.[103] The company even designed its own operating system, at a time when Microsoft was reluctant to supply Windows at a price low enough to meet the necessary price point of a netbook.[104] The initial demand for netbooks was so strong that it attracted extensive coverage from mainstream media in the U.S., culminating in the first-time distribution of ASUSTek's products by coveted retailers such as Best Buy, Amazon, and even Macy's.[105] Impressive as it is, such competitive maneuvering should be regarded as tactical rather than strategic. ASUSTek built its long-term advantages by developing its capabilities before it saw branding as a survival imperative.

Taiwan's PC industry, as a whole, demonstrates that merely expanding manufacturing scale and acquiring technical know-how do not guarantee a firm's increasing influence in the global market. Developing higher-level capabilities takes time and can threaten profitability in the short term. The role of ambitious entrepreneurs remains indispensable in navigating the tumultuous path of capability development.

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[103] Interview with Samson Hu, General Manager, EPC Business Unit, ASUSTek Computer, Inc., 13 Jan. 2007.

[104] Interview with Zing Chen, Deputy Director Product Planning & Management Div. EPC Business Unit, AOOP Business Group, ASUSTek Computer, Inc., 13 Jan. 2007. Interview with Jerry Shen, CEO, ASUSTek Computer, Inc., 13 Jan. 2007.

[105] Suzanne Nam, "The Jonney Machine: How Taiwan's ASUSTek Built Its Cheap Laptop for Grown-Ups," *Forbes.com*, 12 Nov. 2007.

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