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EAST-WEST CENTER

Economics Series

No. 5, September 2000

# Placing the Networks on the Web: Challenges and Opportunities for Managing in Developing Asia

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To be presented at the Second Asia Academy of Management Conference, "Managing in Asia: Challenges and Opportunities in the New Millennium," December 15-18, 2000, Shangri-La Hotel, Singapore.

# PLACING THE NETWORKS ON THE WEB - CHALLENGES AND OPPORTUNTIES FOR MANAGING IN DEVELOPING ASIA

***by***

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## ABSTRACT

Placing the networks on the Web poses a fundamental challenge, but also provides new opportunities for managing in Developing Asia. There is a huge efficiency gap between the region's manufacturing systems and the management of complementary, knowledge-intensive support services. The *challenge* is to reduce this gap as quickly as possible by embracing the Internet as a core business function, despite a weak base of accumulated knowledge of how to manage IT-based information systems. Asian companies, even the best, lag substantially behind their American and European counterparts. There is a potential vicious circle that needs to be broken: a belated transition to IT-based information systems has prevented the accumulation of knowledge, through trial-and-error, of how to design and implement an appropriate IT organization that reflects the peculiar strengths and weaknesses of diverse Asian management systems.

Limited resources prevent any attempt to address these problems in a big leap forward. This implies that in-house efforts need to be supplemented with outsourcing of IT services. There is also a need for strategic partnering with major suppliers of Internet software and networking equipment. The *opportunity* is that the Internet provides almost unlimited opportunities for the outsourcing of mission-critical support services, such as ERP (enterprise resource planning), HRM (human resource management), SCM (supply chain management) and CRM (customer relations management). Furthermore, fierce competition among major producers of Internet software and networking equipment has created a buyers` market - placing Asian firms in a reasonably strong bargaining position.

These developments are generally not well covered by existing studies, which are primarily focused on developments in the U.S. and Europe. The paper tries to fill this gap, and explores how placing global production networks on the Web affects managing in Developing Asia. A conceptual framework is introduced in parts 1 to 3. That framework is then applied to one of the role models of managing in Asia, Taiwan´s Acer Group. Part 1 introduces a taxonomy of expected benefits from Internet-enabled transformations of business organization. In part 2, we argue that the real issue is to analyze how the Internet reshapes the organization of global production networks. In part 3, we assess conflicting claims on how an increased use of the Internet to manage global production networks affects international knowledge diffusion. In part 4, the example of Taiwan´s Acer Group is used to describe the challenge for Asian firms to embrace the Internet as a key management function. And in part 5, we ask what Acer`s experience tells us about Developing Asia´s opportunities.

## INTRODUCTION

There are widespread expectations that the Internet will reduce the cost of doing business along the entire value chain, from supplier to customer, and hence transform competitive dynamics (Department of Commerce, 2000a, chapter D; OECD, 2000a). By transmitting information (text, graphics, voice and data) in digital format instantly, and at much lower cost than earlier technology generations (like electronic data interchange, EDI), the Internet reduces the friction of time and space for economic transactions (Evans and Wurster, 2000). This has accelerated the spread of global production networks (GPN) that provide international corporations (the network *flagships*) with quick access to lower-cost capabilities overseas that are complementary to their own core competencies (Ernst, 2000d). The key is the open-ended structure of the Internet, which allows extra networks to be added at any point, creating almost unlimited opportunities for outsourcing and the diffusion of knowledge.

Placing the networks on the Web is redefining the global geography of production and innovation. This has important - but as yet uncertain - implications for Developing Asia[1], a region that has seen a progressive integration into GPN (Borrus, Ernst, and Haggard, 2000)[2]. On the one hand, this transformation may strengthen further the dominant position of global network flagships, providing them with new opportunities for effective time management, knowledge outsourcing, and the rationalization of global supply chains. Flagships now have much greater opportunities to select best-performing suppliers on a global scale, increasing the pressures on Asian suppliers. On the other hand, the transition from EDI to the Internet may also provide new opportunities for Asian firms, by reducing barriers to network entry, and by enhancing knowledge diffusion.

This poses a fundamental challenge, but also provides new opportunities for managing in Asia. There is a huge efficiency gap between Asia's manufacturing systems and the management of complementary, knowledge-intensive support services. The *challenge* is to reduce this gap as quickly as possible by embracing the Internet as a core business function, despite a weak base of accumulated knowledge of how to manage IT-based information systems. Asian companies, even the best, lag substantially behind their American and European counterparts (OECD, 2000b, chapter 3; Department of Commerce, 2000b). There is a potential vicious circle that needs to be broken: a belated transition to IT-based information systems has prevented the accumulation of knowledge,

[1] These issues are addressed in an international policy-oriented research project, coordinated by the East-West Center, on "Placing the Networks on the Web - Global Production Networks and Local Capability Formation in Developing Asia". Project team members include leading scholars from developing Asia, Mexico, North America and Europe. A web-based *project bulletin board* will use the power of this technology to diffuse the project's findings and to shape policy debates. For details, contact abom@eastwestcenter.org.

[2] Over time, the geographic coverage of such networks has dramatically expanded: from Korea, Taiwan and Hong Kong to the ASEAN region (primarily Singapore, Malaysia and Thailand); and more recently, to China and India. These networks now integrate the region's geographically dispersed, yet concentrated and specialized clusters that feed into triangular trade (Ernst and Guerrieri, 1998).

through trial-and-error, of how to design and implement an appropriate IT organization that reflects the peculiar strengths and weaknesses of diverse Asian management systems.

Limited resources prevent any attempt to address these problems in a big leap forward. This implies that in-house efforts need to be supplemented with outsourcing of IT services. There is also a need for strategic partnering with major suppliers of Internet software and networking equipment. The *opportunity* is that the Internet provides almost unlimited opportunities for the outsourcing of mission-critical support services, such as ERP (enterprise resource planning), HRM (human resource management), SCM (supply chain management) and CRM (customer relations management). Furthermore, fierce competition among major producers of Internet software and networking equipment has created a buyers` market - placing Asian firms in a reasonably strong bargaining position.

These developments are generally not well covered by existing studies, which are primarily focused on developments in the U.S. and Europe. The paper tries to fill this gap, and explores how placing global production networks on the Web affects managing in Developing Asia. A conceptual framework is introduced in parts 1 to 3. That framework is then applied to one of the role models of managing in Asia, Taiwan´s Acer Group. Part 1 introduces a taxonomy of expected benefits from Internet-enabled transformations of business organization. In part 2, we argue that the real issue is to analyze how the Internet reshapes the organization of global production networks. In part 3, we assess conflicting claims on how an increased use of the Internet to manage global production networks affects international knowledge diffusion. In part 4, the example of Taiwan´s Acer Group is used to describe the challenge for Asian firms to embrace the Internet as a key management function. And in part 5, we ask what Acer`s experience tells us about Developing Asia´s opportunities.

## 1. EXPECTED BENEFITS - A TAXONOMY

A simple taxonomy can help to identify expected benefits from Internet-enabled transformations of business organization. The Internet transforms economic transactions, by reducing the cost and speed of communication, and by enhancing the scope for knowledge diffusion. Three benefits can be distinguished: *marketization, productivity and outsourcing*.

### Marketization

It is argued that the new "digital markets" created by the Internet will increase the "*marketization"* of economic transactions. The Internet certainly enables sellers to reach a broader market much more rapidly: "a company that has an on-line business potentially has a worldwide market" (Department of Commerce, 2000a, chapter D, p.2). Equally important is a qualitative improvement in market intelligence: sellers are now in a much better position to track and analyze their customer´s needs and purchasing habits[3]. In turn, the Internet provides buyers with a wider selection of suppliers. It also provides them

[3] The use of such capabilities has raised concern about invasion of data privacy.

with a powerful tool for comparing alternative offers, in terms of prices, quality and delivery conditions.

It would be misleading however to expect that the Internet, on its own, will change relative positions of economic power between buyers and sellers. For instance, earlier expectations that the Internet will shift market power to buyers, especially in business-to-consumer (B2C) markets, have failed to materialize. The same is true for the initial hype that the Internet would bring about a pervasive "disintermediation" of economic relations that would drive down supply and consumer costs and would render commerce ever more efficient (Bar, 1999, p.18).

The underlying assumption that the Internet will lead to a convergence of network governance structures to the New American model is problematic. This assumption denies cross-national and regional variations in the pace of application of these technologies, resulting from differences in economic structures and institutions. It also denies the possibility of unequal access to such markets, and the need for corrective policy interventions. Even within the same industry and market segments, firms may use very different approaches in applying the Internet to GPN (in the computer industry, for instance, Dell has been an Internet pioneer, while Compaq has been a laggard). Firms also differ in their access to and in their position within such networks, and in their capacity to reap network benefits, and hence face very different challenges. In short, the basic laws of competitive dynamics continue to matter. They may be modified, but they have not been rescinded.

## Productivity

As for the effects of the Internet on *productivity*, three benefits have been identified. For sellers, the Internet provides ample scope for cost reduction across all stages of the value chain. One means is to shift sales and information dissemination to lower-cost channels. Cisco Systems, for example, reported that by putting customer service and technical support on-line, it increased customer service productivity by 200 to 300 percent, resulting in savings of $ 125 million in customer service costs.

Second, the Internet can drastically reduce speed-to-market, by reducing the time it takes to transmit, receive, and process routine business communications such as purchase orders, invoices, and shipping notifications. The Internet has greatly expanded EDI`s capabilities: documents and technical drawings can be exchanged in real time, legally recognized signatures can be authenticated, browsers are used to access the information systems of suppliers and customers, and transactions can be completed much more quickly. Third, procurement costs can be reduced by broadening procurement markets and increasing procurement competition through Internet-enabled on-line procurement systems.

## Outsourcing

Arguably of greatest importance is that the open-ended structure of the Internet substantially broadens the scope for *outsourcing*. Both network flagships and first-tier suppliers have shifted from *partial* outsourcing, covering the nuts and bolts of manufacturing, to *systemic* outsourcing that includes knowledge-intensive support services. This has intensified the competition among the providers of outsourcing services: competition now focuses on the capacity to provide manufacturing and design services wherever required. Take the electronics industry. For lower-cost outsourcing, the flagship can now choose between alternative locations, established by major contract manufacturers in Asia, Latin America, the former Soviet bloc, and the European periphery. For higher-end outsourcing, on the other hand, network flagships can choose between specialized clusters in Nordic countries, the US, France and Germany, as well as Israel, Ireland, and Hungary.

What matters is the variety of outsourcing arrangements that the Internet has generated. Our first example concerns the outsourcing of logistics services. FedEx, for example orchestrates the assembly and shipping of laptop computers for Fujitsu; this has enabled Fujitsu to reduce the time consumers have to wait for an order from 10 days to 3 or 4 days (DOC, 2000a, chapter D, p. 4). By turning over much of its computerized distribution system to FedEx, Fujitsu has been able to remove the warehousing and inventory costs from its supply chain, cutting inventory 90 percent.

Increasingly however the focus of outsourcing is shifting to knowledge-intensive support services, including most aspects of information management. As we will see, this may substantially facilitate attempts by Asian firms to embrace the Internet as a core business function (see part 5). For instance, Internet service providers (ISP) provide fee-based access to Internet applications and resources for individuals and companies. Web hosting refers to the outsourcing of web site design and maintenance to specialized third party companies that can reap economies of scale and scope. And application service providers (ASP) provide mission-critical applications, such as ERP (enterprise resource planning), HRM (human resource management), SCM (supply chain management) and CRM (customer relations management) on a subscription basis.

While the Internet acts as an important enabling technology, there are additional reasons to expect outsourcing pressures to grow: the IT skills shortage[4]; the speed and unpredictability of changes in Internet technologies and markets, which makes it risky anyway to sustain large in-house IT workforces; and the high life-cycle costs of purchasing and maintaining networking equipment and Internet applications[5]. Equally important is that intense competition among major producers of Internet software and

[4] In the U.S. alone, 50% of the 1.6 million IT-related jobs are projected to remain unfilled during 2000 (estimate courtesy of Information Technology Association of America, at www.ita.org/workforce/studies, May 10, 2000

[5] While intense competition reduces unit prices of Internet software and networking equipment, the frantic pace of technological change in both areas has drastically cut product-life cycles. For each generation, this has increased the life cycle costs of purchase and maintenance.

networking equipment has created a buyers` market, forcing major vendors to rely on outsourcing as an important market penetration strategy.

## 2. THE REAL ISSUE: TRANSFORMING GLOBAL PRODUCTION NETWORKS

### Misconceptions

Our next step is to clarify two misconceptions that have dominated management debates in Developing Asia on the impact of the Internet. First, there has been a disproportionate concern with the role of business-to-consumer dotcoms[6]. This is in sharp contrast to the development of the global E-commerce market, where business-to-business (B2B) transactions grow in leaps and bounds, leaving behind B2C transactions.

Second, the established terminology is confusing, and obscures an important aspect of the transformation of business organization. The key word is *e-commerce* which is defined as transactions made over computer networks, such as EDI or the Internet (e.g., Department of Commerce, 2000a, chapter D, p.1). E-commerce implies that the Internet creates new "digital markets" and hence will increase the "marketization" of economic transactions. In this concept, Internet-enabled transformations of business organization are reduced to B2B e-commerce which implies transactions between *individual* businesses.

This however neglects a fundamental characteristic of contemporary competitive dynamics: A large share of economic transactions actually takes place *within* global production networks, established by large MNEs (the network flagships)[7]. The real issue then is to assess the effect of the Internet on the organization of such networks, and to explore how this affects managing in Developing Asia.

### Hierarchical Global Production Networks

GPN integrate the dispersed supply and customer bases of the network flagship, i.e. its subsidiaries, affiliates and joint ventures, its suppliers and subcontractors, its distribution channels and value-added resellers, as well as its R&D alliances and a variety of cooperative agreements, such as standards consortia. This may, or may not, involve ownership of equity stakes. These networks do not necessarily give rise to less hierarchical forms of firm organization (as predicted for instance in Bartlett and Ghoshal, 1989). Network participants differ in their access to and in their position within such networks, and hence face very different challenges. We use a *taxonomy* of network participants that distinguishes various hierarchical layers that range from *flagship*

[6] The World Bank for instance, through its Global Information and Communications Technologies (ICT) Department, has announced ambitious programs like a multi-million dollar fund, focused on the development of B2C dotcoms. Similar national programs have followed suit. The irony is that such programs get started, as that sector is in decline. Equally ironic is that the Bank has teamed up with Softbank/Japan, a company that has lost almost half of its market capitalization during the last few months.

[7] For details, see e.g., Ernst, 1994, 1997a, 1997b, 2000b, and Ernst and Ravenhill, 1999. For empirical case studies on diverse GPN, see Borrus, Ernst and Haggard (eds.), 2000.

*companies* that dominate such networks, down to a variety of usually smaller, local network participants (Ernst, 2000b). The flagship is at the heart of a network: it provides strategic and organizational leadership beyond the resources that, from an accounting perspective, lie directly under its management control (Rugman, 1997: 182).

A global *flagship* breaks down the value chain into a variety of discrete functions and locates them wherever they can be carried out most effectively, where they improve the firm's access to resources and capabilities, and where they are needed to facilitate the penetration of important growth markets. This reflects increasing pressures to exploit complementarities that result from the *systemic* nature of knowledge (Antonelli, 1999).

The strategy of the flagship thus directly affects the growth, the strategic direction and network position of lower-end participants, like specialized suppliers and subcontractors from Developing Asia. The *flagship* derives its strength from its *control* over critical resources and capabilities, and from its capacity to *coordinate* transactions between the different network nodes. Both are the sources of its superior capacity for generating profits. One critical capability for instance is the intellectual property and knowledge associated with setting, maintaining and continuously upgrading a de facto market standard. This requires perpetual improvements in product features, functionality, performance, cost and quality. It is such "complementary assets" (Teece, 1986) that the flagship increasingly outsources.

## Carriers of Knowledge Diffusion

To mobilize and harness these external capabilities, flagships are forced to accept a certain *diffusion* of knowledge. This may give rise to a *virtuous circle* for two reasons. *First*, a GPN increases the length of a firm's value chain, as well as its logistical complexity. This creates new gaps and interstices that can be addressed by small, specialized suppliers. While in some cases (like for instance "screw-driver" contract assembly), such entry may be short-lived, this is not necessarily so. Over time, outsourcing requirements may become more demanding and may force specialized suppliers to upgrade their capabilities. By transforming themselves from simple contract manufacturers to providers of integrated service packages, they may increase the benefits they can reap from network participation[8].

*Second*, once a network supplier successfully upgrades its capabilities, this creates further pressure for a continuous diffusion of knowledge-intensive, higher value-added support activities (including engineering, product and process development) to individual network nodes. This reflects the increasingly demanding competitive requirements. In the electronics industry for instance, product-life-cycles have been cut to six months, and sometimes less, and speed-to-market is of the essence (Ernst, 1998). Overseas production thus frequently occurs soon after the launching of new products. This is only possible if key design information is shared more freely between the network flagship and its

[8] For a detailed case study on such inter-organizational knowledge outsourcing in Taiwan´s computer industry, see Ernst, 2000a.

overseas affiliates and suppliers. Speed-to-market requires that engineers across the different nodes of a GPN are plugged into the flagship´s design debates (both on-line and face-to-face) on a regular basis.

To the degree that the flagship has moved to global sourcing, this may erode its domestic base of specialized suppliers. The *collective* knowledge base, which used to be a characteristic feature of the flagship´s home location, may have migrated for good to overseas clusters. The semiconductor industry provides a typical example (Ernst, 1983 and 1997b, chapter IV). Since the 1970s, the leading American producers have moved much of their final assembly and testing to Asia, with the result that knowledge had to follow suit[9]. Over time, much of this knowledge has moved out of individual subsidiaries and has become widely diffused across different network nodes, especially in Developing Asia[10].

## 3. IMPACT OF THE INTERNET - ASSESSING CONFLICTING CLAIMS

How has an increased use of the Internet to manage global production networks affected international knowledge diffusion? What new opportunities does this create for managing in Developing Asia, especially for local capability formation? And what forces constrain the capacity of Asian firms to reap such benefits? Both pessimistic and optimistic scenarios are possible[11].

### Pessimistic Scenario

A pessimistic scenario emphasizes potential negative implications for Developing Asia. First, access to Internet-based technologies and organizational innovations is highly unequal (OECD, 2000b, chapter 3; Jiacheng, 2000). Outside the industrial heartlands of the U.S., Japan and Europe, fundamental constraints exist to *access* (spread and capacity of information infrastructure), *connectivity* (variety of linkages) and *receptivity* (capacity to receive and absorb information). In Asia, for instance, there is only one direct Internet link between two Asian cities, Tokyo and Seoul. More than 99% of the international Internet traffic in Asia is routed through the US (Chismar, 2000).

This has some very disconcerting implications. The current US-centric

[9] Take the case of Texas Instruments: "As far as assembly and testing are concerned we have more expertise here [i.e. in Malaysia] than we have in the U.S. We sometimes have to send our Malaysian engineers to the States to solve their problems." (Interview at Texas Instruments Malaysia, May 1984, reported in Ernst, 1994)

[10] Knowledge diffusion through GPN has also been documented for storage devices (McKendrick, Doner, Haggard, forthcoming; and Ernst, 1997b).

[11] The East-West Center project, mentioned above, assesses these conflicting scenarios, based on structured interviews with global network flagships, Asian suppliers and Internet service providers. We focus on the electronics industry because of its pioneering role in placing the networks on the web, and as a carrier of Developing Asia´s export-led growth. For control purposes, we include a comparative analysis of garments, another major export industry of developing countries that is at the center of controversies about the development impact of IT and globalization.

architecture of its information infrastructure will slow down access of Asian firms to broad bandwidth, which is essential for reaping productivity benefits. It constrains the region´s capacity to adjust the evolving Internet architecture to the specific needs and capabilities of its firms and public sectors. It will also make it more difficult to develop a strong regional pool of hardware and software companies that provide Internet infrastructure equipment[12].

Second, Japan is unlikely to act as the region´s engine of rapid diffusion of Internet-based changes in business organization. This reflects the weakness of the Japanese economy. There are also important structural constraints: resistance to change amplified by a weak political class; high Internet access charges; insufficient access to broadband technologies, and a lack of a standardized payments system[13].

Third, substantial disparities are also emerging within Developing Asia: Korea´s e-business market is projected to be 2.5 times the size of China´s market by 2005, and bigger than the combined e-business markets of Singapore, the rest of Southeast Asia, India and Hong Kong. This reflects a higher stage of development, a broader knowledge base and a more robust national information infrastructure.

**Optimistic Scenario**

Alternatively, there are strong arguments for an optimistic scenario. First, placing the networks on the web creates new entry opportunities for smaller players, providing them with powerful channels for knowledge outsourcing and capability development. For instance, electronic data exchange (EDI), the predecessor of Internet-enabled e-business, proved to be useful, but too expensive for smaller firms[14]. The Internet is likely to reduce substantially such barriers through reduced costs of communication, and almost unlimited opportunities for outsourcing.

In line with our earlier discussion, this enables smaller firms in Developing Asia to access Internet-enabled GPN, while outsourcing most aspects of their information management (see part 1). Most Asian suppliers to GPN have little accumulated knowledge in information management. Many of them do not have proprietary technology, and they have been badly hurt by the financial crisis (Ernst, 2000, WB2). They lack the financial and human resources and the knowledge to develop in-house the

[12] V. Cerf, one of the "fathers" of the Internet, emphasizes that the real profit opportunities are in the design of the complex global Internet infrastructure, especially optical networking equipment, and in the management of global Internet-enabled procurement networks (Lecture, East-West Center, April 10,2000).
[13] It is arguably still an open question whether NTT-DoCoMo's leadership in wireless Internet will change this picture, or whether this is a costly impasse that distracts scarce resources away from catching-up with the US lead in placing GPN on the web.
**[14]** In the US, while 95% of the Fortune 500 companies used EDI extensively, only 2 % of all firms used EDI (Department of Commerce, 2000a, chapter 28, p.25). If this is true for the richest economy in the world, it is obvious that barriers were even higher in Asia. Outside of Japan, only a few large Asian corporations could afford to shoulder the substantial investment costs required for establishing EDI-based information systems.

above services. By way of example, the cost of building and maintaining an electronic commerce Web site averages between $500,000 and $ 2.5 million (Department of Commerce, 2000a, chapter 28), way beyond the means of SMEs. Outsourcing such services thus provides the missing link especially for lower-tier suppliers in Developing Asia to reap the benefits of network participation.

A second, and arguably the most important argument, addresses the impact of the Internet on knowledge diffusion. The Internet not only provides quick and lower-cost access to information. It may also further reduce the friction of time and space for the exchange of knowledge, well beyond what has been achieved by earlier generations of IT. There are claims that the Internet can substantially reduce the constraints to the diffusion of *tacit* knowledge (e.g., Fransman, 1997; Antonelli, 1997). In principle, closer and smoother interaction can now be established between distant local clusters that are connected through GPN. The Internet may enhance a cluster`s learning and innovation potential by introducing *virtual players* and *processes*[15]. Placing the networks on the web makes it possible to quickly connect *virtual players*, creating *virtual teams* that can engage in inter-active learning without necessarily being co-located. With the transition from proprietary EDI to the Internet, *all* network participants can now *interact with each and every other participant*. For each of these different interactions, it is possible to adjust the richness of information, i.e. to *customize* it appropriately (Evans and Wurster, 2000: p.35). This gives rise to the familiar effect of *network externalities*: the more people adopt a standard, the more compelling it becomes. For companies from Developing Asia, this may facilitate their integration of into the global knowledge creation circuit of the network flagship.

## 4. CHALLENGES - THE CASE OF TAIWAN´S ACER GROUP

### A Belated Transition to IT-Based Information Systems

Acer exemplifies a important puzzle that confronts Developing Asia´s electronics industry. While being a major producer of electronics equipment and components, especially related to computing, the company was late to understand the critical importance of information technology as a tool to enhance its operational efficiency.

During the 1990s, Acer was highly successful in establishing a low-cost and flexible approach to the development of its GPN[16]. Based on informal, social peer group linkages, Acer´s decentralized “Client-Server” model provided considerable flexibility to respond quickly to changes in markets and technology (Ernst, 2000a). However, this model now has reached its limits, not only with regard to cost efficiency, but, more

[15] *Virtual players* are buyers, sellers, intermediaries and public institutions that may be located at multiple locations *outside* the cluster but which can interact on time with cluster participants. *Virtual processes* are interactive and real-time transactions, or other forms of communication that are required for supply chain management, demand management, process and product development (Romano and Passiante, 1999).

[16] From humble origins, Acer has grown within less than two decades into a global network flagship that employs more than 32,000 people in 120 enterprises in 37 countries, supporting dealers and distributors in over 100 countries. Acer Group revenues in 1998 were US$ 6.7 billion (acer.com)

importantly, with regard to speed-to-market and flexibility. The catalyst has been the emergence of the "built-to-order" model in the PC industry, pioneered by Dell and others, that now requires a capacity to combine price leadership, quality and customer services with product differentiation and speed-to-market.

Until 1996, huge windfall profits from Acer`s DRAM business (a joint venture then with Texas Instruments) enabled the company to postpone a response to its growing problems in the computer business. However, once the DRAM market crashed, these weaknesses were brutally exposed. Severe price wars, and especially the emergence of low-cost PCs, put enormous pressure on second-tier PC brands: Acer was literally pushed out of the US market[17], and was overtaken by Compaq in former strongholds like Mexico and other Asian markets. Serious problems also emerged with service and support, which are critical in the consumer markets that Acer had targeted with its PC models[18]. Acer faces a fundamental challenge: Based on Internet-enabled "virtual integration", the BTO-model is far superior to Acer`s model that had tried to combine a broad product portfolio[19] and vertical integration with a decentralized management structure based on informal relations.

## The Impact of Globalization

Probably the greatest challenge to the Acer model came from the rapid geographic dispersion of Acer´s production networks to overseas locations, primarily in Southeast Asia and China. Out of Acer´s 21 manufacturing sites, six are large volume manufacturing sites located overseas: two in China, and one each in the Philippines, Malaysia, Mexico and Wales. Equally important are Acer`s 19 overseas final assembly and configuration centers that are much more geographically dispersed to major markets. Adding further complexity, Acer needs to integrate its networks into the GPN of major OEM customers, like IBM (its largest customer).

The coordination of such "networks of networks" requires highly efficient communication. Yet, Acer`s external communication with vendors, distributors, OEM customers and suppliers continues to rely on informal information systems, based on personal contacts through meetings, phone calls, and faxes. Within Taiwan, this system worked reasonably well, due to the dense supply network in the Taipei-Hsinchu cluster. Once manufacturing moved overseas however, these informal networks could not be transplanted. There was no alternative but to develop more structured information

[17] In 1999, the company announced that it would stop selling its own PCs in the U.S. consumer market in an attempt to cut the losses of its U.S. subsidiary.

[18] During 1998, readers´ polls in computer magazines ranked Acer near the bottom of the pack in quality and service (e.g., "Readers rate PC service and reliability", PC Magazine, June 20, 1998

[19] Acer´s extremely broad product portfolio covers not only PCs and peripherals, but also semiconductors, electronic components, software, Internet services, publishing, multimedia content, distribution, and real estate development.

systems that facilitate information exchange and knowledge diffusion and that help to improve coordination[20].

It was only since 1998 that Acer has started to address these problems. Management attempted to reduce it product portfolio for OBM products[21]. Simultaneously, the company was reorganized along five major product lines in order to improve coordination among Acer´s many business units. These moves were accompanied, at long last, by substantial investments in formalized, IT-based information networks that were meant to address major weaknesses in inventory control and supply chain management (SCM).

## The Evolution of Acer`s IT Organization

In line with its decentralized business model, Acer`s IT organization was characterized by high fragmentation: each business began to build its own information systems with functions appropriate to its own needs, but without much concern for the requirements of other units, or the whole group. The resultant patchwork of decentralized IT systems accentuated the problems that had been created earlier by informal, personalized information systems. Top management lacked information on what individual business units were doing. Nor was its possible to exchange on-line information between units. This increased inventory and stifled quick response to emerging problems. It also prevented an effective monitoring of financial performance and obstructed strategic marketing. Fragmentation of IT systems also prevented the sharing of IT resources across business units, and hence increased the cost of developing these systems.

Since 1998, Acer has undertaken various initiatives to introduce Internet-based information systems to its PC business. These initiatives have focused on three areas: customer relations, supply chain management, and the rationalization of Acer´s GPN (Dedrick, Kraemer and Tsai, 1999). Given the sorry state of customer relations, especially in the US, this business function required immediate action. The first step was to establish an integrated worldwide customer database, based on Siebel 99 CRM software. Asia is used as the initial testing-ground: Acer relies on Andersen Consulting to model its service business, look at future customer service needs and implement Siebel 99. In a second step, experience gained in Asia is then supposed to feed into the revamping of customer relations in the US, where Acer is working with a small specialized consultancy to upgrade its existing CRM software. Implementation proceeds step by step by region, centered on regional data centers (one or two in Asia, one in the US, and one in Europe) and three regional call centers (North America, Asia, Europe) that can offer customers 24-hour service. The challenge of course will be to transform these regional subsystems into a unified global system built on standardized procedures.

[20] This is in line with Mark Fruin`s findings for Toshiba that was facing similar problems when it internationalized its Tokyo-centered production clusters (1997, chapter 6)

[21] For instance, Acer gave up its earlier attempt to become a leading OBM supplier of high-end consumer PCs. Instead, it announced a new line of low-cost, single-function devices for the home market.

Supply-chain-management (SCM) has been a second important weakness, where Acer was lagging behind best practice, especially with regard to inventory and speed-to-market. Acer has decided to implement i2 SCM software worldwide[22]. Implementing this system may even require more time than for customer relations management (CRM). The first step was to implement factor planning software in Acer`s US and European plants. This is supposed to be followed by the implementation of i2 software in Acer´s main manufacturing plants and purchasing offices in Taiwan.

### Establishing Internet-Enabled Production Networks

The next and most difficult step will be to extend the Internet to the rationalization of Acer´s GPN, but this will be a long and challenging process. This reflects the messy state of Acer´s GPN: there is not one network, but a patchwork of networks run by different business units, with very little interaction and sharing of network resources. In order to get the process of streamlining started, Acer has begun working with major OEM clients (especially IBM) to develop close EDI and Internet-based linkages[23].

As for the other side of the coin, Acer`s links with its suppliers, apparently not much has happened thus far. Unifying these multi-tier networks into one global SCM system is a truly mind-boggling challenge: some of these networks are overwhelmed, while others are underused, and the composition of these networks keeps constantly changing, especially at the lower-tier levels. There has been some talk of studying how to develop a community network with suppliers. However, catching-up based on purely in-house efforts is no longer a realistic option. As we will see below, Acer apparently has decided to outsource the design and management of a unified global information system that covers all stages of its GPN.

### Implementation

To implement this strategy, Acer has gone through yet another round of organizational restructuring, and established the Acer Digital Services Group (ADSG). One of its tasks is to invest in and develop Internet-related businesses and to coordinate Acer´s operational Internet systems. It remains unclear however what are its specific objectives, and whether this new group has enough power to push through an effective transformation of Acer`s information organization[24].

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[22] Dallas-based i2 Technologies, founded by Sanjiv Sidhu, is the world leader in an area of supply chain optimisation known as advanced planning and scheduling (APS). The company is a pioneer, since the early 1990s, in preaching the benefits of using clever algorithms to plan and optimize corporate supply chains.

[23] IBM and Acer have announced plans to develop "e-business solutions for Acer`s core IT infrastructure and those of its key suppliers" (news release, June 7, 1999, acer.com), yet it is unclear what concrete steps have been taken.

[24] Acer`s website does not provide any information on ADSG´s revenue, equity and employees (as it does for Acer`s other groups), which indicates that this group is still in a very early stage of development. ADSG´s capital has been provided, at equal shares, by the parent company Acer Inc, by Acer Sertek Service

There is no doubt that Acer will find it difficult to implement the IT-related initiatives that we have described before. The difficulties result from its earlier highly decentralized organization. They also reflect a weak base of accumulated knowledge on how to manage IT-based information systems. An equally important constraining factor is a Babylonian mixture of hardware platforms and software programs which makes it difficult to inter-connect the existing disparate systems so that they can effectively communicate and share information[25].

Another complicating factor is Acer´s policy to "run Acer on Acer", i.e. to use as much as possible its own PCs and its Altos servers. This is feasible for some applications, but it may be difficult for heavy-duty functions that require more powerful systems. In principle, "running Acer on Acer is a good idea, as it can strengthen Acer`s capacity to design and manage Internet-based information systems. Yet, it has substantial disadvantages in terms of cost and time required. This is arguably a major drawback in an industry that suffers from intense price competition and where speed-to-market for new products is of critical importance.

There is a vicious circle involved. Acer`s earlier success with decentralized organization and informal, personalized information systems delayed the transition to IT-based information systems. This in turn prevented the accumulation of knowledge, through trial-and-error, of how to design and implement an appropriate IT organization that can address the peculiar strengths and weaknesses of this company. Limited resources prevented an attempt to address these problems in a big leap forward. On its own, Acer was unlikely to succeed where even major industry players like Compaq had stumbled. With its own limited resources, Acer could hope at best to proceed in a gradual, haphazard manner, far too slowly and inconsistently to break out of the above vicious circle.

## 5. WHAT ACER´S EXPERIENCE TELLS US ABOUT OPPORTUNITIES

### Outsourcing of IT Services & Strategic Partnering

This arguably explains why, over the last few months, Acer has aggressively pursued outsourcing of IT services and a number of strategic alliances to catch up rapidly and at reasonable cost. Let us look at four examples that illustrate what are realistic opportunities as well as some potential drawbacks[26]. In line with Acer`s management

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Group and by Acer Computer International. Given the recent frequent changes in Acer´s organizational chart, it is impossible to draw any conclusions with regard to the intended division of labor.

[25] Take ERP software as an example: Acer Information Product Group uses Triton, a program developed by Baan from the Netherlands that, for all practical purposes, has now ceased to function. By contrast, Acer America uses HFA from Friedman Associates running on IBM´s AS/400 platform, Acer Latin America uses R/3 from the market leader SAP, and Acer Computer International uses QAD Inc.´s Mfg/Pro software (Dedrick, Kraemer and Tsai, 1999, p.18)

[26] The following is based on press releases at acer.com, and phone interviews.

philosophy that any business that makes money is a good business[27], the company has been very pragmatic in proceeding from partial to more comprehensive endeavors.

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**Entry into the Market for Internet-Based Business Management Solutions**

A first step has been to use a sales-oriented joint venture with an industry leader, Computer Associates, to reap feedback information on customer requirements, and to use this as a base for improving Acer`s own information management. In April 1999, a joint venture was announced by the two companies to capture an increasing share of Asia´s burgeoning market for business management software. The first step will be to develop software that will enable Taiwanese companies, including SMEs, to conduct financial management over the Internet.

While CA wants to penetrate a potential new growth market for its business management application software ACCPAC that is well established in the US market, Acer has very different motivations. From our perspective, this venture has three interesting features: First, Acer`s contribution will be to provide localization services, marketing, sales and logistics. Its main task is to adapt ACCPAC to incorporate Chinese language, as well as Taiwan´s peculiar financial practices, laws and regulations. Based on access to the program´s source code, this provides Acer with invaluable information on the design of Internet-based business management solutions.

Second, KPMG Taiwan plans to use the joint venture`s solutions to assist Taiwanese SMEs to establish and manage such systems. This in turn will provide Acer with feedback on what is needed to manage and maintain Internet-based management systems. Third, the joint venture´s general manager will be a prominent industry executive with more than 10 years´ experience with leading companies such as Sun Microsystems and Bell Labs. In line with Taiwan´s tradition of knowledge outsourcing through informal transnational technical communities (Saxenian, 1999), this is likely to facilitate the diffusion of complementary tacit knowledge to Acer´s management.

**Marrying OEM with Contract Manufacturing: Acer`s Alliance with Solectron**

Another way to learn quickly Alfred Marshall`s “secrets of the trade” (Marshall, 1890/1916), i.e. the tricks and pitfalls involved in Internet-based SCM, is to link up with one of the leading electronic contract manufacturers. The latter firms provide outsourcing services on a fee basis across the value chain, that extend well beyond the nuts and bolts of manufacturing. In the process, these companies have developed best-practice IT-based global supply chain management systems.

In October 1999, Acer announced an alliance with Solectron, based in Milpitas/Ca, the world`s largest electronics manufacturing services company. The main purpose is to jointly provide Internet-enabled computer design, manufacturing and service

[27] According toe Stan Shih, Acer´s co-founder and Chairman, “Except wifes and husbands, Acer sells everything!” (Shih, 1996,p.136)

solutions for desktop PCs, servers and workstations. It is planned to extend this cooperation in the future to encompass laptops, a variety of emerging Internet appliances for wireless Internet applications, as well as for Internet-enabled built-to-order products where customers are able to customize the final configuration.

The immediate objective of this alliance is of course to accelerate speed-to-market for both companies, and to combine Acer`s manufacturing prowess with Solectron`s superior capacity for global supply chain management. From our perspective what matters again is that this arrangement will provide Acer with low-cost access to critical tacit knowledge about how to run an Internet-based global production network (Solectron`s key competitive advantage), and to combine it with a continuous strength in volume manufacturing.

### Acer`s Joint Venture with GE Information Services

A third possible approach is to enter the market for Internet-based information systems for GPN ("e-commerce services" in industry parlance), by linking up with one of the major global players as an Asian junior partner. In December 1999, a joint venture was announced between ADSG, Acer´s recently established Internet vehicle, and GE Information Services, one of the leading global providers of interned-based e-commerce services. As part of General Electric, GEIS has developed information systems for one of the world`s largest GPN: more than 100,000 participating firms in over 100 countries, with 293,000 employees. This has enabled GEIS to become a leading supplier of Internet-enabled SCM software.

The business plan foresees the venture to become the largest service center for business-to-business e-commerce in the Asia Pacific region by 2002. Capitalized at US$ 14 million, ADSG holds an 85% share, while GE Information Services holds 15%. Initially, the following mission-critical services are provided for Internet-based SCM: buyer-seller matching, appropriate Internet transaction environment, and end-to-end supply chain systems. The venture will also establish a "center of excellence" to service Internet business users from Developing Asia.

For GEIS, the link with Acer provides a low-cost access to the Asian market, in cooperation with a leading Asian company with a well-established brand image. From Acer´s perspective, teaming up with GEIS provides a relatively low-cost approach to learning key features of Internet-based SCM. Acquiring this knowledge should help to improve the efficiency of Acer`s GPNs. This may also enable the company to enter this market as a quasi OEM supplier of certain components of such information systems, both hardware and software. This would have fascinating implications: companies from Developing Asia that successfully used the OEM route for knowledge outsourcing in manufacturing (Ernst, 2000, APJM) may now well be able to replicate this approach for Internet-based information systems.

### Outsourcing of Internet Services for the Acer Global Network

We have argued before that applying the Internet to the management of Acer´s complex GPNs will be a drawn-out and difficult process, and that purely in-house efforts will be insufficient. It is thus hardly surprising that Acer announced in January 2000 that it will outsource the design, implementation and management of Internet services for its GPNs to AT&T Solutions, a leading supplier of such services.

The objective is to transform Acer´s six disparate GPNs that run on different legacy software programs into an integrated, global Internet-enabled information system. It is expected that this will improve the communication flow between GPN participants, such as diverse Acer groups, clients, suppliers and dealers, and hence reduce transaction costs and time-to-market, as well as exposure to glitches in quality and CRM. In the words of Stan Shih: "I am confident that with their (i.e., AT&T´s) outstanding expertise we can significantly improve Acer´s global logistics and service quality." (Press release, acer.com, January 13, 2000). Called "Acer Global Network", this unified Internet-enabled GPN will cover altogether 58 locations worldwide.

Of particular importance are certain innovative features of this outsourcing arrangement. Outsourcing in fact is only partial: Acer retains a finger in the pie, in order to increase the scope for knowledge outsourcing. The Acer Global Network is managed by a task force jointly established by AT&T, Acer and Pagic, a joint venture of ADSG (Acer Digital Services Group) and Taiwan Cellular Corp., Taiwan`s largest private telecom company. Pagic is well qualified for knowledge outsourcing from this arrangement: it has assembled a workforce specialized in the development of value-added networking services, designed to accommodate the different business models of clients, providing an integrated Internet solution..

This type of arrangement is expected to enable Acer "…to learn the management skills from AT&T whilst building a stable global networking system." (Simon Lin, President of Acer Inc., the most important of Acer`s groups). For an Asian company, to achieve such a relatively symmetrical outsourcing relationship requires that it has valuable proprietary assets. In Acer´s case these are its impeccable reputation in flexible volume manufacturing at low-cost and high quality, as well as its strong network of suppliers in Asia that can deliver whatever is needed at short notice.

This window of opportunity however is very limited. As long as these strengths exist, it is possible to use outsourcing of Internet services as a vehicle for knowledge diffusion. This may no longer be possible however once Developing Asia´s advantage in manufacturing has been eroded.

## CONCLUSIONS

This paper argues that placing global production networks on the web can act as a powerful catalyst for upgrading business organization and management in Developing

Asia. This necessitates however that Asian firms overcome their reluctance to embrace the Internet as a core business function, and that they invest in IT as a strategic management system. The challenge is not primarily a financial one - access to funding may not be a major problem, as networking equipment vendors and Internet software companies are eager to penetrate the region`s emerging markets. The real challenge is to rethink established ways of managing that for much of the last three decades have worked well.

The Internet provides a historic opportunity for the region to catch up in the development of structured IT-based information systems. It provides almost unlimited opportunities for the outsourcing of mission-critical support services. At the same time, fierce competition within the Internet industry has created a buyers` market - placing Asian firms in a reasonably strong bargaining position.

To support this argument, we have introduced a conceptual framework that is based on three propositions: First, Internet-enabled transformations of business organization can provide three major benefits: marketization, productivity and outsourcing. Second, the real issue is how the Internet reshapes the organization of GPN and what this implies for the position of Asian network participants. Third, while important constraints continue to exist in Developing Asia to access, connectivity and receptivity, the Internet can substantially reduce the barriers to enter GPN, especially for smaller Asian specialized suppliers. Most importantly, the Internet is likely to improve substantially opportunities for international knowledge diffusion, which could provide a considerable boost to local capability formation.

Using this framework, we have taken a closer look at one of the role models of managing in Asia, Taiwan´s Acer Group. Its experience provides important lessons on the challenges and opportunities that the Internet raises for Asian firms. First, IT and globalization pose a challenge to idiosyncratic forms of Asian management. Acer´s attempt to run a global, multi-divisional and vertically integrated corporation with a highly decentralized management system, based on informal social information networks has turned out to be unsustainable. Not only did it fail to provide the drastic cost reductions required by pervasive price wars in the PC industry. Worse, it left Acer vulnerable in areas that were supposed to be its natural strengths: speed of response to changing markets, quality and customer relations management.

Second, it is important to understand the competitive dynamics that shape decisions on how to use the Internet. In the computer industry, the catalyst has been the emergence of the “built-to-order” model, pioneered by Dell and others. Based on Internet-enabled “virtual integration”, the BTO-model is far superior to Acer`s model that had tried to combine a broad product portfolio and vertical integration with a decentralized management structure based on informal relations.

Third, a failure to develop an effective IT-based information system resulted in poor coordination among the company´s many business units, a situation exacerbated by

the informal, decentralized management system. This left Acer with little alternative but to move away from an outdated business model. A transition was necessary from a decentralized Client-Server model to a system that combines increasing outsourcing and strategic partnering with highly centralized forms of management control.

A final, and somewhat puzzling lesson is that an effective implementation of Internet-based information systems requires the re-establishment of centralized, structured forms of management control. This is puzzling because of the widespread optimism that the Internet will help to expand the decentralization of computer power as well as knowledge (e.g., Fransman, 1997). There is indeed much greater scope for the outsourcing of Internet services, and the same is true for knowledge diffusion. Simultaneously however this has led to a massive redeployment of computing power to a few global command centres each of them consisting of hundreds of computers that can host the software and systems that will be increasingly accessed through the Internet[28].

That the pendulum now swings back to a highly centralized computing model is arguably less mysterious, if one looks at the historical roots of this technology. Like other major IT innovations, the Internet has its origins in work undertaken for the military and Big Science (Ernst, 2000e)[29]. Nevertheless, the Internet can act as an important enabling technology for upgrading the organization and management of Asian firms.

[28] A glimpse of this *Brave New World of Hierarchical Computing* can be had at Intel`s new *data centre* in Silicon Valley (Taylor, 1999) which looks more like a military command bunker than a business office. It is built to survive any conceivable emergency, including the failure of its power systems, fire suppression systems, mechanical systems and network connections. Intel claims that, if worst comes to worst, there is a round-the-clock "situation room" staffed by experts which are claimed to have "the skills to manage *any* event occurring *anywhere* in the world." Intel is spending about $ 1bn during the year 2000 to build 12 similar centres around the world Intel is not alone in heavily investing in such global computing command centres. HP is developing its own global command system, which it will manage in cooperation with Qwest, the telecommunications group. AT&T, IBM and a host of new companies, such as Exodus and Concentric Network, are moving in the same direction.

[29] During the 1970s, DARPA, the US Department of Defense Advanced Research Projects Agency, has funded a series of major projects that would enable research and academic institutions working on military projects to cooperate. This led to the development of the Ethernet standard and TCP/IP, the basic Internet protocol. Another important source was work undertaken at CERN, the European Organization for Nuclear research in Geneva, to facilitate information exchange among its international research teams. This became the platform for related software development.

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