Impacts of Information Technology

on Taiwan's Industrial Structure and Competitiveness

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I. Introduction

The Industrial Revolution began in the last half of eighteenth century in the United Kingdom where the steam engine and other mechanical innovations dramatically increased industrial output and drastically change social systems.   The second wave of industrialization came with mass production methods represented especially by the electrical and automotive industry at the beginning of the twentieth century.   Finally, the third industrial revolution took hold during the 1980's driven by technological breakthroughs in the computer industry.

The emergence of the powerful desktop computer changed existing social systems from industrial production to people's lifestyles.   In particular, the appearance of the Internet has had a significant impact on society.   There were around 4.5 million Internet users at the beginning of the 1990s, and the number reached 260 million in 1999.   As estimated by Computer Industry Almanac, at the end of 1999, the number of people on-line in Taiwan had reached 4.79 million, making Taiwan 11th in the world and the 4th in Asia after Japan, South Korea, and China.

This figure indicates that Taiwan has performed well in promoting network connection.   A network system such as the Internet can cross national boundaries and surpass time differences. This creates fundamental complications for current territorially based systems including regulations, laws, administrations, and economic and social institutions.

This short report introduces recent moves by Taiwan in information and technology (IT) and discusses relevant problems.

II. Current Status of IT Development in Taiwan

Taiwan is widely regarded as one of the major players in the IT industry, which can be roughly divided into two main categories: hardware, and software and services.   Taiwan's information hardware industry has performed impressive ly over the last twenty years or so.   It has established a solid industry foundation and enjoys considerable international competitiveness. The total output value of Taiwan's information hardware industry in 1999 came to US$39.88 billion, an 18.1% increase compared to 1998 (Table 1).   Taiwan was the third largest producer of information products worldwide, next only to the United States and Japan (Table 2) and it captured major shares in the world market for monitors, scanners, keyboards, notebook PCs, and other computer peripherals.   An important milestone in the development of Taiwan's IT industry was the outward investment by constituent firms starting from the late 1980s initially directed towards Southeast Asia and more recently towards China and elsewhere in the world. By taking advantage of the interna tional division of labor, Taiwan continuously shifted its low -end IT production offshore.   As a result, offshore IT production constituted nearly half of Taiwan's total production in 1998 with China the major offshore production location .

Output of Taiwan's information software and services sector came to US$2.96 billion in 1999, a growth rate of 35% compared to 1998 (Table 1).   In fact, the sector seems to have considerable room for further growth.   In particular, software exports will be a key factor in ensuring the future success of Taiwan's software industry.

Table 1 : Output Value of Taiwan's IT Industry,
(domestic and overseas output)

	1998 US$ million	1999 US$ million	Growth Rate %
Information hardware	33,776	39,881	18.1%
Information software and services	2,197	2,966	35.0%

Source: Institute for Information Industry Market Information Center.

Table 2 : Output Value of Top Ten Information Technology Hardware Producer Nations (excluding overseas output)

Rank	Country	1998 US$ million	1999 US$ million	1999 Growth Rate %
1	USA	90,630	95,162	5%
2	Japan	42,558	44,051	4%
3	Taiwan	19,240	21,023	9%
4	Singapore	18,660	18,473	-1%
5	China	14,196	18,455	30%
6	UK	15,398	15,552	1%
7	Ireland	8,667	9,360	8%
8	Germany	8,844	9,197	4%
9	South Korea	8,169	8,862	8%
10	Brazil	8,395	8,227	-2%

Source: Institute for Information Industry Market Information Center

III. The Diffusion of IT and the Structural Change of Industries

The information hardware industry has taken the lead in the development of worldwide demand for software applications and related service industry. The development of the Internet and e-commerce (EC) activities has also created massive demand for EC software.

The past ten years' achievements have prepared Taiwanese industries to enter the new competitive era. The emerging markets for world competition by Taiwanese industry include the handset OEM, communication and broadband networks, IA products, software, and optical electronics. Despite the recent so-called bubble in the network market, Taiwan has tacitly started a transition toward these new markets since the end of the 20th century.

The use of the Internet also contributes to merger and acquisition activity, not only within the network industry, but also among industries. More conglomerates or group companies pop up blurring industry boundaries. One of the special characteristics of the Internet economy is to strengthen the competitiveness of existing enterprises that play right.

Since an enterprise's information system must be constructed to cope with the development of e-commerce, various e-management trends are noteworthy. Supply chain management (SCM) appears to be the most important to guarantee an enterprise's position in its industry. Enterprise resource management (ERM) and customer relationship management (CRM) are two ends that must be carefully caught to link a niche to the market. The application skills of e-commerce and know-how management are also important for a firm to penetrate networking activities.

A network firm actually plays the role of integrating one market with another (both inward and outward). The idea has gone beyond the traditional concept of "a nexus of contracts" as its explanation. Thus, the Internet market must be based on a low degree of command but a high degree of commitment.

Another point of view on the impact of IT with Internet application concerns the effective boundaries between nations. Government taxation of e-commerce would be one way of discouraging its development. But technology protocols and market game rules help firms overcome related problems. The market would determine its own direction and division of labor.

IV. The Competitiveness of Taiwanese Economy

Taiwan's growth prospects depend on the balance between its strengths and weaknesses. Taiwan's strengths are its superior engineering and managerial talent and nimble manufacturers. These key factors will keep some industries, including computers, telecom, and multimedia equipment, at the frontier edge. On the other hand, Taiwan's weaknesses may include the relatively high cost of labor, land, and services. High transportation costs and political barriers to direct trade with China make it difficult for Taiwan to become a center of global logistics.

Threats may come from scaled production conducted by Japanese, Korean, and Chinese companies, focusing on different market areas. Also, Taiwanese firms could gradually lose their share of world markets if they do not maintain a technological influence on standard-building. That is why the government has recently been promoting cooperation among industry, research institutes, and universities.

The use of the Internet delivers various messages for technological development which, in turn, calls for further research on technological innovation. The ten emerging industries of Taiwan in the 1990s have proven their ability to seize market opportunities as well as opportunities provided under the government promotion plans. In the next ten years, the information, precision machinery, biotech, and specialty chemical industries are expected to become Taiwan's leading industries. Internet-related technological development as well as industrial expansion would be accompanied by IT-based industrial development. Meanwhile, the most important factor may be the managerial capabilities of Taiwanese businessmen with respect to IT applications. Their ability to manage globally strategic operations in manufacturing and marketing may help Taiwan maintain its important position in world trade.

Taiwan's industrial structure is characterized by many small and medium-sized firms specializing within a narrow range of the value-chain. The use of IT and Internet applications by these small and medium-sized firms can be viewed as organizing highly efficient and specialized production units with low-cost networking facilities. Taiwan's strength lies in the fact that these small and medium-sized firms can easily fill orders for small quantities and diverse specifications and still maintain low margins. This is the source of competitiveness for Taiwan's economy.

V. Concluding Remarks

The third industrial revolution is "a knowledge-based revolution" and the key to building wealth has changed from natural resources and the technological tools we knew in the past to "knowledge", which is exactly the current development trend of IT.

The government's Plan to Develop a Knowledge-based Economy in Taiwan offers a five-point vision to develop Taiwan's knowledge-based economy to a level comparable to that in advanced countries with in the next ten years:

1. Raise R&D spending to 3% of GDP, with 30% from the government and 70% from the private sector.

2. Enhance the contribution of technological progress to account for at least 75% of economic growth.

3. Boost government and priva te spending on education to at least 7% of GDP.

4. Increase the production value of knowledge-intensive industries to at least 60% of GDP.

5. Strengthen broadband network installation and reduce utilization fees to a level similar to that in the United States.

Taiwan's goal is to become a center of global logistics, but it still needs to cooperate with neighboring economies and strategic partners. This report advocates the realization of regional cooperation under global competition. The theme is generated from the ideas that networks make it crucial to connect production systems with markets and technology and that no one can afford to do all of this alone in the new era of the IT society. Thus, we need cooperative competition, com-coop. For cooperation under a competitive environment, barriers to information transmission must be removed. Moreover, in order to facilitate a better competitive-cooperative relationship, network protocols and standardization will have to be our first step. The success of Linux provides an appropriate message on open-sourcing and cooperative competition.