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## Taiwan: Changes in the Environment for Development

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Deregulation has been pursued by Taiwan's government since 1980, but it has been singularly elusive. Although the worldwide trend toward liberalization of telecommunications has been a strong influence favoring reform, only limited progress has been made. Until 1987 the directorate general of telecommunications (DGT) provided both services and equipment on a monopolistic basis. Customers may now purchase many (but not all) types of equipment from multiple vendors, but for an economy as dynamic as Taiwan's, value added network (VAN) services are conspicuous by their rarity. Liberalization of administrative matters, privatization of DGT, and adjustment of service rates have been seriously discussed, but a sufficiently broad consensus as to what to do has meant proposals have languished in limbo.

This chapter focuses mainly on changes in the environment and on the development of information-related industries in Taiwan. Related policy issues are dealt with in Chapter 17.

### 18.1 Policy Overview, 1945–1989

When Taiwan reverted after World War II, its telecommunications facilities were extremely poor. In Taipei, for example, there were only some 700 telephone subscribers. Lacking sufficient construction funds, yet desiring to meet basic communication requirements, the government adopted policies known as "Self-Sustainable and Self-Developing" and "Popularization of Telephone Services." Users contributed to construction costs as a part of their installation fees.

Throughout the 1970s, Taiwan experienced very rapid economic development. Economic growth forced the government to select more effectively and explore more aggressively the telecommunications technologies available throughout the world. As a result, a six-year *Telecommunication Development*

*Plan* was implemented in 1976. It focused on increasing the popularity of telephones and modernizing long-distance and international services. Modernization was understood to mean that people could directly dial domestic and international calls.

During the 1980s, booming international trade created a huge demand for services. The expanding business sector required information on both domestic and international markets. Not only did the demand for regular telephone and telegraph services increase, so did demand for new services. For example, videotex was introduced to transmit stock market information, commodity prices, and weather information. Recognizing the significance of such an evolution, the government designated both the information and the telecommunications industries as strategic industries in the hope their development would insure continued growth of the economy.

Paralleling the national ten-year (1980–1989) Long-Range Economic Planning Program, which predicted even more pressing future demand for telecom services both in terms of quantity and quality, a Ten-Year Telecommunication Development Plan was set forth. It addressed the necessity of volume expansion so that tensions from imbalances between demand and supply could be alleviated, and the nationwide digitalization of telecommunications.

In 1985 the government announced fourteen major construction projects, totaling some NT\$900 billion. Modernization of telecommunications is one of the fourteen, and it was listed for NT\$65 billion. Goals included viable ISDN services in Taipei, Kaohsiung, and Taichung and a density of fifty by the year 2000 in all metropolitan areas, popularization of rural phone service, and upgrade of networks. By 1987 nationwide density had already reached thirty-one and was more than forty-one in mid-1991.

Taiwan's Council for Economic Planning and Development commissioned a study, led by Tseng Fan-tung, to analyze the causes and effects of reforms in the United States, United Kingdom, and Japan along three dimensions: the motivating forces behind the reforms, reform activities themselves, and the impact of reforms. The result appeared in 1987 (Tseng 1987). The three primary driving forces for reform are seen to be the need for convenient and reasonably priced information demanded by businesses seeking help in achieving higher productivity, advanced by-pass technology, and achievement of universal service.

These same forces exist in Taiwan. Pressure from them continues to build, and proposals and plans for liberalization are emerging. In 1990 the government initiated a six-year plan in which privatization of DGT and liberalization of Type 2 service have been clearly indicated as major policy goals.

## 18.2 Regulatory and Operating Bodies

Based on the Telecommunications Act and its related by-laws, which were formulated in 1958 and revised in 1977, the Ministry of Communications (MOC) regulates the industry. The law indicates clearly that MOC is the primary tele-

communications policymaker within the government. However, this has not been fully realized in the actual policymaking process. This is because MOC gave its highest priority to planning and developing transportation, which diverted time and energy away from telecommunications matters. Responsibility for policymaking thus fell on the DGT, where it has primarily remained.

On many occasions, DGT has initiated policy proposals, while MOC has only played the role of friendly watchdog. For example, DGT drafted the formulas governing rates of return for state-owned telecommunications providers (i.e., for itself). MOC reviewed the proposal, which was then submitted to the Executive Yuan and passed by the Legislative Yuan to become effective. Any revisions would most likely follow the same procedure.

### 18.3 Policy Evolution

Under its monopolistic structure, DGT has been both the supervisor and the operator of Taiwan's telecommunication. It has drafted and executed regulations for equipment manufacturing and service provision. At the same time, it monopolizes the networks and telecommunications business. DGT is, for all intents and purposes, running a self-supervised business. Popularization of telecom services has always been DGT's primary goal.

Liberalization in Taiwan has been following the same sequence as in the United States, United Kingdom, and Japan: first the CPE market, next competition in VAN services, and, finally, open competition with common carriers. Thus, since August 1987 users have been able to purchase their own telephones. Most of what DGT provided were pulse; users flocked to buy touch-tone from other providers.

In 1988, several types of peripheral equipment were deregulated. End-users could own fax machines, modems, and telex and videotex terminals. Mechanical telex terminals provided by DGT have been replaced by electronics ones. In 1989 DGT deregulated VANS. Such services can be offered by DGT or any private company that has a service contract with DGT.

### 18.4 Five Major Telecommunications Interests

There are five major interest groups relevant to this discussion: the government, telecommunications institutions, end users, labor, and equipment manufacturers. Each group's primary focus is discussed in the following, except equipment makers, which are covered later.

Effective and efficient telecommunications are important to the development and maintenance of modern national economies, including national security and social progress. The Executive Yuan, when announcing fourteen important construction projects in September 1984, set an agenda for the nation referred to as the Telecommunication Modernization Plan. It called for investments totalling more than NT\$70 billion (about U.S.\$ 1.75 billion at the time) over the



six years, 1985–1990, to digitalize urban telecom services. Since by law a portion of DGT profits must be remitted to the Treasury, these investments will be at least partially recovered by revenues to the government. Although martial law in Taiwan province was lifted in July 1987, antagonism between Taiwan and mainland China still officially exists. Thus, the Garrison Command under the Ministry of National Defense retains its authority to sample mail and telegraph transmissions.

DGT, which operates as a monopoly, has enjoyed substantial growth over the years. Its average annual profit as a percentage of total revenue was 37 percent for 1977–1988. In principle, DGT observes what the government mandates. All planning and objectives are in line with national master plans. However, stated goals may sometimes be in conflict with the government's intentions. For instance, in 1987, before resolution of debates over price negotiations with its privileged suppliers (the Big Three, discussed later), decisions affecting the procurement budget for switching systems were stalled in the Legislative Yuan and awaited administrative instruction.

Users want quantitative expansion and qualitative improvement of services. Expansion of service to rural and remote areas is always welcome by those reached. Stepwise liberalization of the CPE market has won general applause, despite slow progress and often underestimated demand forecasts. However, with ongoing rapid urban development and economic growth, it is sometimes difficult for users to get new services or sufficiently expand original service capacities in some business districts. Even after several rate reductions, users complain about rates on outbound overseas calls being higher than on inbound ones. Considering Taiwan's heavy reliance on foreign trade (imports and exports combined account for more than 95 percent of GNP), the high rates are seen as a burden on business users.

#### **18.4.1 Labor**

A nationwide telecommunication qualification test is held regularly under the auspices of the Ministry of Examination to recruit new employees for DGT. After passing the test, new recruits obtain civil service qualifications and a life-long job. Employees are entitled to all the fringe benefits of, and subject to all the restrictions pertaining to, civil servants. Career development patterns are fairly rigidly defined. Some employees have complained about the lack of mobility. A person assigned to a job in a certain area is unlikely to be transferred unless a colleague elsewhere is willing to exchange posts.

Although DGT is a government institution, it is committed to operating as a businesslike entity. A union—the Taiwan Telecommunication Workers Union (TTWU)—has been organized by the employees to promote their interests. Owing to the large number of members and a relatively strict organizational structure, the union has greater political strength than other labor unions, including the railway workers and the postmen. According to Taiwan's constitution, seats in both the National Assembly and the Legislative Yuan are reserved for candidates from labor unions. Since the TTWU is the most powerful union in

Taiwan, its candidates are most likely to win these seats. The government and the ruling Kuomintang Party (KMT) pay close attention to the labor movement.

The TTWU functions primarily as a benevolent association. Its main activities have been protecting or advocating member personal benefits—aid for medical expenses, children's education, birthday gifts, group travel, and employee study. The union, despite the technological fluency of its members, was not involved in the policy-making process. The issue of most concern to the union in the early 1990s is probably the proposal to convert DGT into a privately owned corporation, which would greatly affect employee rights and benefits.

The union's role vis-à-vis the ruling party has changed since the establishment of an opposition party, the Democratic Progress Party (DPP), in 1986. That year a DGT employee ran for a legislative seat as a DPP candidate, and upset the KMT incumbent, who also happened to be the union's chairman. Another employee was elected a DPP member of the National Assembly. DPP members have also been elected to TTWU offices. Although the DPP has not proclaimed any explicit objections or alternate proposals to current telecommunications policy, the underlying force of an opposition voice in the union cannot be neglected. In short, the TTWU will no longer support KMT positions as unquestioningly as it once did.

## 18.5 System Development

Utilization of intrafirm networks is still in its infancy, although it has enjoyed significant growth since the mid-1980s. These include electronic key telephone systems (EKTS), PABX, and computer network systems. By 1987 there were 113,216 EKTS installations, 85 percent with capacities below ten lines, and only 3.6 percent handling twenty or more lines. This implies that most users are small or medium businesses, as are most firms in Taiwan. About 25,000 systems per year were being installed in the late 1980s, half of them replacements. The PABX market has expanded tremendously since the mid-1980s, from 1,513 installations in 1986 to 4,200 in 1990. Locally made PABX captured 25 percent of the market in 1986. By capacity, 86 percent were under 100 lines, 4.3 percent were over 200.

Computer networks are mostly for short distances between a company's main computer and its department terminals. A few large companies have island-wide in-house systems, with some even including overseas branches. Formosa Plastic Group, for example, has on-line factory operation. Franchise service businesses frequently dependent on computer network systems for communications with headquarters. It is common for a franchiser to join computer system vendors to develop software packages as part of what is provided to franchisees.

### 18.5.1 Data Communications

Data communications revenue accounted for a very small portion of total telecommunications revenues, but its share is increasing. DGT began a data circuit



leasing service in November 1971. In June 1988, a breakdown of customers showed 9,360 leased domestic data circuits, and eighty-four international; 1,051 had packet switching, 4,600 were subscribers to dial-up services, 139 used circuit switching, 2,282 used public information processing, and 187 used universal data base access service (UDAS). Private businesses were 44 percent of users, 32 percent were state-owned businesses, and 19 percent were government organizations. Information industry and education and research institutes accounted for the remainder. Of the eighty-four international circuits, fifty-one ended in Hong Kong, and thirteen in the United States. Private businesses used sixty-one circuits, and the information industry used seventeen. Most customers were local branches of foreign companies.

Circuit switched public data communication service has been offered since June 1982. In June 1988, the total number of lines was 139, 59 percent used by state-owned businesses, 21 percent by government organizations, and 26 percent by private businesses. By the end of 1990 the number of lines had reached 23,000, and were mostly in the private sector.

UDAS service started in December 1979. In June 1988 there were 187 circuits reaching data banks in more than thirty-eight countries, although utilization concentrated in the United States. Private businesses had 47 percent of the circuits, government organizations had 25 percent. Most used UDAS for internal purposes, but a few of them provide information retrieval services to the public.

## **18.6 Information-Related Industries**

Over the period 1953–1990, Taiwan has generally enjoyed rapid economic growth. In terms of GDP composition, as one would expect, industry has increased its share at the expense of agriculture (which has gone from 35 to 5 percent). The service sector fluctuated in a 40–45 percent band until the early 1970s. Since 1978 the share services have been drifting up, reaching almost 51 percent in 1990.

Although information-intensive service sectors (finance, insurance, data processing, etc.) do not account for a high percentage of GDP, the sophistication of such activities has increased since the mid-1980s as many specialized services have arisen and foreign companies have rushed into the local market. These newcomers, with their ever-increasing demand for information services, help the telecom service industry grow. Another major part of the information industry is the computer industry. By the end of 1987, the total number of microcomputers installed in Taiwan approached 350,000. The total of all other kinds of computer systems was 6,367, an increase of 29 percent from the preceding year. At the end of 1990 there were some 950,000 microcomputers and over 16,600 minis and mainframes.

### **18.6.1 Electronics**

Taiwan's electronics industry came to life in the 1960s with the advent of television manufacturing. It still mainly turns out consumer and other mass

products and components. In the 1960s, foreign investors were attracted by government-sponsored incentive programs as well as by a diligent and abundant labor force with comparatively low wage scales. Foreign technology and professional training propelled rapid development.

In the 1970s Taiwan displaced Japan as the largest supplier of video and audio products such as television sets, radios, and tape recorders to the U.S. market. Since 1980 the structure of the domestic industry has shifted away from being highly labor intensive toward becoming more technology and capital intensive. Likewise, consumer items gradually gave way to industrial and information ones. A milestone was reached in 1984 when electronic products became Taiwan's number one export; the industry has remained the nation's key export industry. Dramatic growth of the information hardware industry, primarily personal computers and related peripherals, has made a significant contribution. Production of such hardware was U.S.\$2.13 billion in 1986 and U.S.\$5.17 billion in 1988, and U.S.\$6.15 billion in 1990. Taiwan's global rank has risen from ninth in 1985 to sixth in 1990. This is the foundation for Taiwan's move into the computer and communication age.

During the initial stages of the electronics industry in the 1960s, foreigners and overseas Chinese dominated investment. In 1977 electronics exports were 79 percent by nondomestic companies. (This falls to 67 percent if a pro-rata share of exports is attributed to Taiwanese minority interests.) As native companies have grown and started business, the domestic share has increased. In 1987, total electronics exports were U.S.\$8.1 billion, only 41 percent by companies owned by foreigners or overseas Chinese. Exports in 1990 were U.S.\$16.4 billion.

The combination of a developing computer industry and the government's determination to develop indigenous manufacturing capability mean Taiwan has created a good environment for development of its telecommunications industry.

### ***18.6.2 The Big Three***

To stimulate telecommunications technology development, the government decided to solicit world-class companies. As a result, joint ventures were established with GTE (the operation is now owned by Siemens) and an ITT subsidiary (now part of Alcatel) in 1973 and in 1984 with AT&T. These are referred to as the Big Three. Each involves a locally owned minority stake. All three produce a range of products, including central office switching systems for the domestic market. The government hoped to attract the best technology available globally to establish an internationally competitive equipment industry. Thus, for example, the agreement with AT&T calls for technology transfer in eight areas—although the exact nature is rather broad and AT&T has a good deal of discretion. To solidify the results of the 1973 agreements, the government instituted a policy of "Local Purchase if Locally Available." Central office switching systems must be brought from the Big Three.

Unfortunately, the original objectives of the government's technology transfer initiatives have not been achieved. Needed switching systems are nominally



supplied locally, and DGT is in compliance with the domestic purchase policy. In reality, however, key components and parts are imported; only a small portion of the assembly and modification work is actually done in Taiwan.

### 18.7 Promoting Development

To stimulate development of telecommunications the government has designated it a strategic industry and offers various measures such as financing facilities, technological support, R&D incentive programs, and assistance for new product development.

Two major institutions manage the financial aspects. One is the Bank of Communications, a government bank for development and reconstruction. It provides mid- to long-term loans and equity investment to strategic industries. By the end of 1987 it had invested NT\$1.8 billion in forty-four new ventures, nearly half of which were telecommunications and information companies. The Bank has played an important role in helping many entrepreneurs during startup. However, as the nature of each business varies, it lacks the expertise to guide or assist management. Moreover, because it is only a minority holder (legally restricted to 25 percent of any company's equity), it often wields only limited influence.

The Development Fund of the Executive Yuan is the other institution. It was formed in 1973 to provide financial support to domestic industry. It can assist strategic industries or ones deemed important to the country that are financially unattractive to the private sector. Its equity investments and loan facilities amounted to NT\$7.9 billion by the end of 1988.

On the R&D front, the Electronics Research and Service Organization (ERSO) of the Industrial Technology Research Institute (ITRI) has played an important role. It specializes in electronics, has helped build up the domestic industry, and has made important contributions to the integrated circuits and personal computer industries. Its pilot plant has been an important source of telephone ICs for local makers competing in the U.S. market. Many of its R&D results have been transferred to local manufacturers for commercialization, including technology for LANs and X.25 packet switching data networks. To continue its strength and sharpen its R&D capability, a project titled "Development of Integrated Service Telecommunication Technology (1989-1992)" was undertaken.

ERSO was reorganized in mid-1990, with a computer and communication research lab (CCL) spun off. The "new" ERSO focuses on semiconductors and electronic components. In a bit over a year after its founding, CCL has developed a number of ISDN products, including an interface card, a telephone set, a terminal adapter, and a PBX. Other developments include several types of communication ICs (e.g., video compression), and work has been done on personal communication networks (PCN) and the deployment of fiber optics to residential users.

The DGT has coordinated joint-development efforts by local equipment pro-



ducers and computer companies. However, with increasing demands from local industry for government support, DGT has adopted a more aggressive attitude in technology development. The Telecommunication Laboratory (TL) used to do planning for DGT, and, as the R&D arm of DGT, it has been dedicated to introducing foreign technologies essential for telecommunications construction work. In 1988, TL took a more active role by cooperating with ERSO to develop integrated communication technology. TL broadened its staff role to participate in actual technology development work. Some 80 percent of its work load relates to servicing DGT requirements, and the remaining 20 percent is targeted at developing technologies or products and smoothly transferring the results to local firms.

TL has developed technology for electronic telephone sets, microwave communication systems, intelligent Chinese terminals, M13 digital MUX, D4 PCM terminals, touchtone converters, automatic message accounting equipment, modems, facsimile terminals, data ports, and 12 GHz DBS transponders.

### *18.7.1 Equipment Industry*

Local development and production of telecom equipment is mainly determined by the demand from DGT and the general public. DGT takes the lion's share. In 1990 the procurement of equipment and facilities for the Taiwan network was U.S.\$1,018 million, 91 percent obtained locally. Switches involve the most complicated technology. Using their manufacturer as an index, the development of Taiwan's equipment industry can be divided into two major periods: 1957–1981, when traditional systems predominated, and since 1981, when manufacturing of electronic switches has predominated.

During the earlier period there were only two producers, each with a relationship with a Japanese firm: Far Eastern Electric Industry Corp., established in 1957, and Taiwan Telecommunication Industrial Corp., formed in 1958. The former transferred technology from Oki Denki, the latter from NEC. Major products were relay systems (1957–1963), step-by-step systems (1957–1969), and crossbar systems (1969–1981). After the entry of GTE and Taisel (Alcatel's local subsidiary) in 1973, production of electronic switches began.

In addition to switches, local manufacturers supply transmission equipment such as PCM and FDM carriers, repeaters, modems, and M13 multiplexers for fiberoptic systems. Many types of terminal equipment are made, including telephone handsets and fax machines.

Total sales of locally produced equipment exceeded NT\$23 billion in 1985, with wired telephonic apparatus such as handsets and switches accounting for 60 percent. In the wake of the opening of the U.S. market and capitalizing on integrated circuits supplied locally by ERSO and the United Microelectronics Corporation (UMC), Taiwan has become a world leader in telephone exports.

Production and export of hand sets is the most active sector of the local industry. With exports of U.S.\$268 million in 1986, and U.S.\$250 million in 1988, Taiwan has become a major supplier to the United States. Nevertheless, for more sophisticated equipment, Taiwan is still basically a technology recip-

ient and most manufacturers maintain foreign contacts for technology inputs. To cultivate domestic R&D capability, some companies have initiated R&D projects by themselves or in cooperation with local research institutions.

Domestic demand for PBX and electronic key telephone systems (EKTS) almost doubled from 1988 to 1990, when it reached U.S.\$54 million. Because domestic demand consists mainly of high-end products, 81 percent of them were imported in 1990. At the same time, local firms produced U.S.\$67 million of mainly low-end PBX and EKTS, 80 percent of which were exported.

More than twenty local firms make modems, mainly 1,200 bps and 2,400 bps, exporting about U.S.\$28 million in 1990. DGT relinquished its control over modems below 1,200 bps in 1986 and modems below 2,400 bps in 1987; therefore domestic demand grew in the late 1980s as prices fell.

Foreign capital and technology have played important roles. In general, there are three forms of cooperation: technical cooperation such as United Optical Fiber licenses from AT&T, off-shore manufacturing plants, such as 3M (Taiwan), and joint ventures, such as by GTE Taiwan, Taisel, and Taiwan Telecommunication.

### *18.7.2 Developing Domestic Technology*

To cultivate indigenous telecommunications technology capability, the government has sponsored R&D projects and transferred technology from abroad. However, due to the lack of systematic policy planning, the good intentions of the government often failed to yield the desired results. For example, Taiwan had some experience manufacturing analog switches and fiberoptics, but the scale is too small to be efficient. Often, users and manufacturers simply purchased products or parts abroad for assembly in Taiwan. Even with government efforts, local manufacturing capability was difficult to cultivate. The entry of the Big Three is another example. The government had reserved the domestic market for their CO switches, but technology transfer has not met expectations.

The Ministry of Economic Affairs, whose primary responsibility is to develop local industry, has also been very active in promoting technology transfer and R&D. It sponsored several high-priority, large-scale research projects carried out by ERSO and CCL: submicron ICs, VLSICs, and HDTV, distributed computing. In the late 1980s there was also project on superminicomputers. The two laboratories have also participated in projects to develop ISDN, CPE, PBX, large-scale software, and related chip sets.

The absence of adequate supporting industries has handicapped the development of domestic telecommunications technology. In fact, with their preemptive technological advantage, financial strength, and market power, the Big Three pose formidable entry barriers to would-be competitors. Increasing awareness of intellectual property rights and national measures abroad to protect against high-technology disclosure overseas have further marred the prospects for unilateral technology transfer.

In 1987, opposition parties raised a fierce debate on this issue in the Legislative Yuan. DGT finally agreed to abandon its procurement approach with the



Big Three and adopt open bidding for CO switches. Traditionally, when DGT planned to purchase equipment from the Big Three, it would decide a purchasing price using certain officially regulated formulas. DGT then negotiated with the Big Three. Negotiations occasionally failed due to the differences in price.

### ***18.7.3 Procurement from Overseas Suppliers***

If equipment is not available domestically, DGT is allowed to buy it overseas, provided the purchase is processed through the Central Trust of China, a state-run agency. This regulation can be traced back to the decades when Taiwan was short of foreign exchange and had to resort to centralized planning and control of limited resources. With an extraordinary U.S.\$70 billion in foreign exchange reserves in the late 1980s and early 1990s, the situation is totally different. Continuation of the rule introduces delays and lowers efficiency.

Beginning in the late 1980s, the accumulation of foreign reserves and a continuous trade surplus with the United States imposed intense pressure on the government to open the domestic market. The government has made efforts to simplify the procurement process and to increase purchases from abroad, especially from the United States.

## **18.8 Conclusion**

Early regulation of Taiwan's telecommunications industry was the result of assumed natural monopoly conditions as well as the economic and political environment after World War II. Only the government was considered to have the ability to initiate development. This is an interesting contrast to the situation in the nineteenth century, when the Ch'ing felt it was better to leave such expensive undertakings to others. Private parties responded by constructing a network. In the twentieth century, private parties were not deemed capable of such initiative. Even if they were, security reasons led the government to want to maintain tight control of telecommunications.

Since 1980, however, economic development in Taiwan has made information transmission and achievement of universal service more important than ever. Advances in microwave, satellite, and fiberoptic technology have meant the network need not to be restricted by limited space. Meanwhile, the merging of computers and telecommunications, and the decline of manufacturing costs for microcomputers, have stimulated the emergence of VANs and diversification of customer terminal equipment. These developments have all shaken the logical foundation of a "natural monopoly" in telecommunications. The worldwide trend toward liberalization has further influenced public opinion and government policies.

Deregulation became the major policy concern during the 1980s. New telecommunications laws are expected during the early 1990s. In anticipation, DGT reached an agreement with Cable & Wireless in December 1991 under which C&W will assist DGT "ensure optimum benefit" from the new laws. This

includes staff training, R&D, technology transfer, and other aid in expanding DGT's network and services. Telecom users on Taiwan should clearly benefit from DGT's reaction to potential competition, and the competition itself.

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