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ABSTRACT

In order to increase the modernization of its society, the Chinese government has marked Information Technology as an enabler of this goal. The implementation of this goal has been in progress for over 15 years. Many landmarks have been reached in hardware manufacturing and software development. However there still remains significant impediments that inhibit rapid growth of this technology into Chinese organizations. This paper will discuss what these obstacles are and how the Chinese government is attempting to remedy them.

INTRODUCTION

In the post-World War II era, productivity in developed countries has been increased due to the application of information technology. There is evidence to suggest that the effect of information technology on the economic development of Third World countries is also significant. According to Edfelt (1986), communications and information-processing technology have the potential to contribute significantly to economic development, assisting in the dissemination of information and providing access to the technology of developed countries. Maier (1987b) states that the technological input of computers is important to the growth process. In China, the country's modernization drive has created enormous demand for computers (Shea, 1988).

This paper explores the state of information technology in China. It concentrates on problems the Chinese have to overcome as they attempt to incorporate computers and telecommunications into business operations. The paper concludes that while this incorporation has a long way to go, the Chinese have made considerable progress towards removing technological and sociological impediments that limit the integration of informaton technology into mainstream business activities.

BACKGROUND

The catalyst for the increased utilization of computers in China has been the country's desire to speed its economic development. In the late 1970s, the Chinese government announced the Four Modernizations program, the goal of which is to modernize China by the year 2000. The Chinese government has emphasized that foreign technology, especially computerization, is crucial to the process (Oechsli, 1988). In 1978, then Vice-Premier for science and technology, Fang Yi, said, "We will . . . establish a number of computer networks and

databases. It is essential to equip information institutions with modern facilities in the shortest possible time" (qtd. in Maier, 1987b). Consequently, the modernization program has resulted in an increase in the demand for computers. As Coll (1989) says, "The computer age is dawning in China."

China's first step towards computerization occurred in 1956, when the Institute of Computing Technolgy was formed in Beijing by the Chinese Academy of Sciences (Maier, 1987a; Maier, 1987b; Lin, 1989). By 1958, the Institute created a working computer prototype, a 32-bit processor with 4K bytes of internal memory (Maier, 1978a). However, China's progress towards computerization was slowed by the embargo imposed by many Western countries in the late 1950s. The Cultural Revolution in the 1960s and '70s was an additional impediment. It was not until 1974 that China's interest in computerization was revived with the 748 Project, a State Planning Commission Project involving the computerization of Chinese characters (Lin, 1989). A further impetus was provided by Fing I, vice-premier for Science and Technology, at the National Science Conference in 1978 when he said that automation and networking should be top priorities in China's modernization plan (Lin, 1989). In 1979 a joint conference on information automation and online retrieval systems was held in Beijing. Lin (1988) says that the seminar provided further momentum, which continued throughout the 1980s . In the early 1980s, the World Bank provided China with US$250 million for university automation projects, while IBM donated a great deal of hardware to four universities in Beijing and Shanghai (Lin, 1988). By 1985, it was estimated that there were 80,000 microcomputers in China (Coll, 1989). Currently the country has approximately 20,000 mainframe/minicomputers and 130,000 microcomputers (Scott, 1990).

The banking industry provides an example of the success that China has had applying information technology. As part of the Eight Five-year plan (1991-1995), the automation of the banking industry has been given high priority, resulting in capital investment/allocation of US$744 million for computers. Today, 80% of the operations at China's central bank have been computerized. This has resulted in increased efficiency and cost savings. Continued effort will be directed at constructing a national clearing system which will incorporate satellite communications (IDC, 1992a).

It is clear that China has made great strides towards computerization. Maier (1987a) says, "As an environment for technology diffusion, China has recently experienced great improvements." And Lin (1988) says, "Much progress has been made in computerized information retrieval in terms of both techniques and equipment."

IMPLEMENTATION PROBLEMS

Despite the progress, the implementation of information technology in China continues to be problematic. The problems range from a shortage of electricity to the culture surrounding the use of computers. For the purpose of this research, the problems have been divided into four categories: infrastructure, hardware, software and cultural. The following section describes the problems in these areas and discusses what, if anything, the Chinese are doing to overcome them.

INFRASTRUCTURE

Computer hardware manufacturing is an industry driven by cost and technology. This poses an enormous problem for developing countries like China who seek to market domestically manufactured computers.

As noted previously, the strategy of the Chinese to increase productivity includes the use of computer technology. While allowing imports, the government's technology committee is facilitating the creation of Chinese-owned manufacturing plants. Unfortunately, in the time it takes to build and tool plants for production, the rest of the world has moved to the next level of technology. This has resulted in computers that are both technologically inferior and overpriced. Consequently, there is no demand for these goods outside of China. Domestically, imported computers are available from both legitimate sources and an extensive black market. The lack of demand for Chinese computers makes it difficult to fund research and development and modernize manufacturing facilities.

The Chinese have addressed this problem in a variety of ways. (1) In order to increase technology and develop large scale production, a central authority (Chinatron) was created to pool manufacturing and research efforts in the electronics industry. This step was taken to offset previous decentralization which led to inefficient small scale production (Frisbie, 1992). (2) Another attempt at increasing manufacturing productivity is to encourage the use of CAD/CAM technology. Chinatron has assembled a team of experts to advise and train engineers in electronics manufacturing concerns. In the first year of this initiative the plan is to train 1,000 people (IDC, 1992b). (3) In order to discourage the purchase of foreign made equipment, the importation of computers was limited by means of high tariffs (Cheung, 1990).

Operating Environment

A prerequisite for incorporating information technology into industrial operations is providing an environment in which the computers operate continuously. Such an environment requires a guaranteed electrical power supply.

A guaranteed supply of electricity is a problem in many developing countries whose infrastructures are still being improved (Braun, 1989; Maier, 1987a; Thorpe, 1984). This is especially true in China. To remedy this the Chinese have adopted the use of Uninterrupted Power Supply (UPS) devices. This solution is not only being applied to information technology equipment but also other industries that have a steady power requirement. While this equipment is now being primarily imported, Chinese-owned production facilities do exist (IDC, 1992c).

Telecommunications

The establishment of a robust telecommunications system is another requirement for a country that wishes to use information systems effectively. The ability to transmit data quickly and accurately is a fundamental part of a competent information system. In countries that lack travel budgets, a telecommunication system is needed to foster exchange of information and collaboration (Scott, 1990).

The creation and expansion of a modern telecommunications network is a major project for developing countries. The Chinese have attacked this problem through importation and domestic development. This tactic has produced dramatic results in the past ten years. As reported by the Ministry of Post and Telecommunications, from 1985 to 1989, the number of telephones grew at a 15% annual rate while the number of lines increased at a 16% annual rate (IDC, 1991).

Future plans are centered around the use of the latest technology in transmission, fiber optics and satellites. The Chinese currently have some fiber optic manufacturing capability. Through loans from the West, the World Bank and the Asian Development Bank, the Chinese will be able to expand existing capacity and import additional cable. The goal is to increase per capita telephone availability to 2% by 1995 (IDC, 1991).

In addition to cabling, a telecommunications system must have a switch that is able to route calls through a network. This device is being obtained through importation. There are currently some joint development efforts (with Siemen's, for example) to manufacture this equipment in China and to transfer the technology to Chinese engineering staffs (IDC, 1992f).

While the efforts by the Chinese are headed in the right direction, there is an enormous amount of ground to be covered. Telephone and data communication availability are very low, the current manufacturing capabilities are lacking, and the amount of funds available for equipment purchase is relatively small.

HARDWARE

Acquisition

Although China is developing its own manufacturing capabilities, it is still dependent on acquiring equipment from external sources. Given the country's limited foreign exchange, there is legitimate concern about how enterprises will afford computers (Shea, 1988).

China has addressed the limited foreign exchange problem by acquiring equipment with loans and donations. In the 1980s, China received a loan from the World Bank for university automation projects (Lin, 1988). The loan gave the Chinese control over what was bought, ensuring that appropriate technology was purchased. In 1985, four top Chinese universities accepted computers donated by IBM (Lind, 1988).

One deleterious effect of donations is that it may be easier for a developing country to acquire new equipment rather than to repair the previously donated equipment, which may be antiquated. This may lead to several problems, including staff retraining and a lack of standardization in the domestic computer industry.

Character Set

The existence of standardized character sets (ASCII and EBCDIC) has allowed users to interface equipment from different manufacturers without any concerns for incompatibility. Unfortunately, the situation with the Chinese character set encoding is in a state of flux. There is currently no single universal encoding scheme. Several groups from Hong Kong, Taiwan and mainland China are developing codes that they plan to submit to the International Standards Organization (ISO). American computer manufacturers have developed their own encoding scheme. Finally the ISO is considering creating another encoding scheme. Until this situation is clarified, manufacturers will have to develop a mechanism that will allow for the conversion between the different encoding schemes.

Printers

The problem with printing Chinese characters revolves around the size of the character set and the complexity of the characters themselves. Standard dot matrix printers have a memory which holds the pattern of dots to print for each character. This technique is difficult to use for the Chinese character set because of the number of characters. Instead, these printers form characters as a picture. The impact of this method is that there is a significant reduction in the speed at which the printer produces output. Recent advances in memory technology are allowing the design of printers that will be able to hold the Chinese character set in a ROM (Read Only Memory). Both Japanese and mainland Chinese manufacturers are selling models that print at speeds comparable to Roman character models. The prices of these printers are also competitive (Kao, 1991).

While laser printers are becoming more popular in China, they do not offer a panacea to the character printing problem. For the Roman alphabet, characters are stored on a ROM cartridge accessible to the laser printer. The Chinese character set is too large to fit on a single ROM. The alternative is to store the characters on the hard disk. This is a workable solution but it suffers from two problems. First, it requires a large amount of disk space. Second, printer speed is reduced as the characters need to be downloaded from disk into the laser printer's memory (Kao, 1991).

Repair amd Maintenance

Developing countries may experience problems obtaining repairs for their computers, or in ensuring that routine maintenance takes place. Such support may also be costly. Sanwal (1989) reports that maintenance charges may run as much as 10 to 15% of the cost of the hardware. And Coll (1989) says that China suffers from long periods of down-time on computers as a consequence of a shortage of maintenance personnel.

This problem is being resolved by the establishment of vendor service centers in cities that have a high concentration of information technology equipment. As the installed base increases, foreign companies can justify locating these service centers closer to the end users. This will alleviate the problem of availability of parts. In addition, companies whose sole business is service are being formed (IDC, 1992d).

SOFTWARE

Intellectual Property Rights

In its effort to attract investment and sales in software, China has faced the problem of unauthorized distribution of computer programs. It is believed that most foreign software used in China today was obtained without approval from the copyright owner (Simone, 1992). Consequently, foreign software firms have been reluctant to either market and/or establish joint relationships.

The cause of this problem has been twofold. First, Chinese regulations pertaining to software use and distribution are either vague or provide little protection to foreign companies. Second, there is inconsequential enforcement of these regulations.

These two conditions alarmed United States Trade representatives to the point where they were about to impose trade sanctions on Chinese imports. At the eleventh hour the United States and China reached agreement on the protection of intellectual property rights. In a Memorandum of Understanding, the Chinese agreed to enact and implement internationally recognized copyright conventions within the next two years. While this is perceived as a step in the right direction, foreign companes are waitng to see if and how these regulations will be written and enforced before making commitments.

Programmers

A problem faced by both developed and developing countries is a shortage of trained computer programmers. In the United States, there is a general shift of university students away from the engineering and science curricula. This is especially true for computer science (Mawhinney, 1990).

The problem in China is more severe. First, there is the unavailability of state-of-the-art equipment. The second problem is that while a student may be trained in the formal aspects of computer science, there is very little expertise available to provide an end user's perspective on what is needed from the information system. This manifests itself in the production of information systems that provide functions that work but are not what the end user needs. This is not a new problem. In the United States, this problem is abated by hiring instructors who have real world experience in system design and implementation. In China this expertise is rare.

The Chinese are addressing this second problem by having major universities bid on custom software development. When the contract is won, the entire computer science department, instructors and students, take part in development. This interaction increases the practical knowledge of instructors which can now be passed on to succeeding students.

CULTURAL

Climate

Of the computing equipment available in China, the usage of this equipment is quite low. Scott (1990) reports that only 15% of computer time available is used for real information processing. His explanation is that there is a poor telecommunications infrastructure, equipment is inadequate, maintenance is slow, and software applications are nothing more than "a big abacus." These findings concur with our research. He notes one other reason. In Chinese organizations there is too little work for too many people, a result of the "iron rice bowl" concept of lifetime employment. The consequence of this idea is to reduce the need for improved efficiency and to therefore lower the need to use informaiton technology.

Data Entry

The bane of any information system is its ability to allow for fast and accurate entry of data. The standard solution to this problem for countries that use an alphabetic language is a keyboard with a key for each character. For countries like China, with languages that use a large number of ideograms, this solution is not viable.

At this point there have been three different methods used to enter characters: phonetic, shape and phonetic conversion. With a phonetic system, the user enters Roman characters whose sound is close to the word desired. The program will display all words, in Chinese, whose sound matches. The user will select the correct word. The shape method is based on the shape of Chinese characters. On a keyboard that has the most frequently used shape components of Chinese characters, the user enters the components of the word. With the phonetic conversion method, the user enters the sounds of the word desired and a program converts it to the equivalent Chinese characters based on an international dictionary made up of grammatical rules.

Unfortunately there are problems with all three systems. For fast data entry, the phonetic system suffers from forcing the user to select a word for each entry made. This would be extremely inefficient for typing documents. The shape method requires that the user understands how to decompose characters into their constituent parts. This method is "criticized for being hard to learn and easy to forget" (Kao, 1991). Finally, the phonetic conversion method imposes technical difficulty on the programmer as the conversion routines are complex.

Adding to the problem of each method is that there is no indication that one system will prevail. Japan, which has the same problem, has standardized on the phonetic conversion method as it has the best user interface. Unfortunately, China is not so technologically advanced as to be able to incorporate this technology universally.

CONCLUSIONS

The evidence that the Chinese are making significant inroads towards the use of information technology is compelling. The government envisions that the implementation of information technology is a primary mechanism to advance the Chinese economy. There are two main vehicles which are being used to achieve this goal. The first is the use of joint ventures. In this way, the Chinese will not only have access to the technology but will be able to train their own people on how to manufacture it. The second method is by coordinating the manufacturing and use of information technology by government-owned enterprises.

The Chinese will continue to encounter significant problems. The lack of capital and technological expertise is inhibiting. It is also unclear whether the management of technology through a central planning group will be able to come up with effective plans to incorporate emerging technologies. The following situation highlights this point. In December 1991, the Ministry of Finance issued a statement to government agencies that they would need central government approval to purchase various categories of goods. Included in this list were microcomputers. This statement was made as a means of controlling year-end spending of surplus funds. The effect of this was to greatly curtail legitimate expenditures on computer equipment. This in turn caused domestic computer manufacturers to have high inventories (IDC, 1992e).

REFERENCES

Braun, R. (1989, November-December). Unisys crafts a high-tech partnership. *The China Business Review.* pp. 40-43.

Cheung, T. M. (1990, August 9). All together now. *Far Eastern Economic Review*, p. 53.

Coll, J. (1989, Spring). Computers in China: Where the Chinese are; Where they want to be. *Journal of Applied Business Research, 4*(2), 17-25.

Edfelt, R. (1986). Telematics, public policy, and economic development with special reference to Brazilian protectionism. *The Information Society, 4*(3), 187-203.

Frisbie, J. (1992, January-February). Chinatron: Ghost of MEI? *The China Business Review,* pp. 30-32.

IDC 1991. (1991, December 23). China telecommunications industry: Past, present and future. *China Informatics*, pp. 221-224.

IDC 1992a. (1992, March 16). Investment in bank automation pays off. *China Informatics.* pp. 57-58.

IDC 1992b. (1992, March 31). China makes good on CAD/CAM call. *China Informatics*, pp. 69-70.

IDC 1992c. (1991, November 1). Brief on UPS market in China. *China Informatics*, p. 198.

IDC 1992d. (1992, February 15). 3COM to open service center in Beijing. *China Informatics*, p. 36.

IDC 1992e. (1992, February 15). MOF's circular has strong impact on PC market. *China Informatics*, p. 31.

IDC 1992f. (1992, March 31). Joint venture brings EWSD technology to China. *China Informatics*, pp. 67-69.

Kao, J. (1991, March-April). Making computers Chinese compatible. *The China Business Review*, pp. 16-20.

Lin, S. C. (1988, September). Library automation in China. *Information and Technology Libraries*, pp. 230-242.

Lin, S. C. (1989, March). Shanghai Jiao Tong University Pao Sui-Loong Library: Toward an integrated online system. *Information and Technology Libraries*, pp. 633-68.

Maier, J. (1987, September 28). Will China be the next Japan? *Computerworld, 31*, 68-78.

Maier, J. (1987, October 5). U. S. shares know-how with China - selectively. *Computerworld, 32*, pp. 73-79.

Mawhinney, C. Projecting information system majors. *Proceedings of 1990 Northeast Decision Sciences Institute*. Saratoga, NY. pp. 38-40.

Oechsli, C. (1988, August). New rules for technology imports. *The China Business Review*, pp. 35-36.

Sanwal, M. (1989). Methodology for end user computing in development administration. *Information and Management, 17*, 117-126.

Scott, J. H. & Perkins, W. C. (1990). Infostructures: How to survive and prosper through the information revolution. In *Research Issue in Information Systems: An agenda for the 1990's*. Wm. C. Brown Publishers, pp. 12-15.

Shea, K. (1988, March-April). Computer investments. *The China Business Review*, pp. 30-33.

Simone, J. T. (1992, March-April). Improving protection of intellectual property. *The China Business Review,* pp. 9-11.

Thorpe, P. (1984, June). The impact of new information technology in the developing countries. *Journal of Information Science, 5*(8), 213-220.