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MAJOR BARRIERS IN TELECOMMUNICATIONS TECHNOLOGY TRANSFER – NORTHERN TELECOM'S PERSPECTIVE

BY

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Major Barriers in Telecommunications Technology Transfer -- Northern Telecom's Perspective

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Abstract

Technology transfer is having a pervasive impact on the conduct of international affairs. The spread of technology across the borders of a limited number of so-called advanced nations has altered the ways in which various global actors relate to each other as well as the prevailing patterns of international trade, commerce and cooperation. The expanded interest in and demand for transborder flows and sharing of critical scientific and technological know-how, has fostered more cooperative ventures, while at the same time giving birth to new forms of economic and technological protectionism.

Telecommunications occupies a strategic position in the Chinese economy. It is one of the two or three major industries upon which the fate of China's entire modernization rests. Telecommunications technologies and services increasingly are seen as the central nervous system of the evolving national and international economy of the twenty first century, not only as a concomitant of future growth and welfare, but as a precondition for both. Thus, leap-frogging into the "state-of-the-art" telecommunications technology is considered by the Chinese government as the most expedient way to propel its economic growth and prosperity. In 1986, telecommunications was given top priority for development in the Seventh Five-Year Plan (1986-1990), and continues to enjoy its privileged position in the current Five-Year Plan. As a result, massive investment has been brought in: from 1986 to 1991, fixed asset investment in telecommunications totalled over $6 billion (U.S.).

Canadian telecommunication suppliers such as Northern Telecom have competed to take advantage of the tremendous opportunities China offers. However, the process of transferring technology across two widely disparate

cultures such as Canadian and Chinese is often complicated by differences in the political, economic, legal, technological and social/cultural systems. In this thesis, the discussion of these difficulties in light of Northern Telecom's experiences will provide helpful insights in understanding such complex processes.

The research is grounded on the assumption that technology transfer is an extremely complex process with interconnectedness between history, current context and transfer process. It is a process in which present actions are related to the past, and to the future. The research maintains that to be successful in China, a company must have a long term vision, and apply it with patience, persistence, and flexibility. The study is a combination of documentary research and field-based case study.

DEDICATION

To my mother and father who taught me the value of hard work and integrity through their own examples.

ACKNOWLEDGMENT

The author wishes to thank all Northern Telecom interviewees for their participation and cooperation in this study. My deep appreciation is extended to my advisors Dr. Jan Walls and Dr. Pat Howard for their prompt, precise and thoughtful suggestions and comments on this work. I would also like to acknowledge the valuable conversations I enjoyed with Mr. Andrew Dymond which ultimately led to this exploration. Finally this undertaking could not have been completed without the continued support and encouragement of my husband, Gregory Shea, to whom I express my heartfelt gratitude.

Any errors or oversight in this work are completely my own responsibility.

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INTRODUCTION

Telecommunications occupies a strategic position in the Chinese economy, especially as it relates to the modernization of Chinese industry. It is strategic because of its specific properties, its rapid development and proliferation worldwide, and its significant impact on other sectors--economic, industrial, commercial, social, cultural and educational. Indeed, the ability to gather, manipulate, transmit, receive and interpret information is one of the main ingredients of successful economic performance. Consequently, telecommunications technologies and services are increasingly seen as the central nervous system of the evolving national and international economy of the twenty first century, not only as a concomitant of future growth and welfare, but as a precondition for both.

Projections by the World Bank, the International Monetary Fund, and the Organization for Economic Co-operation and Development suggest that China is poised to become a major political and economic power by the year 2000. The Chinese government has set itself targets of quadrupling the gross value of industrial and agricultural output between 1980 and 2000, and increasing per capita national income from about $300 to $800 (about 5 per cent per year).

To achieve this target, China desperately needs to modernize its inadequate energy, transportation and communications systems. Only Japan and the West have the technology China requires to become a world-class economic and political power. Leap-frogging into "state-of-the-art" telecommunications equipment and services is thus considered by the Chinese government as the most expedient way to propel its economic growth and prosperity. In 1986, the telecommunications industry was given top priority in the

Seventh Five-Year Plan (1986-1990). The telecommunications industry is growing in absolute terms and is destined to account for an increasing share of industrial output. Between 1986 and 1991, fixed asset investment in telecommunications totalled over U.S. $6 billion.

The debate over the wisdom and advisability of fueling economic growth through increased participation of foreign technology, investment, and influence has been a topic of serious debate for a considerable time. For at least several hundred years, the Chinese have had to consider the merits and demerits associated with Western science and technology. The record of post-1949 China has been one of alternating periods of great interests in and almost total rejection of foreign technology.

The reascension of Deng Xiao-ping and the supporters of economic and political reform in the late 1970s brought with it a new attitude toward the role of foreign economic interests in developing China. "Opening-up" to the outside world became an explicit goal of the new modernization effort. In reinterpreting her previous doctrine of self-reliance, China embarked on a program of massive acquisition of foreign capital investment and technology. In 1991, China's total trade mounted to U.S. $145.7 billion, of which exports amounted to U.S. $71.9 billion and imports U.S. $63.8 billion, leaving a trade surplus of $8.1 billion.[1] By the end of 1991, there were approximately 20,000 joint ventures with foreign partners operating in China.[2]

Despite the rather impressive arrays of increased foreign commercial activities, and the continuing foreign presence in the Chinese economy, few foreign companies with investments in China would maintain that their experiences have been very satisfactory. Canadian companies are no exception. Even companies with an established track record of transferring technology to

China have encountered numerous problems. It has been assumed that these hurdles to profitable business activities have kept foreign investments below levels targeted by the Chinese government.

However, the Chinese economy continues to grow and develop, regardless of the many reported problems and the interruptions caused by bureaucratic obstacles and political upheavals. With the recent reaffirmation by China's leaders of the continuation of the "Open Door" policy, it remains the clear intention of the present Chinese leadership to rely on foreign economic relationships to power the development of the nation's economy. Indeed, the implications are significant for continued foreign participation in the Chinese economy.

China is a market with huge potential. The sheer size and potential of the China market have been and remain the justification for the long-term objectives of China's trading partners both on country-to-country and company-to-company levels. China's telecommunications sector is a fiercely competitive market. France, Japan, Sweden, Germany, the U.S., Canada and Hong Kong are all major contestants in this market. Canadian suppliers are increasingly aware of the opportunities resulting from China's modernization drive, and some have begun to take advantage of these opportunities to penetrate what is generally considered one of the most difficult yet irresistibly vast markets in the world.

Canada began political and trade contacts with the People's Republic of China as early as the late 1950's and continued to develop these contacts gradually during the succeeding fifteen or so years, a period during which the U.S. had no significant contacts with China. Official trade figures indicate that during the late 1970's and throughout the 1980's Canada's trade with China consistently far exceeded the levels of U.S.-China trade on a per capita basis.[3]

Despite the fact that non-manufactured goods (e.g. wheat) usually constituted the bulk of Canada-China trade, Canada has been quite successful in developing its trade with China in certain manufacturing sectors. Foremost among the latter is the telecommunications industry, where Canadian firms have been most active. In the 1980s, Canadian telecommunications companies "captured a very respectable portion of the Chinese market and have therefore contributed significantly to China's development strategy for the sector."[4] It is estimated that a total of eight to ten Canadian telecommunications firms currently trade with China and/or have traded with China during the period of 1978-1990 period. They include small, medium-sized and large manufacturing companies and consulting firms.[5]

Northern Telecom (Nortel) accounted for a great bulk of Canada-China telecommunications trade during the past decade or so. Currently, Northern Telecom occupies the first or second place in terms of the number of lines sold in China.[6] Nortel has established a strong presence in China and has won many contracts. The company is a major supplier of telephone switching systems in China. More than 200,000 lines had been sold as of early 1992, and the Tong Guang Joint Venture was established in 1988 to manufacture Meridian SL-1. It has also sold 1 million lines of DMS switching system, and is currently in the process of negotiating another joint venture to manufacture DMS.

The decision to focus on Northern Telecom is motivated by the realities of Nortel's size and its share of the Chinese telecommunication market, as well as its international success, strength and importance. Northern Telecom is one of those corporations who see China as a major potential market and has accordingly developed a long-term strategy with a set of clear objectives and pursued them with persistence, patience, flexibility and understanding. As a result, they have improved their market share and status.

METHODOLOGY

Technology transfer is an extremely complex process with interconnectedness between history, context and process. It should be perceived as a process in which present actions are related to the past and the future. A deep understanding of technology transfer requires a consideration of multiple factors which includes differences in politics, economic systems, legal environment, infrastructure, technologies, culture and society, as well as language and mode of communication. These components combine to create the complex environment in which technology transfers commonly occur.

The objective of this research is to identify some of the major issues surrounding telecommunications technology transfer to China, using Northern Telecom as a case study. It seeks to determine the relationships of the various elements in the transfer process. The study also attempts to examine and understand the strategies Northern Telecom has employed in addressing these issues.

This research utilizes an approach known as the deductive approach, which begins with an observation and then additional observations are sought to help confirm or reject initial hypotheses.[7] The study takes the position that technology transfer from Canada to China is a phenomenon of particular significance, which when successful will have significant benefits for both Canada and China. The study also maintains that the vast differences between the two countries' political, economic, legal, infrastructural as well as socio-cultural systems cause the process of such transfer to be riddled with complexity and difficulties. One must take into consideration these multiple factors in order to fully appreciate the complexity of the issue at hand. From the case study of telecommunications technology transfer from Northern Telecom to China, the

research seeks to generalize findings to a whole group of cases. "The use of case studies allows one to ground conceptual underpinnings in specific facts. To the extent that these facts are then generalizable, greater depth and completeness occur."[8] The end result is greater understanding of technology transfer.

The study is a combination of documentary research and a field-based case study. The objective of the research calls for data collection via questionnaires and interviews. It was determined that in order to gain the greatest degree of insight and knowledge of the issues encountered by Nortel in their technology transfer process, a structured interview technique, guided by a structured questionnaire, should be used (See Appendix A). This technique allowed for a discussion of the answers rather than solely the receipt of answers. This flexibility and facility for interviewee elaboration of answers provided richer results than a mailed questionnaire could have. These elaborations provided insights and shed light on various issues pursued by the researcher. The interviews were conducted by the researcher herself in the spring of 1992.

The eight interviewees are all Nortel executives who are directly, extensively and continuously involved with Northern Telecom's activities in China. Their experiences and insights were extremely valuable to this research. Although the number of participants was so small as to make normal statistical analysis impossible, they are large by comparison with other Canadian and international telecommunications companies. It is not at all uncommon for a typical telecommunications firm to have two or three personnel assigned to the Chinese market. Nevertheless, the sample selected represents a critical number of Canadian telecommunications personnel actively involved in China, and each of the Nortel executives' experience is of considerable value.

The study is composed of four chapters with an introduction and conclusion. Chapter I is a literature review of related topics in technology transfer which provides the theoretical foundation and analytical framework for the later part of the study. Chapter II examines China's technology acquisition from a historical perspective. Such discussion is extremely helpful in understanding China's current drive for foreign technology and its related technology transfer policies. Chapter III lays out the organizational environment of China's telecommunications industry and the recent development of the industry concerned. The analysis of the field research data in the context of the theoretical framework set forth in Chapter II provides the focus of Chapter IV. In this chapter, the major issues regarding technology transfer between Canada and China are explored from political, economic, legal, infrastructural, and socio-cultural perspectives. As well, this chapter discusses Nortel's strategies in dealing with various barriers and the effectiveness of these strategies.

The breadth of some of the topics brought together in this paper renders it necessary to ascribe certain limits to the study. The study is limited to Canadian suppliers of telecommunications equipment and services, highlighting Northern Telecom's experiences and is mostly a Canadian perspective on the subject. It is also beyond the scope of this paper to analyze comprehensively the current status and the technological absorption capacities of the Chinese telecommunications industry, even though this factor clearly has important implications for the ability of China to handle future transfers. A thorough examination of the issue is outside the realm of the present study. The study also does not attempt to assess the appropriateness and the impacts of Nortel's technology transfer to China since a fair treatment of this issue requires far more resources than what is available to this researcher. The study focuses primarily on technology transfer via joint venture and does not include all possible channels

of transfer. The availability of relevant data prior to 1979 also limited the study to the current period of extensive technology transfer since the "Open Door" policy was initiated.

CHAPTER ONE LITERATURE REVIEW

Technology Transfer

Technology transfer suffers from a wide variety of definitions. There is no authoritative definition of technology transfer even though some writers have been more specific than others. The most general, and most often quoted, definition of technology transfer is that of Gruber and Marquis who conclude that the concept means "the utilization of an existing technique in an instance where it has not previously been used."[1] It means that technology transfer occurs when a technology established in one context is implanted in a different context. It may entail the movement of technology from one location to another, or from one user to another, or a combination of the two; or, as articulated by Bar-Zakey, this transfer may be seen as "the generation and/or use of scientific or technological information in one context or its reevaluation and/or implementation in another."[2]

Most contemporary discussion of technology transfer emphasizes the role of technology in the economic arena. They argue that technology and its advance contribute to change and that this change fuels economic growth through productivity increase. Thus for theorists such as Gee, Marton, and Pugel, technology transfer is the application of technology to a new use or user for economic or productivity gains.[3]

There is another approach which views technology as a "socio-technological" phenomenon, that is, besides involving material improvements, technology is considered to incorporate a cultural, social, and psychological process as well.[4] However, the optimistic assumption of "improvement" as an automatic benefit of technology transfer has often been challenged. Many would argue that technology transfer, particularly inappropriate technology transfer, has

in fact caused a deterioration in the living standard of the local people even at the time when economic growth has been recorded.[5]

Technology transfer as it is conceptualized in this study embraces all the above mentioned aspects. It entails the movement of scientific and/or technological information from one location to another, from one user to another for economic and productivity gains. It is at the same time, a socio-technological phenomenon which incorporates cultural, social, and psychological processes as well.

Stewart & Nihei make a key distinction between technology transfer and technology diffusion. "Technology transfer concentrates on the supply side--on the willingness and ability of the supplier to transfer--and assumes that demand is not a constraint. Diffusion on the other hand takes technology supply for granted, and examines the speed of demand over space and time."[6]

This is an important distinction as it relates to this study. Although China's ability to choose technologies wisely, assimilate them, and diffuse them are also questions which have concerned students of technology transfer to China, this study is mostly an effort to understand technology transfer to China from Canadian technology suppliers' perspectives.

There are many different ways of transferring technology. The explicit mechanisms include direct foreign investment, licensing, turnkey plant, technical agreement, project contract, joint ventures consulting services as well as trade in capital goods such as machine tools, instruments, and transportation equipment. There are also some implicit channels of transfer which are hard to detect, let alone measure, given the tacitness and relative openness of technology. These channels include the flow of public technology information via scientific and technological journals, patent descriptions, meetings, seminars, colloquia, industrial shows, visits to production facilities, and transfer of person- or

instrument-embodied know-how, as well as industrial espionage and other forms of property violation.[7] With the exception of industrial espionage and other forms of property violation which are illegal, each transfer mechanism is most appropriate to a particular purpose or environment, and the significance of each channel changes across nations and over time.

Licensing and Joint Ventures

In China, technology transfer has mostly taken the form of direct sales, licensing, and joint ventures, with joint venture gaining increasing popularity and support from the government.[8] This section of the literature review will try to provide a conceptual framework for technology transfer via licensing and joint venture with special attention to joint venture. The theoretical analysis of barriers to technology transfer is also presented in this chapter.

Licensing is defined as a "contract under which the licensee is granted certain rights to manufacture and sell products utilizing invention, process techniques, and other industrial property rights of the licensor."[9] Licensing is usually technology specific and most frequently includes, besides the technology know-how, trade secrets, trade mark, or sales and distribution rights for particular products. The terms of licensing agreements can vary greatly and are arrived at through bargaining between the licensor and the licensee, and reflect the strengths and needs of both parties. The arrangement is usually subject to certain conditions that are spelled out by the parties to the agreement. It is agreed that the licensee will pay a fee or royalty payment to the licensor for the use of the technology. Often the royalty payment is a percentage (e.g. five percent) of the licensee's sales that were made possible through the use of the licensor's technology.[10]

However, license agreements can create undesirable dependence of the licensee on the licensor. Many license agreements have what are often referred to as "restrictive clauses." The licensor may limit the licensee to a relatively small market territory and license only codified technology, which is a small part of the requisite design or process know-how; or it may require strong and costly quality control procedures; or it may force the licensee to buy certain critical inputs or proprietary components. Unless these can be obtained locally or alternative sources can be found, this may lead to undesirable dependence and exploitation.[11]

In its broadest sense, a joint venture can refer to "any form of collaboration between two or more business entities." However, the term can also be used in a more specific sense to refer to "the establishment by two partners of a third business entity for a specific purpose and whose equity and costs they share."[12] Joint venture is one form of foreign direct investment whereby a foreign company typically provides technology, capital management, and marketing skills while the host company supplies material and labor resources. The actual process of sharing technology in a joint venture can occur in a number of ways. For example, one partner may issue a license to another to use its technology freely in the production of a product. If the technology is of high proprietary value, however, its owner may choose to maintain complete control over its manufacture and simply supply the crucial technology to the production partner in a packaged form, allowing the production partner to incorporate it into the final product. If both parties have strong technological capabilities, technology sharing might be undertaken by means of a cross-licensing arrangement whereby each partner can have access to the other's technology.[13]

According to Susan Goldenberg who studied over one hundred international joint ventures between 1986 and 1987, one advantage of joint

ventures over licensing is that "they can provide greater protection"[14] for the company supplying the technology. Joint venture can also "breed more collaboration"[15] as it "adds the resources of both sides, subtracts from each participant's capital requirements, divides the time required to market, and multiplies the available technical talent."[16]

However, joint ventures are not without inherent problems. Partners may join hands with different objectives. Typically foreign partners with greater technological strength will form joint ventures with local partners of less strength, while the former may want to seek market share and control their proprietary technology, the latter usually demand the latest "state-of-the-art" technology which the former will not happily furnish in order to preserve its technological leadership.[17]

The fact that a partner in a joint venture is essentially an independent entity over whom only minimal control can be exercised can also be a potential problem. For example, if one partner in a joint venture unilaterally determines that capital shortages facing the operations prohibit it from making capital contributions to the venture, the other partners may find themselves in a real bind through no fault of their own.[18] In order to control these kinds of problems, joint venture agreements are often filled with complex legal clauses that try to anticipate any and all problems. Coping with these requirements, in addition to meeting sundry bureaucratic requirements of each partner, often means that joint ventures have higher costs than other businesses.

In 1988, Northern Telecom and Tong Guang Electronics Corporation opened a factory in Shekou, Guangdong province as part of the joint venture to manufacture SL1 digital PBXs and digital telephone sets in ten factories in China. The joint venture is fifty-five percent owned by Nortel and forty-five by the Tong Guang Electronics Corporation, with Nortel providing the technology,

management and marketing skills while Tong Guang supplying material and labor resources. The problems encountered by Nortel in the process of setting up and running the joint venture is the subject of the discussion in Chapter IV.

Barriers to Technology Transfer

A barrier to technology transfer is anything that impedes, restricts, or forestalls the smooth transfer of the technology. There exist many potential barriers to successful technology transfer. The following review on the barriers to technology transfer is explored in a general context and provides an analytical framework for the discussion of Nortel's experiences in transferring technology to China.

Political Barriers

Political barriers to technology transfer are those imposed for political and ideological reasons rather than purely economic reasons. Political barriers arise from both international and national politics and the two are closely related. Changes in domestic politics often bring about corresponding changes in the international political relations, and vice versa. These changes most definitely can affect the transfer of technology across borders. One most important form of international political barrier is export control laws. Export control laws restrict the export of certain goods and technology if such exports are deemed detrimental to national security, or if the withholding of such exports furthers national foreign policy objectives.[19]

Political stability has a great impact on the smooth transfer of technology. Political stability and predictability of change in both international and domestic

environment are factors extremely important in conditioning the risk evaluation of individual firms as well as the firms' ability to adapt and plan future growth.[20] Political and economic uncertainty does not create conducive environment for technology transfer, particularly in capital-intensive sectors such as telecommunications. The tendency for the Chinese leadership to waver between decentralization and recentralization, as evidenced by the events in the summer of 1989 and then the redecentralization again since 1991, has raised serious concerns among foreign investors about the ability and the readiness of the Chinese government to deal with the fundamental contradictions between the central-control of political ideology and the economic reforms. Some practical examples of political influences on technology transfer decisions will be found in the following chapters.

Economic Barriers

Economic barriers take on many forms and they can be imposed by both international and domestic markets. International economic barriers are imposed by international markets, which are external to China and beyond its control. One most important form of international economic/trade barrier is export control laws which restrict the export of certain goods and technology if the exports have a serious negative impact on the national economy.

Rising protectionism as a result of intensified global competition may also preclude growth in certain sectors. Import limitations imposed by foreign countries will inevitably diminish China's foreign exchange reserves, which will in turn limit the country's ability to invest in new productive capacity.

As well, prices for certain highly sophisticated technology are too high, and beyond the immediate reach of the "would-be" technology buyers, even though funds can be secured or suppliers' credit is available to overcome this problem.[21]

Domestic economic barriers are reflected in both economic and trade policies and the existing economic infrastructure. In the eyes of foreign technology suppliers, import barriers, both tariff and non-tariff barriers, are national trade policies that impede the smooth transfer of technology. Tariffs are import taxes most commonly imposed to protect domestic markets from foreign competition. Non-tariff barriers restrict imports by means other than tariffs. Import quotas, government and industry procurement policies that discriminate against foreign goods, and administrative protection measures that entail substantial red-tape for the importation of goods are examples of non-tariffs barriers.[22]

Economic barriers can also be reflected in the lack of economic infrastructure, which provides services to business, specifically to foreign companies. These services include transportation, communications, utilities, and financial services, education institutions, as well as facilities (such as material testing laboratories) that are sector or industry specific. Inadequate supply of such services may compel foreign companies to supply their own at higher cost or to suffer the consequences of inadequate supplies, delays, and interruption in production and delivery. In either case, the cost of doing business goes up.[23]

Legal Barriers

Legal barriers can occur when there are inadequate laws regulating the international economic activities or when the existing laws act to deter or restrict foreign investment. Some examples of these barriers are: restriction on

ownership, royalty payments and profit remittance, delays in government approvals, import tariffs, prior deposits on imports, approvals of imports, restrictions on local financing and fiscal incentives, restrictions on introduction of new products, no allowance of third-party agreements, discrimination against foreign companies, export quotas, local production requirements, price controls. Others include vacillating government policies, problems related to permission to bring expatriates to host countries, lack of export financing, lack of patent protection, length of technology transfer contracts labor laws and so forth.[24] All of these greatly affect the transfer of technology, and may preclude access to high proprietary technology altogether in some cases.

Legal constraint can also be caused by the absence of (or insufficient) government legal services regulating economic activities, providing information, setting standards, administrating the legal-social environment of business, and operating fiscal machinery that both helps regulate the economy and provides revenues for its services. Shortcomings in government administration and regulation may be reflected directly in business costs, or more indirectly as a climate of uncertainty surrounding the activities of foreign companies. Such a climate is always a deterrent to investment and hence to technology transfer.[25]

Lack of a solid legal basis with an effective enforcement system has been a major concern among foreign investors in China. The promulgation of numerous laws and regulations related to foreign investment since the Open Door policy has brought China closer to establishing a legal system compatible with the international legal systems. However, the enforcement of these new laws, as well as certain ambiguity in the interpretation of the laws have not eased the concerns of many foreign investors. The difficulties of transferring technology to China in the Chinese legal context are explored in greater detail in the last chapter.

Technological Barriers

These barriers refer to the absence or lack of a technological infrastructure (sometimes called science and technology base). The absorption and utilization of the technology that is transferred can be influenced by a country's supply of professionals and workers who possess the general education background. Such educational background should be available at all levels of the technology process in order to make the transfer viable. Hawthorne discusses what capabilities the technological infrastructure must provide to personnel at various levels of involvement with the transfer. Operators must have the capacity to operate and maintain product equipment. Foremen should have basic supervisory skills; technicians, draftsmen and production planners must have the ability to adapt the technology to the local environment, while managers must be able to assess and negotiate business opportunities. If personnel with these types of skills do not exist in the recipient enterprise or country, this lack of technological infrastructure becomes a barrier to the successful transfer of technology.[26]

Socio-Cultural Barriers

Socio-cultural barriers exist because often neither the supplier nor the recipient understand the other's cultural values and how they bear on work-related values, factors of production, interpersonal relations, social customs, group activities, and the like. The general values and attitudes inherent in a society can either hinder or facilitate technology transfer. These values are expressed by a country's willingness to accept change. Among others, Hofstede [27], Stewart & Nihei [28] Niehoff & Anderson [29], as well as Novack and Lekachman

[30], all argue that change or modification of such values and attitudes may be a precondition for accelerated technology absorption.

However, resistance to change may not be all negative if such changes are detrimental to a society as a whole. Technology transfer is believed to propagate the socio-cultural values of the societies in which the technology originates, which may clash with those of the host countries. Foreign penetration in host countries is commonly blamed, for example, for contaminating local cultures with egotism, aggressiveness, materialistic tendencies and economic corruption. The corporate culture is often characterized as ruthless and dehumanized. Local patterns of consumption may be unduly influenced by alien ways and styles that raise moral questions and offend aesthetic sensitivities. Concern is also expressed about the unsuitability of the technology transferred to the local conditions. These socio-cultural as well as political arguments often reinforce each other and produce a mosaic of emotions combining nationalism, anti-industrialism, and a sense of powerlessness and insecurity in the face of external influences.

The observation has been made that in the long run, however, most people are willing to accept change but in the short run they resist it.[31] This resistance to change may be caused by the introduction of a new technology that will cause a radical change in attitudes, organization, and current processes. Also, a strong sense of professional pride may cause a resistance to new ideas or methods, particularly when they originate in another environment. This "not-invented-here" attitude is particularly common among scientists, engineers, and technologists, who see new ideas as a potential threat to their professional reputation.[32]

Judith et al have listed several other reasons for the resistance to change, including intellectual resistance--the lack of educational background to deal with

the technology; economic resistance--the new technology is too expensive; sociological resistance--the new technology threatens people's ordered existence; and sociological resistance--the new technology may cause a change in the organizational structure.[33]

Cotton describes five areas in which the cultural barriers are apparent.[34] First, differing value systems may cause misunderstandings due to differing conceptions of right, wrong, proper and improper. Value systems may affect the division of labor, type of supervision and type of work that people are willing to accept. Second, the economic system may give rise to different attitudes toward competition, labor and capital efficiency, and acceptable standards of living. Third, in many societies job security may be more important than the potential for advancement. Fourth, social and family customs may affect interpersonal relationships and the individual's attitude toward group activities. Fifth, the character of interpersonal relationships may affect the organizational patterns that are possible in the recipient firm. In short, cultural barriers to technology transfer may occur as a result of any number of social norms and values that can cause misunderstanding between the supplier and recipient of technology.

Perhaps the most obvious socio-cultural barrier to technology transfer is the language barrier. Technology transfer relies on people-to-people contacts, therefore failure in communication could be a significant barrier. Such a failure may be caused either by linguistic differences or by ineffective individual methods of communication and thought. The language of everyday use is imprecise and easily subject to misinterpretation. The context of the discussion and the backgrounds of the individuals thus determines the level of communication possible.

The foregoing has set out the conceptual foundations of some relevant concepts in technology transfer. All of the barriers to successful technology

transfer outlined above are closely interrelated and they will likely appear simultaneously. Each of these factors raises a number of strategic, political and managerial issues in the context of international technology transfer. The state of legal, social, and economic infrastructure of the country can either facilitate or hinder the process of technology transfer. It establishes the limits concerning how much and what type of technology can be transferred at acceptable risks and costs.

Much of the political, economic, legal, technological and socio-cultural difficulties in transferring technology to China has its roots in the historical experiences of technology acquisition from the West, particularly since the Opium War (1840). Because technology transfer is a process in which history, present and future are closely interrelated, it is imperative to examine China's technology acquisition from a historical perspective, and this is the subject of the following chapter.

CHAPTER TWO: CHINA'S TECHNOLOGY ACQUISITION--A HISTORICAL PERSPECTIVE

History is often regarded as a key to understanding the present and the future. It can provide us with examples of how people have acted and reacted in similar situations. The study of history frequently generates ideas that can be of use when we act today and plan for tomorrow. Naturally history is only to be used with great caution as a guide for our actions and as a tool of prediction.

More than one hundred years ago, a small group of Chinese officials tried to convince a conservative Confucian majority that it was of vital importance for the country to learn Western science and technology. Echoes from that debate were heard continuously throughout contemporary Chinese history when China debated its policy concerning the use of foreign science and technology. Indeed after the Opium Wars from 1840 to 1860, foreign influence became a decisive political force in Chinese internal affairs.

When confronted with Western technology, the ruling Confucian bureaucracy reacted with massive resistance. The arguments voiced against Western science and technology in China had one thing in common: the conviction of the superiority of Chinese culture. There were no reasons for China to model itself upon the West, the conservatives said, and pointed to history, which, according to them, showed that in times of prosperity China never learned from the foreigners, so why should it now?[1] Even if China had to develop its science and technology, why not use the great competence already existing in the Empire, and, for that matter, was it certain that what was good for the West was also good for China? The debate regarding China versus other civilizations has been a constant bone of contention for centuries that followed.

Some Confucian literati-officials saw science and technology as nothing but a means of simple profit-making, whereas the aim of education should be to attain "the time-honored Confucian principles of propriety, righteousness, integrity and sense of shame."[2] Machines, ships, guns and telegraphic and railroad communications were considered artful contrivances beneath their dignity. Others claimed that modern technology was ineffective, that it could be harmful as there was a great risk that it would consume too much of the Empire's natural resources, or that it would lead to a greater gap between rich and poor in China. Some accepted the liberals' assertion that to survive as a nation, China had to learn the military technology of the foreigners, but they said, is it not most unlikely that the barbarians would be stupid enough to teach the Chinese the secrets of their newest and most effective arms? And finally, they put forward an argument that spoke directly to the people: what would happen to the cosmic order if railways were laid on the soil, telegraph poles thrust into the ground, and mining shafts cracked the mountains open? This could seriously and irreparably disturb the "Feng-shui" (spirit of the wind and the water.)[3]

There were, however, those who sought to steer a middle course between capitulation and conservation. These early reformers wanted to make the existing Confucian structure with its virtues of morality, its culture and its tradition, adapt and absorb the Western influence, as it had in response to so many other invasions, taking the best of the new technology and converting the conquerors. These ideas were echoed by Feng Kuei-fen and Zhang Zhi-dong, who articulated the famous slogan: "zhong xue wei ti, xi xue wei yong", namely, Chinese scholarship for the essence, Western scholarship for practical applications.[4] This "Ti-Yong" formula proposes that Chinese ethics and famous (Confucian) teachings serve as an original foundation, letting them be supplemented by the

methods used by the various nations for the attainment of prosperity and strength.[5]

Lin Ze-xu, the high ranking official who had been sent to Canton by the Emperor with orders to stop the traffic in opium, was convinced of the moral supremacy and the virtual invincibility of the Middle Kingdom, but he also realized the superiority of the barbarians in ships and weapons. Lin Ze-xu and his associates were among the very first Chinese who dared to think along the lines that would eventually lead to the famous recommendation of "learning the superior skills of the barbarians."

Li Hong-zhang and his close friend Zeng Guo-fan, two other very influential Chinese officials, occupied the pivotal positions between the conservative, backward, official China of the second half of the nineteenth century and the Chinese with experience overseas who wanted to import Western science and technology in order to awaken the giant. Many elements of Li and Zeng's ideas inspired the "Self-Strengthening Movement (Zi Qiang)." They propounded the idea of founding schools for the study of foreign languages and Western scientific knowledge, translation of books, reform of the traditional examination system, and the spreading of knowledge of foreign culture among those Chinese who frequently did business with foreigners.

One cannot talk about China's modernization effort in the last century without mentioning the Tsungli Yamen. It was the first "foreign affairs" office in the history of China. The Tsungli Yamen was involved, in one way of another, in a great number of projects with the common goal of modernizing China. It played a role in education on different levels: first, simply by encouraging contacts between Chinese officials and foreigners in China and abroad. Secondly, the Tsungli Yamen established the first language school in China, which was to serve as a model for other schools in the capital and other provinces. Thirdly, it

supervised the sending of Chinese students to the United States, a project that was initiated by Zeng Guo-fan and Li Hong-zhang. Fourthly, the Tsungli Yamen approved of considerable modification in the examination system. And finally, it actively supported the translation of Western textbooks and exhorted the provincial authorities to report to the Tsungli Yamen the foreign news that was published in the foreign newspapers at the treaty ports. In addition, ministers who were sent to capitals abroad were requested to report what they thought could be of interest.[6]

The Tsungli Yamen was also instrumental in the introduction of machines and technologies from the West to China. Although the progress of the Tsungli Yamen was slow and that it followed an inconsistent program, it is worth stressing that at least during the 1860s the office was the gate through which Western ideas entered China and where xenophobia was not the rule. It was an official institution that dared to admit the need for Western technology.

Unfortunately, the overwhelming majority of Chinese officials of the time were still convinced that the inhabitants of the Middle Kingdom had nothing whatsoever to learn from the "foreign devils." It was inconceivable to them that China, the Celestial Empire, should be transformed in the image of the West.[7] The Chinese had always seen themselves as the center of the world and all other inhabitants of the earth were barbaric and uncivilized, and the behaviors of most foreign traders and gunmen of the time did little to change that stereotype. Most Chinese then knew very little about the Western scientific and technological traditions, and what they knew about Western culture, philosophy, and religion did not impress them at all. The majority of Chinese officials lived in the past, looking to antiquity for guidance instead of to the future for inspiration. Ancient ways were glorified and contemporary examples despised, citing historical sayings to justify the attitude that it was well and proper to sinicize the barbarians,

but outrageous to imitate their ways. The exaggerated sense of self-confidence and ethnocentric pride is perhaps not that unreasonable when one considers the very heights achieved at that time by the Chinese in philosophies, cultures, sociopolitical institutions, economic development as well as the many discoveries and inventions.[8]

The slow and painful realization of the superiority of Western arms was brought about first by the Opium War of 1840 and then the repeated humiliation and defeats thereafter. Notable among these were the sack of the Summer Palace in 1860; the invasions of Taiwan in 1874, the Sino-French War in 1884-85, the Treaty of Shimonoseki in 1895 and the scramble for concessions by Russia and Germany in 1897-98. Even after the overthrow of the Manchu Empire, the Chinese were frequently reminded of foreign military superiority by the twenty-one demands of Japan in 1914 and the award of Germany's Shandong holding to Japan despite the fact that the China had been on the side of the victorious Allies.[9]

The pressing need for self-preservation and defense soon led to the import of foreign technology. However, the concepts of technology and modernization remained extremely narrow as long as they were largely limited to the immediate requirement of the military. There was insufficient understanding of the ways in which technology needed to be absorbed and generated so that it would suit China's needs.[10] It was quite apparent that for the Qing rulers the immediate goal of pursuing scientific knowledge and technological dexterity was primarily practical and political--the necessary means of survival. The majority of the Chinese officials involved in questions of modernization, including persons like Feng Kuei-fen, Li Hong-zhang, and Zeng Guo-fan, used clear and simple arguments of power: to learn Western science and technology in order to control

the barbarians and enable China to survive as a nation. Defense was thus the first motive for modernization.

The Republican era was a period of inept rulers, chaos, regional warlords' power struggles and corruption. The centers of power were preoccupied with struggles and intrigues for self-preservation and self-aggrandizement. There was little time and opportunity to modernize the country as whole. If some level of modernization did occur during this period, it is often seen as despite the leadership rather than because of it.

The establishment of the People's Republic united China once again as a sovereign nation after a century's semi-colonial rule. Undoubtedly, there had been significant achievements in China's industrialization efforts and improvements in the living standard of one-quarter of the world population, particularly in the first decade of the People's Republic. These achievements are especially impressive in the context of restoring a war-devastated economy and the economic blockades from the West. The abrupt withdrawal of Soviet assistance in 1960 led China to continue adherence to a philosophy and policies of "self-reliance (zili gengsheng)," which further frustrated any earlier inclinations toward increased foreign economic contacts.[11]

The chaos of the Cultural Revolution and the dynamics of factional strife made it impossible for the country to maintain a consistent direction and strategy for a workable modernization program. Sometimes the purpose of modernization was identified with nationalism. At other times, it was linked with the promotion of socialism. Only occasionally was lip service paid to the betterment of the People's livelihood. Of course, the continued isolation from the international community did little to alleviate this situation and probably exacerbated China's inability to compete when prevailing government policies changed in the late 1970s.

In this chapter, the background of China's technology acquisition has been examined from a historical point of view. The reasons for China's failed attempts at modernizing its military and related industries since the Opium War are subject to various interpretations. Some would emphasize external factors, while others would stress internal problems. Some would point a finger at political and institutional inadequacies, while others would delve deep into cultural and individual weakness. However, this author's view is that historical concurrence and process both inside and outside China ought to be taken into consideration when interpreting contemporary Chinese modernization history.

The very requirements of self-defence provided a strong argument for modernization. The dominant intellectual conception of modernization was highly constrained to the immediate practicality.[12] Those who did emphasize institutional and structural reforms were unfortunately short-lived because of the massive resistance of conservative forces within the inept bureaucracy, and more importantly, the constant destruction wrought by repeated warfare condemned China's enfeebled effort of modernization.

For decades to come, Chinese attitudes concerning technology transfer from the outside world would bear the effects of China's unhappy cumulative historical experiences with foreign economic relations. Although national survival is no longer the burning issue, most Chinese are propelled by a sense of self-respect and a historical mission to modernize. Modernization to most Chinese means not only to achieve political, economic, technological, and military parity with the West, but to make contributions to the entire human civilization as their ancestors once did. This historical perspective will prove its usefulness in helping one understand the extremely complex issues regarding China's current modernization drive and its related policies.

CHAPTER THREE: TECHNOLOGY TRANSFER SINCE THE OPEN DOOR POLICY

The Renewed Drive for Modernization

The most recent drive for modernization stems from the lack of success of China's past attempts to attain its modernization goals. After decades of quasi-isolation and with the passing of Mao and the downfall of "Gang of Four", the new Chinese leadership under Deng Xiao-ping recognized the necessity to learn from the industrialized countries of the West and Japan in order to achieve the "Four Modernizations" of agriculture, industry, science and technology, and national defense. The Open Door Policy (kaifang zhengce) was officially introduced in 1978. By the end of 1978 foreign trade reached an annual volume in excess of U.S. $20 billion. China's foreign trade has grown by leaps and bounds since then, reaching $145.7 billion, with a trade surplus of $ 8.1 billion in 1991.[1]

Central to the present set of economic reforms initiated by Deng Xiao-ping is an explicit and dramatic endorsement of the virtues of "opening up" to the outside world and a recognition of the centrality with regard to the role that foreign technology will play in China's modernization. As a result, a period of "foreign great leap forward" was ushered in.[2] China would now be prepared not only to buy technology but also to accept investment from the developed countries of the capitalist world. Between 1979 and 1988 China concluded 27,527 contracts for importing 16,941 technology projects and sets of equipment.[3] Since 1989, the number of contracts signed each year has been increasing both in volume and value, in 1989, 5,779 contracts were signed, representing a total contract value of U.S. $ 6.3 billion, and 7,273 contracts valued at U.S. $ 6.6 billion in 1990 and a highest of 12,978 contracts of U.S. $ 11.9 billion signed in 1991.[4]

The recognition of the country's urgent need to enlist the cooperation and financial support of foreign companies from industrialized and capitalist countries resulted in the promulgation of the new "Law of the People's Republic of China on Joint Ventures" (Joint Venture Law) on July 1, 1979 which spelled out the basic regulations for foreign investment in Chinese industrial enterprises. "This was a near-revolutionary step for the country in view of its recent history of isolationism and the glorification of the doctrine of self-reliance."[5]

In order to attract foreign investment to China, a great degree of autonomy is allowed in joint ventures, a condition provided for in the contracts and confirmed repeatedly by policy statements by senior officials. In a statement at the China Investment Promotion Meeting, June 1982, Wei Yuming, China's Vice-Minister of Foreign Economic Relations and Trade spelled out the rights of joint ventures. These included: (1) the right of joint ventures to decide on their own development program, production management plan and labor-wages plan; (2) the right to buy inputs directly from domestic and international markets; (3) the right to sign various economic contracts with domestic and foreign companies and enterprises; (4) the right to raise Renminbi (RMB, Chinese currency) and foreign currency funds from internal and external financial institutions; (5) the right to establish their own financial management and other management systems, and to determine their own profit-distribution program; (6) the right to hire and fire employees and to adopt the systems of pay scale, wage-form, bonus, and allowance appropriate to themselves for rewarding and punishing employees; and (7) the right to innovate and reform production techniques.[6]

The Joint Venture Law stipulates that all joint ventures have separate legal personality with liability limited up to the contributions made by the parties of the joint ventures. Foreign investors do not have to contribute more than twenty-five percent of the total capital to a joint venture, and that this investment need not be

in cash, but can be in the form of "advanced technology and equipment that actually suits the country's needs." All joint ventures must be governed by a board of directors agreed upon by the investors. The chairman of the board must be a Chinese and the rest can be all foreigners. The board "decides on all major problems" of the venture. The law encourages the importation of "advanced technology" by any joint venture through "reduction or exemption of income tax for the first two or three profit-making years." As an additional attraction, the Law also stipulates that "a foreign joint venture that reinvests in China its share of the net profit may apply for refund of a part of the income tax already paid."[7]

The degree of flexibility and latitude ascribed to foreign investment is especially noticeable in the Special Economic Zones (SEZ). These zones are specially designed to create designated areas where freer interaction with foreign investors would prevail and where market forces would be permitted to play a more prominent role. The first SEZ in Shekou was authorized in January 1979, and Xiamen and Shenzhen SEZs were established in 1980. Fourteen more coastal cities were granted similar preferential status of SEZs in 1984. Each of these zones has promulgated its own series of legislation to govern investments, as well as approval procedures related to establishing foreign investment enterprises.[8] Enterprises in SEZs were to have greater flexibility in management and could offer greater incentives to their employees.

The primary aim of the new economic reform in these SEZs was to have development financed by foreign sources and to export approximately seventy percent of the industrial output in order to generate foreign currency for further development. The incentives offered included preferential taxation (a flat rate of fifteen percent on earnings, compared with thirty-three to fifty percent in other regions), management independence, freedom to employ foreign nationals, and employment governed by contracts with flexible salaries and wage incentives.

Since the SEZs were given administrative authority over the local government agencies, red tape would be significantly reduced.[9]

Unfortunately, the performance of the SEZs has been seen as disappointing.[10] "Inadequate infrastructure, poor management, and `gray market' practices continue to undermine the SEZs' ability to attract and absorb foreign investment."[11] Regional resentment and tension between the SEZs, particularly those in the South, and other regions as a result of sharp disparity in wealth have also made the SEZs a political as well as economic risk for the Chinese leadership.[12] Between 1979 and the end of 1985, the SEZs attracted $1.17 billion (U.S.) in foreign investment, about twenty percent of the total foreign investment in China over the same period. Much of the funds went toward building up infrastructure, and only a small part of the authorized projects were production- and export-oriented.[13]

In October 1986, the Chinese government promulgated "Twenty-Two Provisions to Encourage Foreign Investment," which promised more preferential tax treatment, priority access to and guaranteed prices for supplies and low-cost financing, and other support for export-oriented or technologically important projects. Foreign-invested companies were to be freed from the bureaucratic hassles from which they had suffered, and local governments were made responsible for such investment.

The Chinese government had three goals, according to Simon: (1) to guide foreign investment toward export orientation or to the transfer of advanced technology by the offer of tax incentives and favorable loans and improved labor costs; (2) to lower land-use fees and other operating costs in order to lower production costs to make products more competitive in the international market; (3) to protect the autonomy of foreign-invested companies, to combat low work efficiency, and to streamline work procedures.[14]

The policy of retrenchment, which was enacted in September 1988 to combat an unacceptable rate of inflation, reversed the policy of decentralization. It became clear that the central government would utilize any measure it deemed effective to return order to the overheated economy, including reinstituting central controls. However, the central authorities continue to reassure the West that Open Door policy will continue and that government policy will not adversely effect foreign participation in China's economic development.

As a show of its continued commitment to improve foreign investment environment, on April 4, 1990, the Seventh People's Congress revised the Joint Venture Law. The revised Law allows the foreign party to a joint venture to appoint the chairman of the Board of Directors (previously not allowed). The revised Law also permits multiple parties to be participants in a joint venture (formerly restricted to one Chinese and one foreign party). The Joint Venture Implementing Regulations were also amended to allow joint ventures to be extended for periods of at least fifty years (formerly restricted to twenty years).[15]

Another important breakthrough in the Chinese legal system is the Patent Law which was introduced in April 1985. Since the protection of intellectual property has been widespread among foreign investors and licensors, the Patent Law sparked off an invention boom in China.[16] The adoption of the Copyright Law in 1991 which allows for protection of computer software in China signals yet another milestone in China's legal system.[17]

Since 1979, more than two hundred new laws and regulations relevant to foreign investment and trade have been passed. These items of legislation were enacted in response to demands from Western investors for a more secure legal environment in China.[18] Although questions remain concerning implementation of these laws, their mere enactment signals China's commitment to creating an infrastructure compatible with international commerce and trade.

The Institutional Structure of the Telecommunications Sector

The Ministry of Post and Telecommunications (MPT) with head offices in Beijing, is the head of the telecommunications industry in China. MPT's chief function is to plan, expand and manage the inter-provincial public long distance network and to make and promote technical standards. However, its overall mandate for controlling the industry was limited until 1991 when the State Council granted the MPT authority over all of China's telecommunications networks, whether in the regions or in other warrens of the bureaucracy. Before then, the State Council was responsible for various aspects of the telecommunication industry. MPT did not have autonomous authority over manufacturing, though it had considerable manufacturing capacity of its own. Nor did it have universal control over provincial networks and local telephone service. Equipment purchasing was also carried out, not by the MPT, but by government trading agencies. They operated according to MPT's direction to varying degrees depending on the network application.[19]

Both MPT and the Ministry of Electronics Industries (MEI) operate factories which build telecommunications equipment; competition between the two is keen. The State Planning Commission, with State Council approval, has begun to consolidate manufacturing in digital technology under MEI, although the MPT will likely retain control of considerable capacity in optical fibres and cables, station terminal equipment, carrier equipment, power supply equipment and one or two digital exchange plants.[20]

Until 1991, the responsibility for service provision was also divided sharply between MPT, which took overall responsibility for the public network, and a number of other ministries (such as Ministries of Rail, Petroleum, Coal, Water and

Power and the Military) and government corporations, which have been given the right to plan and build their own private networks.[21]

Within the network of MPT and various other ministries who run their own network systems, China's public switching systems (or "stored-program-control" exchanges) are provided by as many as eight suppliers from six different countries. Such scattered network systems not only compound the operating and maintenance expenses and reduce the efficiency of China's telecommunications, but also fails to meet the rapidly increasing business and social demands accompanying the double-digit industrial growth. Importers and manufacturers forgo economies of scale, localization timetables become harder and harder to meet while services and software support suffer.[22]

China is starting to learn the lesson of the cost of failure to unify its systems. The recentralization of power into the hands of MPT in 1991 has thus made it a monopoly power--China's sole government regulatory body, telephone network owner and main telecommunications equipment manufacturer, all in one. Strategy as well as economics prompts China to buck the global trend of telecommunications deregulation and privatization. Premier Li Peng pronounced back in the mid-1980s that telecommunications--particularly domestic and international long-distance lines--were too important to national security to allow them to develop out of government control.[23]

Telecommunications Development Since 1979

Considerable progress has been made with regard to China's telecommunications services since the Open Door policy. Experts say China is at the initial phase of a dramatic and explosive change curve that will transform its telecommunications system from an unsophisticated, low penetration network to

a fully digital, state-of-the-art integrated telecommunications network. In 1988, China had around eight million telephones and six million exchange lines in its public network. Telephone density is 0.6 telephones per 100 population (compared with 79 per hundred population in Canada.) Although, the number of urban residential telephones is on the increase, rural residential telephones are still extremely rudimentary.[24]

In main or central office switching, the installed technology base spans all generations. Step-by-step, cross-bar, rotary, semi-electronic and magnetic exchanges coexist throughout the country. At the end of the 1985, the network was estimated to be thirty-five percent manual (some estimates are as high as fifty percent), thirty-five percent step-by-step and rotary, twenty four percent cross-bar, three percent semi-electronic and three percent digital. By the end of 1987, the digital lines had risen to over eight percent and estimated to reach thirty percent by 1990. Transmission facilities are predominantly (over eighty percent) open wire. According to the China Investment Guide, in 1989, China had 21,000 kilometers of cable lines and 20,000 kilometers of microwave facilities, over 10,000 telegraph lines and 53,000 long-distance telephones. The microwave is predominantly locally supplied analog, with several imported digital systems on major backbone routes installed in the last few years.[25]

The China Investment Guide also indicates that China's telecommunication has been in a position to manufacture switching equipment for analogue telecommunications networks and large-capacity transmission equipment. It can also manufacture crossbar switchboards, large- and medium-capacity coding crossbar long-distance switch-board, medium-sized coaxial 1,800 channel carrier equipment and 96- channel microwave equipment. In addition, ground station equipment for satellite communications has been successfully developed, and a communications system by long-wave triple group optical cable

has been authenticated for practical use. Despite relatively rapid recent development, the network falls seriously short of fulfilling demand or providing adequate quality of service. The low number of national and international trunk circuits has been a major constraint in recent years, though international traffic has been growing at twenty-five to thirty percent annually.[26]

China's telecommunications investment policy is a rational progression from its overall economic modernization objectives. The Chinese government now recognizes that without an effective telecommunications infrastructure, and without strengthening and modernization of the related electronics and computer industries, desired economic transformation and reform processes will not come to fruition: a commercially oriented and internationally competitive economy will not emerge. Telecommunications development is therefore seen firstly as a facilitator of a more efficient and outward-looking economy, and secondly as a technology conduit to generate modern industries which are themselves an important component in China's export drive.[27]

During the Seventh Five-Year Plan, telecommunications was promoted to one of the priority sectors and continues to enjoy its privileged status in the current Five-Year Plan. China plans to achieve an eightfold increase in its telecommunications capacity during this period. Fixed asset investment in telecommunications totalled RMB 20 billion (U.S. $3.65 billion) over the Seventh Five-Year (1986-1990) Plan period,[28] ranking it in the ninth position in terms of investment in telecommunications, just behind Canada ($1.9 billion), and representing almost two percent of the world market. Approximately 80-85% of all telecommunications expenditures in China are on equipment. The remaining fifteen to twenty percent (around $0.3 billion) included buildings, land and vehicles. When the total investments considered, China is currently investing 0.6

percent of its total GDP in telecommunications (or two percent of total domestic investment).[29]

China's switching capacity is scheduled to increase by seventy-five percent, to thirty-five million lines. By the end of the decade, telephone density (the number of telephone sets per hundred people) will be 2.8 percent throughout the country, ten percent in the cities (large cities like Beijing, Shanghai, Tianjin and Guangzhou will be more than twenty-five percent), twenty percent in capitals of provinces and economically developed cities and costal open cities, more than five percent in medium-sized cities and county seats, and about one percent in rural areas. Automatic telephone calls and automatic long-distance telephone dialing will be realized in cities above the county level and some towns in the economically developed regions; facsimile and telex services will also be developed. A communications network will be set up connecting domestic and overseas databases in order to share resources. In the main cities, optical communications and satellite communications will be widely adopted to build up a visual transmission network and to explore new fields of communications switchboards with video, high-speed facsimiles, visual data, etc.. Mobile communications will be actively developed. Domestic and overseas mobile telephone services will be provided in some trains, motor cars and ships.[30] According to the Far Eastern Economic Review, "China hopes to be well along the road towards developing an integrated services digital network which can handle voice, data, text and image transmission simultaneously."[31]

Despite China's enormous strides in introducing new legislation and improving its industrial capacities, Chinese economic reform continues to develop within the context of a planned economy and central bureaucracy. Internal politics, policy considerations, and traditional influences are often dominant

factors operating behind the system. The seen and unseen forces work together to make the transfer of technology to China a frustrating and difficult task.

CHAPTER FOUR: MAJOR ISSUES IN TELECOMMUNICATIONS TECHNOLOGY TRANSFER TO CHINA: NORTHERN TELECOM'S EXPERIENCES

Northern Telecom

Northern Telecom (Nortel) is the leading global supplier of telecommunications switching systems, with more than seventy-five million of its meridian business communications systems and DMS switching systems in service or on order in more than eighty countries.

Nortel commenced its activities in China in 1972 with participation in a Beijing trade exhibition. Nortel initially penetrated the market with its internationally successful SL1 PABX. Its presence over several years following provided the foundation from which to develop opportunities for introduction of its public switching systems.

Nortel has made significant gains in selling its DMS switches to the Chinese market. The company first began installing these systems in China in 1985. To date DMS systems have been installed in the provinces of Jiangxi, Hainan, Hebei, and in Beijing and Shanghai. In 1988, Nortel won a contract worth about $50 million (U.S.) to supply 226,000 lines of central switching equipment in the provinces of Hebei, Jiangxi, and Shanxi. Nortel supplied DMS 100-DMS 10 central office switching equipment to ten cities in the province of Hebei in 1989. It also contracted to supply its RD-6B wideband microwave digital radio systems to the province. Nortel is also installing a data packet switching system in Guangdong.

Currently Northern Telecom is ranked the fifth largest foreign supplier with 8.6% of market share in China's telecommunications (in terms of the number of

lines installed), behind that of Alcatel France (30.1%), NEC (23.3%) and Fujistu (16.5%) of Japan, Ericson (15.8%) of Sweden, and ahead of Siemens (4%) of Germany, and AT&T (0.5 %) of the US..[1]

In April 1988, Nortel and Tong Guang Electronics Corporation (the former China Bureau of Television Broadcasting, which operates more than fifty factories throughout China) signed a joint venture agreement that will make it the first supplier of digital private branch exchanges in China. The joint venture has opened a factory in Shekou, Guangdong province as part of a joint venture to manufacture SL1 digital PBX's and digital telephone set in ten factories in China. Nortel owns fifty-five percent of the $13 million (U.S.) joint venture, and Tong Guang Electronics Corporation owns forty-five percent. The other partners are Shekou District Economic Development Co. and Factory 834 of Jiangxi province. The joint venture will include the training of Tong Guang's personnel in both Canada and China.

According to the Nortel executives, the joint venture was first set up in rented quarters and then in the new plant finished in the end of 1989. There are four Canadian managers on location with approximately two hundred employees. The factory has an annual capacity to produce PBXs with a total of 100,000 lines. It is expected to expand to 200,000 to 300,000 lines in order to meet the demand of one million per year in the Chinese domestic market. The operation has expanded from the relatively simple task of reassembling machines shipped from Canada to complete assembly from the nuts and bolts stage. The company wants to move toward using mostly available local materials, thereby cutting down on the costs of shipping and importing components into China.

Telecommunications Technology Transfer in China--Major Issues

Reviewing the record of technology transfer between the developed and the developing countries in general, and Canada and China in particular, one cannot help wondering about the complexity and the multifaceted nature of international technology transfer. Indeed, the context of technology transfer to China cannot be fully understood without taking into consideration the complexity of the various elements in the political, economic, legal, technological, and social spheres. Merely to mention these issues is to suggest the difficulties they pose to the process of technology transfer. In this chapter, these complex issues and their interrelationships are examined and analyzed as they are played out in telecommunications transfer of technology to China.

Canadian companies with investments in China have long complained about a number of problems they have encountered. A number of these problems still persist. China's bureaucracy has remained largely resistant to efforts at streamlining procedures, and the bureaucracy remains impenetrable to outsiders. Bureaucratic and operational difficulties have discouraged investors. Intervention by government officials is often arbitrary and unpredictable. Negotiations still require a relatively long time and are often unproductive. Uncertainties persist with respect to the implementation of laws and regulations relating to contracts, taxes, and patents. Foreign exchange shortages continue to pose major difficulties in spite of new government regulations attacking the problem. Internal markets have been limited and have also remained protected against penetration by foreign investors. Services available to businesses are both expensive and of low quality, making China an expensive place for business operation. Recruitment and retaining and dismissal of employees are expected to remain problematic in spite of bona fide attempts at finding solutions. Foreign

personnel have reported instances of corruption, bribery, theft and misuse of resource on the part of the officials.

Many of these problems are not unique to the experiences of Canadian technology suppliers alone, but apply to most Western companies in general. There are, however, certain differences that separate Canada from the rest of Western business investors. For example, Canada and China having similar landscapes, vast size and dispersed populations, many of the telecommunication challenges China faces are similar to those that have already been mastered by Canada. The types of technology that China urgently needs (e.g. satellite, rural communications, and network management and surveillance etc.) are those at which Canada excels. This gives Canadian suppliers certain advantages over their competitors. However, most Chinese are not particularly convinced of Canada's image as a high-tech country. This presents Canadian high-tech suppliers with particular challenges.

Northern Telecom experienced many of the same problems and has developed its strategies accordingly. These strategies--presence, product quality, patience, persistence and performance--have proven to be effective and have begun to bear fruitful results, according to Nortel executives. This year (1992) is the first profit-making year for Nortel's joint venture in China. The study of Nortel's approach to the Chinese market should help to provide some insights in how to transfer technology successfully to China. The political, economic, legal, technological, and socio-cultural barriers to such success and Nortel's strategy for overcoming them are the subject of the rest of this chapter.

Political Barriers

More so than ever before, technology transfer is having a pervasive impact on the conduct of international affairs. Technology transfer can be perceived as the cause of the globalization of critical scientific knowledge and technological capabilities beyond the borders of a limited number of so-called advanced nations. The emergence of new technologies such as superconductors and related special materials, informatics, micro-electronics, and biotechnology have not simply expanded the existing frontiers of human knowledge, but have also provided the wherewithal for enhanced capabilities in the commercial and defense sectors.

In essence, the spread of technology across the globe has altered the ways in which various global actors relate to each other as well as many of the prevailing patterns of international trade, commerce, and cooperation. The expanded interest in and demand for transborder flows and sharing of scientific information and technical know-how have fostered more cooperation, while at the same time giving birth to new forms of economic and technological protectionism.[2]

Recent achievements in science and technology have contributed to a redefinition of the traditional notions of national power. No longer is a nation's capability and influence measured simply in terms of its military might. Economic power, supported and advanced by scientific and technological progress, has become a growing source of global influence. As a result, efforts to protect and nurture domestic science and technological assets have appeared in the export and sharing of scientific and technical resources. Concerns about economic competitiveness as well as national security have been important considerations underlying various attempts to control the transfer of sophisticated technology.

Therefore, technology transfer is not only an economic and socio-cultural issue, it is also a politically motivated activity. Although the current literature available does not seem to separate political considerations as a constraint on technology transfer, this research finds it an extremely relevant factor that complicates the transfer of technology to China. Technology transfer can provide some of the keys China needs to meet its modernization goals. The Chinese government realizes that telecommunications is an extremely important infrastructure upon which the fate of its entire modernization rests. Many of the government's ambitious development plans are closely tied to it. The Chinese authorities are also aware of the military and propaganda value to increased telecommunications capabilities. Therefore, the Chinese government is very hungry for "state-of-the-art" telecommunications technology from the West.

But, there continues to be fear of a boomerang effect among Western high-tech supplier countries with respect to their willingness to transfer technology to China, despite China's recent swing toward cooperation with multilateral arms-control efforts.[3] Controls on exports to China under COCOM continue to reflect serious concerns about China's military capabilities and proliferation activities. The Coordinating Committee for Multilateral Export Controls (COCOM) is an informal organization of the NATO countries plus Japan, which seeks to harmonize export control to Communist countries. The goal of joint export control is to prevent access by the Communists countries to weapons and advanced technologies with military significance. COCOM member countries still require individually validated export licenses for all shipments to China of items on the three COCOM lists. This policy allows licensing authorities in each member country to conduct a thorough review of the Chinese customer and the proposed end use of every proposed shipment of COCOM-controlled items.[4]

A detailed set of commonly agreed-upon guidelines governs the standard of scrutiny that member countries apply to any given shipments of a COCOM-controlled commodity to China. For example, member countries have implemented a policy of "extended review or denial" for license applications involving goods and technology related to nuclear weapons, electronic and antisubmarine warfare, intelligence gathering, power projection, and air superiority.[5] On average, the approval process takes about six months.[6]

Periodically, as relations between China and the West have improved, the idea of abolishing multilateral controls has emerged. Regulations on exports to China were significantly relaxed by COCOM in late 1985. COCOM members were authorized to approve certain export of equipment and technology to China on their own with notification to COCOM. In 1991, COCOM approved the most dramatic regulation of dual-use technologies in its forty-two-year history and introduced a streamlined control list format.[7] But COCOM review is still required for more sophisticated dual-use technology, for military export and for nuclear exports. While the number of technology areas covered by export controls and COCOM have been appreciably narrowed, those areas that remain covered by export controls are being treated with even greater restrictions than perhaps was true in the past.[8]

Despite the progress made toward openness in the Chinese economy, few COCOM countries appear totally prepared to ease current restrictions on high-technology that might be related to Chinese nuclear weapons development, nuclear delivery systems, and so on. For instance, in March, 1992, several key COCOM countries negotiated a new telecommunications agreement, but decided to "explicitly exclude China from eligibility for any control relaxations.[9]

The Chinese has complained vociferously about the continued imposition of so-called "national security" controls regarding technology transfers. Controls

on export to China effect primarily a few key advanced technology sectors such as computers, telecommunications, precision instruments, and advanced manufacturing equipments--areas where dual usage of technology application might extend to the modernization of the Chinese military. Export controls imposed for political reasons by Western countries have certainly limited the types of equipment that China can buy, at least in the short term, if it had not complicated the process of technology transfer.

Domestic political instability also impacts on technology transfer to China. The brutal repression of Tiananmen Square protest resulted in the imposition of a munitions embargo by most Western governments and a moratorium on further liberalization initiatives by COCOM. The United States added further sanctions to punish China's missile proliferation activities on June 16, 1991, tightening export controls on some special satellites and high-performance computers. China has since agreed to adhere to both the Nuclear Non-Proliferation Treaty (NPT) and the Missile Technology Control Regime (MTCR), prompting the U.S. to drop its sanctions in March 1992.[10]

Theoretically, obtaining export permits from COCOM is needed for most of Nortel's technology transfer to China. Operating within this political environment, Nortel has to carefully study COCOM applications and approval procedures and to export only what it is permitted on the COCOM "Green Zone" list . One Nortel executive interviewed said that the company did not have difficulty in getting COCOM approval, though providing proof that their export commodity is for exclusive civilian application has been burdensome and time-consuming, and the company found it difficult to speed up the COCOM approval process. COCOM's numerous significant changes in export control policy for China since the early 1980's has caused some confusion and delay for Canadian suppliers as well. For example, COCOM export permits on some of the Nortel's export items to China

were required in the early 1980s, but by the time the actual export took place such requirements have been removed. Nortel executives believe further liberalization of export control is almost inevitable in the face of changing military alliances, fierce economic competition as well as the growing interdependence of China, Hong Kong and Taiwan.

Domestically, China's decision to import foreign technology has been a topic of serious debate for a considerable time. For at least several hundred years, the Chinese leadership have had to consider the merits and demerits associated with Western science and technology. China's technology transfer policy is, in the short term, to import state-of-the-art technologies in hope of improving the scope of local industries and therefore advancing China's own technological capabilities. However, the Chinese government is aware of the potential adverse consequences of extensive borrowing of technology and foreign involvement in their domestic affairs: overdependence on foreign technology supplies, excessive penetration of the economy by external forces, and the potential destruction of domestic industry etc.. Understandably the Chinese leaders are determined to be self-sufficient in the medium term.

Indeed, the reliance on external sources for scientific and technological assistance has imbued the leadership with a sense of uneasiness that is not easily overcome. The roots of the uneasiness go back further than just China's ill-fated co-operation with the former Soviet Union in the 1950s; it also stems from the period of western incursion into China since 1840. In dealing with the question of foreign technology, there are critical issues that must be dealt with, particularly regarding the apparent loss of control that comes from opening up a society to external forces. In many ways, the events in Tiananmen Square in May/June 1989 reflect the leadership's continued inability to deal with these problems.

Therefore striking a proper balance between domestic and foreign sources of technology is a constant source of policy debate. However, it is important to note that the dichotomy between importing foreign technology and developing local technology should not be carried too far since experiences in both developed and developing countries have shown them to be complementary. Indigenous efforts at upgrading technology do contribute to realizing benefits from imported technology that are greater than those possible without such effort.[11]

There seems to be a consensus within the Chinese leadership that in order to achieve its modernization goals and maintain economic growth, there is no other path but to open the economy to foreign economic participation, the unsettling question is how, how much and how fast. Nortel executives as well as many other observers believe that Chinese government view joint ventures as an effective way of transferring their most needed technology because the equity interest in the Chinese ventures by foreign firms is a powerful economic incentive to ensure the continuing flow of technology into China.[12] Perhaps it is also a reflection of the bitter lessons learned form the humiliating experience with the Soviet Union.

Nortel executives seemed to understand the government's political and economic concerns. According to one Nortel executive, "our strategy in China is in fact no different than what we use in any other international market. We provide what the customers want and do it the way they want it to be done," only in China's case, the customer is the government. They know that the Chinese government is "determined to become independent," and is interested in technology transfers and joint ventures not simply "briefcase technology" and one hundred percent foreign direct investment. In responding to the Chinese government's particular needs, as well as the company's long-term strategy, in

April 1983, Nortel signed a joint venture agreement with Tong Guang Electronics Corporation in Shenzhen, a SEZ adjacent to Hong Kong.

This argument of treating China as fundamentally no different from any other rational economic actor must be carefully considered, for it would seem this approach seriously undermines the dialectic of Chinese history and culture by merely reducing it to a universal motivation of self-interest. Economics negates the utility of political education and the usefulness of societal moral values. It also ignores the important difference of social and economic relations based on the coexistence of central planning and market mechanism economy. Insufficient sensitivity to Chinese historical experiences could result in failure in effective cross-cultural communication.

The argument has been made here that technology transfer is as much an economic one as it is a political one and that the strategies that involve the utilization of foreign technology for economic development also require accompanying political and social changes that can be quite contradictory to the initial rationale for the technology transfer. Deng's most recent effort to bluster the economic reform process has brought China's three-year Tiananmen Square penance of commercial austerity to an end with a new wave of economic resurgence which is characterized with an average growth rate of eighteen percent and over thirty percent in some costal provinces. This year is expected to be the first since the founding of the People's Republic in which private sector will account for more than half of the country's total industrial production.[13] This unprecedented growth has also brought inflation rates up from an average of 2.9 percent in 1991 to a current 16 percent.[14] There is fear that the overheated economy led to political, economic and social unrest. Resentment and cynicism about growing economic inequality and the pervasiveness of corruption and nepotism will make it hard for the leadership to maintain political stability and

mobilize active support for modernization efforts. The authorities in China are acutely aware of the potential crisis and will go to great lengths to maintain its control. Whether the leadership will deal with future political, economic and social crisis in a similar repressive manner as it did in 1989 only time will tell. Until the time comes when Chinese leadership is ready to resolve the inherent instability in its political system, technology transfer to China will continue suffer from unpredictable policy directions.

Economic Barriers

Changes in international commercial environment suggest changing motivations and practices on the part of technology suppliers. As manufacturing technology underwent basic changes worldwide toward greater automation, Chinese manufacturers lost their competitive advantage based on cheap labor in some industrial sectors. At the same time, other newly industrialized economies in the region such as South Korea, Taiwan, Hong Kong, Singapore, as well as Thailand, Malayia, Indonesia and India are strong competition for foreign investment capital. Increased investment in capital investment also reduces the importance of the direct labor component of the costs of goods sold, making off-shore production which previously sought low-wage foreign labor less compelling.[15]

In addition, the rising protectionist sentiment in the developed world may preclude growth in certain sectors. Nearly sixty antidumping actions have already been taken against Chinese products in a variety of industries where increased exports have allegedly led to unemployment in certain sectors in the developed world.[16] These import limitations imposed by foreign countries will inevitably

diminish China's foreign exchange reserves, which in turn limits the country's ability to invest in new productive capacity.

The discriminative cost of "state-of-art" technology can also inhibit technology transfer. Although most of the technology China acquires has already been in existence for some time and the price is thus very competitive, the cost of technology may still be relatively high either because of the high demand on a limited financial resources or because of the high cost of transfer in relation to the volume of business. In some cases the cost could even be lower because foreign technology suppliers want to penetrate the Chinese market in order to establish a foothold by using prices at or even below cost.

China's technology imports in the telecommunications sector are presently limited almost exclusively to state-of-the-art technology, such as advanced digital technology, which its own industries cannot yet produce. However, China's obsession with "highly advanced technology" is not exactly compatible with the objectives of the Western companies (i.e. for highest profits,) who would rather transfer economically sound technology which they consider more suitable for the stage of the China's technological development. High technology ventures in China usually lack the necessary industrial infrastructure and market demands for beneficial economics. These highly sophisticated technologies are often too advanced to interface with China's existing technology and are difficult to operate or maintain.

Foreign exchange is the most serious problem in China's technology acquisition from the western world. Particularly since the mid-late 1980's when decentralization brought an sharp increase in regional and local demand for foreign exchange currency, concerns about the availability of foreign exchange have become an important element in decision-making about technology imports. As with all developing countries, China has not had enough foreign exchange to

meet all the pressing needs of its economy. Hence the most important economic and trade policy objective is to generate and reserve enough foreign currency in order to finance future development. Because the ability of a project to generate foreign exchange is a factor in judging the desirability and the feasibility of that project, much decision-making has in recent years been biased toward projects that promise to earn foreign exchange quickly.[17]

In the eyes of Chinese policy-makers, the unconvertible Renminbi currency allows them to shelter their underdeveloped economy from external forces and choose their own priorities. But the unconvertability of RMB and the country's ability to maintain a favorable foreign exchange reserve have caused foreign investors somewhat reluctant to invest in China. China also needs foreign currency to purchase the kinds of technologies that would develop export-oriented industries quickly, thus enabling them to build a favorable foreign exchange reserve needed for future growth and purchases of other technologies.

Between 1981 and 1985, the Chinese government implemented a series of regulations. These rules cover details with respect to controlling foreign exchange held by individuals, foreign representatives in China, foreign investment enterprises, the transfer of precious metals and specific regulations spelling out the penalties of violating these rules.[18] The Law requires joint ventures have two accounts with the Bank of China, one for domestic and one for foreign currency. These accounts must be in balance. These provisions require joint ventures to generate all foreign exchange necessary for the remittance of foreign exchange dividends and other contributions to the foreign joint venture party and the payment of all foreign exchange expenses incurred by the venture in the course of its operations. Many joint ventures run into problems achieving the required equilibrium in foreign exchange. It is difficult to generate enough foreign currency, especially if the product in question does not have a large export

market or is produced exclusively for the domestic Chinese market. This problem is compounded by the need to import necessary materials and components which can not be sourced locally and by the repatriation of profits.[19]

The strictures imposed by this system have presented significant problems for investors who looked upon joint ventures primarily as a vehicle for entry into the Chinese domestic market. However, these restrictions have been liberalized in recent years as part of the effort to enhance the attractiveness of joint ventures by providing greater access to the Chinese domestic market. Even so, Nortel executives say they still have to export twenty percent of their products manufactured in China, mostly to other Asian countries.

In addressing the foreign exchange issues and encouraging foreign investment in joint ventures, in January 1986, the State Council announced Regulations Concerning the Balance of Foreign Exchange In Income and Expenditures by Joint Ventures ("Balancing Regulations"), which basically allowed joint ventures to utilize their RMB earnings in such a way as to generate foreign exchange income.[20] The Balancing Regulations provided four ways in which joint ventures could earn foreign exchange:1) carry out export sale of their products, thereby generating foreign exchange; 2) receive payment in foreign currency from Chinese foreign trade corporations for those goods which would normally be imported, i.e., "import substitution;" 3) take payments in goods (or purchase Chinese goods with RMB) and then export those goods; 4) if the foreign investor has more than one joint venture in China, he or she can balance the foreign exchange accounts between the two by adjusting their respective surpluses and deficits.[21]

There were, however, pros and cons with the proposed methods by the "Balancing Regulations." First of all, China's preference for ventures to have an export-orientation conflicts with a Western company's mandate not to compete

with itself in existing markets. Thus, it is perceived by technology suppliers as an impediment to transfer technology to China, which is in direct conflict with China's own objective of attracting foreign investment to China. China's image as a low-quality producer as well as unreliable delivery also inhibit exports. Some ventures' products are often priced too high to be internationally competitive.[22]

Secondly, the opportunities of import substitution, or selling domestically while receiving foreign exchange have been limited to a relatively small portion of the ventures' sales and that only for a technologically advanced enterprise. The only circumstances under which the Chinese law permits joint ventures to sell their products on the Chinese market are when the goods produced are items that China "urgently needs" or when they serve a function as import substitutes. Prices for domestic sales must generally be fixed at levels determined by the state price control authorities. In some instances, however, international market prices may be adopted, provided that prior approval has been obtained from the price control department. However, the policy has not been implemented consistently.[23]

The third proposed method has also been problematic due to bureaucratic obstacles. Crossing ministerial or jurisdictional boundaries requires horizontal coordination between ministries, but Chinese ministries and provinces tend to be highly protective of their own sectorial and regional interests.[24]

The most successful method of generating foreign currency so far has been the foreign exchange swap centers. The first such center opened in Shenzhen in 1985, and was initially; limited to domestic enterprises. In 1988, swap center system was expanded nationwide allowing domestic and foreign enterprises to swap with each other in the same center. Currently there are over ninety swap centers throughout China under the supervision of the State Administration of Exchange Control (SAEC).[25]

The swap is carefully regulated because the government views foreign currency owned by Chinese trading companies and enterprises as ultimately belonging to the state. Only companies registered in China may swap; representative offices, traders and most foreign financial institutions are prohibited from trading at the swap centers. Swaps are approved on a case-by-case basis, and applications are treated "in order of urgency." As the swap centers are quasi market-driven, the swap rates are a more realistic reflection of the value of China's currency than official rates, Nortel's experience has confirmed this general feeling among foreign investors. Legal cross-border swapping between different provinces is permitted, but regional protectionism may make it difficult at times. Nonetheless, the system has been a very important method for solving short- to medium-term foreign exchange problems.[26]

Although China continues to modify its joint venture and foreign exchange laws toward greater openness, joint ventures in China will be particularly at risk to foreign exchange shortages until China's currency becomes fully convertible. Though the government intends to do this eventually. The basic framework for balancing foreign exchange is not likely to change in the near future and China's developing economy is not yet sophisticated enough to cope with international currency fluctuations.

High operating costs have been perceived as another major constraint that threatens the viability of many ventures in China. Chinese authorities have imposed artificially high living costs and overhead on foreign companies. Foreign companies were seen as privileged enterprises awash in cash. Many basic services are arbitrarily priced and controlled by state and local monopolies. The gathering of accurate and timely information on the Chinese market and its verification continues to be difficult and time consuming, while insufficient and inefficient infrastructure has further inflated costs. Economic efficiency also

varied widely across the country, with industrial concentrations mainly in Shanghai and the Northeast. Transportation reliability also depends greatly on the location of the ventures. China's low-cost labor was also frustratingly elusive, as low labor productivity more than offset low man-hour costs.[27]

High cost is also compounded by the need of many companies to maintain local offices. The time, manpower, and travel etc. involved demand a major commitment of company resources to the Chinese venture, and they often result in substantial and often prohibitive cost for many companies. It is estimated that the cost of maintaining one Canada-based officer and one support staff in Beijing is approximately CND $800,000 per year. As one of Nortel executives remarked, "Had our company been a small company, we would not have survived China."

High cost, however, is a long-term issue that would not go away soon. Only those enterprises who were able to work either within the Chinese system or devise efficient ways to "short circuit" it, realized advantages in lowering costs. Nortel did so by "working out a compromise, keeping economic viability for both partners as the paramount criterion." They believe, and have made their Chinese partners believe, that if both sides decided to meet the other's interests within the single constraint of economic viability, success seemed to be much more possible. "Success in China means mutual benefits for both Canadian and the Chinese users."[28]

Operating in such a diverse and complicated environment, Nortel executives claimed that they relied on a flexible approach based on a long-term strategy and applied "endless patience." The most crucial and often the most difficult decision involving joint venture strategy is selecting the right partner, according to Nortel executives. Susan Goldenberg's study of over one hundred joint ventures supports this Nortel executives' view.[29] According to one Nortel executive, it is absolutely essential that the foreign firm finds a partner who,

among other things, 1) has the authority to negotiate (something not all Chinese firms have); 2) will prove compatible from an organizational and philosophical point of view to the venture in question, i.e., can be worked with; 3) has clear and assured access to the relevant decision-making authorities, and 4) is fully committed to supporting the joint venture. After five years of painstaking search and negotiation, Nortel found a partner and signed a joint venture agreement in 1988 with Tong Guang Electronics Corp. According to Mr. Darrel Walker, the manufacturing director of Tong Guang Nortel joint venture, "Nortel could not have found a better Chinese partner with which to launch its first major venture in China. Tong Guang, the former bureau of television broadcasting, operates more than fifty factories throughout China."[30]

The benefits of having the right partner with the above criteria are numerous. A compatible partner will be very valuable in facilitating information gathering and communications feedbacks. If the partner has the right connections ("guanxi"--a concept that will be further discussed under the Socio-Cultural Barriers later in this chapter.) he/she can help by arranging meetings with appropriate Chinese officials, providing background information on the nature of the decision-making process and speeding up approval process at various levels of the bureaucracy. A strong local partner can make a considerable difference in the ability of the company to generate market demands; to penetrate the market. However, finding the right partner with the right "guanxi" can be a long and arduous task.

The long-term vision of Nortel has enabled the company to look beyond the immediate frustration of working in a totally different environment with different business practices. As Nortel has continued to be involved in the local market throughout the years, they have gained more understanding of the local industrial and business environment as it pertains to their sector of interest. They

have improved their understanding of the Chinese enterprise's network of suppliers and end-users of the product, as well as the lines of authority in local, regional, and central government agencies. These valuable data helped Nortel make a realistic assessment of the technology transfer process and of the opportunities for future expansion of the company's activities in China.

However, "the Chinese market is no different than any other market in that a company's success relies on the product and services it offers," one Nortel executive believed. For a foreign product to succeed in China, it must either be technologically advanced, or not available domestically, and it must also offer the Chinese quality and value in relation to their modernization goals. This executive explained, "the Chinese know what they want, they know who makes it the best and they will go after them to make the best deal with them."

Nortel successfully penetrated the Chinese market with the direct sale of its internationally successful SL1 PABX and DMS. Accordingly to Mr. Charlie Hsiu, Vice President of Nortel Asia Pacific marketing, Nortel was very careful in selecting a product or systems for specific targeted opportunities. Only by sorting out the best possible market fit, can a company concentrate on those opportunities with the best chances of success. "Because in China, as in other international markets, it is often better not to pursue projects that are marginal, thus result in losing propositions. Losing credibility or reputation, is `losing face,' and it can be costly in China."[31]

Since the Chinese government prefers dynamic technology transfer agreements which must guarantee the updating of the technology transferred during the lifetime of the agreement, a firm must be prepared to do so. Nortel is determined to live up to the reputation of their products. For example, when the meridian SL-1 private branch exchange was first introduced fifteen years ago, it offered about fifty features. Now it offers over one thousand and their licensees

and distributors have received "over the years a non-stop flow of information, which goes a long way towards fostering mutual cooperation and trust" (quote from a Nortel interviewee).

The choice of strategic location for the joint venture is another important decision. Regional differences in terms of government development priorities, levels of sophistication of infrastructual developments, access to capital, natural and energy resources, degrees of local autonomy as well as the supply of skilled labor resources combine to make the selection of venture operation a critical decision. By locating strategically, a company will have a better chance of survival. Having taken into consideration all of these different factors, Nortel decided on Shekou as the site of their joint venture operation, which Nortel executives claim was a good choice.

After twelve years of economic reforms there have been many noticeable improvements in China's economic system, particularly in the costal regions. Although bureaucratic procedures may not have been substantially cut back, the process has been speeded up. The skills, experiences and expertises of the officials, technocrats as well as the bureaucratic institutions have increased tremendously over the last decade. The new reform momentum urged by Deng Xiao-ping seems to have inspired a renewed optimism among foreign investors as evidenced by the large influx of $4 billion (U.S.) in investments, which was equivalent to one fifth of total foreign investment in China since 1979.[32]

However, beneath the impressive economic indicators for the Chinese economy lies a more profound inevitability: the conflicts between the centrally-planned economy and the forces of market reforms and their unavoidable clashes from time to time. Unless the Chinese leadership is ready to address this fundamental issue, the problems of technology transfer will continue to persist.

Legal Barriers

When China embarked on its "Open Door" policy in the late 1970's the nation's planners and economic managers lacked experience in how to absorb and regulate foreign investment, and the country had no body of law capable of providing a viable legal framework for foreign investment activities. Western companies seeking to establish business in China were particularly concerned about the lack of a legal framework. Apart from their own general interests in moving toward greater reliance on law, the Chinese recognized the concerns of the western companies. The number of new laws adopted since the Open Door policy is very impressive and the effort in developing the legal infrastructure is remarkable, considering it was achieved within such a short period of time. More than two hundred new laws and regulations, mostly covering economic and commercial activity, have incorporated significant portions of Western legal doctrine and principles. Among them, the most important path-breaking ones are: the Law of the People's Republic of China on Joint Ventures (1979) and the Patent Law (1984).

Joint venture in China is governed by a rather substantial body of published laws and regulations. At present, the various laws and regulations applicable to joint ventures, when viewed as a whole, provide for a fairly systematic regulatory environment. Nonetheless, a number of gaps remain in this system which continues to pose problems for foreign investors.

Both the Joint Venture Law and the Implementing Act (issued on Sept.20 1983) provide that equity joint venture shall take the forms of a "limited liability company" (youxian zeren gongsi) incorporated and registered in the People's Republic of China. As such, the Law provides that equity joint ventures are subjects to the jurisdiction and receive protection of the Chinese law.[33] However,

the present definition of "limited liability company" in the Chinese law has raised significant legal questions for foreign investors which existing Chinese laws can only answer in part. The Joint Venture Law and the Implementing Act provide the basic outlines of a general company law, with provisions relating the capital contributions, registered capital, transfer of interests, management structure and dissolution of the company. However, the legislation goes no further than to state that the liability of the parties shall be "limited to the amount of the capital contribution subscribed by each and that the parties shall share the profits, risks, and losses in proportion to their respective contributions to the registered capital."[34]

Few foreign investors dispute the fact that a joint venture company incorporated in China should be subject to the jurisdiction of Chinese laws. Nonetheless this requirement has proven troublesome for many investors, largely because of the uncertainty that exists as to the impact of subsequently enacted legislation on the provisions contained in joint venture contracts.[35] At a time when China is actively engaged in the task of building a comprehensive legal framework, investors are understandably concerned that their rights spelled out in contracts entered into today may be unfairly impaired by future legislative enactments.

In light of these uncertainties surrounding the issue, many foreign investors have attempted to insert protective provisions in joint venture contracts. In general, explicit language to the effect that the contract shall prevail over subsequent legislation is not accepted by the Chinese authorities. However, "renegotiation clauses" and similar provisions have been successfully negotiated in some cases. These generally provide that in the event that a new law is enacted which adversely affects the economic benefit of the contract to the foreign investor, the new law shall be observed by the parties but the contract

should be renegotiated or other action taken on the Chinese side to ensure that the foreign investor's interest is not harmed.[36]

One of the most vexing problems in negotiating a joint venture contract is the capital structure of joint ventures and the valuation of in-kind capital contributions made by the parties. Capital contribution is essentially the parties' equity in the ventures which is registered with the Chinese authorities at the time the venture is formally established. Capital contribution can take a variety of forms including cash, in-kind contributions such as machinery, equipment, and intangible property, such as proprietary technology, trade marks and other industrial property rights. In addition, the Chinese side is permitted to contribute rights to the use of a site as part of its capital contribution.[37]

In general, Chinese negotiators have tended to adopt the strategy of first eliciting from the foreign side the proposed valuation of its in-kind contributions and then matching that amount by assigning an equal, and usually highly inflated, value to its contributions of factory buildings and land-use rights. Based on the principle of "equality and mutual benefit," the Chinese will then demand reductions in the valuation proposed by the foreign side before they accept a reduction in the value of their own contributions. Although this practice may seem unfair to many Westerners, the memory of exploitation by the West over the past century and half stays alive for most Chinese, and if they can use it to bring a sense of guilt on the part of their foreign counterparts while at the same time strengthen their own bargaining power they feel no shame in doing so.

The Implementing Act explicitly requires that "the conclusion, validity, interpretation, implementation of joint venture contracts and the resolution of disputes thereunder shall be governed by Chinese law."[38] Nortel, like many other Western companies, argued that Chinese law was incomplete in many respects. At the time of Nortel's initial negotiations with its Chinese partner, for example,

China did not offer any protection of intangible property rights such as patents, trademarks, copyrights, and the like. Although the law has explicitly stated the sole governing role of the Chinese law, as a matter of practice, the Chinese authorities have been flexible enough as to permit the inclusion of provisions allowing foreign arbitrators to supplement Chinese law with "commonly accepted international commercial practices" where no existing Chinese rules address a particular issue.[39] In Nortel's case regarding the provisions of patent protection, the two parties agreed to base its patent provisions on the British patent law. Since 1985, the Chinese Patent Law extends legal protection of industrial property rights beyond the protection afforded by contracts signed prior to that time.[40]

Another serious concern of foreign investors has been the extent to which joint ventures are permitted to exercise control over the hiring and firing of staff and workers. Although both the "Twenty-Two Provisions" and the Regulations on Labor Management in Joint Ventures Using Chinese and Foreign Investment assure foreign enterprises of their "right of autonomy" in labor management, full autonomy is not yet a reality. Instances have been reported in which a large number of candidates have been recommended to a joint venture by influential authorities. If these "recommendations" are ignored, there is a good chance the joint venture will face unexpected retaliation in one form or another. In a country where the "iron rice bowl" has been in long practice and job security taken for granted, the dismissal of employees can be quite controversial and often means bad publicity for the company. Nortel insists on full autonomy in its hiring practice in order to reduce future chances of firing, and all interviewees believe that they have been fairly successful in getting what they wanted in their recruiting effort, partly due to their powerful local partner as well as good relations with the local labor bureau. Nortel claims that their employees are "young, bright, quick and

eager to learn, and had not yet acquired the "bad work habits and attitudes" commonly found among state-owned enterprise employees.

Although in theory the Joint Venture Law views the contract (hetong) as the fundamental document which provides for the establishment of the venture by the parties and the charter as the code of governance, in practice, most Chinese abhor the use of standard contracts and legalistic style. Chinese have a traditional aversive attitude toward legalistic approaches. A lawsuit is perceived as mean-spirited, unfriendly, even unethical at times, and often causes great loss of face for both parties involved, and is viewed as the avenue of last resort. The Chinese have argued strongly for "friendly discussions" and mediation; upon failure the disputes should be referred to the Chinese arbitration institution. Most Western companies, on the other hand, particularly those of Anglo-Saxon legal tradition, are accustomed to explicit contracts. They feel obliged to make provisions for every possible contingency in order to protect themselves and prefer to have third party arbitration mechanism especially when gaps in legal structure are encountered.[41]

There is also a general tendency among the Chinese to regard contracts as considerably less final and binding than their Western counterparts. They prefer a give and take attitude toward everything, including the breadth and depth to which foreign technology will be accessible to the Chinese sides. This attitude has been very difficult for most Western companies to accept. Northern Telecom representatives have come under pressure by their Chinese partners to renegotiate certain terms of a contract even up to the later stage of the implementation. Frustrated by these demands and the consequent delays and additional time required, Nortel executives handled it with patience, persistence and understanding. A flexible approach and willingness to adapt its practices to suit the needs of their Chinese partners and the local environment enabled Nortel

executives to accept these requests with good grace and they agreed to make adjustments to the contracts.

The traditional perception of stigma about lawsuit has shown some changes in the last a few years. There had been very few court cases demonstrating the actual implementation of law and the enforcement of arbitration, mostly because the strong dislike of formal legal actions by the Chinese, and the foreigners did not want to attempt any legal arbitration for fear of threatening future business relations with their Chinese partners. However over the last few years, the Chinese themselves have become more willing to accept arbitration as a method to resolve disputes with foreign partners, and consequently there has been "explosive growth" in the numbers of disputes brought to arbitration.[42]

The increase in arbitration cases has been greatly assisted by the China Council for the Promotion of International Economic and Trade Arbitration Commission (CIETAC). CIETAC handles almost all arbitration arising out of disputes between the Chinese and foreign parties. CIETAC is widely credited by the foreign business community as a "relatively inexpensive, expeditious, and fair forum for resolving disputes with Chinese parties."[43]

Unfortunately, many of these arbitration are limited by a judicial system unable to enforce CIETAC's arbitration awards. The problem lies primarily in the lack of coordination between CIETAC and the regional Chinese courts. This is due to the tendency that regional courts refuse to enforce awards against local economic interests. They are inclined to protect enterprises located within their jurisdiction by blocking attempts to freeze the non-performer's bank account, the most effective means to secure compliance with an award. Freezing the bank accounts of the non-performing party in China requires the approval of the court with jurisdiction over the bank in question. Since most companies keep accounts

in their neighborhood bank branches, this rule in effect means that the non-performer's local court must cooperate in enforcement actions. The local court can render all enforcement efforts futile by refusing to cooperate.[44]

The increasing parochialism of China's court system is a predictable result of the growing economic and political independence enjoyed by the provinces. As a result, the Chinese judicial system suffers from rampant court-to-court hostility. The problem is compounded recently by loopholes of the newly revised civil procedure law in 1991. Under the new civil procedure law, local courts have been "provided various excuses to avoid enforcing arbitration awards." Now any courts may decide not to enforce an arbitration award involving foreign interests if any of the following circumstances can be proven by the non-performer: there was no valid arbitration agreement between the claimant and the non-performer; the non-performer was not informed of the arbitration proceedings; CIETAC did not obey its own rules; the matter arbitrated fell outside the scope of the relevant arbitration agreement or jurisdiction of CIETAC; the arbitration award was contrary to social and public interest.[45] These vaguely worded lists provide regional courts with a wide range of reasons to delay or obstruct enforcement of valid awards. Faced with the task of overcoming all of these possible rejections in a court friendly to the non-performer, a claimant could not be blamed for despairing of the prospects of success.

Although questions remain concerning the implementation of China's many new laws and the potential problems of some of the new regulations, their mere enactment signals China's commitment to creating a legal infrastructure compatible with international commerce and trade. Despites China's enormous progress in introducing new laws and regulations, China's legal system continues to develop within a planned economy, which will no doubt show variations that will affect foreign investments in China. The ultimate test of China's commitment to

foreign investment lies in the leadership's ability to balance the increasing dependence on foreign participation in the Chinese economy and the over-riding concern of control, stability and independence.

Technological Barriers

Since the 1950s, the Chinese Communist Party proclaimed "the love of science" to be a national virtue. It is not surprising the extent to which the drive to enhance Chinese scientific and technological capabilities has so often predominated in the policy-making process in light of China's modern history and its determination to achieve technology independence. In spite of periodic differences between various leadership factions regarding an appropriate science and technology (S & T) development strategy for China, it has nevertheless been viewed as a means of catapulting the country ahead both economically and militarily. While the development of S & T has been a desired end, the means by which it can be achieved have been complicated by political disputes, differences over investment opinions and disagreements over economic priorities.[46]

The Cultural Revolution was a major setback in China's S & T development. It stagnated just at the point when Western nations were making their own "great leap forward" in science and technology, and at a time when the computer and electronics revolution were beginning in the industrialized world. In addition, the closure of most major universities and research institutions resulted in the loss of almost a complete generation of scientists and technical personnel, as well as severe shortages of educated and experienced engineers and specialized manpower. Even today, after a decade of concerted effort, China remains behind the West and Japan in such critical S & T fields as micro-electronics, computers and telecommunications.

China's technological barrier is also reflected in the "virtual absence of application engineers in the manufacturing sector."[47] Applied engineering is qualitatively different from research, though it encompasses some elements of what is often termed applied research. In some ways, it is more akin to absorptive research and development (R & D) than to creative R & D and is necessary for the assimilation and adaptation of imported technologies to obtain the maximum economic benefits. Many western observers point out that Chinese engineers are very capable and have a lot of training in theory but lack hands-on practical experience.

In most industrialized countries, technological capability resides not only within individual enterprises, but also within engineering service companies, who are major actors in the diffusion of technology. The Chinese economic system, however, has traditionally suffered from weak links between science and technology and production. There has been a tendency to overdevelop "independent research institutes" while neglecting S & T activities within production enterprises. For example, China now has over 9,100 research institutes, the majority (more than five thousand) of which are not directly connected with enterprises; by contrast over ninety percent of Japan's R & D units are directly linked with companies.[48]

The perverse incentives of Chinese socialism, whereby enterprises were not responsible for engaging in sales of their products, have resulted in the lack of incentives for application engineering and innovation. This has over the years worked against cooperative research, internal transfer and clear national industrial standards. However, since the late 1980's there has been a growing belief that major structural impediments such as the separation of research institutes and enterprises as well as managerial deficiencies and organizational bottlenecks, such as rigid bureaucracy that hindered the useful deployment of the

most talented people involved in research and development, have been constraining the contribution of S & T to economic modernization. It became increasingly clear to the Chinese leadership that national wealth and power depend on the vigorous development of S & T. Chinese leadership also recognizes that the key to the post-war development of Western technological capabilities is to be found in the unleashing of a combination of entrepreneurial talent and market stimuli. In this context, an explicit attempt has been made to link the economic reforms with the reforms of the S & T system in 1985. The thrust of these reforms is to ensure closer collaboration between research and production through contract research, remunerated consulting services and joint teams for some development work. This reform has many consequences for Chinese science and technology in such areas as the administration of research institutes, the financing of research, the research role of institutions of higher education, and the development of new attitudes toward intellectual property.[49]

A cornerstone concept in the S & T reform is the term "commercialization of technology."[50] This term signals the recognition of new technology as a major asset in economic development; the results of research and development efforts can themselves constitute commercial items and the increasing importance of intangible commodity in the international market. The decision to treat technology as a commercial commodity is a fundamental conceptual change for the Chinese; it represents an abrupt departure from previous thinking. Traditionally most Chinese regarded the product of mental labor as a common human heritage which could not and should not be monopolized by the patent holder, particularly in a socialist country. This general mentality of treating innovation and technology as a free public good does not encourage conscious R & D effort and has led both Western and Chinese commentators to conclude that it has, in part, caused China's retarded science and technology development

programs in the past. By contrast, technology in the West is often protected from unauthorized copying by an elaborate patent law. A patent gives an inventor monopoly rights over his invention for a specific period of time. The general consensus in the West is that technology is extremely important for economic development, i.e. "the existence of the patent systems and a wide range of license agreements has facilitated extensive diffusions of new technology as well as rapid economic growth."[51]

The absence of intellectual property protection in China has caused concerns among some foreign technology suppliers about the protection of their technology in China. The Chinese are purported to be very good at reverse engineering and there are many alleged violations of intellectual property rights. It is, however, difficult to pirate most advanced telecommunications technology because of the intrinsic nature of the design process involved. The software component of most digital electronic technology is extremely firm-specific and cumulative in nature. Most innovative companies keep their technological lead by innovating continuously. Moreover, only the largest and most aggressive telecommunications equipment suppliers can afford huge R & D programs and are capable of the ongoing technological innovation. Although reverse engineering can stimulate innovative activity in a fast developing technological area such as telecommunications industry, it does not alter the fact that reverse engineering and unlawful copying penalizes the most innovative firms for their R & D efforts. Nortel executives interviewed agreed that although China's technology absorption capability is high and it continues to improve, at present, China's technical work force is such that they will not constitute a serious competitive threat in the near future.

While manpower inadequacies do appear in the context of technology transfers, foreign firms seems to agree that the Chinese are moving up the

learning curve effectively. In the absolute terms China has a large pool of scientists and engineers (approximately 2.4 million), Even though the quality of training received by those in the pool varies a great deal, and the distribution of talent by region and economic sector is unbalanced, China does have a cadre of technical specialists to facilitate technology transfer.[52] China already has considerable technological capability, especially compared with that of other developing countries. There are certain "pockets of excellence" in China's S & T endeavor. According to a recent assessment of seven important areas of technology conducted by the Science Application International Corporation of McLean, Virginia, China was doing world-class work in two areas--solid state lasers/nonlinear optics and shaped charges. Very good but uneven work was being done in three others--non-silicon electronic materials sensors, optical data processing, and good work in another--high-powered microwaves, whereas rather uninspiring and derivative work was done in the seventh--recombinant DNA and cell fusion technologies. Future prospects were considered to be promising in most cases.[53]

In technology transfer, expertise and knowledge are transmitted between individuals and organizations. Necessary training by the supplier to bring the skills of the technology recipients up to the required technological level is the basis for successful transfer of technology. The Chinese authorities seem to be fully aware of this and insist on comprehensive transfer of technology. Most capital projects involving direct sales have very elaborate familiarization and training elements.[54] So the inclusion of attractive training component by foreign technology suppliers in technology transfer agreement can be an important method of market penetration. According to Nortel executives, the company has invested rather heavily in training for their Chinese partners not only as sign of goodwill and commitment but also to ensure that their products are properly

installed, operated and maintained. As one Nortel interviewee said, "We will train our staff until we think they can perform their jobs satisfactorily." Although many foreign suppliers have complained about the amount of time required for training and the numbers of Chinese workers to be trained, Nortel executives claim that they are more concerned about the effectiveness of the training of second-generation trainees by first-generation trainees, and the retraining of the trained and skilled staff. So far approximately thirty Chinese staff have come to Canada to receive Nortel product-related training on installation, operation, management, supervision, and maintenance. The abilities of these trainees to perform the functions assigned to them once they return to their home enterprise and to train others provides a good indication for assessing the efficiency of their training. Apart from training their own personnel, the trained engineers must also train the customers in applications and maintenance of the product. Most of those who came to Canada have been training other Nortel joint venture employees in the Xi'an Training Institute. The frustration for Nortel is that sometimes the trainees who had received training in Canada, upon returning to China, would not work on the job they were trained for due to job reassignments or for whatever other reasons cited. Consequently they were not able to provide training to others as they were supposed to. For the most part, however, Nortel has been very satisfied with their training program.

While there has been little disagreement on the need for research to serve the economy, the debate in China has been about the appropriate relationships between science and technology and the appropriate mechanism to ensure closer collaboration between the research sector and the economy. Although the onus placed on science and technology to drive economic and military modernization is no less burdensome, the ability of the present leadership to guarantee results is no more certain. Technological progress does not occur in

a political or institutional vacuum; the improvement of China's modern technology capabilities depends on whether China can efficiently integrate imported technology with its own technological infrastructure. Such an objective can not be achieved without solving the problems of: inefficiencies in the allocation of natural and labor resources complimentary to imported technology; the inadequacy of the present infrastructure to rapidly absorb and disseminate technology; the inadequacy of management personnel; failure to create large-scale production from experimental laboratories or small-scale production; inadequate numbers of scientific, technical and engineering personnel; and lack of uniformity in scientific manufacturing equipment and instrumentation.

Socio-Cultural Barriers

Technology transfer, be it hardware or software, is value-laden. It reflects, in design, operation, and inherent expectation about its utilization and advantages, the culture in which it was conceived. Although one of the more benevolent objectives of technology transfer is to benefit the recipient by upgrading capacities in some fashion, any such improvement is usually accompanied by adjustments, accommodations, and often concessions, among individuals, institutions, and practices in the receiving nation, that are necessitated by new requirements introduced into the economic/social system by the alien technology. A society's willingness to accept such changes may be a precondition for accelerated technology absorption.

Socio-Cultural barriers in technology transfer are perhaps the most obvious ones, yet most difficult to define and quantify. It is often difficult to disentangle the specific consequences of culture in technology transfer for they are obviously intertwined with many of the systematic and structural

characteristics of the Chinese economy, yet failures in recognizing the significant role of cultural differences in such transactions will seriously undermine the effectiveness of technology transfer.

Perhaps the most salient, at times controversial, aspect of cultural differences as it relates to technology transfer is the relative importance of personal relationships in Chinese business practice compared with the West. Emphasis on personal relationships ("guanxi") has always been part of the Chinese way of doing things. Social conventions such as the significance of family and kinship groups and obligations toward relatives; respect for age and hierarchical position; group orientation; avoidance of conflict and the need for social harmony; and the different implications of the concept of "face" are very often explained by Confucian values and codes of behavior. In many ways, Confucianism provides historical legitimation for the persistence of communal values and obligations. The evident success of Japanese business which claims its inspirations from the writings of Confucian ideas has given a new impetus to attempts to demonstrate the unbroken linkage of Confucian ideas embodied in contemporary Chinese practices.[55]

Hsiao et al explain the values of vertical relationships, personal loyalty and reliability of modern China in terms of the Confucian ideal of "filial duty." The importance of vertical relationships in the Chinese society leads to enterprise-based paternalism, with little effective horizontal, interorganizational communication and coordination.[56] The emphasis on mutual reciprocity and interdependence finds its expression in the practice of "guanxi" connections in business and social lives. Although good relationships established with Chinese counterparts may constitute good basis for a continuing business relationship, the problem for a Westerner business person is that any "filial duty" owed by Chinese colleagues is always likely to be subordinated to obligations to senior state

officials whose powers of patronage are considered greater and more pervasive. Such obligations, at times costly ones, are very difficult for Western business people to understand, let alone accept.

As China modernizes and decentralizes, some argue the concept of "guanxi" is becoming more important and corruption will be ever more widespread. Ironically under the veneer of what appears from the outside to be increasingly modern business practices and values, certain fundamental cultural values remain unchanged. The still weak infrastructure and the lack of market information, goods, and services continue to provide powerful incentives for maintaining good "guanxi" with others who may have shortage goods or know of their whereabouts. Clearly, if stronger bonds of loyalty exist between two friends than between two contractual partners, it is relatively easy to rationalize corrupt practices as satisfying obligations to friends and patrons.

The challenge for Canadian investors, as for all others, is how to adapt to the Chinese environment. Many companies hire Chinese expatriates as their representatives. Many of these expatriates have connections in various ministries, who will be helpful in facilitating the process of technology transfer in many ways. For example, one of Nortel's chief executives responsible for their China operation is a Chinese expatriate whose knowledge in both Chinese language and culture is believed to have furthered Nortel's cause considerably. However, the use of Chinese expatriates ought to be exercised with caution. Although cultural affinity of the Chinese expatriates is important in bridging the cultural and language gaps, it can also be used as a justification by the Chinese to attempt to compromise the expatriates to help develop the Motherland, and so forth.

Another much discussed feature of Chinese culture is the emphasis placed on collective behavior. This becomes evident in the Chinese decision-making

style. The political and administrative structure prevalent in China predicates a decision-making process that is based on collective, not individual responsibility. It is rare that any one individual has the ultimate decision-making authority. Also because of inexperience of Chinese negotiators in international commercial negotiations, their somewhat turbulent recent history in acquiring technology from foreign countries, as well as China's economic and political systems which have over the years structured incentives/disincentives in such a way that a dominant driving force on the Chinese side is self-protection, individuals have been unable and/or unwilling to make decisions without collective consensus.

The Chinese decision-making process is thus very time-consuming. The number of approvals at the governmental level which must be obtained often seems to be an overwhelmingly complex process, especially for what seem to be very minor issues. The unnecessary delays and the consequent high cost due to these delays are unacceptable and inexplicable to most foreigners. On average, it takes two to three years to complete a joint venture contract. It took Nortel close to two years to conclude its joint venture agreement with Tong Guang.

The most important barrier to be overcome in the negotiation process is the mistrust of the motives of foreign partners, according to one Nortel executive. History exerts great influences on an individual's perceptions of the salience of different aspects of his or her decision. Contemporary Chinese history has planted a general sense of mistrust of foreigners and a suspicion of change among many Chinese, particularly the older generations. The political isolation of the post-1949 China till the recent reforms did not help to reduce this tendency. Pye suggests that the Chinese are xenophobic in their distrust and distaste for the foreign and their respect for Chinese tradition and commitment to Chinese nationalism, but they are at the same time xenophilic in their admiration for the material success of foreign technology, and hence seek to use foreign technology

to restore Chinese greatness and assert Chinese superiority.[57] Whatever link is made between Chinese history and joint venture negotiations, there can be no doubt that the ultimate concern for the Chinese is to develop trust with their foreign partners and for the Western investors to establish sincerity.

Much is being made about the concept of "face" in the literature on Chinese social mores. The concept is perhaps best explained in examples such as the following: in negotiating a deal foreigners sometimes complain that Chinese counterparts appear to accept an agreement in public but then fail to live up to it in practice. The reason is that the Chinese negotiators did not want to lose "face" by admitting to the foreigners that they do not actually possess the requisite authority to make the decision or the capacity to perform obligations which involve the participation of another organization which was not consulted when the contract was drafted. Tan explains such behavior in terms of the Chinese traditional avoidance of conflicts and the need to maintain harmony in the wider society, the result being that they will go to great lengths to preserve the semblance of harmony through compromise.[58]

Cultural barriers are often exacerbated by the added difficulties of linguistic differences. The Chinese language is especially rich in shades of meaning inherited from millennia of use. When they are translated into English, or vice versa, they convey different nuances. Discrepancy often arises from inexact translation or intrinsic ambiguity in the Chinese or the English language. A comparison of the English and the Chinese versions of contracts reveals frequent discrepancies in shades of meanings. For example, a misunderstanding happened between Nortel and their Chinese partner about inclusion of a component in the transfer agreement. According to the interpretation of the Chinese version of the contract the Chinese thought it should be provided by Nortel, whereas Nortel had no such intention based on their understanding of the

contract. There is a general tendency to view Chinese as wanting more for less; however, deliberate misunderstanding on either side was not likely, according to one Nortel executive. It is possible misunderstanding occurred either because of the error in the translation of the contract or because of the intrinsic ambiguity in languages. Since then Nortel has insisted on having both English and Chinese versions translated by the Hong Kong Legal Translation Bureau in order to minimize potentials for misunderstanding.

The Chinese language remains a mystery to most Westerners. Despite the fact that more and more Chinese are learning English, the demand for English-speaking personnel far exceeds the supply. Consequently the language gap persists and is aggravated by the fact that many technical terms have no equivalent word in Chinese. When they do they are either not standard translation or not in common use. Very often Chinese interpreters have limited technical backgrounds, while those with technical background have greater difficulties with English. Nortel claims that they minimized the chances for misunderstanding by always using their own staff with both the language skills and the technical background.

Misunderstandings caused by linguistic differences are one source of difficulties in the daily operation of international joint ventures. This nature of misunderstanding can be accepted more easily with grace and humor. However, misunderstanding due to ignorance on either part is hardly a laughing matter. Lack of knowledge and appreciation of Chinese culture will compromise one's ability to learn and to control the situation. Many foreign business people are frequently inexcusably ignorant about Chinese society and culture simply because they have not taken the trouble to inform themselves adequately. One embarrassing story a Nortel executive shared with me was that once at a negotiation with the Chinese, a flag of Republic of China was placed on the table

instead of that of the People's Republic. Such embarrassment would have been avoided if there had been some knowledge and awareness of the situation.

The foregoing discussion has only touched some of the barriers in the course of technology transfer to China. The dynamics of forces both internal and external to China will continue to influence the transfer of technology to China. The changing international political and economic environment suggests changing motivations and practices on the part of technology suppliers. The inherent contradictions of China's political system mean that uncertainty in political and legal environment will likely continue. Other factors such as shortage of foreign currency, inefficiencies in the allocation of natural and labor resources, the inadequacy of present infrastructure, the lack of scientific, technical,and engineering expertise, as well as lack of managerial personnel will continue to be significant barriers for technology transfer to China.

CONCLUSION

This paper has merely hinted at some of the problems that arise in the course of technology transfer to China from a Canadian perspective. The study began with a survey of related documents on technology transfer and barriers to technology transfer in the general context. The literature review helped to define some of the important concepts relevant to this research and provided the later analysis with a theoretical foundation.

Following the literature review was the discussion of China's earlier technology acquisition experiences from a historical perspective. The discussion helps one understand current Chinese technology transfer policies and behaviors in light of China's modern history. Critical factors were discussed, including China's quest for technology since the 19th century, its concern about the corrupting influences of foreign material culture which accompanied that quest, massive technology imports from the former Soviet Union in the 1950s, and the confused technology policy of Mao's government. If would be a fundamental mistake to view China's present technology transfer situation abstracted from the experience of its recent history and Chinese interpretations of that experience.

After a summary of current Chinese telecommunications infrastructure and recent development in the sector of interest, the study attempted to explore some of the most important barriers that exist in technology transfer across two widely disparate cultures such as Canadian and Chinese. These barriers are explored in the context of political, economic, legal, technological and socio-cultural arenas. Problems of politics, economics, infrastructural constraints, cultural and languages differences, when viewed in their complexity, seem to make idiosyncrasies of technology transfer to China a bit more comprehensible.

The case study with Northern Telecom enabled the research to address these issues in a very pragmatic way. Northern Telecom's success seems to indicate that success in China requires long-term vision with patience, persistence, performance and flexibility. It requires attention to the microdynamics of politics, economics, legal and socio-cultural elements at the enterprise level as well as the international surroundings. According to one Nortel interviewee, "success in China must rely on old-fashioned hard work and understanding of the customer's needs."

Although this study has largely accepted the technology transferred to China from Northern Telecom as a given without questioning the appropriateness of its choices to the specific situations in China, future research should be conducted to assess the impacts of such technology transfer. The strategy of supplying whatever the government wants may also raise questions to the critical minds, for "what is good for the Chinese government is not necessarily good for China, and what is good for the joint venture may not be good for China either." Given China's large spectrum of telecommunications capacities and the varying demand for different levels of sophistication of telecommunications technologies and services in different parts of the country, it is questionable whether the government's penchant for the most sophisticated technology transfer to China is an effective strategy. The full effects of such technology transfer to China, be it beneficial or not, will take time to be felt, and it might be premature to make any definitive judgment and/or draw any practical conclusions at this time. However, it is not too early to begin analytical examination of technology transfer process. Such a task is too enormous an undertaking, given the present resources of the researcher; hopefully it will be meaningful for other researchers to explore this issue at greater depth in the future.

The present Chinese policy of encouraging foreign participation in the modernization of the Chinese economy, which will no doubt continue to show variations that will affect the confidence of foreign investors, is likely to be a long-term one. It would be difficult for the Chinese leaders to contemplate carrying out a genuine effort to modernize Chinese industry without continuing such a commitment. If this perception is accurate, China will continue to import considerable quantities of technology in the foreseeable future; the political, economic, legal, and socio-cultural frameworks which shape technology transfer policies should therefore continue to develop and increase in definition.

Yet even if policies remain consistent and new laws add greater certainty to the expectations of foreign investors involved in technology transfer, some problems arising from the complex process of technology transfer are likely to continue to exist. Although priorities within China and the country's response to unfolding global economic and political events are becoming increasingly intertwined, the fundamental tension between the maintenance of political control and authority and the promotion of the increasing importance of foreign investment in the Chinese economy will remain inherent in the Chinese technology transfer environment for some time to come.

This research has used the concept of modernization in the Chinese context which is less influenced by the fervent debate elsewhere. In the West, the fundamental assumptions of modernization have often been challenged in regard to motivations and overall effects of modernization on a society. The imperative of modernization, according to critics of modernization, is self-interest in disguise on the part of the West. The drive to modernize the rest of the world in the image of the West is a convenient rationalization for the new economic imperialism, and people and society are judged more or less advanced according to the criteria of the Western industrial nations, thus the pervasive power and

influence of the West was logically included in the proclamation of modernization. Opponents of modernization theory argue that modernization, while projecting Western development model on the rest of the world, it at the same time destroys local cultures and indigenous ways of life and creates a self-perpetuating dependence on Western nations for their technologies and capital. The Chinese interpretations of modernization and their understanding of the impact of modernization on a society tend to be more influenced by their own historical experiences and circumstances than the fervent debate outside China. Modernization per se is a positive thing for many Chinese. It connotes the ideal of prosperity and power, of material success, of improved living standards and the comfort and convenience of modern technology which alleviates mankind from the sufferings of labor. Even the conservative forces within China do not oppose modernization for the same reasons often cited by critics of modernization theory in the West. Their argument, which is not against modernization but rather represents disagreement about the pace and extent of modernization, is often discredited because it is often based on political calculation and self-preservation for power and control. What is surprising is that the fundamental concepts of modernization had been largely accepted without much challenge, even by most Chinese intellectuals. Concerns about the impacts of modernization and technology are mostly limited to the corrupting influence of Western material culture and bourgeois thinking and lifestyles on the Chinese society, which is not unlike those of reformers of last century. The question of long-term profound effect of modernization and technology transfer on China's environmental and agricultural sustainability has largely been ignored. Although China has insisted on "socialism with Chinese characteristics" in their development approach, such insistence is unfortunately an ideological justification which seeks to rationalize the ongoing economic reforms in a socialist

country. Only when the fundamental assumptions of modernization and technology transfer are challenged, can the questions of overall impacts of modernization and its related policies be addressed with some liberating alternatives.

Appendix A

Questionnaire Guideline

Name_____

Position_____

1. When did Northern Telecom first start doing business in China? In your opinion, what motivated that decision?

2. What do you think of the climate then? How has it influenced your company's decision?

3. What sorts of technology have been transferred to China from Nortel? Are they still in use in China?

4. How did Nortel transfer its technology? and why was that particular method chosen over others? How effective was that method?

5. What are the initial barriers of doing business in China? How has Nortel managed these problems?

6. How has the international and domestic political environment influenced the Company's decision? and how have been managed?

7. How have these barriers changed over the years? In what ways have they influenced your company's operation in China?

8. What, in your opinion, is the most difficult thing to overcome in your company's technology transfer to China? How did your company handle it?

9. How did you decide on your joint venture partner? What choices did you have? How long did it take the Company to do that?

10. What are some of the important factors did your company have to consider before choosing a joint venture partner?

11. Why did the Company choose Shekou as the operation site? Would a different location make a difference?

12. How long did the negotiation take usually? Where did they take place? In what language are negotiations conducted?

13. What are some of the most difficult issues to negotiate? and why do you think they are difficult? Please give some examples.

14. What strike you as the most glaring differences of negotiation styles between yourself and your Chinese counterparts?

15. How did the Chinese legal environment effect your company's negotiations? Please give a few examples of legal differences and how they are resolved?

16. How faithfully has the agreement been carried out by both sides? What do you do if there are deviations?

17. How would you describe the technical capability of your Chinese counterparts? How has the absorptive capacities of your Chinese partners changed over the years? What has been your company's influence in this change?

18. What kind of training are included in your company's technology transfer, if any? What did your company hope to achieve with the trainings? How effective are they?

19. How is the management style used in the joint venture different from that used in Canada? Do you think it is an effective management strategy?

20. How much say do you have in the hiring and firing of employees? Has labor management been a source of constraint in your experience?

21. What do you think of "guanxi" ? How has it influenced your business practice in China?

22. What role does cultural differences play in the transfer of technology? Have they facilitated or hindered technology transfer in your judgment? Please give a few examples.

23. Do your think your company's overall strategy has been largely effective? Do you agree with that strategy? What improvement can be made on your part?

24. Would your company consider another joint venture in China? If so, what would be done differently?

NOTES

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