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Governmental and Cultural Influence upon the Information Technology Industries

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GOVERNMENTAL AND CULTURAL INFLUENCE UPON THE INFORMATION TECHNOLOGY INDUSTRIES

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ABSTRACT

Two nontechnical areas that have significant effect on the industrial welfare of a country are its government and culture; the computer software and hardware industries are no exception to this. It can be stated and easily defended that from birth to maturity, how a country fares in the computing enterprises, and software in particular, may depend heavily, if not entirely, on the attitudes of government and the norms of society as a whole. The influence of government, culture, and society upon computers and software in particular is examined here.

INTRODUCTION

The information technology industries are truly international. It is possible for an engineer to leave his office in Atlanta, travel to a computer center in Tokyo or Geneva, and immediately be productive. The tools, the operating systems, languages, are either identical or similar enough that the engineer will feel very much at home, at least technically. How this engineer fares in a foreign country though, especially over a longer period, may ultimately depend more on the non-technical environment defined by the local government and society than on the technical environment presented by the computer used or project worked on.

I present here a number of representative cases that illustrate how governments and cultural norms can either provide a fertile environment in which a computing industry can flourish or impede it to the point of being virtually non-existent. I begin with what may be the most interesting case and one which I have had some personal experience, China (the People's Republic). From China, I move around the world and discuss governmental and cultural influences in other nations.

CHINA

If one were to plot China's progress in computing during the past thirty-five years, it would appear as a distorted sine wave with the slope of progress increasing steadily until the mid-1960s; it would then abruptly plummet only to begin to increase again a decade later. This is the path China has followed with all of its modern industries; a path that closely reflects the whims and attitudes of a closed, oscillating government.

My work as a professional software developer at a high energy physics research laboratory presents the opportunity to deal with a large population of scientists, engineers, and technicians from around the world.[1]

[1]High energy physics laboratories are often centered around particle accelerators which are very complex and expensive

Recently I had a conversation with a Chinese physicist who took his undergraduate degree in Beijing and continued with graduate studies in the United States. He stated that as an undergraduate he never once came in contact with a computer. It was not until he arrived to work in the U.S. that he gained experience using computers; his Ph.D. adviser handed him a FORTRAN manual and told him to go off and learn to program. This is both surprising and unfortunate for a discipline such as high energy physics that is married to computing.

Had this student stayed in China to complete his studies, upon graduation he and his peers would be assigned by the government to fill jobs where they are most needed. While he would have likely ended up in a position related to his major field of study, he would have little control as to where or for whom he would be working; thus he would have lacked a major motivation that exists in the West to pursue the technical fields.

This hapless graduate student's woes are due in a large part to the official Chinese government policies over the past three and a half decades. Computer technology research and development started in China in 1956 but took a ten year hiatus beginning in 1966 with the Cultural Revolution. It was not until 1979 that the government realized the importance of computing technology when it began to place a national emphasis on it. As a result, China lags far behind almost all the world in software development. Even the most optimistic government estimates place it well in the twenty-first century before it is at parity with the West [25].

In 1979 the government developed a National Computer Policy (NCP) that included general applications, software engineering, and scientific applications. Funding and support has been improving during the 1980s. In 1984, the Software Industry Association of China was established.

Special economic zones have been created, such as "Zhongguancun Street," the Silicon Valley[2] of China. Here, hundreds of new enterprises and private companies have sprung up [25]. Completely with the knowledge and blessings of officials, these enterprises try as they can to act within the restrictions of a government that attempts to liberalize the Chinese economy while maintaining social and political control.

Progress is not without its opponents, however, even in the government. One example is *The Stone Group*. As China's most successful high-tech capitalist venture, Stone has caused resentment and opposition from government and industrial officials who resent their inferior products being undersold. However, high ranking government officials clearly support such ventures to the extent of suggesting that Stone take over operations of a state-owned microcomputer plant in financial trouble [17].

China has always been strong in basic research and development. It is the technology transfer from the lab to the factory where it lags [17]. Convincing industrial and business managers to incorporate new technologies is difficult in a society where the status quo is more important than risking possible failure through innovation.

China's "Iron Bowl" policy of employment security and lack of in depth knowledge of computing is hindering its attempts to modernize its society. Attempts at automation are further hindered by the abundance of cheap labor and no governmental or industrial structure that is willing to accept it or realize its benefits. Furthermore, the Chinese society in general, which is 80% agricultural, has not seemed to have acquiesced to functioning in a high-tech and modern way. For example, when the electric power fails (which is

apparatuses. The relatively few number of them in the world and the open, cooperative nature of the research they support makes for a constant scientific interchange between many countries.

[2] "Silicon Valley" is a term commonly used by Americans and non-Americans alike to describe any hi-tech region.

common, especially away from the major cities), employees whose work depends on electricity see this as a vacation and take the day off [1].

When attempts at automation are made, a common belief is that by acquiring the hardware, modernization has been achieved. Computers are viewed as number crunchers for simply solving numerical problems instead of being viewed in the whole concept of general automation. Even then, it is not uncommon for computing managers to really not understand what they have and the resources are wasted and mismanaged [1].

EUROPEAN ECONOMIC COMMUNITY

While attending the Third Annual Conference on the C++ programming language, I had the opportunity to encounter a number of software professionals from Europe and Japan as well as the United States.[3] Among them was a young German software entrepreneur. Fresh from Germany with his frustrations in dealing with the German software market, he was intent on making a success in the packaged personal computer software market in the United States. He states, "There is nothing happening there [Germany] in packaged software. It is all happening here." He believes that the structure of the culture and governmental support is conducive for custom software and not for the mass market. World Bank figures confirm his opinion as the market for packaged software in Germany and Europe as a whole is limited [20]. Perhaps the prime reason for this is the multitude of languages and cultures makes the development of packaged software difficult.

Since the early 1980's, the European Community has been coordinating software efforts via two major projects, Eureka and ESPRIT. These projects are concerned with life cycle automation and other technologies with the major emphasis on reducing costs and increasing quality. ESPRIT is funded by the EEC's budget and Eureka by each member nation [18].

Independent of the EEC, the German government is spending much on the information technologies by sponsoring joint industrial projects in advanced computer systems, integrated digital networks, software and robotics, Computer Aided Design (CAD), etc. Within Germany, however, there is a conflict between the government intervening at the expense of free enterprise and of falling behind [9].

British government efforts in the 1980's included the Alvey project which was intended to increase the research activities in the information technologies. With its conclusion in 1988, government funding dried and many of the Alvey projects are attempting to continue with ESPRIT funding [19].

The French software industry began with government efforts in the early 1970's. The plans were to develop the domestic hardware and technology fields. While the successes of these plans are in question, the parallel industries that were created as a result has been quite successful in the French and European markets [18].

A Matter of Perspective

How a country is faring in the software technology race often depends on whose viewpoint is being considered. It is commonplace for the author of one nationality to view his or her own country in a pessimistic light while dwelling on another country's assets. This point was considered by two authors, one British and the other German, who studied how the Germans and British view one another [9].

The authors, Row and Stiegler, found that while the British view the Germans as "trail-blazers" and themselves as "has-beens," the Germans view themselves as "laggards" in technology. A British study suggests that British managers are more resistant to new technology than their German counterparts and that Germans were most

[3]The Third Annual conference on C++ is sponsored by the USENIX organization and was held in April, 1991 in Washington D.C.

interested in reliability and long-term effects. Many Germans, however, don't agree, suggesting that Germans are conservative toward technology. Franz Arnold of Scientific Controls stated, "[German] People here look for ways to do more efficiently what they are already doing. In the U.S. and Britain, they see technology as an opportunity to enter new types of business."

In other words, Germans view themselves as ahead in terms of improving existing applications but too slow in developing new ones. Germans feel that this was brought about by their strong tradition in mechanical engineering and desire to improve it.[9]

Germans work significantly fewer hours per year than their Japanese and the American counterparts. Unlike Britain, Germany is a federal state and regional variations must be considered. There are indications that Germany could experience a more difficult transition to high-tech society than Britain [9].

An interesting side note is given by Richard Sharpe of *Software Markets* newsletter. Software engineers in the UK often believe that they are superior to other nations' staff. Sharp says that this is a myth [24].

INDIA AND ISRAEL

It may at first seem odd to group two countries such as India and Israel. India, after all, has a population 185 times the size of Israel's. They do have two significant things in common; they both possess a large pool of English speakers who are highly educated and relatively low paid. Where they differ is also significant. Israel with its small population, already has a long history in electronics. Interestingly, many Israelis see the export of computer software as a natural extension of exporting another type of software, religion [4]. For India, on the other hand, computers are culture shock [2].

The constant threat of war, though encumbering, has forced the Isrealis to be versatile in utilizing their meager resources. This adaptive mentality is well suited to integrating new technologies. This is in contrast to India with its very large and tradition bound population facing tremendous problems. The Israelis are highly motivated and harder working when compared to their American counterparts [4].

Beginning in the mid 1980's, the late Indian prime minister Rajiv Ghandi's government established policies designed to encourage competition and growth in the electronics and computer industries. In the past, international companies resisted dealing with India due to a large bureaucracy and small market potential. These new policies may help this [2]. They are aimed at getting India into the software export market and relaxing import constraints to encourage foreign investment. The government also has ambitious plans to establish "silicon valleys" in several places [3]. These efforts seem to be paying dividends as many foreign companies such as UNISYS went into a joint venture with Bombay based Tata Industries [16].

Israel's attempts in modernizing its software industry have not been helped by its government which places no special importance on the software industry. It believes that it has no more obligations toward high-tech industries than such low-tech ones as food and manufacturing. This leaves a void where governments in other countries have provided leadership and coordination. Its lack of interest in communications hurts as well. There can be also no doubt that the uncertainty of its defense is a hindrance [4].

JAPAN

Tuneyoshi Kamae of the University of Tokyo, while presenting a paper on computer networking in Japan at *CHEP '91*[4], commented while his country has the justified reputation of good cooperation between government and the private sector, cooperation among government agencies is often impossible by law. Thus the Ministry of International

[4] The 1991 Computing in High Energy Physics (CHEP '91) was held in Tsukuba, Japan in March.

Trade and Industry (MITI) and the Ministry of Culture and Education (MCE) maintain two incompatible networks. Such formal legislation greatly impedes the kind of unified computing efforts that developed wide area networks such as BITNET and the Internet in the United States.

However, within the governmental spheres of influence, cooperation between the public and private sectors in Japan is well established for all industries. Beginning with its NCP in 1972, the Japanese government has provided leadership and coordination in significant ways. A prime example is the SIGMA project which is currently migrating from its research to commercial phase.

SIGMA (Software Industrialized Generator and Maintenance Aids) represents Japan's major effort to catch up in what it perceives as it lagging behind the United States and Europe in software development. It intends as its goal to developed high quality software in high quantity (a universal wish perhaps). By automating the software development process, the desire is to eliminate the expensive and lengthy process of manually creating software [22].

When SIGMA concluded its first five-year phase in 1990, it was viewed by many as a failure by not reaching its primary goals. Nonetheless, it was successful in creating new technologies for distributed development environments and underscores how government support can yield dividends even when it misses its original target [23].

Japan's well publicized Fifth Generation Computer Project is now more than a decade old. It receives strong government backing and its primary goal is to develop artificial intelligence technology [31].

Large computer projects need not always be primarily driven from government sources, however. The TRON project strives to produce a "Highly Functionally Distributed System." It receives support from over 130 companies in Japan, the United States, and Europe [31].

A key player in the Japanese government's role for its support of the software industry is *MITI*, the powerful Ministry of International Trade and Industry. It is spending hundreds of millions of dollars on numerous projects including SIGMA and the $357 million Institute for New Generation Computer Technology for research into artificial intelligence. MITI supported research has already aided bringing Japan to dominance in other information technologies such as semiconductors [29].

Laszlo Belady of IBM related his experiences while working for eighteen months at the IBM Japan Science Institute [10]. He believed that the Japanese have a very positive attitude towards software and are problem oriented people who are very willing to cooperate. Tasks are partitioned among a group according to skill and not necessarily seniority or interest. In other words, it is not beneath a senior person to perform a menial task if that is the most appropriate way to get the job done. The difficulties in writing Japanese force them to communicate verbally and while they don't always agree, they do listen to each other.

Belady further elaborates how the Japanese approach each job with the same intensity regardless of duration or interest. The disadvantage of these traits, he believes, is that plans are implemented even to failure and that Japanese often have difficulty handling exception cases or coping with changes [10].

Culture can affect the way the whole software life cycle is approached. For example, in Japan maintenance is typically assigned to the developer since turnover of personnel is low relative to the West. The maintenance problem is reduced but the emphasis on documentation is as well. What documentation there is often does not have to be as extensive due to Japan's homogeneous nature (leaving less chance for ambiguity). Recently, as the turnover rate has increased, the maintenance problem has also [11]. In addition, programmers historically have low status compared to the West so many companies often don't give them advanced tools [26].

THE SOVIET UNION[5]

Five years ago when a Soviet Electrical Engineer who had been conducting research at Fermilab[6] returned home he brought with him an IBM PC clone. Even then by Western standards it was a very mundane piece of hardware with only a quarter of a megabyte memory installed – American export restrictions at the time forbade such hardware from having more. As I was noticing the Cyrillic characters he so carefully scribed onto the keyboard, he confided in me that he had another quarter of a megabyte of memory in his suitcase.

Though such restrictions have been lifted by the United States, this anecdote illustrates the state of Soviet information technology. There exists an unavailability of even the most basic hardware at home. These shortages were caused by lack of domestic production and tough Western export restrictions.

During the 1940s and 1950s, Stalin forbade the study of computers as a "bourgeois" science. As a result, only the Soviet military had some applications [8]. Thus, access to computers and automation was limited from the beginning by government decision.

The Soviet Union is now in a transition phase between a centrally controlled economic system to something closer to a free market. As it moves in this direction, it is attempting to cast off those policies determined to be unnecessary or obsolete. Information technology was one of Gobachev's keys for restructuring the economy. The poor quality of domestically developed software, which has never been very good, has prompted the government to set up a committee to review software quality [8]. As late as 1986, personal computers were seen as a security threat [15]. As modernization proceeds, government and party officials anticipate a challenge to their information power and may impede its progress [8].

Prior to *Perestroika*, the Soviet Union carried out a large scale program to bring computer-based information systems, called Automated Enterprise Management Systems (ASUPs), to industrial enterprises. This project illustrated the limits of "reform from above" for the information industries since its results were mixed at best – most of Soviet Society is still untouched by automation. The Soviet economy, in spite of what one might think, never did respond well to the imposition of uniform policies from above [7].

With *Perestroika*, the Soviets are attempting to open and modernize their information technology with the rest of society. Little awareness of the problems that come with computerization such as crimes and employment changes have considered by them [8]. Pirating of Western software has always been common and it is estimated that less than 20% of all Soviet software was developed domestically, the balance being mostly stolen copies from the West. This activity is hard to discourage in a non-profit oriented society. The domestic software industry has thus been severely hindered [14].

Computers have bareley touched Soviet life outside the military. They are significantly impeded by the lack of competition and user feedback. Furthermore, what computers they do have are modeled after the West rather than satisfying their own needs even to the point of interfacing in English [15]. It may be that automation just does not fit in well with a social and economic structure that limits free access and promotes secrecy. What the computer does best is really opposed to the Soviet system [7].

Vadium E. Kotov of the USSR Academy of Sciences recently pointed out an interesting effect the relative

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[5] I use the words "Soviet", "Soviet Union" and "USSR" for lack of better terms that describe the now defunct Union of Soviet Socialists Republics.

[6] The Fermi National Accelerator Laboratory, or Fermilab, is located outside Chicago and is one of the principle High Energy Physics Research Labs.

hi-tech lack there has created [32]. He writes,

> Soviet programmers, used to overcoming the obstacles of the "pessimistic" hardware available to them, often managed to solve the same problems as their Western colleagues by just inventing more sophisticated algorithms and designing software quality.

My experience tends to confirm Kotov's statement, at least from the Western perspective. Problems here, especially in large companies and government labs, are often solved by merely acquiring better and faster hardware rather than making better use out of what exists. This solution of "throwing" hardware at problems is justified as being less expensive in time and money than employing costly humans to improve the software.

Kotov continues by citing three major reasons for current lack of government support for computing there, specifically large-scale government projects: severe economic problems, perceived failure of other national programs (e.g., SIGMA), and the poor state of Soviet computing hardware technology. A current project there, START, ran its three year initial course ending in 1988. The official government policy of "self-sufficient" support of basic research has encouraged participants in START to create small companies to market the technologies developed. Perhaps only now, with the "Second Russian Revolution" that occurred in August 1991, can real progress eventually occur. However, with the apparent breakdown of central authority that followed, the Soviet Republics must be more preoccupied with putting food on the table than giving priority to computing modernization. It remains to be seen whether the Federation of Republics will carry on with the reforms that Gobechev introduced.

THE DEVELOPING PACIFIC RIM

The most dynamic developing economies of the pacific rim, South Korea, Singapore, and Taiwan, share with each other rapidly expanding economies and hard-working, enterprising populations.

South Korea

In spite of the domestic turmoil that has been prevalent in the press in recent years, South Korea has been engaged in a number of publicly funded research and development computing projects [13]:

- Super:
  Combines resources from public, private, and academic sources to prevent S. Korea from lagging behind other nations in the information technologies.
- NAIS:
  Computerization of government.
- The next generation of telecommunications software.
- Administrative support for the 1988 Seoul Olympic games.
- ° TACCIM:
  Joint U.S.-S. Korean military support.

Singapore

The government of Singapore recognizes the importance of the information technologies and is attempting to create a climate to foster their growth. Included within its NCP are plans for coordination between government and industry. Visible efforts include increased funding for R&D, encouragement for local development of software for export, tax incentives for both domestic and foreign companies to develop software in Singapore, and technology transfer [5].

Taiwan

For Taiwan, the formation of the Institute of Information Industry in 1979 was a major step in the direction of promoting the computerization of government and industry. Anticipated manpower shortages are prompting the government to increase support to universities. Similar to Singapore, the government has supported four national programs [6]:

- Financial Information Systems
- Meteorological Systems
- Residential registration (citizen information)

- Nationwide access to medical records

With government encouragement, initiatives are being undertaken with organizations worldwide including IBM, Hewlett-Packard, and Wang. In 1983 the Software Engineering Institute was formed in cooperation between the Institute of Information Industry and IBM to promote the development of software personnel. Hewlett-Packard in the past has worked with the Institute of Information Industry on word processing and expert systems. All of these efforts center on Taiwan's desire to compete with the more developed software producers in the U.S., Japan, and Europe [6].

BRAZIL, MEXICO, AND ARGENTINA

The three most populous countries of the Americas south of the United States, Brazil, Mexico, and Argentina, are struggling socially, economically, and politically. Their lack of stability in all three areas tends to weigh down efforts of modernization. Nonetheless, all have undertaken in recent years national programs to develop their computing industries.

Brazil has the oldest national policy in the region beginning in the mid 1970's. The primary goal is technical independence. It places heavy restrictions on all computers by embargoing all computers except those not available in Brazil. This has resulted in a relatively inefficient industry regarding price and performance. Domestic consumption of small computers is 1.3% of that of the United States (its GNP is 6% of the U.S.). Although its industry is growing steadily, its growth rate lags that of the United States. Government restrictions of computing could damage the economy by hindering its introduction and increased use [28].

However, recent developments indicate Brazil's recognition that significant trade barriers hinder more so than aid domestic development in the information technologies. In September of 1990, President Fernando Collor de Mello stated his desire to end the restrictions. Recently the Brazilian Congress agreed and the opening of the markets is targeted to begin in 1992 [30].

Mexico started its national policy in the early 1980s and like Brazil's, technical independence was its goal. Its policy was not as restrictive as Brazil's due to its unique relationship with the United States. Mexico shares a large border with the U.S. with extensive trading routes already in place. Similar restrictions would be nearly impossible to enforce. As a result, Mexico's industry is more efficient and this is reflected in the price and performance of what is available there [28].

Standing between the policies of Brazil and Mexico is that of Argentina's. Starting in the mid 1980's, the Argentinean policy is less restrictive than Brazil's but more than Mexico's. Computing prices, though significantly higher than international levels, are still below those in Brazil [28].

EASTERN EUROPE

In all of the pre-1989 Soviet satellites, the government defined the computing industries. With the revolutions of 1989-1990 being too recent to have significant impact in the information technologies there, it is still difficult to consider their computing industries separated from virtual government domination. Like the Soviet Union, all of its former satellites lag dramatically behind Western Europe, the U.S., and the Pacific Rim.

The Eastern European countries may not be able to export many goods and services to the West, but they have proven proficient in one export: computer viruses. Programmers from Bulgaria and the Soviet Union seem especially adept at this activity. Causes have been attributed to a number of reasons including resentful programmers fed up with being forced to pirate Western software and increased availability of Western literature detailing the concepts of viruses [36].

Czechoslovakia and Poland were early players in computing both starting in the early 1950s. Bulgaria and Hungary followed in the 1960's. Finally Romania completed its first computer installation in 1973 [27].

Romania illustrates, as China does, how a government can significantly disrupt computing activities [35]. The isolationist and dictatorial policies of the Ceaucescus' severely hindered progress in computing. Old fashioned techniques such as political purges and censorship were applied to control those who participated in the new technologies.

Nonetheless, Romania developed a computing industry though it was limited in scope. Today, the Romanians strive to come "from under the rubble" in computing as well as all other areas that were decimated by years of oppression.

For the section of Germany that was once know as the East, the first computer was produced in 1965 with general data services beginning in the early 1970's. The main producer was the ROBOTRON combine which manufactures EDP systems and peripherals, minicomputers, business equipment, printing equipment, telecommunications, and more. Special attention has been given to decentralized data technology [27].

THE UNITED STATES

What is commonly defined as modern computing began at the conclusion of the Second World War under the support of the United States Government. The first applications were strictly military but by the early 1950's computing was moving into the commercial arena. Without doubt, however, computers got their start from direct government interest.

The United States, with no official NCP, does not have the appearance today of having officially sanctioned efforts such as Japan or Western Europe. It does however, support very large publicly funded software projects. The Pentagon alone, which controls a budget larger than the total governmental budgets of most countries, has had significant impact on the domestic and global software industries. It was U.S. Army support that caused the creation of the first totally electronic digital computer at the close of the Second World War. Other government funding to universities and industry produces much research in all areas of computer technology from telecommunications to avionics [20]. So while there exists no single direction for software and computing technology, public support continues to be a prime driver of it in the United States.

However, the U.S. relies heavily on the private sector to maintain the country's leadership in the information technology industries. Perhaps the most visible example of this is the Microelectronics and Computer Technology (MCC) consortium. Begun in 1983, it consists of a number of large American companies such as Digital Equipment, Boeing, and Rockwell contributing resources to respond to foreign (i.e., Japanese) advances in high technology.

Though from the beginning it lacked any direct government financial support, MCC certainly has been operating with full government knowledge and moral support [33]. Recently it has endeavored to work closer with both the government and universities [34].

In recent decades, the American hi-tech work force has been a mobile one. This has had an interesting and significant effect on software development methodologies. The high turnover of software professionals has forced increased efforts spent on documentation and peer review; when a programmer leaves the company, those left behind have to be able to maintain his code. While naturally increasing the development costs of software, better documentation and a cooperative approach can only decrease the overall life cycle costs.

CONCLUSIONS

The effect government and culture have on software (and computing industry as a whole) can be profound. The activity of government can range from promoting the software development for the benefit of both government and non-government related fields (as is the case in most countries) to the deliberate disruption of all computing activities. Such disruption can be moderate as in the case of Brazilian import restrictions to a virtual cease of computing activities as in China during the Cultural Revolution.

Cultural influences are perhaps more difficult to quantify but present nonetheless. Japan with its homogeneous, mono-cultural society relies less on documentation and more on the stability of the work force. The European Economic Community, which encompasses a multitude of languages and culture, relies less on packaged software and more on custom development. The Soviet citizens' general apathy and disregard for intellectual property rights greatly hinders domestic development of computing technologies. In the U.S. high turnover forced increase reliance on documentation and co-development.

NATIONAL COMPUTER POLICIES [21]

Beginning with Japan in 1972, numerous countries have established National Computer Policies (NCP). Matley and McDannold define an NCP as follows:

> a government-sponsered or -endorsed document (or set of documents) that indicates the "official" role of the computer, and telecommunications in general, in terms of its relationship to the society and its business activities.

NCP's vary in scope, success, and sanction. A country lacking an official NCP may have incorporated a small number de facto ones by one segment of society standardizing and influencing others (e.g., the United States). Except for France and Japan, NCP's tend to address technical and business issues. Both France and Japan addressed social issues as well.

For developing economies, NCP's are important. They give direction and motivation to commit limited resources. Countries with established computer industries or ones that are large in size have a harder time establishing an NCP [12].

Country	Date	Comments and Areas Addressed
Japan	1972	World's First NCP. It has been partially implemented (e.g., SIGMA). As in France, it addressed social as well as technical and business issues. Saw its homogeneous society a plus.
France	1978	By mid 1980's, France abandoned its "we'll do it all" attitude and move closer to a Japanese model. Addressed the social issues as well.
China*	1979	Not an official NCP but more of a government awareness. Tends to copy West, 15 to 20 years behind, seeks to acquire U.S. technology.
Singapore	1980	Computerization, education, computer services, computer installation, computer security, focus on applications.
Taiwan	1980	More education, planning, software engineering, business planning, testing, international codevelopment, manufacturing, 5 projects, emphasizes computer systems. Institute of Information Industry formed in 1979.
United Kingdom	1982	Committed funds for $550 million over 5 years in 4 enabling technologies.
S. Korea	1983	Goal: Achieve U.S. and Japanese levels of technology by the year 2000, raise R&D to 1% of GNP, emphasizes electronics, chips, components, etc.
EEC*	1983	The ESPRIT program is similar to an NCP in nature.
Australia	1984	Covers education, expand R&D to 1.5% of GNP, move from low-tech to high-tech.
Brazil	1984	Promotes competition, government promotion, free access to data, education, comp of state owned, preference to Brazilian firms.
Israel*	1984	Avoids break-through research and concentrate on proven technology such as software engineering technology, communications, VLSI, databases.
Canada	None	Similar to U.S., risked becoming dependent on trading partners for high-tech needs, worked to turn this around in the 1980s.
Germany	None	Government works to assure competitiveness and support industry.
India	None	Attempts at fostering domestic industry are recent and limited.
Ireland	None	Seeks to improve its economic condition via computers.
Netherlands	None	Acting as "Dutch Trader" for companies doing business with the EEC.
Sweden	None	Has privacy concerns and has no strong history of central control.
USSR	None	Industry in disarray with problems in most areas. Tends to copy West.
USA	None	Has many publicly funded projects and standards [20].

*Not an official NCP but signifies national awareness and initiatives.

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