

Information Technology Planning in country

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Chapter 1 Information technology (IT) in today's Vietnam

By any international standard the level of 'computerization' in Vietnam is low. Five years ago Vietnam compared unfavorably with other countries in Southeast Asia, such as Thailand and Singapore, where numerous, relatively advanced implementations of IT were in place both in industry, the service sector, and in public institutions. Today, the situation in Vietnam has improved, but the gap with neighboring countries has, if anything, widened. As a country located in a resourceful and newly-industrialized region, Vietnam is unquestionably a latecomer in the systematic use of IT. Among both end-users and computer professionals in Hanoi and HCM City for example, there is a well-recognized need for more up-to-date workstation equipment and a need for better access to data communications.

Vietnam has a relatively small number of computers installed. In relation to its population of more than 72 million, the number of computers are extremely few. Our most recent estimate for the first quarter of 1994, based on a series of visits to industrial firms, higher education institutions and government agencies during the second half of 1993, as well as interviews with Vietnamese and foreign experts, is that some 40 000-45 000 computers, mostly PCs and other microcomputers, are in use in Vietnam.

A more conservative estimate, provided by persons working in the Vietnamese IT service sector, is a national total of 35 000 computers. We think that the latter figure is too low, considering the rapid rate of expansion during the last four-five years.

In 1989, while one of the authors of the current report prepared a policy oriented, case study-based report for UNIDO on the application of microelectronics and information technology in Vietnam, (1) the national total of microcomputers was estimated to be only 3 000-3 500. According to estimates for the year 1988 the number of microcomputers in use in the HCM City area was 300 plus about 500 in Hanoi and vicinity. (2) However, this and other estimates did not take full account of the direct imports by industrial and other companies as well as the transfer of all kinds of electronic equipment through private channels and donations from abroad. The total figure was actually about four times higher.

If our estimate for the first quarter of 1994 proves to be correct, a total of 40 000-45 000 computers implies a remarkable growth rate of more than 12 times in less than five years. The bulk of the growth came in the last 2-3 years, when large numbers of PCs were brought into the country. As was the case five years ago, our recent figure can be confirmed only in retrospect, because of lack of current data and very limited information on "non-official trade". With the US trade embargo lifted in February of 1994 (reducing the need for "non-official trade") and with the general improvement of Vietnamese techno-economic statistics, figures may soon be available.

If Vietnam may seem poor in terms of computer and peripheral equipment, it is relatively better off in IT professionals. The level of training is good, where staff are trained, but there is now a pressing need for more professionals such as programmers and systems analysts. Until recently, access to softy are has not been a significant



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problem, because the US trade embargo "ensured that software could be pirated, rewritten for local conditions, and sold at reasonable local prices with impunity".~ There is a predominance of DOS-based application programs with extensions into the graphical user-interface and memory-management features offered by the Microsoft Windows operating system. While visitors to Vietnam have often noted a fair amount of enthusiastic local software production activity, very few of these products have been exported due to lack of marketing capacities and access to international distribution channels.

In spite of the limited numbers of computers and other information technology already transforming parts of the industrial landscape of Vietnam. Increasingly, manufacturing industry is applying electronics to its production processes and, more significantly, to its administration. Banks and other credit institutions are beginning to use data communications and computerized databases. In several sectors of the central government there is a strong move to modernize administration with information technology. At other levels of government, such as in the provinces, the administrative services are being improved by systematic use of microcomputers. Many other examples of diffusion of modern IT could easily be listed.

Electronics and information technology in Vietnam: The need for policy coordination. Nonetheless, it is obvious to any observer of today's Vietnam that the country remains a late-comer in the use of microelectronics and other information technology. Five years ago, in early 1989, experience accumulated through UNDP-funded projects in Vietnam indicated the following problems for the diffusion of information technology in Vietnam (3):

- Limited number of specialists and few opportunities for the development of human resources.
- Low technical level of available hardware and software.
- Limited number of computers and related equipment.
- Lack of technical advisory, maintenance and repair services.
- Insufficient institutional framework: limited facilities and activities in universities, institutes, centers, specialized commercial companies, etc.

Since 1989, impressive changes have appeared in certain areas and for certain applications. Most of these changes have come through new educational and training opportunities and more effective -- often informal -- transfer of know-how and other specialized information related to the application of computers and other information technology. Yet, despite these recent changes, the prevalent characteristics of IT in Vietnam -- implicit in the five points listed above -- are the same. It is our impression that the IT situation may soon change dramatically to the better. One of the preconditions for change is the new policy platform for the country's IT development.

Foot Notes:

1. "Microelectronics and information technology in Vietnam: An overview", (Vienna: UNIDO Regional and Country Studies Branch, PPD (Spec.), 1990), 58 pp., based on Jan Annerstedt, "Microelectronics and information technology in Vietnam: Towards a national policy framework", (Lund: Nordic. Center for Innovation, 1989), 72 pp. For the current study, selected



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data and other material from these two reports were updated and included in the text that follows.

2. For the year 1988, a sum of 300 microcomputers in the Ho Chi Minh City area was provided by the Ho Chi Minh City Committee on Science and Technology. It was an estimate and no information is available on how it was once calculated. According to our 1989/90 sampling of data in both northern and southern Vietnam, the figure was too conservative. Observation made in 1993 by Rob Hurle of the Australian National University.
3. The terms-of-reference for a study formulated by UNDP in April, 1989, as an "Overview of computer utilization - a programme note," p. 2.

A national program to promote information technology

Since the summer of 1993, Vietnam has its own national program for the development of IT. It is an ambitious and comprehensive program, covering a wide range of important issues. It "requires that our country further develop IT in every sector" and not just among the ministries and public agencies. IT should be used to enhance quality and effectiveness in manufacturing and services as a means to support the country's overall economic reforms.

The national IT program is a Government Resolution (No. 49/CP/1993), signed by Prime Minister Vo Van Kiet. Every government agency is ordered to follow the guidelines and reach the objectives. So, at least in principle, every minister will have to find ways to implement the national IT program.

What is new in the 1993 national IT program is its practical orientation. It is a program for better diffusion and application of an existing advanced technology. The IT Resolution is made credible and realistic because it addresses the program's implementation, e.g. the "effectiveness of the application of computers in socio-economic activities". What is left out of the national IT program are operational goals with clear strategies for their implementation. The implementation of the national IT program will require a higher degree of joint effort and cross-sectoral coordination, especially in combining policies for technology and innovation with policies for industrial development and restructuring, trade, infrastructure improvement, administrative reform, education, and other manpower development. It is our belief that policies for the development of IT cannot be effectively implemented in isolation from other economic and social policies. In countries with well-developed IT infrastructures, computer and telecommunication technologies are applied to nearly every aspect of social and economic activity. In Part Two of this report, especially in Chapters 5 and 6, the implementation problems of the national IT program will be elaborated.

The IT program does not incorporate possible positive linkages between the progressive IT policy of Vietnam on the one hand and the current policies for industry; foreign trade; education and training; administrative reforms and the communications infrastructure on the other. The national IT program identifies some



of these cross-sectoral linkages, but limits itself when it comes to the creation and development of an IT industry in Vietnam.

The IT program was never meant to be just a government program. In mid-1993, the central government promulgated the IT program as a cross- sectoral program to be located in the new economic context of Vietnam. Institutions and enterprises in all sectors, and in the whole country, were encouraged to participate in the program's implementation. In each of the six areas of IT applications included in the Resolution, the involvement of a set of different institutions and enterprises inside and outside of government was to be sought. We recommend that this approach be observed during the process of the program's implementation.

In sum, we think that the separate policies influencing IT developments will have to be better orchestrated. What is required now -- to give an example in organizational terms -- is coordination and joint policy develop- ment by the Ministry of Science, Technology and Environment, which pioneered the policy development behind the national IT program, and, e.g., the Ministry of Heavy Industry, which until recently could command or at least influence virtually all public enterprises assembling electronic products and developing information technology.

An emerging Vietnamese 'IT industry'

To help broaden the on-going policy discussion, we propose that the concept 'information industries' (1) or 'IT industry' will be introduced also in Vietnam. 'Information industries' -- encompassing computers and communications equipment, software and information services -- is a notion that may suggest ample and unorthodox ways of identifying and assessing strengths and weak- nesses in the country's use of microelectronics and other information tech- nology as well as Vietnamese production of electronics, including final assembly. Taking such a broad view on IT development, manufacturing and applications may help combine separate policies to be implemented in several government sectors, in the services and in different branches of industry, as well as in agriculture, forestry and fishing.

It will be difficult, however, to devise a generic development strategy for the whole IT industry in Vietnam without further specifications. The IT industry is not an easily operational concept for strategy-making if it includes each and every enterprises engaged in the manufacture, provision, mainte- nance and operation of information technologies. Moreover, many IT products and processes available on the world market are rapidly changing, even disappearing before they are captured in the official statistics. (1) At face value, the IT industry is a technologically defined part of two major economic sectors, industry and the services. It cuts across many traditional industrial sub-sectors. IT is incorporated in products and manufacturing processes and increasingly in what is usually classified as the service sector.

To simplify matters, we may define information technology (IT) as what is done with microprocessors and other electronics products after they are manufactured and installed. Anything that comes before IT, we consider to be electronics production. However, the 'IT industry' notion covers all the links in this chain of activities.



In the report, we will use the 'IT industry' concept to distinguish among the reasons why a well-orchestrated mix of government policies really matter in today's Vietnam. We will also elaborate the characteristic features of the industry as defined by information technology and by its main applications.

Foot Notes:

1. The 'information industry' concept is used in several industrialized countries to identify linkages between different branches of industry as well as between different sectors of the economy. Cf., e.g., Information Industries, (Canberra: Department of Industry, Technology and Commerce & The Australian Trade Commission, /no date/).
2. Cf. John Houghton, "The Australian information industries: Identifying opportunities", (Melbourne: CIRCIT Working paper No. 2, 1991).

Chapter 2 Microelectronics and the global 'IT industry'

In most countries, microelectronics has diffused into nearly every field of human activity. This miniaturized technology, including integrated circuits and the more recently invented microprocessor, is having a strong impact on socio-economic development. The increasing scope has been the principal mechanism by which the electronics production or the 'IT industry' has grown and is probably the reason it now generates more revenue than any other industry in the global economy.

Which are the different uses or applications for electronics products? How are these products used in society? What sub-industries are encompassed by the term 'microelectronics'? These and similar questions cannot be answered before the 'IT industry' is further defined. For policy-making and for the creation of appropriate industry strategies, the Vietnamese decision- maker has to con- sider the complexity as well as the dynamic nature of the IT industry and its electronic components.

Components buied on microelectronics, such as microprocessors, micro- controllers with built-in software, and LCD displays, electronic timers, have been designed into millions of new products, including home appliances, automated bank tellers, and telephones. The combination of microprocessor technology with electro-mechanical devices (e.g. electric motors and actua- tors) in products such as machine tools, farm equipment and motor vehicles have revolutionized these industries. It seems that the potential applications for office automation are only limited by the processing power of computers and networking hardware and the features of the software that runs on them. A complete list of technologies, products, and applications related to micro- electronics would be very long indeed, and the list is growing constantly as new possibilities are created through advancing technology.

As the size and heterogeneity of the IT industry have increased, espe- cially during the past ten years, it has become difficult to describe electronics markets in a simple



way. In order to analyze the industry and set policies for its advancement, it must be broken into segments. Each industry segment may have a unique set of competitors, technologies, standards and markets. Policies that encourage the development of one segment of electronics may retard the development of others. Hence, from a government policy perspective, it is important not to treat electronics production as a single, monolithic industrial entity.

In the global IT industry, many segmentation schemes are in use. [Figure 1](#) shows six alternate schemes for segmenting the industry.

Figure 1

Six alternative ways of segmenting the IT industry	
SEGMENTATION	DEFINITIONS/EXAMPLES
SEGMENTATION No. 1: BY END-USER MARKET	
CONSUMER ELECTRONICS	Sold to the retail market.
COMMERCIAL ELECTRONICS	Sold to companies.
GOVERNMENT SYSTEMS	Sold to governments
SEGMENTATION No. 2: BY SUB-INDUSTRY	
Computers and Data Storage	From portables and PCs, to workstations and super computers.
Peripheral Equipment	Such as printers, monitors, keyboards, scanners, etc.
Communications Equipment	From telephone hand sets, to LANs, to central switches.
Automotive Electronics	Including engine controls, sensors, displays, audio systems, etc.
Consumer Electronics	Including audio, video, television equipment, etc.
Industrial Electronics	Such as machine tool controls, robots, etc.
Medical Electronics	Including diagnostic equipment, life support systems, etc
Instrumentation	Such as frequency analyzers, electronic scales, testing equip., etc.
Military Electronics	Such as remote sensing, guided missile controls, etc.
SEGMENTATION No. 3: BY PHYSICAL COMPOSITION	
HARDWARE	Such as: <ul style="list-style-type: none"> • Computers (micros, laptops, minis, mainframes, etc.) • Data Communications (modems, LANs, muxes, etc.) • Disk Drives (hard, floppy, optical, removable, etc.) • Graphics (digitizers, image processors, etc.)



	<ul style="list-style-type: none"> • Monitors (PC, Macintosh, etc.) • PC Accessories (mice, keyboards, printer accessories, etc.) • Printers, Plotters, and Hard Copy Devices • Scanners/Recognition Equip. (OCR, bar code, image, etc.) • Telecommunications Equipment (fax, voice, ISDN, etc.) • Tape Drives (cartridge, DAT, cassette, reel) • Terminals (display, special-purpose)
SOFTWARE	Such as: <ul style="list-style-type: none"> • Applications Software (spreadsheets, word processing, AI, etc.) • Communications Software (email, networking, fax, EDI, etc.) • Systems Software (DBMS, Languages, Utilities, etc.)
SEGMENTATION No. 4: BY MANUFACTURING TECHNOLOGY	
HAND ASSEMBLY	Pin-trough-hole.
AUTOMATED ASSEMBLY	Automated pin-trough-hole, SMT, COB, TAB, Multichip Module.
SEGMENTATION No. 5: BY LEVEL OF PACKAGING	
COMPONENT	Semiconductor, bare circuit board, disk drive head, connector, etc.
SUBASSEMBLY	Assembled circuit board, disk drive, flat panel display, etc.
FINAL PRODUCT	Personal computer, printer, LAN hub, television, VCR, etc.
SYSTEM	Management information system, airline reservation system, etc.
SEGMENTATION No. 6: BY MARKET TYPE	
VERTICAL	Vertical markets are often referred to as niche markets, specialized, industrial, producer, commercial, or professional markets. Most often, these kinds of markets are made up of companies buying and selling to each other, and not directly to the general public. Sales to vertical markets are known as 'indirect sales'. Vertical markets are characterized by relatively slow but stable growth rates, because the absence of a retail market partially protects them from variations in consumer spending. Products sold into vertical markets tend to have what economists call a 'low elasticity of demand' -- in other words, they are so-called necessary items. Gasoline pump controllers and power generating equipment are examples of products with low elasticity of demand. Products sold into vertical markets tend to be highly functional and produced in low or medium volumes. These types of product



	tend to cost more and generate relatively high profit margins for the companies selling them. Wireless utility readers, automatic test equipment, and police radios are examples of products sold into vertical markets. It is important to note that not all vertical markets have slow growth rates. For example it is estimated that sales of local area network (LAN) equipment have been growing at 25 percent annually since 1990.
HORIZONTAL	Horizontal markets are often referred to as mass markets, generalized, consumer, or home markets. Because these kinds of markets exist at the retail level, they are subject to a 'high elasticity of demand' because consumers can refrain from buying them during periods of poor economic conditions. However, because of their generalized appeal and large potential size, products sold into horizontal markets can also show exponential sales growth rates. Horizontal markets, then, have the potential to be much larger than vertical markets but are often unstable. Products sold into horizontal markets tend to be characterized by limited functionality, high volume production, and severe price competition. The production of this type of equipment generally results in very low profit margins for the manufacturing company. Televisions, video equipment, and cellular phones are examples of products sold in horizontal markets.
HYBRID	Of particular interest are products that span both vertical and horizontal markets, such as the personal computer (PC). For example PCs and related peripheral equipment are sold to both firms (directly via the brand name company or through a systems integrator) and to the general public (in retail outlets). This is one reason why the PC market is one of the largest single markets in the world. Annual PC sales doubled between 1987 and 1990, growing from US\$24 billion to US\$48 billion. Most of that spectacular growth was in vertical markets (approximately 80%). Much computer peripheral equipment has followed this trend.

SOURCE: BRIE (Berkeley Roundtable on the International Economy), University of California, USA. All market estimates are from Dataquest, Inc., an electronics market research company in San Jose, California.

None of these alternative segmentation schemes describes the whole IT industry fully. They each use a different perspective, but overlap in ways that are important for developing a wide-ranging, but coherent set of policies. For example, a segmentation by manufacturing technology (Segmentation No. 4) could be helpful in devising a strategy for electronics production that used either hand assembly or automated assembly of electronics products as a foundation for growth. But first, the manufacturing technology used in the production of different hardware products outlined in the segmentation based on physical composition (Segmentation No. 3) would have to be researched. What kind of products would a Vietnamese IT industry based on hand assembly be able to manufacture? Likewise, what kind of products



would a Vietnamese IT industry based on automated assembly be able to manufacture?

Another of the segmentation schemes presented in Figure 1 is based on industry sub-sectors (Segmentation No. 2). This segmentation lists the computer, data storage, computer peripherals, and communications sub-industries. In Vietnam, these three sub-sectors of the IT industry are sometimes referred to as the "informatics" industry. A further elaboration of Segmentation No. 2 could help industry strategists identify sectors that are growing faster than others, possibly indicating a market opportunity for Vietnamese firms.

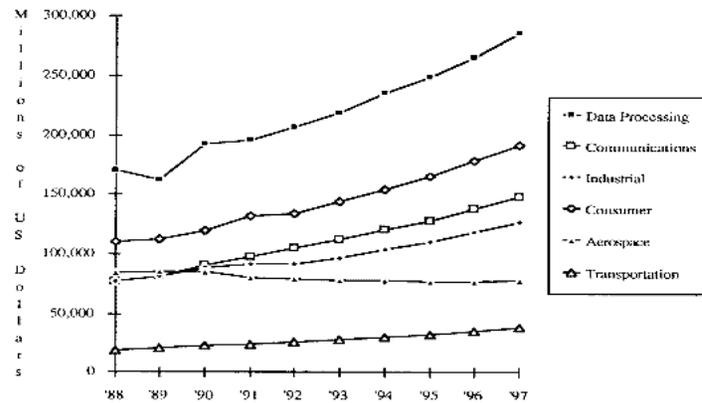
Similarly, an analysis of different types of markets (Segmentation No. 6) may suggest a mix of actions for optimal results. In terms of economic development, vertical markets may provide steady, stable growth, while horizontal markets may provide rapid growth. By combining different policy measures, the Vietnamese government should aim to develop an IT industry that serves high growth segments of both vertical and horizontal markets, while avoiding overly competitive or highly volatile segments.

Figure 2 presents the estimated factory revenues for the production of electronic equipment (along with growth forecasts) for six electronics sub-industry sectors. Data processing and communications generated an estimated 332 billion U.S. dollars in 1993. This figure represents revenue from equipment only; if the revenue generated from data processing and communications services were added to the figure, the worldwide annual revenues generated might easily approach 1 trillion US dollars. In terms of growth rates, data processing (including computers, data storage, and peripherals) is estimated to be the fastest growing sub-sector, followed by consumer electronics and then communications. In terms of strategic policy, it is important keep in mind that these sub-industry categories are highly aggregated. Each industry sub-sector is comprised of a wide variety of smaller sub-industries, some of which may be growing much faster than others (see Segmentation No. 5 in Figure 1 for an example of a less aggregated set of categories).

Figure 2
Worldwide factory revenues from electronics equipment production 1988-1993 estimates; 1994-1997 forecasts



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SOURCE: Dataquest Inc., San Jose (California), USA.

We have presented the IT industry in this complex way, not to confuse our readers, but to underline the major thrust of this report: A mix of policies, created through collaboration between all major actors in Vietnam, will be required to develop the industry in a dynamic way.

Policy-makers in Vietnam should learn to quickly and easily discern the characteristics as well as the policy requirements of different segments of the industry. At the earliest possible date, a team of highly motivated industry analysts should be brought together to provide market intelligence in the various fields of electronics. No single expert can understand all the current issues that exist in the industry, but individual analysts could specialize in particular industry segments and be equipped with the latest tools for information gathering and intelligence work. There are powerful new research tools available for this purpose, including CD-ROMs and on-line information services, as well as companies that specialize in providing electronics market and technical intelligence to government and industry.

Chapter 3 IT producers and IT users should join hands

The national IT program lacks a production dimension. No assessment of the resources needed for creating facilities for electronics manufacturing has been done. Several questions remain to be answered: Which resources will have to be mobilized in order to shape an efficient 'architecture of supply' of all the necessary elements of IT production, including full access to micro-processors and similar electronic components, that are necessary for production within Vietnam? What will the role of foreign companies be in the development of electronics production in Vietnam? How



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can trade policy be formulated to encourage the development of Vietnam's electronics manufacturing capacity?

There are other plans in Hanoi designed to stimulate manufacturing of electronics in the country's IT industry, but these plans are not formulated in the new economic context and rely solely on ministerial guidance and support. In fact, for about two years, there has actually been a policy platform for the development of "the electronic and informatics industry" in Vietnam. It was drafted by the Ministry of Heavy Industry, as the responsible ministry, but the concepts and policy perspectives were those of the former economic system, when the state was in command of the economy. Hence, this policy statement concentrates on the nearly 100 "state-owned enterprises under central and local management", and raises the possibility of joint ventures between these public enterprises and foreign electronics companies. It discusses both the domestic market and foreign markets as possible driving forces behind a Vietnamese industry.

In most countries, if not all, the growing use of information technology in industry and in society stimulates the development of the manufacture of electronics products and their use in society. A widening market and a more sophisticated demand encourages the development of production. For instance, the design of new electronics products are often influenced by the needs of advanced local users. In furthering its national IT policy, the Vietnamese government should not focus solely on the diffusion of IT. The supply base of microelectronics and other IT by way of local production is equally important. There is a need as well for an advanced industry policy. Any efforts to diffuse information technology in Vietnamese industry and in

society should be matched by efforts to improve the country's manufacturing base for electronics products. In an economic environment of accelerated technological change, such as in today's Vietnam, one can be sure that people working with IT will have ideas about new products. The government should design its policies for industry to ensure that entrepreneurs and advanced users have the ability to implement their ideas quickly and effectively by drawing on the local electronics manufacturing- and supply-base.

Trade policy and the role of foreign companies

The manufacture of electronics, as it currently exists in Vietnam, could be used as a starting-point for building up the country's industrial capacity. However, in the short term, it is realistic to assume that most of the advancements in Vietnamese electronics production will come through links with foreign companies. Foreign companies can supply the necessary capital and highly-specialized technology. They may also have good access to the global market both for the procurement of advanced parts and the distribution of final products. Establishing beneficial linkages with the international electronics supply-base and gaining access to foreign markets are two crucial elements for the rapid development of electronics production in Vietnam that foreign companies can help with.



How can government encourage foreign companies to establish manufacturing facilities inside of Vietnam? The limited size of the local market will require that these types of investments be oriented toward the export market. Trade policy in general, and import/export tariffs in particular, can be powerful tools to foster foreign investment in manufacturing.

Low tariff schedules for parts will allow foreign and domestic companies alike to obtain components from abroad at world-market prices. Import tariffs placed on finished goods can foster domestic manufacturing activity (as is now the case in consumer electronics in Vietnam). But when import tariffs are too high, the flow of badly needed goods (such as advanced computers and telecommunications equipment) could easily be impeded, creating extremely negative consequences. But if even 5-10 per cent of all advanced electronic equipment sold in Vietnam during the next five years were manufactured inside the country, domestic manufacturing capacity would be vastly improved from its current state.

A proper mix of government policies should help create an environment ripe for innovation and entrepreneurship in software, electronics-related services, and hardware production. Policy-makers should take into account the tight linkages between the production and the use of electronics products by encouraging their simultaneous development. Domestic electronics production in Vietnam should be encouraged through both general or specific policies. Together higher-education and specialized training represents such a mix of both general and specific programs. The development of a supportive environment for entrepreneurship and the selective procurement of computers and other IT products by government is another mix of general and specific means.

As we read the draft national policy for electronics production by the Ministry of Heavy Industry, it does not provide effective tools for cross-sectoral coordination of the kind discussed above. Electronics production is not related to the demands by Vietnam's principal IT users. Nor does the policy statement conceive the industry's development along with the changing market for IT products and services.

One illustration: More advanced needs among professional IT buyers in Vietnam could help differentiate and advance the market for microelectronics. This might stimulate local production including an active involvement of the private sector.

The government should address the user-producer relationships, which may be difficult to penetrate in detail but which have to be tackled, if an original policy for industrial development should become successful.

Part The players

Two



Chapter 4 Why government policy still matters in Vietnam Cross-sectoral policy coordination or 'orchestration'

When this report was being prepared, a major shift occurred in Vietnam's economic position in the world economy. This shift altered the technological preconditions for modernization and growth in the country's economy. The long-term trade embargo against Vietnam, imposed and orchestrated by the US government, was lifted on February 4, 1994.

The total effects of the trade embargo on Vietnam's technological and other innovative capabilities are hard, even impossible to assess in economic terms. For nearly thirty years in the North and nearly nineteen years in the South it has been difficult for Vietnamese firms and institutions to obtain the best electronic equipment and other information technology for the money available. Solutions such as hand-carrying computers into Vietnam did not address problems such as long waiting periods for new equipment, high costs, lack of spare parts, and lack of after sales service.

There are ultimate examples of problems in the operation of industrial enterprises due to the trade embargo. A cement plant that could not buy the powerful Hewlett-Packard computers it needed was forced to develop a sub-optimal technical solution to its production control system, which eventually led to an explosion with death and injuries among its staff members.

Today, Vietnam has full access to the world market in the field of microelectronics. In the months before the lifting of the trade embargo, some electronics specialists claimed that the end of the US blockade would not fundamentally change the technological preconditions for economic growth in Vietnam. We think they are wrong. If the spectacular growth of industrial production in Vietnam continues during the 1990's, and if the improvements in the country's socio-economic environment gains speed, there will a strong demand for sophisticated products and services that previously were not easily available to Vietnamese firms and institutions.

It would be dangerous, we think, if the government -- at both the central and provincial levels -- backs off and leaves this volatile situation entirely to the new market forces. The government still has important roles to play, for instance by facilitating the diffusion of computers and other electronics applications through standard setting, creating a better economic environment for the advanced use of information technology in all sectors of Vietnamese society, and devising a trade policy that will help stimulate electronics production inside of Vietnam.

Chapter 5 How implement a 'national program' for IT? The policy platform from which to develop



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On August 4, 1993, Prime Minister Vo Van Kiet signed Government Resolution No. 49/CP "on the development of the information technology in the country during the 1990's". This Resolution contains Vietnam's first comprehensive program for information technology (IT) involving not only the government at the central and provincial levels, but also industrial firms, scientific and technological institutions, educational establishments, etc. It is a program placed in the new economic context, where the central government agencies will have to interact with other socio-economic forces to reach a national goal. "Enterprises in all sectors are encouraged and provided with a favorable environment to organize and implement projects to computerize their business and services." Projects using modern IT in the health services and, even, in the cultural life of the country "will be implemented soon".

Six months later, in early 1994, the program was promulgated as the general conceptual model to be used in cross-sectoral promotion of other fields of technology as well.

The national IT program emphasizes six fields of IT development or areas of IT applications:

FE IT for management of the government: Like in the private sector, Vietnamese decision-makers in the public sector have already begun using IT for the improvement of the daily administration and for short- and medium-term planning.

However, the national IT program goes several steps further. While the central government needs of a much more effective information system, this can be realized by building "an IT infrastructure" which would include swift data communications networks offering email services and bulletin board systems. What is needed further, the program says, is a better integrated information system, connecting different ministries, sectors and localities across the country. Such information systems could, for instance, link data on natural resources and the physical environment with technological and scientific information. This would imply linking several management information systems.

FE IT to strengthen economic activities: Data for the management of investment funding and to monitor market prices and the foreign-trade performance, etc. can be better realized by modern data communications systems. The service sector could also be improved. Efforts should be made, the program underlines, to modernize by way of IT the Vietnamese energy sector; its transportation system; and the postal and telecom services. The "computerization" of business activities should also be supported.

FE IT for manpower development: IT education in secondary schools should be used to popularize IT applications, disseminate general information on IT, and strengthen the use of IT as a learning tool in schools. It is necessary, the program continues, to formally train a large contingent of qualified professionals in the field of information technology. A high-priority national project on IT, education, and training should be formulated and implemented. The program should also be part of a research effort "for the active application of IT in education and training" more generally. IT should be a working tool for at least part of the country's working force.



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FE IT research and experimental development: The research on IT in Vietnam should expand, but it should be oriented towards developing modern applications and acquiring up-to-date knowledge from abroad. Research should be less basic and more oriented towards new IT products, especially new software, and the development of a Vietnamese IT industry. Both highly-specialized research in key institutions and more generally oriented R&D at the technical and other universities should be promoted.

FE IT industry: Progressively, Vietnam should build its own information technology industry. First by producing software for the domestic market and then, step-wise, for the world market. It might be necessary to use special government measures to foster the software industry such as "centers for software development".

The same ambitions should guide hardware production in Vietnam. Over the next seven years, it will be necessary to introduce special policies and measures in support of enterprises producing IT equipment for the domestic market. Such initiatives could be linked to joint ventures with foreign partners.

FE A data communications infrastructure: The national IT program puts emphasis on data transmission networks as a national system. Such a national data communications infrastructure should, from the start, be linked also to regional and international networks. This implies that any improvements of local and national data transmission networks should comply with international standards and procedures.

The government underlines the 'open systems' concept to information interchange: a "computer system must follow certain standards (both the hardware and software) so that it can be integrated into the National Network and be compatible with international networks."

The national IT program also points at a limited set of policy instruments that would help the Vietnamese to reach the objectives specified in the six areas of IT applications. We will discuss these policy instruments, as well as other possibilities, in the following chapters.

Observers have found the national IT program frank in its descriptions of the Vietnam's current weaknesses, realistic in its attempt to identify and differentiate among the objectives for IT applications in various sectors, and visionary in linking its policies to the on-going, fundamental changes in the structure of the economy and of society. We agree. It is an excellent platform from which to develop a consistent, well-integrated set of projects and actions that could link innovative resources within the public sector as well as between government agencies, industrial firms, REED, and higher education establishments. Over the last few years, one of us has had the opportunity to follow some of the policy deliberations behind the program. From this it is clear that the final, relatively brief document is the outcome of technologically well-informed deliberations, involving many Vietnamese specialists in industry, government, and research.



A national agency for IT development

To implement the current national IT program through the year 2000, there is now a national IT Board, chaired by the Minister for Science, Technology and Environment, plus a separate Council of scientific and technological advisors, chaired by a prominent mathematician and IT specialist. During the first eight months, the Board and the Council were served by a small secretariat inside the Ministry of Science, Technology and Environment. This secretariat was given a more autonomous status in April 1994 as the country's first national agency for IT development. (1) It will operate across government sectors, as IT agencies do in some other countries in South East Asia. It should serve all ministries and assist better the IT development for educational, industrial and other socio-economic purposes.

We find these three elements of an implementation structure well-organized and sufficient to meet the immediate demands for strategic decisions, informed advice, and prompt execution. Taken together, the Board and Council members represent a wide spectrum of Vietnamese decision-makers and IT expertise. However, as we have already implied, in order to implement each of the main projects outlined in the national IT program, many more institutions and firms have to be mobilized than those currently represented among the Board and Council members.

For the successful implementation of this long-term national IT program, it might be advisable for the government to organize separate task-forces or sector-specific program groups. These groups of experts could monitor the implementation of, for instance, one or several data communications networks at the national level such as the one for banks and credit institutions. It could also monitor the linking of these emerging national networks with international networks. The monitoring of the project and program activities, the formal regulation of available cross-sectoral resources, and the overall coordination of the IT program could be retained by the IT Board and the national IT agency.

Task-forces and program groups are not new to the Vietnamese government, although they might be named differently. In the field of information technology there have been several successful attempts to coordinate different efforts by small, highly-qualified groups of experts drawn from different ministries, agencies and consulting firms. One recent example is the implementation of Vietnam's academic, research, and educational data communications network (VAREnet; cf. Chapter 9). We realize that such task-forces will have to be supported by the central government -- such as the national IT agency -- if they should have any chance to coordinate across the sectors. Their access to information will have to be built on trust from the major actors such as the DGPT -- the Directorate-General of Post and Telecommunications -- Vietnam's telecom agency, which has a virtual monopoly of Vietnamese telecom services outside the military sector.

To strengthen the current implementation structure, we recommend that a small group of policy specialists conduct a small investigation into the previous programs for IT development in Vietnam to make an assessment of the failures in their implementation. This should be done only for the purpose of avoiding similar administrative problems today. It must be underlined that the implementation of the



1993 Government Resolution No. 49/CP will be performed under very different technological and economic circumstances than the previous resolutions on electronics and, more generally, on other information technology. These resolutions (No. 173/CP/1975 and No. 245/CP/1976) were put in place under very different circumstances. A long war had ended, the country had just been reunited, and the economy was still firmly state-controlled. Still, there may be important lessons to be learned and experiences accumulated for those who are now implementing the 1993 IT Resolution.

Foot Notes:

1. The Agency of the National Program for Information Technology.

Chapter 6 Three more players in Vietnam's 'IT policy community' Industry, research, and higher education

While the state sector in Vietnam has lost some of its weight in the Vietnamese economy, the government still appears to be an important actor on the national economic scene. In 1989, when our previous report on Vietnamese microelectronics and other information technology was prepared, we identified three other centers or clusters of influence in (a) industry, (b) research, and (c) higher education. We also encountered an emerging fourth interest grouping: Vietnamese electronics engineers and other information technology professionals which -- in the late 1980's -- were just organizing themselves as a nationally. Five years later we found this association effectively serving as a forum for IT professionals, sponsoring national conferences, regional workshops, newsletters, and computer journals. Although influential in some policy matters, the Association has not entered the national policy arena in Vietnam with the same weight as the three other interest groupings.

In 1989 we identified a multi-polar Vietnamese 'IT policy community' with both separate and common interests, and attempted to show how differences of opinion on Vietnam's IT matters were anchored in particular needs. As it was in 1989, it should now be possible to generate a common understanding of what the prime national goals for IT development in Vietnam are. In 1989 the central ministries in Hanoi were certainly not alone as a moving force in policy-making towards high-tech in Vietnam. Other players active in the emerging Vietnamese information industry were also effecting policy -- they are even more active now, five years later.

As is the case in other countries, the leading advocates for each of the three IT interest groupings in Vietnam mentioned above have all been able to influence decision-makers at the national level about what to do next in support of Vietnamese information technology. If these groups manage to coordinate their efforts, they will represent the single most powerful interest group besides the government itself. In the previous report, we noted that the central government needed to be more sensitive to



the needs and concrete suggestions formulated by these outside interests, acting either alone or as a group.

In 1994, we can still observe the same three major IT interest groups besides the central government. They have become very important partners, in some sense senior partners for the government in implementing any national plan for information and communications technologies:

FE The industrial interest groups has changed significantly over the last few years and will change even more, we believe, in the next few years. It is likely that the private IT industry -- Vietnamese companies, foreign-owned companies, and joint-ventures -- soon will have more influence on government policy than the state-owned enterprises.

At present, in early 1994, major industrial interests in IT are coordinated by what could best be called a state holding company. Based in Hanoi: The Union of Electronics Industries is under the Ministry of Heavy Industry. Although the influence by politicians and government officials on the country's industrial development has weakened, the Union of Electronics Industry remains an important instrument for IT policy for the Ministry. Recently, however, the National Assembly decided to limit the direct influence by the Hanoi ministries on state-owned companies. (This principal decision will also affect the management conditions for companies owned by provinces and cities.) Eventually, the decision may lead to a privatization of the public-sector companies and thereby to a break-up of all the unions of industries including that of electronics.

From the examples we have seen, it seems as if foreign vendors and investors prefer working with state- or city-owned IT firms, although the level of technology in these firms is generally low.

FE The research interest group, which represents Vietnam's long-term efforts to create capabilities in the broad field of electronics and information technology.

The major research and development institutions have their prime IT facilities in Hanoi and HCM City areas.

FE The higher education interest grouping, which has modified its position over the years and never really reached the same degree of influence on the national IT policy as the two previous groupings. It may gain influence on national IT policy in the near future.

The third interest grouping consists of several scores of institutions in the higher education sector plus some in the private sector such as the Thang Long University in Hanoi and the Lotus College of Information Technology and Management in HCM City. The biggest and most resourceful institutions are the ones located in the two metropolitan areas. There is a variety of reasons why it is important to treat the three interest groupings separately. The interests of each of the three clusters -- in industry, science, and higher education respectively -- yield different priorities for Vietnam's information technology. There are obvious causes for this behavior: they



perform their own activities for different objectives and within different socio-economic settings.

At the same time, however, they do have interlocking interests. For specific purposes, the collaboration between them could become quite intense, e.g. for manpower development and in diffusing better technology and know-how. This may be of importance for the government's implementation of its policies, since the government more and more has to rely on the active participation of more resourceful players.

More and stronger players may complicate the orchestration or coordination of separate government policies. It should be realized that the nature of coordination and planning in the field of information technology in today's Vietnam is different than five years ago. The national program for IT has to be implemented through the structures of government, the companies active in electronics and IT, and some of the foreign vendors of technology. This will be very difficult to achieve unless all major interest groupings agree on the goals and means of such a national program. Strong support by the three interest groups will be critical to the policy implementation. The government will not be able to implement any national IT program by its own capacities.

Unlike the previous report, we include a chapter in this report on an even more resourceful group of players, namely the foreign vendors in IT products and services. This external group was already well-represented on the Vietnamese market in 1989-1990, while the macro-economic situation was being stabilized. But since the economic reforms and the opening of the Vietnamese market, they have become much more active in pursuing their own corporate strategies, in building service organizations, and in creating customer relations in Vietnam. Some of them have gone further and created joint ventures with local partners; others are planning their own production facilities.

Today, no element of a national IT policy can be designed and implemented without considering the role played by foreign companies. In the near future, the foreign companies might become considerably more important.

Chapter 7 The foreign vendors and the foreign direct investors

At the end of the 1980's, Vietnam was in desperate need of foreign direct investment (FDI) to help modernize the country's industrial production capacities. Foreign capital was required for the rehabilitation and maintenance of existing machinery as well as for the installation of new machinery. There was not enough capital accumulated within the country for the investments planned and for the transfer of technology. Five years later, the situation has changed dramatically. Capital needs are still enormous, but more FDI is beginning to move into the country. The government has been active in attracting foreign capital to its industrial sector, while hoping for the transfer of know-how and modern technology as part of commercial investments. Some of these investments are related to microelectronics and IT.



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In general, foreign investment in electronics and IT industries have moved slowly into Vietnam. Many of the leading companies have paid visits to the country and planned for their commercial activity, but they have not yet announced or realized their plans. A few companies, like the French-owned IT company Bull, have invested in joint ventures, but failed to accomplish their objectives and have now scaled down production. The GenPacific company, based in HCM City but also with an office in the nation's capital city, was founded in 1988 and was set up to assemble personal computers (PCs) at the circuit board level for the Soviet and eastern European markets. Its production line never reached full operation before these markets collapsed. Government tax policy also contributed to the cessation of PC production (see [Chapter 15](#), and [Chapter 3](#) and [8](#) for discussions on tariffs and Vietnam's IT industry development). GenPacific is now more of a software production house, systems integrator, and service company than a manufacturing firm.

At the time, GenPacific was seen as a pioneer joint venture in a "high-tech" area. Many similar arrangements were expected with foreign-owned IT companies, who were expected to provide advanced IT products such as computers and telecom equipment. Some such arrangements did actually appear, but only in the hand assembly of consumer electronics products built to the design of Japanese, Korean, and European companies (see Part Four of this report). Assembly now takes place in Vietnam for the mass market of radio-cassette players and television sets. These products are manufactured using parts sold to the Vietnamese companies by the foreign partners.

Among foreign computer and other IT firms, most that are currently investing in Vietnam seek local partners to represent them as sales agents and service centers. Actual production of computers and other electronic equipment is rare, and, so far, it seems that only little production is planned.

In our 1989 investigation, we discussed indications of growth in foreign investments within the emerging Vietnamese software industry. Given the relatively high numbers of software engineers and other specialists in the country, a software industry seemed a likely prospect for Vietnam. The competition in international subcontracting from countries like India proved to be strong and a take-off in software subcontracting is yet to be seen. There are, however, a number of examples of successful sales of software, from HCM City area in particular, but they are all economically insignificant.

Some overseas companies are now doing what we expected in the late 1980's, namely running small software development or computer training centers in Vietnam to investigate the local capabilities and monitor the manpower development in the IT sector more generally. The conditions for some of these new investments is assessed by the Technology Promotion Department of the Ministry for Science, Technology and Environment, but the foreign companies are given no special status or other benefits.

Some of the show-room or training activity by foreign vendors is combined with building a sales and after-sales-service organization in Vietnam. These companies are actively recruiting local staff among young computer specialists, who are thus given a chance to use much more sophisticated equipment than they were trained on.



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Foreign firms are also active in building market confidence and a positive image among potential consumers after thirty years of trade embargo. Among US companies, Apple Computer has provided the Ministry of Education with equipment for a small training unit. Compaq Computer has offered to equip a similar unit elsewhere and to run seminars on microcomputer applications for government staff in Hanoi. Hewlett-Packard will create its own "open systems center" in Hanoi. IBM, which came back to Vietnam somewhat earlier, in September 1993, has not only signed a dealer-contract with its former South-Vietnamese company -- which survived the embargo years as a service firm under a different name, but with some of the same IBM 360 computers from pre-1975 vintage -- but also with two local distributors in Hanoi. Like Hewlett-Packard, IBM will create its own Institute of Science System (for education and applied research) in Hanoi and is conducting a feasibility study on hardware development and production in Vietnam. Digital Equipment (DEC) exposed its technological capabilities and know-how in a highly-esteemed series of seminars on open systems, and is now building its organization to sell its products and services. Oracle has visited the country, but has not started commercial operations. Vast numbers of illegally copied versions of Micro-soft personal computer (PC) application programs (such as Word, Excel, and FoxPro) and operating software (such as DOS and Windows) are in use all over Vietnam. This is because of weaknesses in the legal protection of commercial property rights in the country. Microsoft has indicated this as the main reason why the company has not yet entered the Vietnamese marketplace.

In the group of US companies, the most far-reaching business venture to take place before the lifting of the trade embargo was engaged by UNISYS. Bringing to Hanoi a team of 14 consultants to work during for one month with the Ministry for Science, Technology and Environment, UNISYS created a "strategic review of national information technology development" in Vietnam. The work was finalized in December 1993 together with 10 Vietnamese IT experts and focused on areas such as education and training; data communications (e.g. wide-area networks for the government), the financial sector; and the higher-education sector. The report (called the "IT 2000 programme" [\(1\)](#)) also suggested a National IT Agency to deal with technical standards and to coordinate educational initiatives. The whole endeavor, paid essentially by the company's own funds, was performed under contract between the Ministry of Science, Technology and Environment, Mitsui (Japan), and UNISYS Asia (USA).

This "strategic review" gave UNISYS access to vital information on public sector needs for its own business planning, and opened the possibility of implementing the detailed proposals in the review report. However, the Ministry has so far avoided any exclusive deals or commitments to buy the company's products and IT services.

For the Vietnamese government, a close but temporary collaboration of this kind with one of the leading IT companies in the world may have given important insights into the way in which large programs are planned from a business point-of-view. However, the experiences from other developing countries that work very closely over a long period of time with one particular IT firm have not been entirely positive. Vietnam should study further the experience of Singapore and its close relations to IBM, whose systems have not met the country's needs in terms of flexibility and adaptability.



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Among other internationally operating IT vendors and electronics manufacturers, East Asian firms are the most visible in Vietnam marketplace. Some of them, like Mitsui and Fujitsu, seem to deliberately avoid advertising their presence in the country to their competitors and to the general public. Fujitsu has started to build a software education center with the Ministry of Science, Technology and Environment to be located in Hanoi. With the very limited time of our investigation, it was not possible for us to screen all the foreign IT vendors or study their market behavior.

It would be difficult to overestimate the importance of these new players to the future of electronics and IT in Vietnam. Figure 3 compares the relative size of the US-based IT companies now active in Vietnam.

Figure 3

US-based IT firms in Vietnam			
Company	HQ Location	Products/Services	'93 Sales
IBM	Armonk, NY	Large computer systems, personal computers, etc.	\$62.7B
Hewlett-Packard	Palo Alto, CA	Mid-range computers, networking equipment, technical work stations, printers, etc.	\$20.3B
Digital Equipment	Maynard, MA	Mid-range computer systems, PCs, etc.	\$1 4.4B
Unisys	Blue Bell, PA	Large computers, databases, systems integration, government systems, etc.	\$8.4B
Apple	Cupertino, CA	Personal computers, etc.	\$8.0B
Compaq	Houston, TX	Personal computers, etc.	\$7.2B
Microsoft	Redmond, WA	Personal computer software.	\$3.7B
Oracle	Redwood City, CA	Large database software.	\$1.5B
Total Sales			\$126.2B

SOURCE: Computer Select CD-ROM, Company Profiles, New York: Ziff-Davis Publishing, /no date/.

The annual sales of most of the firms listed in Figure 2 far outstrip the output of Vietnam's manufacturing sector (US\$4.9 billion US dollars) and the largest two, IBM and Hewlett-Packard, have annual revenues larger than Vietnam's entire gross domestic product (\$15.2 billion US dollars in 1992). Many Japanese electronics firms are also very large. For example, Fujitsu's 1993 revenues were 29.8 billion US dollars.

When negotiating with companies as large as those listed in Figure 3, it is important for policy makers to bear in mind that the current market for IT products in Vietnam is insignificant in terms of worldwide revenues. These companies are in Vietnam to



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gain a position in the future growth of Vietnam's IT industry. They are interested in establishing an early position in a market with sizable potential over the long term. For that reason, most are not interested in establishing a local manufacturing presence in the near future, if at all.

Over the next few years, the principal force of change in information technology in Vietnam will be the rapid increase in trade and foreign direct investment (mostly in services). According to our sources, the foreign IT firms currently operating in Vietnam see the following positive factors in the country:

FE A small, but rapidly increasing domestic market for consumer electronics, computers and other electronics products and services, based on a population of more than 72 million.

FE A strategic location in the South East Asian region that could foster a certain industrial specialization or division of labor among nearby countries active in IT industries (i.e. software).

FE A relatively well-trained work-force with a high number of experienced IT specialists compared to many other developing countries.

FE Relatively advanced institutions performing IT research and development.

FE Concrete plans for substantial improvements in the country's economic infrastructure, including options for wide-area networks and advanced international telecommunications.

Compared with some of its neighboring countries, Vietnam is still far from being a leading-edge market for the products and services generated by the internationally operating 'information industry', but the government seems determined to make the best of the country's position in the Asia-Pacific region. Ambitions are strong among government decision-makers to make Vietnam a compelling location for assembly and manufacturing in consumer electronics and, possibly, in the assembly of computers and related equipment.

One of many reasons why the typical foreign investor in the international IT industry is still waiting to invest in Vietnam, is the fact that business regulations are unclear. Some of the institutions supporting the new market economy are not in place or, if they actually are, they are not compatible with the new economic situation. Important institutional capabilities in support of a dynamic industrial environment have yet to materialize. This will be elaborated in Part Three of this report, especially in Chapters 8 and 12.

Foot Notes:

1. Also known as A strategic review of national information technology development, Hanoi, 1993.



Chapter 8

Why market-supporting institutions are vital to the IT development

The economy of Vietnam remains overwhelmingly dependent on exports of crude oil, minerals, and primary sector produce. Still, a basic element in the national economic development strategy is industrialization. The government wants a swift transformation of the relatively small industrial sector to a larger and technologically more up-to-date one, while not neglecting the on-going modernization of agriculture and food processing. Vietnamese industry should become competitive in the domestic as well as on foreign markets. Thus, the industrialization could be described as export-driven.

This current strategy for Vietnam's industrial development is a clear departure from two earlier strategies: (1) The 'basic industries approach', inspired by the former Soviet development model, which puts a few key industrial subsectors -- such as the steel industry and the machine-tool industry in the center; and (2) a 'resource-based strategy' for industrialization, which focuses on the optimum exploitation of the domestic resources drawn from mining, agriculture, fishery and forestry. Both strategies concentrate on the supply or the availability of existing resources for industrialization in Vietnam. Even though these two supply-side strategies have lost support among policy-makers, they still have many proponents. Actually, in deliberations on the industrial rehabilitation and growth there is often no clear dividing line between those who still propose the 'basic industries approach' or the 'resource-based strategy' and the others, who promote the export-driven strategy.

The latter, third type of strategy for Vietnamese industrialization looks into the expanding markets for industrial products -- at home and abroad -- while identifying the necessary means for indigenous industrial production capabilities. Following this third approach, there is no ambition to create a coherent industrial structure in Vietnam, but to find dynamic subsectors in industry, where old and new products and processes could be exploited commercially. One such possible sub-sector, already much discussed as part of this third industrialization strategy, is the IT industry.

Among Hanoi's decision-makers there seems to be a clear understanding that to succeed in this particular sub-sector, where new and advanced technology plays a crucial role for competitiveness, the country needs to attract foreign direct investors, who will see Vietnam as a potential market and/or as a production platform for exports to the South East Asian region or to the world market.

The original model of a centrally planned economy, as applied in Vietnam, has been weakened considerably in the course of implementing the economic reforms of the late 1980's and early 1990's. Decentralization of economic decision-making has led to changes in the structure and the ownership of industry. Now, the market is seen as the single most important environmental factor for any macro-economic planning and policy-making.



In economic terms -- given any of the three industrialization strategies summarized above -- Vietnam's competitive industries largely derive their advantages from basic factor conditions such as low wages, cheap raw materials, special skills among the work force, etc. On the other hand, the IT industry would symbolize modern Vietnam as an 'investment-driven economy'. This means that competitive advantages are achieved through sustained investment in production capacities, in applications and improvements of imported technology, by exploiting economies-of-scale through improved production capabilities and, of course, also through some factor-cost advantages. (1) In the early stage of the 'investment-driven economy', market demands could play a role for selecting investments. In a later phase of the development -- when the local and national markets have developed further -- there will definitely be much more of demand-pull from customers on various markets.

While furthering the third type of strategy for Vietnamese industrialization -- the export-led, market-oriented strategy -- the regional and international markets will play increasingly important roles for the diffusion of new products, processes and related services. This might have far-reaching implications for the structure of industry and for the organization and management of industrial firms. The changes may involve conflicts and redundancies. But like in other economic transformation processes, institutional changes will be needed to create a hospitable environment for the industrial enterprises. (2)

Regulation and institutional reforms do not have to be a consequence of economic growth. More often institutional reforms and regulations may come first. We have seen clear indications of this while visiting a number of companies in Vietnam's IT industry. The economic history of the highly-industrialized countries also provides plenty examples of government practices and programs that have paved the way for new industries and revitalized old ones.

Like any other market economy, Vietnam's new economy needs rules and regulations, i.e. institutional support to an environment that fosters entrepreneurial and innovative businesses. Markets do not exist and operate aside from the rules or apart from institutions that establish them and help them grow. In retrospect, countries like Japan, South Korea, Malaysia and Singapore each have created rather different institutional and regulatory arrangements for their national economies. There are, consequently, a variety of ways in organizing markets for, e.g., electronics and other information technology products and services. And, there is no single best way for linking government and markets while streamlining the institutional support to economic growth.

Common to all market economies is the fact that a seemingly endless range of institutions matter to the dynamics of the national market and in the ways the national market is part of the world market. Vietnam's financial system, for instance, does not stand alone in channeling investment capital to the IT industry. Foreign direct investments are growing. Government purchases and service arrangements generate import investment funds. Joint ventures provide access to international banks. These market-supporting institutions do not stand alone; they interact among themselves, with the government and with firms and institutions in other parts of the economy.



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One illustration of the complexity of government policy and regulation: Without formulating an explicit policy for the IT industry, but while reforming its tax system and changing tariffs mainly for fiscal reasons, Vietnam has created a vital assembly industry for electronics products, mainly consumer products such as television sets, radios and tape-recorders. Nearly all television sets of virtually any brand are assembled in the country; in some cases there is local production. Cf. Chapters 14 and 15.

In Vietnam's new 'investment-driven economy', a market-oriented strategy for industrialization would probably lead to a further decentralization of decision-making. Yet at the same time, it will require more elaborate public policies at various levels of government.

Diffusing microelectronics and promoting an IT industry in Vietnam, allowing more foreign direct investments in this industrial sector, and letting market forces play a larger role, will be necessary but not sufficient conditions for economic growth. A whole new system of cross-sectoral coordination, technical standards, taxes and other public regulation and rewards will have to be developed. The government will have to combine measures and policies across ministerial boundaries in order to create an economic environment that promotes industrial investments in IT.

To sum up: No market can survive and prosper without regulations, without an institutional support structure. (3) As we have pointed out, a national market for IT products and services is a function not only of the companies that do business in that market, but of rules and regulations that restrict and stimulate their market behavior. The market-supporting institutions are, in turn, influenced by the links to regional and international markets through trade and financial transactions; technology and skill transfer; international standards; patents, licenses and other legal arrangements; price and quality competition; safety standards; customer-support and after-sales service agreements; etc. The patterns of constraints and incentives may be national in character, but they resemble the patterns of other countries. National markets tend to be interdependent.

Foot Notes:

1. Cf. a briefing document by the Centre for Technology and Social Change, "Structural competitiveness in Australian industry: Towards an action plan", (Wollongong: TASC, 1992).
2. Cf. Freeman, C: Technical change and unemployment. The links between macro-economic policy and innovation policy, Maastricht: MERIT (University of Limburg), October 1993 (working paper), pp. 33-.
3. Zysman, J: (1993). How institutions create historically rooted trajectories of growth, Berkeley: BRIE (University of California), October 1993 (working paper).

Five core institutional capacities



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From our case studies and interviews in both the South and the North of the country (listed in Appendix 1) it is obvious that Vietnam still provides a very weak institutional support to its new market economy. This is probably more apparent in the new high-tech IT industry than in several traditional branches of Vietnamese industry.

Here, the ultimate question is which institutional capacities that really would matter to an export-led IT industry development in Vietnam. Of course, we cannot provide an easy answer to such a fundamental query. Nevertheless, during our investigations in 1993, supplemented by discussion in early 1994 with foreign IT vendors and potential investors in the telecom area, we could list five general institutional weaknesses: (1)

FE The legal and regulatory system: Several business or commercial laws must be updated and, more importantly, new ones promulgated. The industry needs clear rules -- also for the IT markets. The organization and liquidation of firms must be monitored and regulated. Little respect for contracts and other formal business deals regarding royalties, licenses, property rights, etc. creates chaos in the different IT markets (including the market for computer software) and prevents innovations, international trade and general growth.

FE The financial system: The organization and regulation of banks and other credit agencies plays a paramount role in any highly-industrial economy, especially if investment capital is not easily generated by industry itself. The government could monitor the development of financial institutions in Vietnam so that they, on a professional basis, can provide investment capital also to the IT industry and related service firms.

FE The labor market and labor relations: The character of labor relations at the shop floor and on the labor market in general has certainly influenced positively innovative capabilities in industrial economies such as the German, the Japanese, and the Swedish. High quality, production flexibility using IT, new products accommodating microelectronics, etc. may more easily be generated and produced depending on labor relations and the organization of production.

FE Institutions creating and/or disseminating knowledge and know-how: Any industrial economy is dependent on an institutional set-up responsible for the effective diffusion of knowledge to industry and other economic sectors. The organization of the country's R&D base and of its technological infrastructure has to be up-dated continuously. The combination of public and private forms of disseminating and appropriating knowledge could be stimulated by institutional means.

FE The political-administrative system: The government must have the capacity to shape economic adjustments by setting and enforcing rules and allocating resources selectively towards purposes it may define. Fundamental institutional changes in support of a dynamic market economy would be the result of many different initiatives at various levels of the government machinery, including the provincial administrations. In Vietnam -- like in the highly-industrialized countries restructuring their industries and their national economy -- there will be a need also to



modernize government continuously in order to better promote industrial innovation and sustain economic growth.

If these five institutional weaknesses or shortcomings were tackled more or less simultaneously while being connected to the high ambitions of the 1993 national IT program, this would, most likely, stimulate the IT industry considerably and induce economic growth. Administrative and other institutional reforms, and the creation of new market-supporting institutions, could facilitate necessary changes in the economy in general and in the diffusion of microelectronics and other information technology in particular. If there will be only minor institutional and regulatory changes, and if they will be tackled without linking them to the industrial expansion, there will probably be obstacles in attaining the objectives for the national IT program. In the introduction to this report, we suggested a proactive approach specifically to the advancement, diffusion and application of information and communications technologies. The approach contained a whole set of medium-term objectives, which would address also the five institutional weaknesses listed above.

While learning from the experiences of other countries, Vietnam must find its own ways of promoting an IT industry. There is no universal route to success. Institutional capabilities for economic growth vary among countries and new organizational and regulatory inventions may stimulate development. During our investigations, we have noticed useful informal and pragmatic solutions to administrative problems. We have witnessed early examples of constructive involvement of private sector experts, consultancy firms, foreign advisors, and professional associations in the design, planning and implementation of various public policies.

Whilst market forces, including foreign direct investments, may play the main role in modernizing Vietnamese industry technologically, both public institutions and non-governmental organizations must continue to adapt and streamline the market-supporting institutions.

Foot Notes:

1. We acknowledge John Zysman's original contributions to our deliberations.

Chapter 9 A national information infrastructure From LAN and WAN to NII

Compared with most other countries in South East Asia, Vietnam has a weak economic infrastructure. However, the government is determined to substantially improve transportation of all kinds, communications and other infrastructure within a medium-term perspective. By using modern information technology, significant improvements can be attained even within a short period of time. While the technical



capacity of telecommunications equipment is being improved, the general price levels for the same equipment is coming down. To the benefit of the industrial and other professional users the country's telecommunications are now being developed with sizable resources, but much remains before an international technical standard is reached.

For a developing country like Vietnam it may prove to be relatively inexpensive to attain high standards in its national telecom system. However, the improvements can easily be offset, if an ineffective or otherwise inappropriate administrative structure will govern the telecom sector. Also, even if prices of telecom and related computer equipment are falling, the technical and economic lifetime of this equipment is becoming shorter.

Not just in the most highly-industrialized countries, but also in the countries of South East Asia, industrial and other telecommunications users would have a stake in the construction of a National Information Infrastructure (NII), which would include electronic communications networks and databases, computers with modems, automatic switches, etc. (1) Even in its early phase of development, such an information infrastructure would put vast amounts of information at the users' disposal. This infrastructure should be wide enough to include also small and medium-sized companies. The notion of a National Information Infrastructure, which has gained influence in the most industrialized countries, can help unleash an information revolution also in Vietnam that may change the way industry performs, institutions work, and professionals interact. Even more importantly, it may open considerable information resources in other countries for Vietnamese users.

The government has recognized the need for a data communications infrastructure in its 1993 national IT program, which has a practical orientation and looks to the "effectiveness of the application of computers in socio-economic activities". The program says that it will not be enough to enhance the situation locally by improved local area networks. What is needed is, for instance, a "national data transmission network to be linked to international networks."

During the course of our investigation, we visited the library of one of Vietnam's leading universities, the Polytechnic University of Hanoi, to get a first-hand impression of its stock of specialized literature in the broad field of microelectronics and IT. We found a central library that had critical gaps among internationally important scientific and technological journals, where textbooks and monographs were relatively old, and where the students' access to what was actually available at the library was severely limited by reading room space and poor copying facilities.

In a bag, during the same library visit, one of us carried a lap-top computer with a portable CD-player that in seconds could search and retrieve information from 174 000 articles from just one CD-ROM disk, available at a annual subscription fee of US\$1000 that includes a monthly up-date. The disk not only contained the full length articles from leading journals, newsletters and fact-sheets dealing with microelectronics and other information technology, but also two dictionaries (of electronics and of computer terms) and more than 20 000 company profiles with their main products listed and described.



We left the University library with the firm belief that an investment of just a few thousand dollars in hardware plus a handful of CD-ROM disks would shift entirely the conditions for studying for hundreds of students (and surely also for the university staff, who rarely have much better library conditions than the students). However, a CD-ROM reader at a modern library must be easily accessible to many users at the same time and should therefore be integrated in a local area network to attain optimal flexibility. This, in turn, will influence the technical criteria for procurement.

Yet, our library visit is just one illustration to how modern information technology could greatly improve the performance of an institution or a firm without costly investments. A similar functional benefit could be attained by investing in a modem that would connect the university library to the Central Institute for Scientific and Technological Information, Hanoi, which for years has had on-line search facilities via international data-bases, but which has failed to develop close 'customer relations' with, e.g., the library of the Polytechnic University. Another reason for the failure is the relatively high costs in using some of these on-line library search facilities. Public and private sector firms in the neighboring countries are already exploiting this type of information technology and are -- with some assistance from government agencies -- linking up to the international data communications infrastructure. In Vietnam, particularly during the country's transition to a market economy, the government could act as a mentor or facilitator for an emerging National Information Infrastructure. Government actions could enhance the efforts by industry and assure the growth of an information infrastructure available at reasonable costs for the users. Building on similar principles as in the industrially most advanced countries, Vietnamese government efforts to promote an emerging National Information Infrastructure in Vietnam could be steered by objectives like the following:

FE Extend the service concept to assure that information resources are available at affordable prices to the industrial firms and to all relevant institutions in society such as R&D institutes, universities, high schools and other training establishments, etc.

FE Facilitate imports and the diffusion of modern information technology, which is not yet developed and/or produced in Vietnam. Demonstrate new IT applications and assist (directly or indirectly) in developing these applications across the economic sectors to better fit the current and future socio-economic conditions of Vietnam.

FE Promote interactive, user-driven data communications networks as a basis for the country's already emerging wide-area networks. As a Vietnamese NII evolves as a 'network of wide-area networks', government should ensure that professional and other users can transfer information across networks easily, efficiently and at relatively low costs.

FE Secure specialized training of relevant staff serving the networks and to major user-groups such as scientists and engineers, teachers and students, etc.

FE Provide access to government information. The government should ensure that its agencies use the wide-area networks and the emerging NII to expand the information available to other users. As the Ministry of Trade and Tourism already is making some of its economic intelligence available through its publications, modern information technology would make on-line searches in some of its data bases easy.



FE Ensure information security and network reliability. Wide-area networks in Vietnam must be trust-worthy and secure, protecting the privacy of its users. The overall system of communication should become reliable, quickly repairable in the event of failures and, perhaps most importantly, easy to use.

FE Improve the management of critical technological resources such as the optical fiber nets, electronic switches and the radio frequency spectrum to make transmissions of data more reliable.

FE Protect intellectual property rights. The government should investigate how to strengthen Vietnam's copyright and patent laws and assist Vietnamese software developers and other information technologists in retaining their property rights. The government should apply international intellectual property treaties to prevent piracy and to protect intellectual property in the IT field. It should survey license agreements and help protect Vietnamese interests in situations where commercial and otherwise stronger companies abuse their bargaining power.

FE Coordinate with other countries. Because information crosses national boundaries, it is critical to avoid technological and other obstacles and to overcome unfair policies that would otherwise handicap Vietnamese users.

Foot Notes:

1. When developing this section on the concept of a "NII", we have made an effort to compare with policies formulated in some of the technologically leading industrialized countries, e.g. by the current US government. Cf. "The national information infrastructure: Agenda for action", presented in 1993 by the Clinton administration.

Technical changes -- and institutional changes

Four years ago, it was not simple for a Vietnamese firm to use fax machines to communicate with customers in other parts of Vietnam or abroad. Today, the international service is both easily accessible and technically reliable. The overseas telephone lines have greatly improved by direct satellite links. Still, it is sometimes quicker and more convenient to pick up a phone in Hanoi for direct-dial calls to a small town in Australia or Sweden than to call a mid-sized city in Vietnam.

However, the qualities of these services are now improving; the customers in both government and industry are receiving better telecom services inside the country. But they are still waiting for practical possibilities of transferring large batches of electronic data through the telephone lines or by radio between the small and medium-sized cities around the country. The big cities plus the two metropolitan areas (around Hanoi and HCM City) are much better connected.

Among the highly-industrialized countries, massive investments in R&D for microelectronics and telecommunications from at least the mid-1970's until today have changed the technological foundations for modern telecommunications. So



Strategic IT Plan – Country sample

have program controlled switching systems, requiring less maintenance and permitting continuous adjustments to new functions and services including the transfer of voice, data, text and images and various combinations of them. Satellites and optical fibers have permitted enormous increases in capacity and helped decrease transfer costs. Within just a few years, it is expected that bandwidths and other transfer capacities will grow much further.

Changes in ownership and alterations in the control of telecommunications facilities plus a further commercialization of some of the services have opened the telecom infrastructure to new user groups and paved the way for important functional adjustments of national and world-wide telecom infrastructures. A similar development is now being planned in Vietnam. The DGPT, the Vietnamese telecom agency, has already been divided into functional "groups", which are supposed to function relatively independently of each other. However, the organizational reform of the DGPT has just begun and the real outcome for the telecom customers is unclear. Before radical reforms, the government should study in detail both positive and negative experiences in other countries that have already undertaken similar changes of their telecom authority.

The technological foundation of a National Information Infrastructure (NII) in Vietnam requires a whole series of improvements of the data communications networks, databases, fully-automatic switches, etc. It is our impression that the DGPT of Vietnam is moving in this direction. Given the current level of technology installed, it will be a long way to go, but experiments in areas such as data communications has indicated that changes could be implemented fast and relatively smoothly.

At present, three major wide area networks are being considered: One for the government, which is planned by the Government Office in cooperation with different ministries and provincial governments; one for the institutions of research and education, which is the so-called VAREnet (Vietnam's academic, research, and educational data communications network) and is planned by the Ministry of Science, Technology and Environment in cooperation with other ministries and the Institute of Information Technology (within the National Center for Natural Science and Technology); and one data communications network for the bank and credit institutions, which should permit on-line payments and the use of credit cards as well as plastic cards for teller machines.

For the Vietnamese telecom services, the economically most important development in the near future might be the creation of open data communications networks, which would facilitate connections between the three wide area networks under planning. Once the national networks and similar technical improvements are in place, these services can develop and proliferate. There may easily be more commercial data communications services such as for EDI (Electronic Document Interchange), a service which is already needed by some Vietnamese service firms.

If a Vietnamese version of a NII could be established along with the three wide area networks, the users in industry and elsewhere would benefit from an abundance of advanced information services easily available worldwide. Given that the government will adhere to the principle of 'open networks' this may improve the



Strategic IT Plan – Country sample

country's resources and innovative capabilities enormously. By 'open networks' is meant large, connected wide-

**** Missing a part ****

This data connection, which is the backbone of VAREnet, has been funded by Australian sources since early 1992. It is administered on an experimental basis and may continue until the Internet services are made easily accessible to any Vietnamese end user. In the first phase of this experiment, the software used was largely that available in the UNIX environment, in particular ftp, mail, the UNIX editors, and page viewers. Lately a full UUCP (Unix to Unix Copy) network connection was established to provide both electronic mail services and file transfers, and, more importantly, to automate the network. See the next section of this chapter for further details.

More recently, Internet clients in Vietnam have been offered a third option, which might also become convenient for daily use. It requires a joining fee, a monthly subscription plus a data volume charge. By calling a local number a switch is made available that will permit interactive data communication on the Internet and on other international networks. It is called the VIETPAC (Vietnam's Packet Switch Data Network) and is a data communications service implemented by a joint venture between Vietnam's DGPT (the Directorate-General of Post and Telecommunications) and the Australian Telstra OTC International. In fact, VIETPAC is an extension of telecom services offered in Australia.

The VIETPAC dial-up service (on X.28 with a maximum speed of 2400 bps) can be substituted by a dedicated line, leased from the DGPT. Later, this service may operate on X.25 at speeds up to 9600 bps. In this manner, the VIETPAC will eventually allow access to the major international data communications networks.

On April 4, 1994, prime minister Kiet of Vietnam and prime minister Bildt of Sweden exchanged email messages via Internet. It was the first time a senior government official in Hanoi used the Internet as a tool for inter-governmental communication. It was also a significant symbolic act. The Vietnamese premier was probably one of the first political leaders in a developing country to communicate on the Internet. Vietnam formally joined the Internet organization in April 1994, which means that the country's data communications users are able to access services on the Internet, including email. Eventually, the users will also communicate via a national gateway. Looking ahead to the provision of the Internet Protocol in Hanoi, five Internet domain names for Vietnam have already been registered with the Internet authorities:

FE gov.vn to government institutions

FE ac.vn to research institutions

FE edu.vn to educational institutions

FE com.vn to commercial enterprises

FE org.vn to other organizations



The Ministry of Science, Technology and Environment (MOST E) is the Internet administrative contact, while the Institute of Information Technology (see the next section of this chapter) is the Internet technical contact. At present, the Australian National University acts as the primary name server

**** Still Missing some more ****

National and world-wide electronic mail

Since about two years, Vietnam has been accessible by electronic mail (email) through the Internet. In the beginning it was just a handful of users in Hanoi, all linked by modem to the Institute of Information Technology, which is functioning as the national node until a more permanent organization is in place in 1994. Electronic mail is one of many services offered through the international Internet, which is one of the major data communications 'network of wide-area networks' accessible to private and public users in virtually all countries. There are other international electronic mail systems as well, e.g., CompuServe, America Online, and GENie, which are now accessible to user in Vietnam.

Some data communications firms operating also in Vietnam, seem to have already achieved a relatively wide usage of their services in Vietnam. However, says an Australian observer, none of the network facilities offered has reliable Internet connectivity, although some use services with Internet gateways, such as CompuServe. Once a well-functioning Internet gateway is in place, it would provide an Internet connection for these networks.

In the first half of 1994, the Internet data communications services could be reached by the Vietnamese end user through three types of channels:

- An automatic call-up connection via modem to a server in, e.g., Hong Kong or Singapore, which would then provide all the services on-line directly to the individual customer in Vietnam. Software is easily available (for a PC and Apple Macintosh) that will reduce the minimum time to seconds, not minutes, while transferring email messages to and from the local user. For commercial trade information and for other services, a server at the Asian Institute of Technology in Thailand, provides Internet and other data communications services to about 120 customers using email in Vietnam. It is organized from Hanoi by TDACO, a private Vietnamese company.
- A call-up via modem to a server at the Institute of Information Technology, Hanoi, which stores Vietnamese email messages in order to transfer them daily to the Internet via a server at the Australian National University (ANU), Canberra. (At ANU, in August 1994, some 80 messages to Vietnamese email addressees are being transferred every day using a similar procedure and the same telecom connection.) No on-line service on the Internet is currently available to local Vietnamese users.

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In early 1992, as a pioneering effort, the Institute of Information Technology began conducting an experimental link to the Internet through the Australian National University. The link was implemented using the public switched telephone (voice)



network (PSTN), with calls initiated and paid for in Australia. Later, a SCO Unix system was provided to the Institute by the Ministry of Science, Technology and Environment (MOSTE), and this enabled a Hanoi end of the UUCP (Unix to Unix Copy) link to be established.

Along with the first data communications experiments at the Institute of Information Technology, work was commenced towards the establishment of a national wide-area network. It was decided to use the public domain software WAFFLE and its UUCP capabilities. (1) During the early stages of the experiment, the use of WAFFLE was very limited, largely because of the lack of telephone lines to the Hanoi offices and, in practice, much of the email and file delivery within Hanoi and vicinity was accomplished by motor-bike. There were a number of complaints from customers collecting their email messages from the Institute of Information Technology, and this had reduced the number significantly. Email users remained only a small group. It seems as if the lack of telephone line and modem capacity was the major cause of the problems.

The dial-up connection (PSTN) used in the early part of this experiment provided two services: The first one offered data file transfers (using the UUCP suite of programs). The second service was the most popular: Electronic mail (email) links with an Internet address (all addresses were "hanoi@coombs.anu.edu.au", and were sorted in Hanoi). There were more email messages into Vietnam than out of the country; a typical month would have had 80 to 100 messages in and 15-20 out.

In view of the likely traffic in the second part of the 1990s, it was decided to abandon the use of the ordinary telephone network as the physical layer and turn to the X.25 packet switched link from AUSTPAC in Australia to VIETPAC in Vietnam as the improved link. (2) Although the bandwidth of this connection is small, it does provide greater reliability than the existing PSTN, and the costs of transmission are significantly reduced. Furthermore, the X.25

Foot Notes:

1. Hurlle and Thai writes in June, 1994: This decision was taken because WAFFLE will run on almost any DOS-based PC, from those using the Intel 8086 processor to the most modern 80486 and Pentium-based systems. There are many such systems available in Vietnam. WAFFLE also implements a version of UUCP and can use dial-up for its data communications, thus enabling a complete network to be built up using already existing technology. UUCP is considered a standard in the Unix networking world and, as such, is regarded as a better choice than alternatives. WAFFLE was extended by the Institute of Information Technology with the addition of some Vietnamese language facilities, and the extension of the addressing scheme to the domain name style used within the Internet.
2. This upgrade of the Internet link in and out of the country was made possible by a small grant from the Australian government through the Australian National University.



Chapter 10 Manpower development: Education, training, re-training

Eight years ago, in southern Vietnam, there were not sufficient job opportunities for academically trained computer scientists such as program specialists. Four years ago, in 1989/90, higher education institutions like the Computer Science Center of the University of HCM City could not meet the rising demand for training -- neither from the private companies wanting to hire programmers, nor from students wanting to study informatics and computer science. In the spring semester of 1989 there were five qualified applicants for each student place. Despite efforts to expand the educational facilities, and the introduction of evening classes, there were not enough places for all the students.

Four years later, in 1993/94, the situation has somewhat improved, but the number of student places are too few to meet the demand. Facilities for training using PCs and other machines can not meet minimum requirements. Among the interest groupings presented in Chapter 6 as members of a Vietnamese 'IT policy community', the higher education interest grouping is by far the weakest. It has never really reached the same degree of influence on the national IT policy as the two previous groupings. It may, however, gain influence on national IT policy in the near future. The fact is that both government and industry have realized the serious problems caused by too few computer scientists and engineers being trained to meet the raising demand of software and hardware specialists. Their qualifications, given the generally outdated equipment available at the educational institutions, has also been questioned. We have heard complaints that the universities -- and that includes the technical universities -- are 'hopelessly behind'.

Having visited the major universities in the Hanoi and HCM City areas, we are not at all sure that the situation is discouraging. Actually, our first-hand impression of some of the academic teaching done there, are -- in several of the cases -- very positive. Ambitious and energetic teachers, but inadequate, malfunctioning and outdated technical facilities.

Courses organized in the private sector, for instance at the Lotus College of Information Technology and Management in HCM City, is coming of age. 4-5 years ago, there were only a few meager experiments of privately organized academic teaching in informatics, e.g. at the privately-funded Thang Long University, Hanoi, which is still operating but in small scale and with very limited budget. Now, the technically most resourceful teaching, primarily in the form of vocational training and relatively short, highly specialized courses, is organized by private institutions. The training by the vendors of information and communications equipment is also increasing and attaining a much higher level of quality than just 2-3 years ago. Specialized seminars for Vietnamese IT experts are being organized by major vendors such as Compaq, IBM, DEC, and others..

The revitalization of old initiatives, like the "Institute Francophone d'Informatique," (IFI) (1) , is being further promoted through bilateral aid money from several



countries. IFI, linked to the Polytechnic University of Hanoi, will be starting in 1994 and will be staffed by French-speaking teachers from Vietnam and from abroad. It tries to serve also at as a meeting place for computer professionals in the Hanoi area.

It is not possible for us to summarize the Vietnamese education and training efforts in the field of information technology. The picture is changing all the time and there are now so many different options of specialized training, including vocational training, that nobody really can paint a representative overview even with a big brush. One thing is clear, however, the demand for teaching is much higher than the supply of teachers.

In short: The availability of specialized, highly-skilled personnel is still low in Vietnam. Improvements suggested and discussed long ago at different ministries, including the Ministry of Education, have not been implemented -- probably because of lack of resources. Other manpower developments issues could also have been solved, given more resources.

Foot Notes:

1. The first ideas in 1989 and 1990 was to create a separate university including a graduate school. Now, five years later, it has become a more realistic endeavor. Cf. the ideas in Miranda S & Nhan Le Thanh: "Rapport de la mission au Vietnam du 19 Decembre 1988 au 9 Janvier 1989", Valbonne: LISAN-CNRS, 1989-01-14.

Setting quantitative targets, mobilizing resources

A first step in the solution of these problems would simply be to provide new resources or redirect already available resources. This can be done in cooperation between institutions at the local and central levels of government, where the initiative rests with the educational establishments. But the qualitative aspects of any policy-measure, which are equally important, has to be based on analyses of how the labor market for this highly specialized work-force will develop in the near future. This was underlined in our previous report.

Such a type of manpower planning is rather complex and difficult to perform and may have to include an analysis of the local and regional differences within Vietnam; priorities and planning objectives should not simply be transferred from technically more advanced countries. The other interest groupings, the ones outside of the government sector, have to be involved in discussing the most urgent matters and in setting some of the priorities.

What has happened on the Vietnamese labor market for IT-skilled persons is a rather quick diversification of the IT jobs. Like in the technically more advanced countries, the job structure has developed and will surely continue to develop and lead to a further specialization or division of labor among computer specialists. A recent study (1), which will be further discussed later in this report, sets a target for the next 5-6 years for education and training to 1 500 "systems analysts", 500 "program managers"



and 3 000 programmers. The calculation of these numbers was made by comparing the number of IT personnel per thousand inhabitants in different countries.

We agree that specific targets are set, also for different categories of IT personnel, but find it more appropriate to link these quantitative targets with the existing resources at each of the major training centers, including the major universities. By doing this, the means for implementing the plans will be easier to identify and improve.

The training of the different categories of IT specialists will have to be organized quite differently for the different categories of personnel. Obviously, there are special requirements in skill-formation for programmers, systems analysts, operators of mini-computers and computer networks, engineers and technicians for hardware maintenance, etc. Furthermore, new skills are needed for new types of programming tasks and other software developments. The time needed for the training will also vary substantially between job functions.

We suggest that a small group of experts on education and training will look into the proposed targets to suggest ways in reaching them using different organizational solutions. The new agency for the implementation of the national IT program could monitor the current IT labor market and explore needs for highly-specialized personnel among different sectors in society for the next 2-3 years. If necessary, the agency might suggest cross-sectoral coordination to design better courses and training facilities. The migration between sectors of different types of IT experts such as experienced systems analysts might also be facilitated.

In the current educational planning more attention should be given to the major areas for practical applications of information technology, certainly so for industrial application areas, but also for others. This will have to be related to the availability of specialized training programs.

Four years ago, we discussed a medium-term solution to the lack of qualified manpower in computer science and informatics, namely to set up separate schools for informatics in the major cities. This would not substitute the university-based courses but permit medium-term training with a specialization in selected areas of application. Without government planning, this has actually happened: In the last few years, many private initiatives were taken to respond to the demand for these specialized IT-related courses. We see this a sign of the times: Where government does not act, there will be room for other players to step in.

However, to avoid a more serious manpower shortage in this area, government could act as a facilitator, an active partner which coordinates its policies for industry and education better than before and provides guidelines and inspiration to the other players, who will not always look to what-could-be-called the national interest.

Foot Notes:

1. UNISYS, A strategic review of national information technology development, Vol 1, Hanoi, 1993, p. 15



Chapter

11

RED capabilities and IT development

There is practically no research and experimental development (REWED) performed in the business enterprise sector of Vietnam. Most modern technology is brought into production through the imports of machinery and other products from abroad, through joint ventures and foreign investments, through transfer of know-how in the form of licenses, consultancy services, etc. Of course, some high-technology is generated locally, e.g. through the polytechnic universities and some of the other universities and through a few national institutes. (1)

Nonetheless it is easy to find examples of incremental technical change in Vietnamese industry, and even some extraordinary shifts in production technology, but the typical industrial firm -- whether in the north or in the south of the country -- is still a plain production unit, very much dependent on technological advances outside of the firm.

This description also covers the IT industry of Vietnam, which has no particular high-tech features. During the preparations for this report, we have visited a limited number of companies producing computer software, which probably would qualify as original prototype development. These companies have close links to university departments or research labs.

We have found no specific plans by the government to enhance R&D for industrial purposes. And there are no public policy programs to foster innovative capabilities at the level of the firm. Until today, R&D activities in Vietnam are performed essentially by three types of institutions only.

FE Laboratories and other R&D or technical units within a ministry or under the auspices of a government agency. (In the industrialized countries these specialized units typically correspond to industrial laboratories within firms or labs linked to other business structures.)

FE University and other higher education departments which perform research and experimental development as part of their normal activities. Far from all departments at Vietnamese universities have the personnel, equipment and other resources to perform research and very few have any kind of IT equipment -- apart from a PC or workstation for administrative purposes.

A small group of national R&D institutions of which the most important is the National Center for Natural Science and Technology with facilities in the north as well as in the south of the country. In 1993/94, the government brought two of these national centers the National Institute of Technology and the national laboratory for atomic energy to the Ministry of Science, Technology and Environment.

This institutional set-up makes R&D in Vietnam a separate activity from technological innovation. The government has created a number of specialized R&D institutions, some of them relatively well-equipped, but not managed to connect them very well to the industrial firms. What's missing too are strong technological



capabilities, located with or closely linked to production. To phrase this differently: Vietnam has no "national system of innovation". (2) As Vietnamese REED activities are not organized to easily and effectively support industrial firms operating in the modern market economy, most business enterprises do not rely on the R&D institutions as they try to develop products and new manufacturing processes. Or in economic terms the supply of research results is not in line with the demand, since there is only little interaction between scientific research and industrial technology.

The institutional set-up for the country's REED activities and, more particularly, the formal linkages between R&D and industrial production have been changing constantly over the last thirty years, notably during the last ten years. Some of the institutional and procedural changes were triggered by shifts in the macro-economic policy or by the general drive towards a market economy. Other changes were generated by the government's policies for science and technology. Still other changes were actually unintended consequences of the fiscal crises in the public sector. When visiting a number of IT firms and institutions, we encountered a gap between the country's scientific and technological activities and its industrial production. If there are links between science and technology, these tend to be formal arrangements rather than functional partnerships, which makes Vietnamese R&D economically ineffective. Nearly all persons interviewed expressed similar opinions. But this situation may be changing along with the establishment of high-tech centers (3) or 'technology parks' in the two metropolitan areas. Efforts by some foreign companies to transfer more systematically technology and skills between foreign subsidiaries and local companies, e.g. a subcontractor, is another such example. We have noticed that industrial managers seem much more interested in technology and entrepreneurship issues now than five years ago.

What really matters to the emerging IT industry in Vietnam are informal, practical links between specialists at the R&D units and in the firms. Such links have been emerging and are enforced by the economic circumstances; few REED scientists and engineers can afford not to have 'two jobs'.

The government has come to accept a growth in research outside of the R&D institutes as well as consultancy work by R&D scientists and engineers outside their formal job position.

In recent years, commercial contracts and other formal arrangements have helped mobilize some R&D in support of industry. Moreover, a rapid expansion of independent, privately-owned consultancy firms has also been tolerated, although not encouraged, thereby supporting the drive towards further commercialization of the country's research results and technology.

In Vietnam there is a substantial number of R@D institutions in the field of microelectronics and information technology. Most of them are rather small units and seldom well-equipped such as a university department for informatics or computer science or a multi-disciplinary research groups at one of the polytechnic universities. In several of these units, there may be a small number of scholars and engineering experts who communicate their research results internationally; most REED scientists and engineers do not expose their research to a larger audience. Even some IT firms have staff members with formal research training (Ph.D.).



Strategic IT Plan – Country sample

Actually, in most areas of information technology and related scientific disciplines, Vietnam does not lack first-class IT experts. But the number of such experts is low in comparison with other countries in the region. Vietnam has a rather small pool of top-expertise in IT.

A main negative feature is the lack of coordination between the many IT units and firms and the low intensity of cooperation between many of leading computer scientists and engineers. At the Polytechnic University of Hanoi there are at least four separate departments or units engaged in advanced training of computer engineers and other specialists, but there seems to be very little coordination between the four units, such as for exchange of equipment and sharing of costly facilities. We think that the government should impose cooperation to avoid waste of scarce resources and to stimulate joint, multi-disciplinary activities in both teaching and research.

It is impossible in a report like this to present all units performing R&D of relevance to IT in Vietnam. That would require a separate document. But we will introduce two of the leading institutions in the field of microelectronics and information technology and mention some of the many others. The Institute of Information Technology as well as the Institute of Technology have their headquarters in Hanoi, although they perform research and experimental development in the rest of the country as well.

Foot Notes:

1. The general descriptions in this chapter are taken from Jan Annerstedt & Nguyen Thanh Ha, Demolishing the ivory tower: The drive to commercialize research and experimental development in today's Vietnam, in Vu Cao Dam (ed): Science, Technology and Society in Vietnam, Hanoi: Institute for Science Management, 1993, pp. 109-130.
2. The term "national system of innovation" was coined by Christopher Freeman in his Technology Policy and Economic Performance: Lessons from Japan, London: Francis Pinter, 1987, and further developed in part 5 of Giovanni Dosi, et al (eds), Technical Change and Economic Theory, London: Francis Pinter, 1988. However, it needs further clarification to become a useful analytical tool, particularly for comparisons between nations.
3. There are several being planned in both Hanoi and HCM City. The first to start functioning will probably be the Hanoi International Technology Center, which is being built in 1994 by the Schmidt Group, a Hong Kong-based firm.

The Institute of Information Technology

The Institute of Information Technology (IOIT), founded in 1976, is part the National Center for Natural Science and Technology. Originally IOIT was its Institute of Computer Science and Cybernetics. It is probably one of the best equipped IT institutions in the country. At present there are some 150 micro-computers (286, 386, 486 processors), 2 minicomputers and relatively advanced data communications equipment. Although the Institute performs parts of its scientific and technological



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activities in the south of the country, all its main activities are located to the Hanoi area.

Its staff of about 200 persons, include 3 professors, 12 associate professors and another 50 persons with Ph.D. or equivalent academic degrees. They work in six departments, which are responsible for education and training and consultancy and technical support services. The R&D performed is labeled as follows:

FE In computer science: artificial intelligence; pattern recognition and image processing; programming languages; parallel processing, information cryptography.

FE In software engineering: distributed database technology; computer graphics; software engineering methodology; system analysis and design; multimedia; management information systems.

FE In technical informatics: networking, informatics on telecommunications; systems support.

FE In automation: robotics; process control, CAD/CAM.

FE In information technology for socio-economic systems: economic modeling and systems analysis; design and implementation of computerized information systems for socio-economic activities.

FE In mathematical problems of information technology: mathematical modeling; numerical methods; 'computational statistics'.

The most successful software developed by the Institute is now in operation in more than 40 countries. Recently, an automatic optical reader has been developed at the Institute but it is not yet tested on the market.

In March 1992, UNESCO entered an agreement with the Vietnamese government to promote the Institute of Information Technology as one of several regional center for IT development in the South East Asian and Pacific Region. It became a node in a regional "informatics network" which, inter alia, should develop and coordinate cooperative research activities, promote technology transfer, organize advanced training courses, workshops and symposia at the regional level. The status as a UNESCO Regional Institute of Information Technology seems to have raised the quality of computer and communications equipment and made it easier for the Institute to recruit highly-qualified staff members.

As this is written, the Institute of Information Technology plays a leading role in the creation of Vietnam's national data communications systems. On an ad hoc basis -- via the Australian National University -- the Institute's server is also a gateway to the world-wide Internet and other data communications system. For several years, the Institute of Information Technology has been a central player in the attempts to establish VAREnet, Vietnam's academic, research, and educational data communications network. Cf. Chapter 9 for further details on VAREnet.



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IT expertise in the academic research community seems to have good contacts with the Institute of Information Technology. It is probably not an isolated institution although it could serve a more active role as an education and training center in cooperation with one or several universities. Some academic staff at the universities need to up-date their knowledge and skills and the Institute could be seen as a proving ground for advanced teaching methods in the field of informatics and computer science together with one of the universities. As the use of IT grows within the universities -- for both research, teaching, and library services -- more and better-skilled staff is needed.

Other institutes or departments of the National Center for Natural Science and Technology are also performing highly-rated research on IT and electronics. There are several laboratories with electronics and other IT expertise. But the projects are usually small-scale with tiny budgets and limited in time.

For many years, the National Center for Natural Science and Technology played important roles in the general promotion of R&D in informatics and computer science. In some areas, we were told, the Center

Chapter 12 Shaping the Vietnamese IT market Property rights, technical standards, privacy protection

A national market for electronics and other IT products and services is a function of the companies and the customers that do business in that market. But, more than that, laws and other formal regulations stimulate and restrict the market behavior of both companies and customers. In fact, the IT market -- like any other market -- cannot prosper without a proper set of rules and an institutional support structure. This was discussed at length in Chapter 8.

In our case studies and interviews in Vietnam's industrial sector we have found only weak institutional support of the new market economy. This seems to be even more apparent in the IT industry than in other branches of industry. For Vietnamese IT production the most obvious lack of institutional support relates to the ownership of computer software.

One reason why there is no real software industry in Vietnam is that there is no real market for software in Vietnam. There are many users of software, but there are relatively few buyers of software. Typically, software is appropriated informally by firms, institutions and individuals, who rarely pay anything for the product.

All persons we have met during our investigation know that there are virtually no buyers of software in Vietnam. The major producers of software, like Microsoft, know that they have thousands of non-paying customers in Hanoi and in other cities in the country. They also know that the central government has not yet created a software market by setting the proper rules and enforcing the law of ownership.



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We strongly believe that the intellectual property rights issues in Vietnam must be reconsidered. With an expanding cross-boarder flow of applications programs and other computer software, Vietnam must re-examine its legislation and administrative procedures in these matters to link up more effectively with its major trading partners. The intellectual property regime of Vietnam should be similar to that of other market economies.

It might be useful, at this early stage of Vietnamese software development, to examine the property rights issues from the vantage point of potential exporters. Such an examination may identify a need for a single national ministerial control mechanism dealing with all economically relevant areas of intellectual property protection. Administrative control could also device strategies for the protection of Vietnamese computer software at home and abroad and help firms and institutions retrieve their investments in software development.

While advancing the protection of Vietnamese computer software, the experiences from other countries in South East Asia, and elsewhere should be studied. Especially important are the advanced, already developed and implemented property rights regimes. Vietnamese lawyers should also learn how to deal with exclusive rights issues and infringements. The government should improve the commercial and other protection of stored data or databases.

In the near future, it may also become necessary to develop protection against 'unfair commercial practices' in the information industry. Since Vietnamese firms in the IT industry are still weak, foreign competitors may be tempted to use the opportunity to do business in Vietnam by preventing their Vietnamese competitors from acquiring essential information and restrict or delay the supply of key components and other technology.

Vietnam has much to gain by being an active participant in the shaping of 'fair commercial practices' of the information industry and in strengthening the international property regimes in this industry.

Technical standards

Among Vietnamese companies installing computers and providing IT services to the government sector, we hear about ambitions to attain a higher degree of technical standardization. The idea behind is to reach economies of scale (primarily for the after-sales services), to be able to move computer programs from one application area to another, and to exchange different kinds of data. Yet, until recently, little has been done in Vietnam to create such standards even for data exchange.

In the early 1990s the standardization issues seem to have caught the attention also of senior decision-makers in government and industry. Much effort has been put into the endeavor to promulgate Vietnamese standards in information technology, of which two -- TCVN 5712 on the 8-bit character encoding, and TCVN 5713 on Chu Nom -- have been accepted by the government and published in 1993. These are actually the first national standards in Vietnamese IT.



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The Vietnamese national standards agency, TCVN, has several work items in progress for 1994, including standards for Vietnamese keyboards, computer terminology, and local area networks (LANs). In 1993-94, the TCVN has upped its involvement in international ISO activities, becoming a 'participating member' of the key ISO/IEC JTCl body.

We agree with one member of the standardization agency that "it is regrettable that these activities have yet to gain much visibility, and, hence, have not yet triggered a much-needed wider participation from users, practitioners and vendors in Vietnam." Much may depend on reforming the work style of the TCVN itself to more fully reflect the needs of a modern market economy.

The national IT program of 1993 clearly underlines a need for 'open systems' -- at least within the government sector. This concept should promote, the program says, compatibility of systems and products and should facilitate their further development and expansion. Moreover, Vietnamese 'open systems' should be the same or similar as in the rest of the world. Cf. Chapter 9 for the discussion of 'open networks' meaning large, connected wide-area networks, where many different users as well as telecom service providers can interact without principal technical restrictions. At present, within the Ministry of Science, Technology and Environment, deliberations take place on how the 'open systems' policy should be implemented. Among the objectives under discussion, the following could be listed [\(1\)](#)

- To promote sharing of resources between different ministries and departments and to reduce duplication of efforts in developing common applications. 1
- To be independent of any particular supplier and to support the development of the local IT industry.
- To maximize the value of IT training and investment and to simplify procurement and reduce the costs of IT equipment.

The government's push for 'open systems' may also reflect changes in the Vietnamese IT market. As we have already seen in Chapter 1 of this report, the dominant feature is a wider use of decentralized, low-cost equipment, mostly PCs. And, like in other countries, the PCs and the stand-alone work stations have already created a demand for better data communications services. Among users we have interviewed in industry, government and R&D, data communications are regarded as necessary to attain a more optimal use of the existing technical facilities.

Bringing many different elements of an information system into line requires both standards and the development of norms. Vietnamese IT users cannot expect standardization of computer hardware in the next year or two. Hanoi has no procurement policy in place, but a policy being prepared within the State Planning Committee. In principle, it could be launched in 1994 and implemented in 1995. Singapore and Hong Kong experts have provided some inspiration to the Vietnamese deliberations. But we have noticed signs of resistance to centralized control of IT hardware procurement. Different ministries and government agencies want their own way of organizing their IT equipment and applications to attain optimal technical solutions.



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Standardization of hardware may not be needed, if standards for functionality, formats and data exchange protocols are generally accepted and implemented in the Vietnamese government sector. Compliance with standards could mean that a system would deliver messages in a format which can be effectively processed by a different system elsewhere. For a Ministry, this could imply standards for the electronic format of texts, for data transmission (e.g. X.25) and the address structure of the messages.

[\(2\)](#)

Other advantages in being a late-comer in the use of information and communications technology (ICT) should not be underestimated. Vietnamese users do not have to suffer with some of the pioneers in installing large, capital-intensive main-frame computers, which created centralized and rather inflexible institutions and other organizations. Some of these organizations -- in both government and industry -- face problems in adjusting to a technological environment where small work-stations and PCs gain a greater share of the IT market. The typical Vietnamese IT users could face a technical environment with a much more widespread availability of PCs and portables, which are combined with effective data communications networks.

Foot Notes:

1. UNISYS. A strategic review of national information technology development, Vol I, Hanoi, 1993, P. 24.
2. Cf. the European Procurement Handbook for Open Systems. See also Id;T Magazine, Brussels: The European Commission, DG XIII, Winter 1993, p. 6-9.

Privacy protection

Some of the reforms of government institutions have been accompanied by automation of administrative functions using electronic databases and on-line search procedures. Following these techno-organizational changes, let us provide an illustration of a possible policy initiative that could anticipate a flexible approach within government by using outside expertise: The Office of the Government is planning an automated communications network (a wide-area network) consisting of an electronic data center in Hanoi with provincial and local nodes that collect, compile and transmit information to and from the center. Not only public but also private services in today's Vietnam requires data to be moved onto electronic systems. Some of this data will be accessible nationwide in the near future.

When data on individual citizens are becoming more easily available to the authorities, there is a debate in Vietnam -- as in most other countries on the need for legal protection of the privacy of individuals and of groups of individuals. However, as far as we know, there is no preparation going on for a privacy protection act in the parliament. And no authority oversees the establishment of new electronic data bases and electronic communication networks from a privacy-protection point-of-view.

If future databases, such as the new taxation system, will contain detailed personal data in a centralized data bank, reactions could come from citizens arguing for better



privacy-protection. Furthermore, even distributed systems of independent databases operated locally could easily be made universally accessible. Whether centralized or decentralized databases, the advent of electronic records on individuals may call for better privacy protection. These information-technological changes may also call for institutional or procedural reforms. It might be appropriate to invite a committee of experts from different sectors of society to draft a legislative proposal that provides a comprehensive scheme of privacy protection for individual records that are stored and communicated by electronic means.

Chapter 13

Software production in Vietnam Small scale today -- large scale tomorrow?

Standardized computer applications are easily available world-wide at relatively low costs. By starting late, Vietnam may find considerable advantages simply by being able to exploit better the whole range of more or less advanced software without being locked into particular systems solutions.

In both HCM City and Hanoi a growing number of firms provide increasingly advanced software services. Most of these firms are newly established, but a few have operated for more than ten years. Some of their customers may have a long-term experience in computing. Others customers merely need help in better using existing information technology systems. These software and IT service firms could be treated as the embryo of an advanced IT service sector in Vietnam.

Besides the two metropolitan areas, the size of this IT service sector is still small. If the IT specialists working in universities, and inside the computer departments in city, provincial and government administrations, considered alongside the private firms, the sector could be considered to be larger. In-house software services are still relatively important in Vietnam. For both small and large customers, the trend is now to buy services from IT service firms. This trend follows what is happening in other countries. Some vendors offer package deals which include not only hardware, software, and systems design (i.e. systems integration), but staff training, software maintenance and upgrading, and around-the-clock technical service. Undoubtedly, this part of the IT sector will expand very rapidly over the next few years.

Like in some of its neighboring countries, Vietnamese software development may take off from local customer adaptations of standardized computer programs. As is the case with most personal computers and their applications, the first such tools to come to the market are geared toward the handling and processing of the local language and its writing system. Such applications may ease the penetration of computer usage among all sectors of society, and serve an important role in popularizing microcomputers. Hence, more user-friendly software, customized for the Vietnamese language, could facilitate a rapid diffusion of computer and communications application among industrial firms and public institutions.



There are several examples of new software products that have reached the domestic market such as a low-cost word processing program in Vietnamese written by a Hanoi scientist, who now runs his own software firm. Although many more Vietnamese-language applications are already available in the marketplace and exhibit the creativity of Vietnamese programmers, the level of software development and systematic integration into the computing environment remains very limited, partly due to the lack of diversity of computer platforms and limited access to detailed and thorough technical information. Much remains to be done with respect to Vietnamese-language processing.

Already five years ago there were clear ambitions in Vietnam to create a broader and more coherent base for the future development of 'information industries'. Software production and related services were seen as an obvious candidate for rapid industrialization. These ambitions, which were recognized by the central government, have yet to materialize. The way by which they will be implemented may have direct implications on the success or failure of any IT development strategy.

As of 1994 the Vietnamese software industry is still very small. There are no radically better facilities for training of software engineers at the technical universities. The number of engineering and mathematics students specializing in computer science and informatics at the universities has not grown significantly since 1989. Despite ambitions to launch a Vietnamese software industry, the most relevant manpower development has not been a part of the government's modernization scheme for the industrial sector.

To sum up: Software development in Vietnam has not advanced by the speed expected in the late 1980's. On the contrary, the imports and diffusion of information and communications equipment has grown nearly exponentially and software imports have followed -- though not quite at the same rate. With few restrictions and virtually no rules for intellectual property rights, it has been easy to copy and distribute standardized computer programs and software packages at very low costs. Although local demand for software better adapted to local needs is now rising, the current shortage of highly-skilled software personnel, which was projected already in 1989, is still a limitation to any ambition to build a fully-fledged software industry in Vietnam.

It is a general opinion among Vietnamese specialists in computer science and software engineering that there is a quite sophisticated and expanding demand for software of all kinds. However, if we compare Vietnam with neighboring countries, there are still relatively few customers and software demand is not as diversified. Although small, the software demand of Vietnam is now expanding rapidly.

Due to on-going organizational changes throughout society and the application of IT technology to the new conditions in Vietnam, many new jobs for software specialists will be created simply because of changing technical configurations. In other words: the software and IT service sector will continue to grow. But it is far too early to expect many jobs being generated in Vietnam by more advanced, innovative software demands such as parallel processing, multi-media, and expert systems.



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The demand may be growing, but there is no well-functioning software market in Vietnam, as we have already underlined in Chapters 8 and 12 of this report. The rules and regulations needed for a software market to really work and perform well are not yet in place. The government provides only limited institutional support to its new market economy. If the institutional shortcomings are not offset by government policy, they will continue being a real barrier to the software industry development.

What is software development and production?

Computer software has been among the fastest growing industries in most East Asian countries in the last few years. The global market is dynamic and diverse, providing a wide variety of market niches to be exploited by newcomers. It might be appropriate for young Vietnamese software companies, already operating on the local or domestic market, to try out new software products for the international market. However, the global software industry represents a challenging and swiftly changing environment that usually requires substantial marketing and distribution efforts as well as an international organization for after-sales service and technical support.

Software differs from electronics hardware, which usually are made from interchangeable components and constructed through a sequential assembly process. Software products are the outcome of an iterative process of design, coding, testing and redesign. Thus there are few formal approaches to the creation of computer programs. Centralization, standardization, re-usability and similar criteria for mass-production are not easily applied to computer software production. Even if companies may follow standardized procedures within their organization, there are only very few industry-wide standards for product features, tools and project-management techniques.

Software is often seen simply as a non-standardized good, composed of complex knowledge for still-evolving markets. Thus, in most developing countries, factory-type methods of mass-production of software are rarely applied to production.

In highly developed countries however, mass-production techniques and modern management practices have been moving into the software industry. Indeed, some experts believe that further standardization of software production will become an important lever for the swift and cost effective creation and diffusion of software applications. In some cases these practices have been applied to developing countries as well.

Even though software may be highly dependent on the specific characteristics of the market, the software industries in several of Vietnam's neighboring countries have begun the transformation from an 'unstructured service' into an industry offering an internationally marketed set of products with a guaranteed level of quality. By creating libraries of interchangeable software code that are used as "building blocks" for quickly assembling programs, companies in some of these countries have been able to enhance the international competitiveness of their products. Software production tools that use this "building block" approach run on powerful technical workstations and are called 'computer aided soft engineering' (CASE) tools.



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Another innovation in the way software is produced has been the development of software subcontracting arrangements. More and more, large electronics companies, including large software developers, 'outsource' routine tasks to specialized software subcontracting firms. Moreover, software subcontracting is sometimes organized on a global scale. European and US firms, for example, are using software subcontractors located in India to create an international 24 hour production schedule. In principle, this type of arrangement, could reduce the amount of time it takes to finish a project by half. During our interviews and visits to some of the Vietnamese IT service firms, we have seen early examples of subcontracting arrangements with a major foreign customer and a software house in Europe.

The software and IT service sector includes a range of specialist activities that may be grouped in the following six categories:

1. Systems software development such as operating systems, compilers and utilities.
2. Development of packaged applications.
3. Development of specialized "firmware" that is built into particular hardware products to perform a dedicated function (e.g. computer code embedded in engine controls for automobiles).
4. Hardware/software integration; including systems planning, design, installation, and maintenance (systems integration).
5. Custom application development and service.
6. Data processing services offered to customers.

These six categories of specialized activity may also be seen as six (or more) separate IT markets.

Systems integration

What is now available in Vietnam are the small scale services listed as point 3 through 6 above. Point 4 corresponds to the activity known as 'systems integration'. Systems integration is the stage of production in the IT industry that combines hardware and software into usable systems. It is a strategic activity in electronics production because it is the point in the where the design, manufacturing, and use of IT products come together.

Systems integration -- also known as 'value-added reselling' (VAR) if the integrator only sells products manufactured by other companies -- involves the packaging of computer hardware with application software. It often requires consultation with customers to determine computing needs and to design appropriate applications. 'Systems integrators' must know their customer's business very well.

When an organization introduces a new computer system, the way work is organized and performed can be drastically altered, especially when computers are used in the organization for the very first time. Consequently, the quality of the systems integration will be crucial in determining the organization's future level of productivity.



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Once the hardware has been obtained, the system assembled, and the software operating correctly, systems integrators often install the equipment at the customer's premises. Computer systems can absorb more labor time than they save when they are not functioning properly or are mismatched to the user's needs. In a competitive commercial situation, how well computer systems are implemented can help to determine the company's ultimate success or failure.

In today's Vietnam, where there is a severe shortage of people that have previous experience or formal training in operating computers, so-called 'systems integrators' often provide training for the customer. Besides design, sale and installation of the computer system, contracts often include an ongoing service to maintain and upgrade the equipment. Sometimes pre-fabricated software is sold directly to the customer, but, more often, software must be customized for particular needs. In some cases, existing software is inappropriate for a particular need and entirely new software must be written.

The state-run IT company, VEIC, has three companies involved in systems integration. The Vietnam Informatics Company (Hanoi), GenPacific (in both Hanoi and HCM City), and Vietnam Computer Company No. 2 (HCM City). The government is the largest market for these companies; the most important application is word processing. Local area networks are rarely installed.

VEIC plans to build a software development center that will focus on applications for administration and manufacturing. Eventually, exports of these software applications will be advanced, but there are no detailed plans in place.

These services could become a viable resource base for a specialized software industry. So far, we have seen few examples of products aimed at larger markets (even at the national level) such as packaged applications and systems software.

Preconditions for expansion

Given the time available for our work in Vietnamese industry, we do not have enough specific knowledge of the necessary skills and resources in Vietnam in order to recommend a coherent strategy for the coming software industry development.

To develop a strategy for a Vietnamese software industry it will be necessary to consider the various characteristics of the different software markets listed above. Probably, there will be separate industry policy approaches to each of these six or more markets.

The strengths and weaknesses of the software services offered in today's Vietnam should be analyzed in detail while a government policy is being formulated. To us, it is still unclear if the software services currently available on the Vietnamese market could be used as a basis for advanced software development.

Any further policy deliberations will have to consider how a Vietnamese software industry will be able to overcome the following obstacles. (1)



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- A weak institutional support-structure: the software industry in Vietnam cannot expand because of inadequate legislation to protect intellectual property. It will not be enough to formally establish a property-rights regime in Vietnam; it will have to be enforced as well.
- Small domestic market: The current levels of demand for all kinds of computer applications are not high enough to stimulate the creation of a large domestic software industry. However, the Vietnamese market is now growing faster than ever.
- Low levels of experience and a limited amount of expertise: The development of a software industry in Vietnam is hampered by the considerable lack of experience and low numbers of programmers, systems analysts, and project managers available in the country. Cf. Chapter 10 above.
- Lack of development tools and weaknesses in methodology: There is a general lack of standardized design and verification tools in Vietnam, which makes it difficult to accumulate (and diffuse) experiences from different projects. Similarly, the ability to re-use software components from existing applications is still underdeveloped. Due to limited experience with large scale software development projects, computer specialists in Vietnam tend to follow non-standardized approaches to design and implementation of new programs; and often, for the same reason, there are difficulties in specifying performance requirements before detailed design and coding begin.
- No marketing tools and after-sales services: The Vietnamese software industry has to build relatively advanced marketing competence and after-sales facilities, particularly since it is entering the global market as a newcomer. Initially, this lack could be compensated for if local firms act as subcontractors for internationally operating firms. The software markets are dominated by companies with effective organizations for world-wide marketing, distribution, and back-up service.
- Language difficulties: Competence in the English language will have to be improved to match the requirements in the IT industries (e.g. for reading manuals, and communicating with foreign vendors and customers). More and more, English is the dominant language in this industry.

We support the movement to 'open systems' that facilitates inter-connections and networking between computers and communication equipment of different brands. We believe that it is excellent that the government in its 1993 national IT program strongly underlines the 'open systems' concept to information interchange both generally and for specific projects: A "computer system must follow certain standards (both the hardware and software) so that it can be integrated into the National Network and be compatible with international networks."

Such measures might actually provide important stimuli to a Vietnamese software industry -- indirectly by increasing the general qualities of software development and directly by linking local software development with systems software and application programs developed internationally.

There are at least three trends in the global IT industry that could make it difficult for a Vietnamese software company to enter the international market without becoming a sub-contractor or partner to a foreign software developer.



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First, more and more advanced standard-package software is being developed and delivered along with computer and communications hardware. Products from local software developers will have to compete with packaged software that is becoming available for more and more specialized applications. The market dominance of a few operating systems (most notably Microsoft Windows) and the decline of closed, proprietary systems (such as Digital Equipment's VAX system) has made it possible to for software companies to sell packaged software that is compatible with a large number of installed systems.

Secondly, during the past few years, automation of coding and testing of software is being introduced world-wide. It will probably be easier, with a steadily decreasing number of personnel, to develop relatively large computer applications programs using standardized programming methodology (including CASE tools). This trend might raise the entry barriers for newcomers in the international software industry and cause less resourceful companies to leave the international market.

Thirdly, it is not obvious that software development, production, and service for the international marketplace will generate much new employment in Vietnam. With a decline in mainframe computing and an expansion of small, inexpensive but powerful personal computers running standardized programs, small, specialized software companies will find it difficult to generate new job opportunities. Improved programming skills among the end-users may also offset an expansion of software services.

Foot Notes:

1. Cf. a similar analysis in UNISYS, A strategic review of national information technology development, Vol 2, Hanoi, 1993, p. 27 etc.

Coordination of policies

The real basis for a software industry in Vietnam is manpower. Good vocational training for IT professionals plus advanced specialized training and re-training for programmers and systems analysts will create the necessary conditions for improved IT services and, eventually, a software industry. But highly-skilled and experienced programmers are necessary but not sufficient conditions for such an industrial expansion. What is needed is a mix of policies to complement the educational efforts already discussed in Chapter 10.

If a software industry should emerge in Vietnam in the near future, the government must orchestrate different policies to attain the best possible conditions for growth. Apart from the education and the manpower development policies presented in Chapter 10, here is a list of some of the policies to be combined:

- Capital mobilization: The financial incentives to expand production from IT services to innovative IT development and production should be scrutinized. Most companies in the Vietnamese software business are small and not financially strong enough to expand into advanced software production.



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- Government procurement: Several ministries and provincial administrations are already customers for local software service companies. The system design and programming tasks required by these public agencies could be used to upgrade skills and advance IT. This will require a more active and technically-informed buyer as well as a sharing between ministries and other institutions of both positive and negative experiences regarding the procurement of domestically produced software.
- Foreign vendor involvement: Government could encourage foreign software producers to transfer, much more systematically than today, skills, software methodologies, and experiences to local partners. This could be made a requirement when a public agency is buying hardware and software from foreign vendors.
- Capacity building and technology transfer: When negotiating foreign assistance from bilateral and multilateral sources, the government could specify more clearly its goals to develop the country's IT infrastructure. From the Paris donor meeting in 1993, there are clear indications that several leading donors are willing to assist Vietnam more actively than before in its development of information and communications technologies.

In order to sell software products on international markets, Vietnamese software developers must assure buyers that their software will work with the buyer's system. To do this, developers should test their software with a wide range of computer systems, local area network configurations, and peripheral devices such as printers. By helping to establish facilities for the testing and verification of software products, the Vietnamese government could assist small software developers, interested in selling software internationally.

Such a testing facility would not cost very much for the central government or even a provincial administration. But it will be too expensive for a small software developer to buy all the equipment necessary to perform this kind of detailed testing and verification.*1 Program developers could rent the facilities by the hour to test their software. The center may also provide expert staff to assist software developers and help correcting problems as they arise.

A center like this could house a range of computer systems (such as 286-, 386-, 486-, and Pentium-based machines as well as a range of Apple computers) running a variety of operating systems (such as DOS Windows, UNIX, and Apple's System 7), linked together by a variety of networking systems (such as Novell Netware, Windows NT, and AppleTalk), and connected to a variety of printers, scanners, and monitors.

Chapter 14 Hardware production in the global context How could Vietnam find its niches?

Like computer software, the IT hardware is the final outcome of a long series of innovative activities taking place before the end-user can operate a computer system or enjoy a consumer product. Someone, somewhere, must conceive the product. Then, the product must be designed, manufactured, tested, sold, and installed. A similar



process of innovation must be carried out for each component that makes up the final product.

Much of modern electronics are based primarily on semiconductor technology, particularly integrated circuits. An integrated circuit is able to house millions of micro components (such as transistors, resistors, capacitors, diodes, etc.) on a single flake of silicon no larger than a thumbnail. But an integrated circuit by itself is of little use. Integrated circuits are only useful as one of many components that make up final products.

Final products are assembled from various semiconductors (including integrated circuits), bare circuit boards, connectors, wire harnesses, plastic or metal cases, picture tubes or flat panel displays, and the like. In this way semiconductors and other components are 'packaged' into final products. After the product is manufactured, it must be marketed, sold, distributed, installed, and, from time to time, serviced. If the product is to be used as part of a larger system, it must be 'integrated' into a systems design in order to be usable. In a highly simplified manner, Figure 4 outlines the various stages of production in electronics for both components (part A) and final products (part B).

Figure 4

Stages of production for electronic components and final products						
A) Components (such as bare circuit boards, semiconductors, and plastic cases):						
CONCEPTUALIZATION	Stages of Production			END USE		
Product Design	Manufacturing Design	Component Manufacturing		Distribution		
Stage 1	Stage 2	Stage 3	Stage 4			
B) Final Products (such as televisions, computers, and fax machines):						
CONCEPTUALIZATION	Stages of Production Manufacturing-Related Function				END USE	
Product Design	Manufacturing Design	Component Purchasing	Product Manufacturing	Systems Integration	Marketing Sales, Service	
Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	

SOURCE: BRIE (Berkeley Roundtable on the International Economy), University of California, USA.

For policy purposes, we use a very broad definition of "production" -- covering all stages of electronics production from conceptualization of a new product to its installation at the premises of the end-user -- in order to highlight the range of activities and actors involved in the IT industry. We treat manufacturing as an important, but not all-encompassing stage of production.

The optimal tools for government to support one stage of the long production process may be different than for other stages. For example, policies designed to encourage



'product design' (stage 1) may include market research, the formation of venture capital for start-up companies, and establishing computer aided design (CAD) centers. While policies designed to encourage 'manufacturing related functions' (stages 2 through 4 in part B) could include investment in CAD tools specifically intended for printed circuit board layout (stage 2), establishing connections with component distributors in Singapore and Hong Kong (stage 3), and helping to upgrade Vietnamese companies engaged in electronics production from hand assembly of printed circuit boards to automated assembly. Because of the special importance of software in systems integration (stage 5), policy recommendations for this stage of production were already discussed in Chapter 13 .

Global networks and regional specialization

Along with the integration of the world economy, in most product fields, the IT industry tends to be globally organized. Certain geographic regions or clusters have emerged which specialize in one or just a few aspects of production and/or in one or two product families. (1) Some of these regions have a very long history in the production of electronics.

But there is no real stability in this division of labor of the modern IT industry. New regions emerge and begin to play important economic roles in manufacturing of electronics, while the older regions may lose out or manage to sustain while reorienting themselves into a new specialization.

If Vietnam should advance its IT industries, what will be the country's regional specialization within the current context of the world economy? How will Vietnam fit into today's world-wide pattern of specialization of electronics production? What degree of flexibility will be needed in investments into Vietnam's new IT industry, if it should survive a very competitive and changing environment while continuing to grow?

In today's Vietnam, as we will see in Chapter 15, hardware production capabilities are even less well developed than the software sector, which is very small (cf. Chapter 13 above). From such a small beginning, it may seem unrealistic to develop all aspects of production in all product areas at the same time. Instead, policy makers in Vietnam could focus on creating a limited set of capabilities that would make sense for Vietnam's IT industry, given the current trends in the major electronics markets.

There are at least two separate strategies for the development of a viable Vietnamese IT industry. The two strategies have different objectives, but both could lead to an electronics manufacturing capability. One is the manufacturing of electronics components for international -- not local -- markets, using Vietnam as an internationally-oriented production platform. The other strategy is the making of final products and sub-assemblies.

The first strategy will probably be risky and expensive and would have to involve substantial investments, particularly from internationally operating contract manufacturers. Electronic components are typically produced in technologically advanced, high-volume manufacturing facilities that require large initial investments.



Strategic IT Plan – Country sample

We have already seen some attempts at component manufacturing for international markets being established in Vietnam. The most recent example is Daewoo, the Korean computer and consumer electronics company, which plans a joint venture to manufacture television picture tubes with Hanel, a Vietnamese electronics company owned by the Hanoi city administration. For Daewoo to succeed in its investment, most of the picture tubes will have to be exported. We should underline that the Vietnamese IT market is not large enough to justify the establishment of component production facilities that produce solely for the local market.

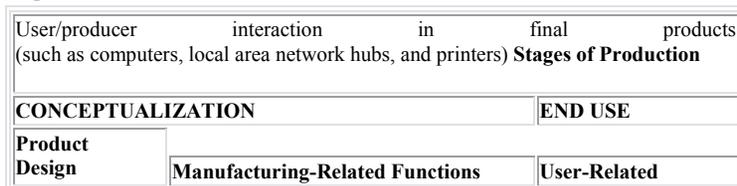
If implemented in Vietnam, this first IT industrialization strategy will have to involve a massive transfer of technology, since the production facilities will have to be built more or less from scratch. The single most important input from Vietnam to such an investment will not be capital but relatively cheap, well-trained labor. Because of severe price competition in electronics component markets, most foreign companies that would come to Vietnam for the manufacture of components will be seeking low wage rates. Contemporary Vietnam has one of the lowest wage rates in the world. (2)

This first IT industrialization strategy may be more risky than the second, since many electronics components used in IT products are widely available at low costs. Vietnam is located in a region which is especially rich in electronics components, so rich that many European- and US-based IT firms have set up 'international purchasing organizations' (IPOs) in South East Asia to procure parts to supply their own worldwide manufacturing operations. Because of the high level of competition in international markets for electronics components, particularly in East Asia, the profit margins of the producers tend to be low.

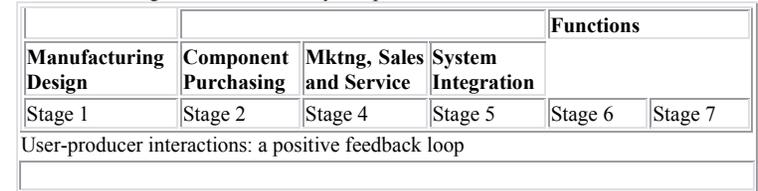
The second IT industrialization strategy takes a different departure. To implement this strategy, manufacturing facilities for final products, located in Vietnam, could easily purchase low-cost components from nearby vendors. The strategy would improve the country's own capacity to produce final IT products and sub-assemblies, while not contributing to the internationally organized manufacture of electronics components by very large corporations.

The strategy suggests that Vietnam builds capacities to manufacture at the product level. Product-level manufacturing capabilities will allow beneficial user-producer interactions in electronics and other IT. It is likely that people deeply involved in IT applications in Vietnam will have ideas about new products. Local product manufacturing capacity -- well-connected to the international supply-base for electronics components -- would ensure that entrepreneurs and advanced users would have the ability to implement their ideas quickly and effectively.

Figure 5



Strategic IT Plan – Country sample



SOURCE: BRIE (Berkeley Roundtable on the International Economy), University of California, USA.

Figure 5 presents a highly-simplified, schematic representation of user-producer interactions at the level of final products.

Intense user-producer interactions, enforced by mutual trust, allow advanced users to specify the requirements of new systems to product designers, speeding up the process of innovation. On the other hand, product designers can suggest to users what is technologically possible, allowing them to try new approaches in solving application problems.

This type of dynamic user-producer interaction stands out as one of the notable features of the regional clusters of activity in the modern IT industry.

Foot Notes:

1. For example, Singapore and Malaysia have developed a specialization in disk drive manufacturing, circuit board assembly, and final product assembly. South Korea has developed specialties in semiconductor manufacturing (DRAMs in particular) and consumer electronics. Phoenix, Arizona (USA) is the location of many firms (including Motorola) that specialize in manufacturing semiconductor and telecommunications products. Huntsville, Alabama (USA) is home to some of the largest contract manufacturers in the world. Contract manufacturers specialize in assembling circuit boards and final products for other companies on a subcontract basis. The area surrounding Dallas, Texas (USA) houses a cluster of semiconductor activity. Electronics companies in Japan are strong in many areas, but they are particularly so in consumer and industrial electronics. Japan also leads the world in the deployment of advanced manufacturing process technology, such as highly automated final product and circuit board assembly. The southern portion of the San Francisco Bay Area (known worldwide as Silicon Valley) has nearly every aspect of the electronics industry available locally. This is one of the reasons it is so resilient, dynamic, and innovative.
2. In October 1993, production workers in the state-owned electronics plants earned approximately US\$35 per month.