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AN OVERVIEW AND COMPETITIVE ASSESSMENT OF THE U.S. AND CANADIAN SOFTWARE PRODUCTS INDUSTRIES

INDUSTRY SCIENCE AND TECHNOLOGY CANADA

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EXECUTIVE SUMMARY

INTRODUCTION

The introductory section defines the Software Products (SP) sector and discusses difficulties with establishing its boundaries and categories. A simple taxonomy of software products is provided.

Further, this section briefly reviews some problems of software product quality and discusses several issues of portability and standards. Important problems and current issues in protection of and fashions in software products form separate subsections.

In the latter part of this section, the global markets for software products are reviewed. The world market for SP was in the range of US$60 billion in 1989. World markets are dominated by the United States which accounts for over a half of the world total. Of this world total, close to US$ 36 billion, or 60 percent of apparent consumption is in North America, with the U.S. enjoying 57 and Canada 2.5 percent world market shares. Overseas, 28.5 percent of the world market is accounted for by Western Europe, 5 percent by Japan and the remaining 7 percent by the rest of the world.

In the EC, which accounts for about 7/8 of Western European markets, apparent consumption was in the order of US$ 17 billion in 1989. Import penetration is in the 55-60 percent range. Virtually all the imported products are from the U.S.

In Japan, where the demand for software products is still much lower than in other parts of so called Triad (North America, Western Europe and Pacific Asia), the apparent market is climbing to US$ 3 billion. About half of the market is penetrated by imports, mostly of U.S. origin.

U.S. companies are the largest exporters of software products. The bulk of the US$ 10 billion plus exports goes to Western Europe, and a growing share to Pacific Asia.

OVERVIEW OF U.S. SOFTWARE PRODUCT INDUSTRY

The U.S. industry is the world's dominant supplier of software products. The companies headquartered in the U.S. dominate over 97 percent of their own US$ 34.5 billion domestic market and export at least US$ 10 billion to Western Europe and to

Pacific Asia. As a result, the U.S. industry supplied over US$ 44 billion of products, to these three markets in 1989, over 70 percent of global demand.

Some of the highlights of the overview are:

- Last year, there were approximately 13 thousand software products companies in the U.S. They range in size from one person companies to those with worldwide revenues of over US$ 1 billion.

- The industry employs 260 thousand persons, the largest companies employ several thousands of people.

- While the industry slowed down to 10-12 percent growth in 1989/1990, it grew on the average by about 20-22 percent a year in the 1980s. In 1988/1989, the most aggressive individual leading companies grew at much faster rates, at 50-150 percent a year, albeit not over the longer term.

- The most profitable companies achieved profits in the range of 15-20 percent of sales. The leading software companies exceeded US$200 thousand per person in revenues, and were at least twice as productive as the average SP companies.

- The U.S. SP industry derived close to 30 percent of its income from exports. The leading exporters derived over half of their income from abroad.

- The U.S. SP companies typically spend 8-12 percent of their revenue on R&D. In the leading firms R&D represents 20-25 percent of sales.

- The top SP companies are concentrated in 15 U.S. states, with California and Massachusetts in the lead.

The U.S. SP industry is a typical fragmented industry. There are only two companies with annual sales of US$ 1 billion, 30 companies with sales of over US$ 100 million a year, a further 130 with sales of over US$ 10 million, 850 with sales in US$ 2 -10 million and and 12,000 below US$ 2 million in annual sales. The industry is still fragmented for a number of reasons. Most important are low barriers to entry and a high variety of demand in the SP markets.

Mergers and acquisition in the U.S. SP industry have accelerated since 1980s. This pattern is expected to continue into at least the early 1990s.

COMPETITIVE ASSESSMENT OF THE U.S. SOFTWARE PRODUCTS INDUSTRY

The assessment of strengths and weaknesses of the U.S. Software Products industry is based on an evaluation of the four critical determinants of U.S. national competitive advantage, which shape the environment in which local firms compete. The methodology for assessment through the prism of the "Diamond of National Advantage" which is used here, is the one developed by Prof. Michael Porter of the Harvard Business School. It is summarized in the Appendix.

The four determinants of national competitiveness are the factors endowment, the demand conditions, domestic rivalry and situation in support industries.

First among the factor determinants are the unrivalled U.S. knowledge resources, reviewed at some length. Further, the U.S. is endowed with the largest pool of computer - educated human resources: more than 1.2 million people.

The U.S. risk-takers have accumulated large capital resources, despite a low savings rate and the higher cost of capital in this country. The U.S. venture capital (VC) industry is managing a pool of around US$ 31 billion, investing just above US$ 3 billion in 1990. Wealthy individuals and VC funds were instrumental in the development of the U.S. SP industry.

More recently, a number of large companies such as IBM have set up divisions or subsidiaries that invest in promising SP ventures.

The size of the U.S. economy with 250 million consumers, is the most prominent among U.S. physical resources. The U.S. offers a very agreeable lifestyle to SP talent. Finally, the U.S. offers SP firms an unrivalled continent-sized, transportation and communications infrastructure.

In the demand determinant, the U.S. comparative advantage is based not only on 250 million consumers, but also on a number of unique, sophisticated, independent buyers. Most prominent among them are the U.S. Department of Defense, (purchases over US$10 billion of software), IBM, other U.S. computer hardware manufacturers, large corporate users (such as GM), as well as large distributors.

The U.S. SP industry built its leading competitive position by a strong and early home demand, by unparalled growth rates, and by early penetration of European and Asian markets.

The U.S. SP industry's competitiveness is sustained by intensive domestic rivalry and by close cooperation with related industries, such as U.S. computer hardware vendors.

The U.S. government significally influenced the country's factors endowment: capital, human resources and knowledge. The DOD and other government procurement played a crucial role in stimulating the demand. This U.S. government complemented by export support initiatives. The government also influenced the structure of the industry by its anti-trust policies and by encouragement of U.S. consortia. The efforts to strengthen related industries, such as Sematech, are noted.

Table 3.8 (P.87) succinctly compares the U.S. position with its G-5 competitors. In all but three of the 20 dimensions, the U.S. SP industry rates first. It is not in danger of losing its world leading position in the next five years.

OVERVIEW OF CANADIAN SOFTWARE PRODUCT INDUSTRY

Canada is the third most intensively computerized country of the world, after the United States and the U.K.

In rough numbers, the size of Canadian market was close to C$ 1.5 billion in 1988. A good one third - C$ 460 million was supplied by hardware manufacturers, mostly from the U.S. IBM, Unisys and DEC are the leading software vendors. Of the total independent software product market of C$ 1 billion, only about a half was supplied by Canadian software producers. The other half was imported in one way or the other, mostly from the U.S.

The 1988 revenues of the Canadian SP industry reached C$ 640 million. Canadian independents supplied over a half a billion dollars - C$ 524 million - of software products to Canadian clients and exported C$ 306 million of software products in that year, to a total of C$ 830 million. The C$ 306 million of software exports includes, however, software produced by the Canadian-based IBM Research Laboratory.

Canadian software product revenues in 1990 totalled slightly less than C$ 1.1 billion. This figure represents 13 percent growth over the 1989.

The industry employs over 17 thousand people. There are close to three thousand SP firms, according to ISTC. There is one first-tier company, Cognos Inc. There is also a group of about 30 second-tier companies and a group of about 100 other companies with sales over C$ 2 million annually. The top 31 companies account for two thirds of industry revenue.

Growth of 13 percent is foreseen for the next five years. The same forecast also examines growth in a variety of industry segments.

Canada's SP industry is also fragmented, for reasons similar to those in the U.S.A.. Merger and acquisition activity has followed such activities elsewhere in this global business. A special feature in Canada is the takeovers of smaller Canadian firms by the U.S. competitors. The SP industry will likely continue restructuring in the 1990s.

COMPETITIVE ASSESSMENT OF THE CANADIAN SOFTWARE PRODUCT INDUSTRY

This assessment of the Canadian Software Product industry is based on four critical determinants of Canadian national competitive advantage. Again, the methodology of Porter's Diamond (for more on the Diamond, see the Appendix) is used.

In the factor determinant section, the Canadian position is analyzed in the following categories - knowledge resources, human resources, capital resources, physical resources and infrastructure.

Canadian universities, colleges, government research laboratories, private research facilities and statistical establishment are profiled. A comment on the availability of literature, as well as information resources concerning SP technology, markets and industry, concludes this subsection.

Canada has an important pool of 120-130 thousand well-trained software professionals. The employment picture in this area is not yet very clear.

Capital resources are a degree of magnitude smaller than in the U.S.. In 1989 the capital pool was C$ 3.3 billion, with disbursements of C$ 343 million in that year.

Individual investors play a crucial role in financing start-up companies. About seventy private venture capital companies are active in Canada, but nearly all are absent from early stage financing. For such private capital, the SP industry has to go to the U.S.. Public funds play an important role in the venture funding and represent one sixth of a total. Half of the investments in software companies come from public funds.

Proximity to the U.S. is one of the strongest competitive advantages of the Canadian SP industry. Canada is also competitive in business infrastructure with other OECD countries.

In the demand determinant, Canada suffers from a small domestic market. While the sophistication and discrimination of buyers is quite good, Canada does not have the immense clients, found in the U.S. Exporting to the U.S. market is imperative for survival of Canadian SP firms.

As far as rivalry determinant is concerned, a strong domestic rivalry has not developed in Canada. In Canada, rivalry is international, with competitors from the U.S. and from offshore. In the related industries determinant, the weakness in support industries (microelectronics, computer hardware) handicaps the SP industry.

The Canadian government has played a noticeable role in influencing all four determinants of national competitiveness.

The Table 5.1 (P.133) compares the Canadian competitive position with non-US G-5 competitors. In most, if not all of 20 dimensions, the Canadian SP industry is or could be highly competitive with its trade rivals from offshore.

INTRODUCTION

SOFTWARE PRODUCTS (SP) SECTOR

The focus of this paper, and in fact of the whole study "Benchmarking the Canadian and U.S. Software Products Industries" is the software products (SP) sector. Industry, Science and Technology Canada includes in the sector "companies whose primary business is the development and marketing of their own software products, ...".

There are few other sectors in the economy, where the difficulty to map the boundaries of a particular sector are as prominent as in the case of SP.

The problem with computer programs is that they come in so many shapes and forms and that they are supplied in such a variety of combinations. They are available as software, that is in reprogrammable form, or as firmware, embedded in the chips, to be read only. Firmware clearly does not form part of the sector. Furthermore, important types of software are beyond the sector boundaries. Software which is developed and used by individuals or within the same organization is not included,

because it is not sold in the marketplace. Much software is sold as custom software, tailor-made for a particular requirement of a particular user. Such an offering, if provided by value-added resellers, may however be based on another company's software product. The boundary between software products and customized software is becoming blurred, as the suppliers of SP are striving to customize and tailor their products and the suppliers of customized software increasingly rely on standard methods and reusable elements and blocks of software. In addition, software may be bundled, supplied with hardware, as part of a turn-key or customized system, offered by a variety of system integrators, value-added resellers, consultants or processing service companies.

Much software is produced by hardware manufacturers. Companies such as IBM, NEC, Unisys and DEC have been major developers of software. These are excluded from this study, as the primary focus of these companies is computer hardware.

A Software Product (SP), is understood to be a software program, sold or licensed in multiple, identical copies, not to be substantially modified by the user.

A Software Product Company (SPC) is a company, whose main business is producing and marketing its own SPs. Many such companies are also involved in providing various types of related computer services (such as consulting, third party maintenance or training), with proportion of the activities/services varying over time. The SP sector as defined here will include only the bona fide Software Product Companies.

A caveat is a must. It is clear that with so many overlaps, possible duplications, blurring of boundaries, as well as different interpretations of the inclusion or exclusion in individual categories, it is very difficult to obtain an absolutely clear picture of this very dynamic sector. Any intercompany and international comparisons must be made only with a greatest caution. The lack of statistics on the industry and differences in defining and categorizing software products, does not diminish the great importance of this sector.

SOFTWARE PRODUCTS (SP)

Software Product Taxonomy

There are tens of thousands of products developed by the software products industry, which can be categorized in several ways. In a simplest scheme, software products can be classified according to their computer platform and according to their function.

The software products have been traditionally classified as written either for large mainframes, for minicomputers or for microcomputers. By the beginning of the decade, however, there are in fact at least ten identifiable classes of computing machines, ranging from supercomputers to notebook computers. The trend towards rewriting software, developed for one model or one class of computers, for use on an another has been noticeable for some time.

Functionally, products belong to one of the two classes: systems software or application software.

Systems software helps the computer to manage their tasks. The systems programs that control basic functions of the machine, such as program and data read-in or managing of machine resources (e.g. memory, input/output), are called operating

systems (OS). The other type of system software are the tools, that perform generic functions close to the system that help in constructing new programs and maintaining existing ones. Some examples here are languages, (e.g. C, Cobol, Pascal, Basic, ADA), compilers and interpreters, utilities, graphics and database management systems. A new class of sophisticated system development tools is Computer Aided Software Engineering (CASE). Some analysts treat tools as a separate category, because it has become as large and as important as the systems software category.

The other type of software products are applications, programs that instruct the computer how to perform tasks for users. This category has also a number of tools programs that perform generic functions in proximity to the end user. We speak of horizontal applications, if the applications, such as text processing, graphics, accounting, planning and scheduling or engineering/scientific, can be used in a wide cross-section of industries. Vertical software is used by a narrower segments of users, such as programs for circuit design, income tax calculations, psychological testing, restaurant menu preparation, mortgage loans administration or toxic material identification. Educational software, with, for example Computer Assisted Instruction/Computer Assisted Training of grade-five mathematics or reasoning by analogy, and recreational software are often treated as separate categories.

Catalogues of applications software products have to be updated several times a year, so rapid have been releases of new products that today number in the thousands, if not tens of thousands. Some of the market segments, for instance word processing, are seen as overcrowded. Elsewhere the potential is barely scratched. To illustrate, to date most software products have provided tools for customers to use. With emergence of multimedia products, the products start providing not only tools, but also content.

Software Product Quality

A costly aspect of software product development is finding and fixing different categories of errors.

The quality of software is most important in SPs, because products have to be substantially better than programs developed in-house or by custom software developers.

The quality control concepts and techniques indeed do improve quality of software. Testing should be a part of each phase of the software product life cycle to determine not only correctness but also efficiency, usability and portability of the developed product.

It is increasingly understood that an overall test plan is critical to the entire software product development. Such a plan must be carefully designed, developed and implemented as thoroughly as possible.

A number of manual and automated techniques of program validation have been and will continue to be developed. For most applications, two types of testing are distinguished. Testing the internal operations of programs has been called "white box" testing. It tests how the system works. Testing external functions is referred to as "black

box" testing. It tests what the system is doing.

Because exhaustive testing is next to impossible, various testing tactics, such as the "extreme case", the "error seeding" or the "mutation", have been found to be quite effective.

Program testing strategies may divide the whole into testable parts in a top-down approach or build the whole from tested parts in bottom-up approach. Both approaches have their advantages and disadvantages.

The traceability matrix is used as key documentation for tests planning, execution, acceptance and maintenance. Structured walkthroughs are used to track test results. Error categorization and statistics are used as estimate problem severity and predict the extent of failure.

Years ago, W. Edwards Deming formulated principles for Total Quality Management (TQM). These principles, using statistical quality control techniques, are increasingly being applied to the software engineering of software products.

The state of testing in North America is far from ideal. The importance of testing is being increasingly recognized, as the Japanese software quality challenge becomes more real.

Portability and Standards

The users of software products are interested in as open an environment as possible. Independent software product vendors have been driven to provide portable software. The techniques for writing portable software have been gradually perfected.

Hardware suppliers traditionally have not promoted easy moves from one computing environment to another. With profound changes in the industry, marked by dramatically increased competition, they are starting to embrace open system concepts. To illustrate, in September 1990, NCR became the first large U.S. computer manufacturer to announce that its whole family of computers will run on standard systems software - MS/DOS and OS/2 at the PC level, Unix for higher levels.

The existence of standards greatly influences the possibility to develop freely portable software. There has been a significant progress towards developing standards, but the standards in software are yet to be finalized.

Standards come in two types - open and closed. In open standards, at least three types may be distinguished:

- o De jure, formally agreed upon standards involving International and National Standards Organizations, such as ISO or CSA. They are

the only standards with the force of law behind them.

Example: Open Systems Interconnection (OSI) of ISO.

- o De facto or so-called industry standards. These standards are established by practice, usually by some dominant user or supplier establishing a "good idea".

  Example: SQL (Structured Query Language) for interface with RDBMS or WINDOWS for graphical user interface (GUI).

  Often, the standards organizations will document an industry practice as a standard. Hence, formal standards may develop from a particular industry standard, after it has stood the test of time, or at least after it has been in use for a sufficiently long time.

- o Standards established by fiat. Influential, powerful users can establish a standard merely by announcing their view of the way the field should be.

  Example: ADA language established by Department of Defence.

The closed, proprietary standards work only on one vendor's equipment. These are quite numerous, with a variable coverage, some widely adopted, most very limited.

Example: SAA of IBM.

Software standards have been slower to evolve than say standards for peripherals interfaces. The main agreements have been on programming languages, such as those for Fortran, Cobol, and more recently for Basic, Pascal, Ada and C.

The agreement on operating systems has been slower in coming. The users have pressured for a single standard operating system-one that will work on any type of computer, allowing to mix-and-match hardware and software from different suppliers. Improper standardization has its own drawbacks. The risk of a standard made too soon, is a fossil, that needs updating. The risk of a standard, conceived too narrowly, leads to impossibility to communicate between incompatible systems. Ignoring international standards could become an obstacle to growth internationally.

The Unix operating system is making significant inroads into the marketplace. Although not yet dominant, it is already embraced by a significant percentage of uses.The strongest force helping its penetration are its features that enable distributed processing, such as a strong multiuser and multitasking capability, a relatively easy portability from platform to platform and an easy replicability in different sizes of solution systems.

The advance of Unix into marketplace still has to overcome several obstacles. Residual resistance by vendors to giving up the traditional preference for locking in their client base into their proprietary products is one. The existence of dozens

of versions of Unix is another one. The perception that Unix is too complex may be yet another one. The adoption of Unix will most likely come only gradually.

The intensity of the feud between Unix International (UI) and the Open Systems Foundation (OSF) over the Unix operating system, boiling for several years, is the best example of the complexity of processes involved in arriving at key industry standards. No wonder that standards are objects of strategic alliances of major industry players, as their particular form could determine who will control multibillion dollar sales. Standards must be seen as one of the most important driving forces of future competition in the marketplace.

Protection

The world of software is plagued by wide-spread unauthorized use and by piracy. The problems with property rights stems from several characteristics of software:

- o software is intangible, difficult to see, and thus not considered by many a real property;
- o software can be virtually instantaneously and easily reproduced, and that virtually without any limits;
- o software products are often seen as overpriced, offering in many cases more features than what an average user needs;
- o the useful life of many programs is short;
- o unauthorized use of software is difficult to detect and prevent, especially as a program exists simultaneously in a variety of forms (flow chart, source code, object code, firmware).

Moves to protect software in law as an intellectual property, provide three methods of protecting investment in its development: patents, copyright and trade secrets. Though similar in some ways, copyrights and patents are fundamentally different forms of legal protection. Copyright protects works that owe their origin to the expressive efforts of a creative individual. As long as a work is original in the sense that it was created independently, it can be copyrighted even if a closely similar work is already in

existence. A copyright owner has rights only against those who use his work without his permission. Software has traditionally been protected under copyright laws.

Both the criteria for obtaining a patent and the protection it offers are much greater than those applicable under copyright law. Patents protect the discoveries of inventors. A valid patent generally requires the invention of something that is both "novel", in the sense of never having existed before, and "unobvious", in the sense of being beyond the ordinary skill of an expert in the field. For as long as it lasts, the owners of a valid patent has a monopoly right to prevent anyone from using their invention, including other persons who have made the same discovery independently.

In software, patents do not cover specific computer programs; instead, they cover particular techniques that can be used to build programs, or particular features that programs can offer. Once a technique or feature is patented, it may not be used in a program without the permission of the patent holder - even if it is implemented in a different way.

Both copyrights and patents are frequently confused with trademarks, which are words or other symbols that have come to identify the source or sponsorship of merchandise or services Legal protection of trademarks is based not upon creative authorship, as in the case of copyrights, or upon inventive discovery, as in the case of patents, but upon the investment of time, money, and skill in selecting a mark and

inducing the public to identify it with a particular source of goods or services. Each of these three ways has its own prerequisites and protects certain aspects of software in different ways.

Unfortunately, the origins of patents, copyright and trade secrets predate the development of the computer. Computer software is a new and unusual subject matter for all three types of protection and it is not surprising that to date the courts have not arrived at a clear, widely-acceptable framework for analysis of software protection disputes. Each of the accepted methods of protecting software fails to address adequately at least one of the above problems. Outside of these methods, no other protection in law is available. Unfortunately, the act of creation does not, of itself, give an individual any intrinsic right to control the reproduction, dissemination, transmission or use of computer software. As a result, the legal protection afforded to software is not at all satisfactory and is surrounded by uncertainty and what is worse, varies from country to country.

Propelled by very substantial losses caused by piracy, the software Industries have pushed their national governments to strengthen national protection of intellectual property. The magnitude of losses is indeed staggering. The U.S. SP firms alone lose annually at least US$2-3 billion, according to the U.S. government estimates.

Throughout the 1980s, most of the OECD governments took a series of steps to strengthen and modernize their intellectual property systems. To illustrate, the Government of Canada substantially amended the Patent Act and strengthened the

Copyright Act, which provides explicit intellectual property protection to computer software.

Such national responses, alone are not adequate. Economic and political problems created by cross-border international piracy have emerged as the critical issue. Global solutions are needed. The OECD countries, lead by the United States, placed issues of trade-related aspects of intellectual property (TRIPs) on the agenda of the latest, Uruguay Round of negotiations under General Agreement on Tariffs and Trade (GATT). Against the strong objections of developing countries, they hoped to set minimum international standards for protection of patents, copyrights, trademarks and trade secrets and to agree on a code for enforcing the intellectual property rights. Despite fundamental differences in the two positions, a slow progress was made in the GATT talks.

The Uruguay Round of talks was, however, stalled over the inability of the U.S. and the European Community to reach agreement on another major issue (cuts in farm subsidies). If the current efforts to revive stalled talks succeed, by the end of 1991 the Uruguay Round of negotiations may be completed.

Thus, the search for good ways to protect software, whether by legal means, or otherwise, goes on. Until some adequate simple scheme is in place, a combination of administrative, legal, technical and commercial measures must be taken by each SP company to protect this form of intellectual property.

Fashions in Software Products

Comparisons have been made between software products and record industries. Both share the problem of intellectual property. The analogy is valid at least in one other aspect: presence of fashions and fads.

As in records, certain products become very quickly hits. In the games PC category, there are products, such as Karate Champ, that sold over 500,000 copies. In the business PC category, the products such as the Visicalc, Lotus 1-2-3, WordPerfect, Word or Excel, became the bestsellers of the time. Many consider Windows 3.0 the single most important software announcement of 1990. More than two million copies have been sold worldwide since. Understandably, each such product has legions of imitators. Usually, only one or two become most popular and are able to "shake off" competition.

Examples of the present fashions in classes of products are "virtual reality", "multimedia software", which combines sound, images (near-photo quality) and animation, with conventional text and graphics, "CASE", tools for improving software development productivity or "networking software" for operation of PC-based networks.

It is difficult to forecast transiency or permanency of these phenomena. Each of the fashions leaves a permanent residual. Take AI, for example. It came

oversold and now it is suddenly "demodee". However, expert systems are being incorporated into many diagnostic and financial analysis packages. Many emerging peripheral products, such as scanners or hand-writing tablets or speech inputs, are based on previous pattern recognition work.

MARKETS AND THEIR DYNAMIC STRUCTURE

Global Market For Software Products

Total software product market for 1989 is estimated to be in the range of US$60 billion, depending on whose data sources are used and how the dis-aggregation from custom software, integration, turnkey and services are performed. The figure is therefore useful for orientation purposes only. The world market is dominated by the United States which accounts for over a half of the world total. Of the world total, close to 60 percent of apparent consumption is in North America, with the U.S. having 57 and Canada 2.5 percent world market shares. Overseas, the 28.5 percent of the world market is accounted by Western Europe, 5 percent by Japan and the remaining 7 percent by the rest of the world.

Using the U.S. software product market figures (INPUT 1991) as a base, it is estimated that approximately two fifths of world software products market is in systems software, with three fifths in the application software product category.

Within the system software segment, 38 percent was in systems controls, 23 percent in operation management and 39 percent in tools for applications development. Within applications software, close to a one seventh is sold as a part of turnkey systems.

In 1989, the market was expanding at 12 percent a year for applications software and 13 percent for system software. For the next five years, growth is expected by INPUT to continue, at 14 percent rates, in both categories. If this were indeed a case, by 1995 the world market would double to US$120 billion.

In 1989, software products for mainframes accounted for 37.5 percent, for minicomputers 32.5 percent and for workstation/PCs 30 percent. Mainframe products account for close to half of systems software and less than one third of applications software. Minicomputer products account for about one third in both categories. The workstation/PC products account for one sixth of systems software, but 40 percent of applications.

If the present trends of growth continue, with 20 percent plus growth rates a year in workstation/PC categories and 10 percent or less in the larger systems, the 1995 structure of the market will significantly change.

By 1995, the market shares of the slower growing segments of software products for mainframes and minicomputer will shrink from present 37.5 and 32.5 percent to some 30 and 27 percent respectively. On the other hand, the market share for workstations/PCs will increase from the present 30 percent to 43 percent. In applications, these lower-end software products could account for more than a half of all applications markets. The fastest growing category is expected to be in operations management tools for workstations/PCs, where rates of growth might exceed 30 percent a year.

World Trade In Software Products

For software products, demand exceeds domestic supplies in Western Europe and in Japan. They are net importers, the U.S. is a net exporter.

In the EC, which accounts for about 7/8 of Western European markets, the apparent market was in the order of US$17 billion in 1989. Import penetration is in the 55-60 percent range. Virtually all the imported products are from the U.S.

In Japan, where the demand for software products is still much lower than in other parts of so called Triad (North America, Western Europe and Pacific Asia), the apparent market is climbing to US$3 billion. About half of the market is penetrated by imports, mostly of U.S. origin, but with some U.K., German, and French products as well.

U.S. companies are the largest exporters of software products. Microsoft derives 60 percent of its revenues form abroad. About a half of Lotus's sales and over one third of Borland are from outside the U.S. The bulk of the US$10 billion plus exports goes to Western Europe and a growing share to Pacific Asia.

The magnet of the United States, as the largest market of the world, has attracted US$700-800 million of EC exports, pre-dominantly from Germany, France and the U.K. The Japanese exports, other than the embedded software and videogames,

have been minimal to date.

Both the Europeans, and more recently the Japanese, have started to advance to the U.S. by acquiring parts of or taking over established U.S. software product companies. The increased worldwide investments into software product industry are creating fear in the U.S. that such trends will accelerate, and that the U.S. will see its software product industry challenged, with its leadership eroded.

SECTION TWO

OVERVIEW OF U.S. SOFTWARE PRODUCT INDUSTRY

The U.S. industry is the world's dominant supplier of software products. The companies headquartered in the U.S. dominate over 97 percent of their own US $34.5 billion domestic market and export at least US $10 billion to Western Europe and to Pacific Asia. In 1989, the U.S. industry thus supplied over US $44 billion of products, over 70 percent of global demand.

PRESENT INDUSTRY STRUCTURE

Last year, there were approximately 13 thousand software products companies in the U.S. They range in size from one person companies to those with worldwide revenues of over US$1 billion. At the top, there are two companies with 1990 sales of well over US $ one billion: Computer Associates International (CA), with US $1.3 billion 1990 revenues and Microsoft Corporation with US $1.28 billion. In 1989, CA became the first company to exceed the US $1B revenue barrier, but by 1991 it seems that it will be overtaken by Microsoft, which claims that its sales in 1991 will increase, to over US $1.5 billion. In 1990, there were furthermore over thirty companies with sales of over US $100 million in the U.S. industry ranks. The top independents are listed in Table 2.1.

Table 2.1 The Top U.S. Independent Software Vendors (1990)

Rank	Vendor	Software Products Revenues (US$ Millions) 1990	
		Worldwide	U.S. Only
1	Computer Associates International	$1,310.0	$720.9
2	Microsoft Corporation	$1,276.0	$575.8
3	Lotus Development Corporation	$ 684.0	$358.4
4	Oracle Corporation	$ 677.7	$311.7
5	Dun & Bradstreet Corp. Software Services	$ 539.0	$360.0
6	WordPerfect Corporation	$ 407.2	$325.8
7	Novell	$ 398.0	$238.8
8	SAP AG	$ 286.0	$ 16.0
9	Software AG of N. America	$ 260.6	$ 54.7
10	SAS Institute, Inc.	$ 240.2	$126.8
11	Ask Computer Systems, Inc.	$ 239.7	$189.6
12	Autodesk Inc.	$ 237.8	$126.3
13	Ashton-Tate Corporation	$ 227.8	$ 78.4
14	Pansophic Systems, Inc.	$ 215.3	$124.7
15	Cincom Systems, Inc.	$ 207.7	$ 78.9
16	Borland International Inc.	$ 183.7	$118.5
17	Legent Corporation	$ 175.7	$106.0
18	Information Builders, Inc.	$ 167.3	$105.4
19	Software Publishing Corporation	$ 153.5	$115.6
20	Candle Corporation	$ 151.4	$ 75.6
21	McDonnell Douglas Systems Integration Co.	$ 132.0	$ 88.0
22	BMC Software Inc.	$ 125.0	$ 76.5
23	Informix Software, Inc.	$ 121.3	$ 66.7
24	American Management Systems, Inc.	$ 120.9	$105.6
25	Aldus Corporation	$ 120.1	$ 62.5
26	The Santa Cruz Operation, Inc.	$ 111.8	$ 61.5
27	Goal Systems	$ 110.0	$ 70.4
28	Systems Center, Inc.	$ 105.0	$ 54.0
29	Compuware Corporation	$ 105.0	$ 63.0
30	Cognos Inc.	$ 103.5	$ 41.2
31	Comshare, Inc.	$ 103.0	$ 50.0
32	Symantec Corporation	$ 101.9	$ 83.6
33	Boole & Babbage, Inc.	$ 100.2	$ 59.1

(Source: Software Magazine)

At the low end, the smallest companies are born and die virtually daily, the precise census is therefore difficult to keep up to date.

The industry employs 260 thousand persons. The largest companies employ thousands of employees. Computer Associates International leads here, with approximately seven thousand. Microsoft Corporation had by the end of 1990 close to 6,800 employees. The smallest companies are companies with one or several employees.

While the industry slowed down, to 10-12 percent growth in 1989/1990, the industry grew in the average by about 20-22 percent a year in the 1980s. In 1988/1989, the most aggressive individual leading companies, grew at much faster rates, still at 50-150 percent a year. Table 2.2 provides a list of top ten companies with fastest revenue growth in 88/89. The list includes both acquisition and non-acquisition growth.

Table 2.2 Top Ten With Greatest Revenue Growth (1988 - 1989)

Rank	Company	%
1	Cadre Technologies Inc.	160
2	Knowledgeware	147
3	D&B Corp.	125
4	Attachmate	100
5	Microfocus Inc.	65
6	Informix	60
7	WordPerfect Corporation	57
8	Autodesk	52
9	BMC Software Inc.	51
10	Santa Cruz	49

(Source: Software Magazine)

Only a few companies could sustain such growth over even a medium-term period. Five companies with fastest growth over a medium term (1983-1988), are listed in Table 2.3.

Table 2.3 Fastest Growing Companies, 1983–1988

Rank	Company	Five-Year Growth (CAAGR)	
		Sales (%)	Profits (%)
1	Oracle Systems	123.7	130.6
2	Ashton-Tate	76.2	113.7
3	Computer Associates	64.9	79.4
4	Microsoft	63.8	80.4
5	Lotus Development	64.6	33.8

(Source: Electronic Business)

It is interesting to note that by 88/89, none of these five companies continued their growth with rates exceeding 50 percent a year.

The largest companies were also among most profitable. Table 2.4 lists top five profit makers of U.S. for 1988. By 1990, at least two of the previous profit leaders - Ashton Tate and Oracle Systems - suffered losses.

Table 2.4 Most Profitable Software Companies (1988)

Rank	Company	Profit as a % of Sales
1	Microsoft	21.0
2	Ashton-Tate	15.6
3	Oracle Systems	15.2
4	Computer Associates	14.4
5	Lotus Development	12.6

(Source: Electronic Business)

The leading software companies are at least twice as productive per employee than average companies. The 1989 their revenues per employee were in the order of US$200 thousand plus per person. Table 2.5 lists the top ten in that category in 1989.

Table 2.5 Top Ten Companies In Revenue Per Employee 1989

Rank	Company	Thousand of Dollars
1	System Software Assoc.	$250
2	Software Eng. AM.	$250
3	Software Pub.	$240
4	Attachmate	$217
5	BMC	$214
6	ASK Computer	$202
7	Microsoft	$201
8	Computer Assoc.	$200
9	Lotus	$198
10	Ashton-Tate	$186

(Source: Software Magazine)

The U.S. Industry as a whole derived close to 29 percent of their income from abroad in 1989. The tendency to export is much stronger among the leading companies. For the top 50 companies, the revenue from sales outside of the U.S.A. was 35 percent, with five leading exporting companies substantially above this mark. For these, half or more of their income comes from exports. Table 2.6 ranks the leading five exporters.

Table 2.6 Top Five Software Product Exporters In 1989

Rank	Exporter	Exports %
1	Cincom Systems Inc.	66
2	Microsoft	56
3	Autodesk	55
4	Comshare	50
5	Informix	49

In the 1980s, software companies typically spent 8-12 percent of their revenues on R&D activities. By 1989, R&D outlays shrunk in comparison with previous years. The leading software companies still spent 20-25 percent of their revenue on R&D. This amounted to tens of thousand and in several cases over a hundred million dollars a year. The Table 2.7 lists the top ten R&D spenders in absolute terms, and as a percentage of their revenue (in 1989).

Table 2.7 Top Ten Leading R&D Spenders, 1989

Rank	In Millions of Dollars		Rank	In Percent of Revenue	
1	Computer Associates	$170	1	SAS Institute	45%
2	Microsoft	$110	2	Ashton-Tate	26%
3	Lotus	$110	3	BMC	25%
4	SAS Institute	$ 93	4	Softlab	24%
5	Ashton-Tate	$ 69	5	Legent	23%
6	Software AG	$ 59	6	Compuserve	20%
7	Compuserve	$ 40	7	Software AG	20%
8	McDonnell Douglas	$ 35	8	Lotus	19%
9	Legent	$ 33	9	Ingres	19%
10	Novell	$ 31	10	Boole	18%

(Source: Software Magazine)

In 1990, a year of recession, R&D outlays dropped somewhat. To illustrate, Ashton-Tate dropped from 26 to 25.9 percent, Lotus from 19 to 17 percent. However, Microsoft's R&D climbed from 12 percent in 1988 to over 15 percent by 1990. With increased revenues, the R&D budgets have increased in absolute terms to substantial amounts.

Regional Distribution of the U.S. SP Industry

The top fifty U.S. independents are headquartered in the following fifteen U.S. states:

California	16
Massachussetts	4

Virginia	4
Washington	3
Ohio	3
Texas	3
Illinois	2
Michigan	2
Georgia	2
Utah	2
North Carolina	1
Maryland	1
New Jersey	1
Oregon	1

This geographical distribution corresponds well to the geographical distribution of the leading high technology clusters around the country. In California, the clusters are known as Silicon Valley and Orange County. In Massachussetts, it is Route 128. The Virginia and Maryland companies are in the Washington, D.C. watershed. The Metropolitan New York and New Jersey cluster serves as a magnet for companies located in these two states. The Seattle cluster influences the companies in the state of Washington. In Texas, it is Dallas/Forth Worth and Houston, in Ohio, Columbus cluster. In fact, these 15 locations map perfectly into the top thirty technological clusters of the U.S.A. Each of the "software" states offers a pool of talent, attracted by the presence of high technology firms, from which to recruit, as well as presence of research universities or government laboratories, the source of talent and knowhow. It is no coincidence, that venture capital is often present as well, as for instance in California, Massachusetts or in New York/New Jersey. Government procurement is the attraction of Washington, D.C. The aerospace industry is the economic engine in the state of Washington.

Each of these fifteen states has in place a program (some have more than one) dedicated to high technology-based economic development. Each of these states has at least three university-based centers. A number of these states offer matching grant programs to companies that will work with universities to develop new products or technologies. Many states offer helpful advanced education programs. All the states offer job training to new or expanding companies. With the exception of California, all there states offer technical assistance to the companies. Last but not least, each "software" state offers some form of state loans or state grants or both, sometimes in multiple form. Table 2.8 provides an overview of the top fifteen SP states. Interestingly, there are also fifteen U.S. states, ranging from Alabama to Wyoming, that have none of the above features, programs and incentives in place. Not a single important SP company has located there.

Table 2.8

Leading U.S. Software Product States

Stage	Overall HTD Thrust		High Technology Education			Labor and Technical Assistance		Capital Assistance Programs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	High tech development programs	Task force or council	University based centers	Research grants	Other university programs	Industry training w/state funds	Technical assistance	State loans	State grants
California	1		3	Yes		Yes		1	
Georgia	1	Council	3		Res. consortium	Yes	1	1	
Illinois	2		3		HS programs	Yes	2	1	1
Maryland	2	Task force	3			Yes	2	4	
Massa-chusetts	2		5	Yes	Teacher training	Yes	3	2	1
Michigan	2		3-4	Yes	Dbase net.	Yes	3	3	2
New Jersey	1		5	Yes		Yes	3	2	
New York	2		5	Yes	Scholarships	Yes	4	3	
North Carolina	2		3-4	Yes	Math & Science HS	Yes	2		1
Ohio	1		5	Yes		Yes	2	2	1
Oregon	1		3	Yes	High tech educ. council	Yes	3	3	
South Carolina	1	Task force	3			Yes	3	1	
Texas	1	Council	3-4	Yes		Yes	1	1	
Utah	1	Council	3	Yes		Yes	1	1	1
Virginia	1		3-4			Yes	1	1	
Washington	1		3-4	Yes	TV courses in engineering	Yes	1	1	

(Source: Office of Technology Assessment)

SOFTWARE PRODUCT INDUSTRY CHARACTERISTICS

Software Product Industry is a fragmented industry. There are some relatively strong vendors, as well as many very small vendors in this industry, most just hovering above the viability threshold.

By size, the U.S. SP industry firms can be classified into at least the five categories, of the Table 2.9.

Table 2.9 Classification of U.S. SP Firms

Type	Annual Revenues (US$)	Number in Class (1989)
Very large (giants)	More than 1 B	2
Large (first - tier)	100 M - 1 B	30
Medium (second - tier)	10 M - 100 M	130
Small (third - tier)	2 M - 10 M	850
Very small	Less than 2 M	12,000 (approx.)
U.S. SP Industry Firms	Total	13,000 (approx.)

(Source: U.S. Department of Commerce)

Industry concentration/fragmentation is in other industries measured by the market share of the top four flight or fifty companies.

The top four and the top eight companies in the U.S. software product industry did account for less than seven and ten percent of total revenues respectively. Even the top 50 companies represent no more than one fifth of the industry revenue in that year. (To put this volume in perspective, IBM produced as much software products as the top 50 software products companies combined).

The industry is thus a still typical fragmented industry. In fragmented industry no one firm has a market share large enough to control industry direction. The emerging leading position of Microsoft Corporation in some critical segments of the market has became notable lately. Some other companies have emerged as leaders in their product lines as well. The industry is still, by and large, populated by small and medium companies, mostly privately held.

The industry is fragmented for a number of good reasons. First of all, it is still a young industry, no more than 22 years old. At least seven forces continue to keep the industry fragmented.

- o Production aspects of the software product industry have had extremely low barriers to entry;

- o Significant economies of scale are absent in production aspects of the business;

- What is more, the industry manifests some diseconomies of scale in creative activities, where talent often performs rather poorly in large organizations; (for more, see Frank, W. Critical Issues in Software)

- Frequent new products introductions tend to favour smaller firms;

- High diversity of products reflecting a variety of platforms and services of many widely different vertical niches, often requiring customization, tends to favour smaller specialized firms;

- Close control and supervision is required for successful development of software products;

- Significant owner - manager barriers of exit exist, due to appeals of software writing, even if the profitability is low.

To sum up, there are several good reasons why this industry remains fragmented, although increasing concentration is evident.

Merger and acquisition activity in the software products industry has accelerated since mid-eighties. This pattern will continue at least into the early 1990s, based on expectations for a continuing company/product shakeout in a maturing industry. Thus the industry is in the process of transforming itself. Many of the transactions are huge,(see Table 2.10).

Table 2.10 Top Software Deals - 1989

Firm Acquired	By Whom	Price (Mil. $)
Telerate (33%)	Dow Jones	670
McDonnell Douglas (Tymnet)	British Telecom	355
Management Science America	D & B	333
Cullinet	Computer Associates	306
GTech	LBO	290
ISC Systems	Olivetti	174
Control Data (Ticketron)	Carlyle Group	150
ISI Systems	Memotec Data	130

(Source: Broadview Associates)

Several trends are leading to consolidation in this fragmented industry. Some of the important drivers are:

- o Dearth of venture capital for software companies, forcing second- and third-tier companies to offer themselves for acquisition;

- o Costs of developing products have sky-rocketed, as they must be offered simultaneously in several operating systems (UNIX, DOS/Windows, VMS, Mackintosh, OS/2); and in several international markets;

- o Lack of qualified human resources, especially in management but also in software development;

- o Drive for economics of scale in marketing, as the cost of marketing has sky-rocketed even more than costs of production;

- o Drive for economies of scale in distribution;

- o Customers require total solutions forcing alliances between suppliers of compatible components;

- o Standardized products erode margins, offered by small companies, by reducing price;

- o The trends towards modularized products tends to favour larger companies, who can organize larger configurations;

- o Lack of market access to the overcrowded retail outlets forces mergers of production-rich, distribution-poor companies with "tired" companies having strong market access;

- o Threat of substitution by firmware forces smaller commercial players out of business.

The large players of the U.S. computer industry, or some of the foreign companies have become recently involved in the small independents as minority shareholders. An example here includes IBM's recent investment in more than a score independent software companies, most importantly in Lotus Development Corporation.

Furthermore, formation of alliances has been very intense. Several types of alliances have emerged as popular:

- o third party (most popular, including VARs)

- o co-marketing (esp. IBM, HP)

- joint development (e.g. Tandem's T.I.M.E.)

- strategic relationships (longer-term, e.g. IBM-15).

Alliances are effective for leveraging individual resources and for providing synergy in all stages of the value chain. As a result of these and other trends, the market-oriented part of the industry will likely further consolidate in the 1990s.

SECTION THREE

COMPETITIVE ASSESSMENT OF THE U.S. SOFTWARE PRODUCTS INDUSTRY

Any strategic assessment of strengths and weaknesses of the U.S. Software Products Industry should be based on a systematic evaluation of the most critical determinants of U.S. national competitive advantage, that shape the environment in which local firms compete. The methodology for assessment through the prism of the "Diamond of National Advantage" used here, was developed by Prof. Michael Porter of the Harvard Business School. Its basics are summarized in the Appendix to this paper.

ADVANCED FACTOR CONDITIONS

In this section, the U.S. position in advanced factor endowment is analyzed in the following categories - knowledge resources, human resources, capital resources, physical resources and infrastructure. Only the first three can be discussed at length. So far, the U.S. companies have proven to be the best in mixing these factors for their competitive advantage.

Knowledge Resources

Unrivalled U.S. knowledge resources, relevant to software products, have been accumulated in the country's universities and colleges, in government research laboratories, in private research facilities, in a fine statistical establishment, in the body of scientific and industry literature, and in a number of specialised firms providing reports and data bases about software trends, industry and markets.

Universities and Colleges

The United States entered the 1990s with an unmatched university and college system. Over seven million students are enrolled in about 3,400 institutions of higher learning, taught by 700 thousand faculty members. The U.S. also spends more than any other country in the world on education, over $400 billion, 7.5 percent of GNP.

There are 184 research universities and Ph.D. granting institutions. The top twenty receive 40 percent of all federal funds. The excellence of the top technical institutions such as M.I.T. on the East Coast or Stanford University and Cal Tech on the West Coast, of the other leading universities such as University of California, Carnegie-Mellon, Cornell, Michigan, Pennsylvania, Texas or Utah, is known all over the world. Graduate students from abroad flock to them in large numbers. The top computer-related faculty is rarely matched elsewhere.

Government Research Institutes

There are over 700 government-owned R&D facilities, including the largest national laboratories. They collectively perform some US$17 billion of R&D.

Some fine examples of government facilities contributing to the U.S. technological capability include the Institute for Defence Analysis, Research Analysis Corporation (RAC), or Centre for Naval Analysis within Department of Defense, Los Alamos, Lawrence Livermore or Argonne National Laboratory of the Department of Energy. The National Aeronautics and Space Administration's Centers (e.g. Goddard, Ames, JPL, Johnson, Lewis or Marshall) produce some of the best software programs, available through the Computer Software Management and Information Center (COSMIC).

Government Agencies

In the legislative branch, several agencies produce quality reports; some of them contributing to the strength of SP industry.

Congressional Research Service (CRS) and Office of Technology Assessment (OTA) are the two most relevant agencies here. They have the capability of a very thorough policy assessment of a number of industries, including computer-related ones.

In the Executive Branch, the Office of Science and Technology Policy (OSTP) and the Federal Coordinating Council for Science Engineering and Technology ("FIXIT") are the two leading policy making agencies.

The role of the government in creating demand conditions for the industry will be discussed later. Here we shall focus only on the role of the government as a knowledge resource. Some of the key government agencies influencing the development of the industry include:

- The Defense Advanced Research Project Agency (DARPA), which functions as the source of information on the trends in the technology for the Department of Defense.

- The Office of Secretary of Defense (OSD), which guided the ADA, START and SDI initiatives.

- National Science Foundation (NSF) which provides directions for national computing networks.

- Office of the Chief Economist within the Department of Commerce. Several of agencies reporting to this office provide objective statistics and analysis to the SP industry:

- Bureau of Census
- Bureau of Economic Analysis
- Bureau of Industrial Economics
- Office of Federal Statistical Policy and Standards

These agencies have scores of experts that provide companies with data on industry or market trends.

o Institute of Computer Sciences and Technology within the National Institute of Standards and Technology (NIST), an agency affiliated with the Department of Commerce, has a highly regarded technical group of 250 experts who work with the industry on computer-related standards.

Private Research Institutes

A number of private research institutions, whose work contributed to the development of computer programming, is located in the U.S.A.

Among the leading institutions, one should mention at least AT&T's Bell Laboratories. They are a national resource of strategic importance. So are IBM's research laboratories at Yorktown Heights and in San Jose.

In addition, other leading private research institutes are:

- o Rand Corporation
- o System Development Corporation
- o Stanford Research Institute
- o Arthur D. Little
- o Batelle Memorial Institute
- o MITRE Corporation

Private Market Research and Information Provider Firms

In addition to several hundred consulting companies, lead by international firms, such as (alphabetically) Arthur Andersen & Co., Coopers & Lybrand, Deloitte & Touche, Ernst & Young, KPMG Peat Marwick Thorne and Price Waterhouse, there are close to 150 research companies in the U.S. that analyze computer industry and markets, including software products.

Among the largest companies are (alphabetically): Computer Intelligence, Datapro Research, Dataquest, Focus Research Systems, Find/SVP Inc. Frost & Sullivan, Gartner Group, Input and International Data Corporation. While all cover the whole industry, they differ in level of analysis and quality of data bases provided. Medium-sized companies and boutiques focus on some aspects of the industry. Examples here might be Broadview Associates, specializing in mergers & acquisitions, Technology Transfer Institute in seminars on software development, or Venture Economics in tracking venture

capital industry and start-ups.

There is also a score of major information retrieval services, with access to hundreds of computerized databases. Alphabetically, some of the larger firms are Compuserve, Dialog, Dow Jones News, Orbit, Mead (Nexis), Reuter, The Source and Western Union Informaster.

The U.S. are also a base for over a dozen computer product testing firms. The pack is lead by National Software Testing Laboratories Inc.

Publications

The U.S. is a base for a number of outstanding publishers, such as McGraw Hill, Prentice Hall, Addison Wesley or Harper & Row, that produce hundreds of publications on computers every year.

Close to 200 computer magazines and newspaper serve the U.S. computer community. Some thirty magazines have a circulation of more than a hundred thousand readers, several over a half of a million. PC magazine produces over 750 thousand copies. In addition, there are at least 150 newsletters that focus on specific aspects of the computer industry. The quantity and quality of available information on technology, markets and companies allows the U.S. competitors to work with a sharper picture of their competitive environment.

To sum up, no other country in the world has generated such an abundance of knowledge resources in the computer industry as has the U.S..

Human Resources

The United States is endowed with the largest pool of computer-educated human resources. More than 1.2 million people derive their income from using the computer professionally. Large pools of talent are to be found in the user companies, working on the demand side of the market place.

The computer industry employs hundreds of thousands of personnel on the supply side. The Table 3.1 provides a picture of employment in the industry in the 1980s.

Table 3.1 U.S. Computer Industry Employment (000's)

Industry Subsector	SIC Code	1983	1985	1986	1987	1988
Computer Programming and Software	7372	136.8	192.8	213.7	237.4	280.1
Data Processing Services	7374	215.1	253.3	272.1	300.2	328.0
Computer Related Services	7379	63.1	63.7	98.4	100.9	120.4
Computer and Data Processing	**737**	**415.0**	**514.6**	**584.2**	**638.5**	**728.5**

(Source: U.S. Department of Labor, Bureau of Labor Statistics)

The estimate and projection of the demand for U.S. software workforce by occupation is given in the Table 3.2.

Table 3.2 Distribution of Software Workforce by Occupation in the U.S.A.

Occupation	1986 Jobs	2000 Jobs	% Growth
Computer Programmers	479,000	814,000	70
Systems Analysts	331,000	582,000	76
Other Specialists	38,000	59,000	54
Total	**848,000**	**1,455,000**	**71**

(Source: Bureau of Labour Statistics
U.S. Department of Labour)

The increased demand for software specialists comes from the trends towards more outsourcing by users and to provide the customer with a solution tailored to the specifics of the company involved, where a standard software product is complemented by service and consulting.

The demand for software specialists thus exceeds the supply. The supply of software programmes grew at 35 percent a year in 1980-1982, at 17 percent in 1982-1986, but in fact declined since then. Last year, only some 27 thousand B.Sc. students graduated in computer science, compared with over 40 thousand in 1986. Critical shortages have appeared in most of the categories of software personnel. In

management, the gap exists in the categories of CEOs, CFOs and in Director of Marketing. In staff positions, the critical shortages have been most pronounced in the senior systems development and consultant categories.

The industry copes with the shortage in several ways. Software specialists are recruited abroad, in the U.K., in Canada and in Australia. Software writing is also farmed out to countries such as Singapore or India. Efforts to increase programming productivity proliferate.

Capital Resources

The pool of capital available in any country is determined primarily by a nation's savings rate. On this score, the Americans have accumulated large capital pools, despite the fact that traditionally they saved less than offshore competitors. The overall net U.S. average savings rate was historically 7.5 percent. In the 1980s, the situation deteriorated as the average dropped to 3 percent, with progressive reduction in the second half of the decade. Corporate saving has also fallen in the 1980s. The government deficit has risen, absorbing substantial private savings and net foreign borrowings.

Real interest rates have risen in the U.S. from the lowest in the world in 1950s, to among the highest in the 1980s. As the capital is being raised both through debt and equity, the cost of capital cannot be measured simply by the cost of such borrowing.

Nevertheless, some reasonable estimates of the overall cost of U.S. capital can be made. The cost of capital is higher in the U.S., compared to offshore competitors. The real after-tax cost of funds oscillated in the 1980s around six percent, while for instance in Japan, it was less than two percent.

To sum up, the Americans do not save a lot, the cost of capital is high and yet there are large pools of risk capital in the U.S.

The explanation lies in the fact that the Americans, compared to other nations, are greater risk-takers. Several main categories of risk capital market players are relevant to the formation of SP companies. They are individual investors, venture capital investment funds, small business investment corporations (SBICs), investment banks and venture capital subsidiaries of large firms.

Only the most important categories of "individual investors", "funds" and "large companies" will be discussed.

Individual Investors

The U.S. start-up companies receive in fact substantially more financing from the wealthy entrepreneurial individuals than from venture capital funds. These individuals bring to companies not only capital but also added value of the experience of successful high tech entrepreneurs, with first-hand exposure in areas such as Silicon Valley or Route

128. These high-risk taking pools of capital are unique to North America. Even within the U.S. there are regional differences. This capital it is to be found in California more often than elsewhere.

Funds

The U.S. funds venture capital (VC) industry made up of 650-plus firms. Of this number, no more than 80 are larger than US$100 million in paid-in capital. About a third - some 220 - are in fact smaller than US$10 billion. Over a half of the VC firms are in the US$10 - 100 million range. The pool of money under their management rapidly expanded to and has stabilized around US$31 billion. Some of the most active firms are listed in Table 3.3.

Table 3.3 The Top 20 Most Active U.S. Venture Capital Firms 1988

1988 Rank	1987 Rank	Total 1988 Investments ($M)	Total 1988 Investments # of Deals	Firm	Location	1988 Paid-In Capital ($M)
1	1	644	49	Warburg, Pincus Ventures Inc.	New York, NY	1321
2	3	246	49	First Chicago Venture Capital	Chicago, IL	506
3	8	202	68	Aeneas Venture Corp.	Boston, MA	NA
4	-	164	63	Schroder Ventures	New York, NY	336
5	12	144	69	BancBoston Capital	Boston, MA	NA
6	5	120	76	Security Pacific Capital Corp.	Costa Mesa, CA	277
7	7	100	21	Morgan Capital Corp.	Wilmington, DE	NA
8	13	98	284	Clinton Capital Corp.	New York, NY	54
9	11	95	40	Chemical Venture Partners	New York, NY	300
10	-	9	6	Boston Ventures Management Inc.	Boston, MA	150
11	-	8	21	TA Communications Partners	Boston, MA	NA
12	15	84	34	Manufacturers Hanover Venture Capital Corp.	New York, NY	206
13	10	75	50	Hillman Ventures, Inc.	Menlo Park, CA	NA
14	9	70	61	Hambrecht & Quist Venture Partners	San Francisco, CA	650
15	-	70	15	Frontenac Co.	Chicago, IL	331
16	4	60	42	TA Associates	Boston, MA	378
17	38	58	150	John Hancock Venture Capital Management Inc.	Boston, MA	533
18	16	57	13	Prudential Venture Capital Management Inc.	New York, NY	201
19	23	56	44	Sprout Group	New York, NY	127
20	14	55	151	New Enterprise Associates	Baltimore, MD	284

(Source: Venture)

Net new venture capital investments have been declining since 1987, from close to US$5 billion to just above $3 billion by the end of the decade.

* * * * * *

A Short History of the Funds

The U.S. funds industry evolved in three distinct phases.

In the late 1970 and early 1980s, venture capital rapidly expanded on the high technology and stock market boom. The expansion was helped by easing of regulation, admitting pension funds to participate in ventures and by lowering of the tax on long-term capital gains. The successful ventures, such as DEC, Tandem Computers or Apple Computer, provided investors with annual yields as high as 50 percent.

Predictably, such success attracted oversupply of capital that started to overcrowd the "interesting" niches. To illustrate, in Winchester discs, US$6 billion chased US$1 billion of business opportunity. The resulting fiascos and the 1987 stock market crush ended this phase of evolution of the industry.

In the next phase, characteristic for the latter part of 1980s, the funds rushed to invest into leveraged buy-outs (LBOs), which promised not only high returns but also a much shorter turnaround of invested funds. The collapse of junk bonds and some spectacular failures of LBOs lead to a near-death of activity, ending the second phase of development of the industry.

By the end of the decade, the industry has started to return to its roots, to seed and expansion financing, but still reluctant to invest into start-ups. The "seeds" risk relatively modest funds. The expansion cases promise a turnaround of capital in three years. However, more risky start-ups require 5-7 years of patience. No more than 10-12 percent of investment were into start-ups. On the backdrop of the recession, a much more cautious attitude prevails. The caution of investors is reflected in substantially reduced new investments. As a result, the industry's ranks are being trimmed as well.

(Source: Adapted from Financial Times of London)

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Portfolios of the funds have diversified lately, away from high tech in general, and from information technologies in particular. Even software product companies, most successful in high tech industry, find it increasingly difficult to attract VC funds.

The role of the venture funds was particularly important for the software products industry, where barriers to entry were low, where entrants were numerous, but where traditional sources of credit to finance a rapid development were scarce, as software products have been seen as relatively "intangible".

The major commercial successes in software product development, such as Microsoft or Lotus, were backed by venture capital. So were the successful software distributors, such as Businessland or Softsel.

Large Companies

A number of large companies have set up divisions or subsidiaries that invest into promising ventures, relevant to corporate development of the investor firm. These giants thus obtain new "fresh" products at low cost. Their criteria for investment is an appropriate mix of strategic, technological and financial considerations.

IBM's recent minority investments in a score of U.S. software product companies provides the best example of such investments. In fact, IBM is taking on a role of a quasi-high tech venture capital company. Other large computer players, such as Hewlett-Packard, DEC and EDS have invested into SP companies for similar reasons.

This phenomena is not limited to U.S. companies. Over the last five-six years, the Japanese companies have invested into over 200 U.S. high-tech companies, including a number of SP product companies, well positioned in strategic market niches. The Japanese investors have included the traders (Mitsubishi, Mitsui, C. Itoh, Marubeni), banks (Sumitomo, Sanwa, Mitsui), securities firms (Nomura, Daiwa), computer/communications companies (Fujitsu, NTT, Kyocera), and even non-computer companies (Kobe, Nippon Steel, Kubota).

Similar investments are being made by the Koreans, Taiwanese, investors from Hong Kong and Macao, as well as by a number of Europeans (U.K., German and French companies lead here).

Physical Resources

Among the physical resources, the most prominent determinant is the size of the U.S. economy. There is no other place on Earth, where an advanced industrial economy operates on a scale comparable with the U.S. The existence of a relatively homogeneous, prevalently English-speaking, market of 250 million population provides

companies with a continental-size environment, where a product can be offered most of the times without any regional modifications. Contrast this with a position of a company offering its SP product from, say a Danish or Swiss location to the other European markets.

Furthermore, some areas of the United States, such as California or New England, offer a very agreeable lifestyle to attract hard-to-get software talent. It is not a coincidence, that Silicon Valley evolved in the best climate of the U.S. Quality of life, offering excellent housing, with an access to attractive recreation (beaches, ski slopes) and/or an access to a plethora of cultural and entertainment amenities (usually offered by a large metropolitan centres, such as Boston or New York) seem to be definite advantages for attracting SP firms to some parts of the country.

Infrastructure

The U.S. offers any company locating there an unrivalled continent-sized, more or less homogeneous infrastructure.

For swift transportation, a company has an access to a network of over 830 airports with scheduled flights. The U.S. system offers an annual capacity of 630 billion passenger - km, and 16 billion ton-km of cargo.

For swift communications, a company can plug into a network of over 127 million of access lines of working telephones. Fax works everywhere. The data can be transferred at high speed across the continent at low cost. A company can plug into a number of computer networks, such as ARPA Net or NSF networks.

The mail and the courier services, such as DHL, Emery and Bankers Dispatch, operate coast-to-coast. It is easy to transfer funds more or less instantaneously. The flexibility of operations, offered by credit cards, is unmatched in Japan or in the European Community.

Contrast all this with other continent-sized economies, such as the Soviet Union, India or China, and the enormous competitive advantage of the U.S. in this respect becomes evident.

DEMAND CONDITIONS

The second broad determinant of competitive advantage of U.S. Software Products industry is demand for its products.

While the U.S. comparative advantage in demand quantity - existence of a large home market, with a population of 250 million - is extremely important, even more important is the quality of such demand.

Quality of Domestic Demand

U.S. firms have gained competitive advantage because they are supplying domestic buyers, who are among the world's most sophisticated and discriminating buyers of software products.

In the United States, the installed computer base is unrivalled anywhere in the world, both in absolute, but also in relative terms. Using a measure of computer power per capita, at 132 MIPS/1000 people, the U.S. users demand computer power more than everybody else, by a large margin. Even the second most computerized country, the U.K., is outdistanced by a factor of 2. With others, the situation is even worse. For instance, Japan, Germany or France computer use represents only 40 percent, 30 percent and 25 percent of U.S. use per capita, respectively.

The U.S. industry has developed a number of unique, sophisticated buyers:

- U.S. Department of Defense (DOD)

  The DOD's enormous research budgets, often distributed through Defence Advanced Research Projects Agency (DARPA) and enormous purchasing power have a significant impact on the SP industry. DOD is the single largest purchaser of software products (customs software as well) from the industry. According to published reports, the purchases did exceed US$10 billion by the end of the decade, more than 30 percent of the total

home demand.

- o IBM

  The dominant computer hardware manufacturer, IBM (annual sales US$56 billion, 375 thousand employers) produces US$ 8 billion of software, about as much as the top 50 independents taken together. But IBM is also a huge purchaser of software from the independents. Last year it purchased over a billion dollars in packages.

- o Other U.S. Hardware Manufacturers

  Other leading U.S. computer hardware manufacturers are also large software vendors. For instance, Unisys sold in 1988 US$875 million software, DEC US$795 million and Hewlett Packard US$500 million. They all are also purchasers of products from the SP industry.

- o U.S. Corporate Users

  The leading U.S. computer corporate users in 1988, with more than US$500 million annual information systems budget are listed in Table 3.4 The largest companies are industrial (5), financial institutions (3), communications (2) and distribution (1).

Table 3.4 - Leading U.S. Corporate Users of Computers (1988)

	Estimated Is Budget (US$M)	Total PCs & Terminals
General Motors Corp.	2,880	114,000
Citicorp	1,500	20,000
General Electric	1,100	99,000
Ford Motor Corporation	836	80,000
American Express	800	40,000
E.I. Du Pont De Nemours	775	25,000
Sears Roebuck & Co.	600	140,000
AT & T	600	89,000
McDonnell Douglas	550	50,000
GTE	525	63,000
Bankamerica	500	30,000

(Source: Computerworld)

o Distributors

Finally, the U.S. has uniquely sophisticated buyers among their distributors, whether large or smaller. The franchised chain Computerland in 1989 had over US$ 2 billion of revenue, Businessland reached US$1.2 billion. Although the software revenues are only a fraction of the total, they still amount to hundreds of million in value. The software-only distributors, such as wholesaler Softsel sold US$500 million of products. Egghead sold US$200 million. Distributors are not only significant customers but more importantly, discerning buyers. Their specifications increase the quality of the products offered.

Large Market Size

The size of U.S. market and particular patterns of growth of country's demand for software products have reinforced U.S. industry's competitive advantages.

The existence of more or less homogeneous U.S. market, (same business culture, same language, same basic laws and regulations), with a population of 250 million, has increased competitive advantage for U.S. firms. Home market size is most important to companies that require heavy investment into R&D, and to companies which are able to achieve economies of scale in marketing and distribution. The proximity of large domestic demand is particularly comforting in this industry, where technological change is so rapid and with such high levels of uncertainty.

Number of Independent Buyers

According to the 1990 Gallup survey, the large and small users expect from their suppliers roughly the same: first of all service, then product availability, delivery time, followed by good price, supplier's reputation, support/training and customization capabilities. Both segments buy over 90 percent of their software from numerous resellers.

Table 3.5

Top North American Resellers 1988

Rank	Company	Location	1988 Est. Rev. ($)	Number of Stores
1	Tandy	Fort Worth, TX	1.3B	350
2	Businessland	San Jose, CA	1.0B	94
3	Nynex	Atlanta, GA	400.0M	81
4	Computerland Canada	Brampton, ONT	306.3M	70
5	Pactel	Walnut Creek, CA	300.0M	15
6	Computer Factory	Elmsford, NY	280.0M	59
7	Sears	Chicago, IL	250.0M	59
8	Inacomp	Troy, MI	241.5M	89
9	Egghead	Bothel, WA	202.0M	143
10	CompuCom Systems	Cherry Hill, NJ	200.0M	2

(Source: Computer & Software News)

Top U.S. Franchisers 1988

Rank	Company	Location	1988 Est. Rev. ($)	Number of Stores
1	ComputerLand	Oaklawn (CA)	2.0B	739
2	Entre'	McLean, VA	560.0M	183
3	ASCII Group	Washington D.C.	475.0M	220
4	MicroAge	Tempe, AZ	460.0M	212
5	Valcom	Omaha, NE	375.0M	180
6	Todays Computers	Exton, PA	300.0M	168
7	Connecting Point	Denver, CO	290.0M	170
8	DOS	Columbia, MD	150.0M	35
9	Hartco	Anjou, QUE	110.0M	78
10	Software City	Teaneck, NJ	75.0M	94

(Source: Computer & Software News)

The Table 3.5 lists the top U.S. Resellers and top U.S. Franchisers.

According to Spring 1990 poll of U.S. companies by the Gallup Organization Inc., large U.S. business (Fortune 1000) prefer buying their software products from:

- Major Chains 27%
- Independent Dealers 12%
- Mail Order 10%
- Manufacturers 4%
- VARs/Consultants 2%

In contrast, medium business (US$5-100 million annual sales) tend to buy more software from the channels that offer expertize:

- Independent Dealers 24%
- Major Chains 23%
- Software Only Resellers 12%
- VARs/Consultants 10%
- Manufacturers 8%

The presence of a large number of independent buyers has created an environment for growth and innovation for the U.S. industry, superior to industry elsewhere.

Early Home Demand

Initial local demand for software products in the U.S. started emerging with increasing speed several years after 1969, when IBM (partly in response to the threats of U.S. antitrust actions) "unbundled" software from computer hardware.

By the end of 1970s, software vendors started to coalesce into an industry, with their sales exceeding for the first time US$1 billion. The U.S. industry had a head-start of several years over any foreign competitors. In 1979, the first blockbuster products "Visi Calc" and "Wordstar" were released. The industry leaders also started to appreciate the advantages of economics of scale in marketing and distribution. The industry leaders understood that the software cottage industry had to make way to large professionally-managed firms. Launching a "best seller" became a US$50-100 million project, limiting the field to the ablest competitors.

Growth of Home Demand

The software product industry as a whole dealt with rapid technological changes and invested in new products, at frenetic pace.

The rates of growth in demand were close to 40 percent for the U.S. industry's products in the early 1980s. Such rates of growth stimulated aggressive investment by venture capitalists, whose appetite was already stimulated by successes of computer hardware ventures. An investment frenzy lasted until 1987.

These rates of growth were as important to competitive advantage, as the absolute size of the huge U.S. market. Foreign competitors, who grew more slowly, generally remained followers in the technology race.

Increasing Saturation

While early penetration helped U.S. software product industry to become established, the increasing saturation forces it to continue to innovate and upgrade. The increaingly saturated U.S. market benefits U.S. companies in several interesting ways.

The push to upgrade hardware products every six to eighteen months, brings the U.S. companies a steady, annuity-type income stream, representing a good 5-10 percent of industry's revenue. This volume is larger than all the revenues of Canadian software product industry. The push is relentless, in fact so strong that it starts to receive resistance from users.

U.S. home market saturation also encourages stronger firms to penetrate the European and Japanese markets, to sustain growth and to spread the costs of newer updates.

Internationalization of Domestic Demand

The solid comparative advantage, created for the U.S. software product industry by a continent-wide demand is further amplified by additional demand from abroad.

U.S. firms supply over a half of the EC and Japanese market, to a total of some $10 billion of exports. U.S. firms gained there their advantage, as the needs of home buyers identified potential for similar demand abroad. This "anticipatory" demand has been a direct result of having the most sophisticated buyers - early adopters - at home. Thus, for instance the U.S. appetite for credit cards has positioned U.S. credit card companies, such as Amexco, to achieve a commanding position in information processing of credit card purchases around the world.

Probably the strongest stimulant of software product industry exports comes from the existence of the IBM world network. Let us recall that IBM Deutschland, IBM Japan, IBM UK, IBM France, and IBM Italia are each larger than or comparable in size with NCR, Olivetti or Bull. Their purchases and support of software products amount collectively to hundreds of millions of dollars in exports.

Similarly, the exports of software products piggy-back on exports of platforms of other U.S. hardware manufacturers, like Unisys, DEC, Hewlett Packard or Apple.

Another powerful stimulant of U.S. software product exports is the U.S. Department of Defense. The U.S. has annual foreign arms sales of over U.S.$9 billion. The U.S. exported in 1980-1987 US$35 billion of arms, with US$20 billion of offset deals, into about 30 OECD and Third World countries. Again, software products, although a tiny portion of the amounts, do represent significant exports for the U.S. industry.

A large segment of foreign demand for U.S. software comes from foreign subsidiaries of the U.S., multinationals. Once the software product is adopted in the home base, chances are that its adoption abroad is made substantially easier.

The U.S. universities contribute to increased foreign demand for the U.S. software products in a more subtle way. The foreign nationals trained at the U.S. universities get acquainted with the U.S. packages, and after their return home, they acquire these products for their operations.

Other powerful mechanisms for an indirect support of U.S. exports in this area are the regional organizations, such as NATO or OECD, where the U.S. way of doing things plays a prominent role.

The U.S. dominance of the International Bank for Reconstruction and Development (IBRD), better known as the World Bank, and of the International Monetary Fund (IMF), helps indirectly in spreading of U.S. software packages into various markets, affected by World Bank/IMF programs.

Last but not least, as an immigrant country, the U.S. has a vast pool of native speakers matching practically any foreign market of the world. None is more important than the demand by close to 25 million Hispanics (comparable to all the population of Canada), which helps forming a natural bridge to the developing markets of over 250 million Spanish-speaking Latin Americans, and to close to 40 million Spaniards.

Taken together, these powerful demand conditions, mutually reinforcing each other, support the U.S. industry to maintain as yet, an unchallenged competitive position in software products.

DOMESTIC RIVALRY

The third broad determinant of the competitive advantage of U.S. software product firms is the strong domestic rivalry.

The correlation between strong domestic rivalry and competitive advantage has been established in a number of industries in Harvard Business School studies of international competitiveness.

Domestic rivalry in U.S. software products industry created pressure on U.S. firms to continuously improve and innovate. It was this very pressure to innovate that makes domestic rivalry a superior engine of competitiveness, when compared with international rivalry. So far, the competitors come from less aggressive environments of Western Europe. This might change, if and when the Japanese competitors seek to penetrate the North American market in earnest.

The domestic rivalry creates visible beneficial pressures on the industry. Even active feuds between the industry leaders, such as the one between Microsoft and Lotus, are typical for internationally successful industries. Strong local competition continues to

pressure U.S. firms to sell aggressively abroad. While there are casualties, the intensive domestic rivalry has, by and large, strengthened the whole U.S. software products industry.

Geographical concentration of rivals in a couple of U.S. regions both reflects and augments these benefits. Silicon Valley in California and Route 128 in Massachussetts are prime examples of concentration in micro-computer software companies and firms involved in software for minis, respectively.

The U.S. domestic rivalry has been strengthened by spinoff processes, both in Silicon Valley and around Route 128. The employees or contractors for one company leave to form their own company, often not too far from the mother company. The most important single factor in such spinoff processes are the entrepreneurs. It is the entrepreneur, who has the largest multiplier effect for creation of new jobs: 500:1 to 1000:1. While the examples, involving famous companies are more readily available in computer hardware companies - Apple and NeXT, General Automation and DEC, IBM and Amdahl or CDC and Cray, the spinoff processes have unfolded in the U.S. software product industry as well. One example for many: Mitch Kapor's move from Visi Corp to Lotus.

Another form of spinoffs is the creation of software business from the hardware manufacturing. Example here might be the 1987 spinoff of Claris from Apple.

Intensive domestic rivalry created also creates an environment that attracts new late entrants. New companies identify new segments of the market. A good example here is Novell, which in 1983 identified networking, as an emerging new business. Six years later, by 1989, the company produced US$282 million of networking software, full two thirds of their total revenues of US$422 million.

Intensive domestic rivalry has also attracted established companies to the new industry. The U.S. software products industry does benefit from entry by firms from related industries. The best example here might be $4.5 billion Dun & Bradstreet Corporation, that formed Dun & Bradstreet Software, through the acquisition of McCormick & Dodge and Management Science America. In 1989, the new entity had combined sales of US$450 million, and is one of the largest U.S. software product firms.

U.S. RELATED AND SUPPORTING INDUSTRIES

The fourth and the last broad determinant of the competitive advantage of the U.S. software product firms is the presence of first-rate industries that either supply, support or are otherwise related to this young industry.

The industry's competitive advantage is enhanced by close working relationships between the U.S. world-class hardware suppliers and the U.S. software product firms. The companies learn of capabilities of new platforms still on the drawing boards. The U.S. companies serve as test sites for development work.

The U.S. software developers are quick to obtain the newest models of computer hardware, on which to develop their software, ahead of geographically removed competition. Often they are made aware of the new opportunities - tipped off, - ahead of official releases.

U.S.-based hardware manufacturers with international exposure are valuable sources of information and insights on foreign markets for U.S. software product companies.

These benefits are enhanced by the close geographical proximity of firms. The proximity of people with the same business culture quickens the free flow of information, putting U.S. software companies ahead of others.

U.S. companies in this industry also benefit form superior U.S. advertising media. The United States media companies have been among the most innovative and sophisticated in the world. The industry has at its disposal over a hundred U.S. headquartered first-rate communications, public relations, advertising and marketing companies, with knowhow of promoting the software products not only in the U.S., but in many overseas markets. None of the smaller countries would have promoters of the calibre of Regis McKenna Inc. in marketing or public relations firms such as Burston-Marsteller or Hill & Knowlton.

The U.S. companies in related industries recently started to share activities and to forge formal alliances. Witness the IBM's involvement with a number of independent software product companies. The success of one related industry leads to an increased demand for products of the other. To illustrate, the success of minisupercomputers in the Japanese market has lead to increased sales of the U.S. software products there.

THE ROLE OF THE U.S. GOVERNMENT

Faced with unprecedented new technology challenges from abroad, the U.S. has been increasingly concerned that its ability to compete in world markets is eroding.

The April 1991 report of the authoritative Council on Competitiveness, titled "Gaining New Ground" states that the U.S. position in many of the 94 critical technologies is slipping and in some cases has been lost altogether. U.S. public policy does not adequately support U.S. leadership in these critical generic technologies and does not address sufficiently issues related to the role of technology in U.S. competitiveness, according to the Council.

While the position may be lost forever in a number of technologies, such as memory chips, printed circuit boards or optical information storage, the report concludes that in software technology the U.S. is still in a leading global position and is not in danger of losing this position in the next five years.

Before looking into the contribution of the U.S. government to the success of the software industry, the key policy players within the government must be identified. Only the role of the federal government can be discussed here, although there are numerous initiatives at the state and local government level, that have influenced the industry as well.

Key Policy Players

At the federal level, the debate about the technology strategy has been inconclusive. In the Executive Branch, the three strongest advocates of U.S. industrial strategy for technology - intensive industry, of which the software product industry is a part, are within the government proper. It is the Department of Defense (DOD), with its Defense Advanced Research Project Agency (DARPA) and the Department of Commerce (DOC), with its National Institute of Standards and Technology (NIST), while in the White House, the Science Advisor to the President and the Office of the Science and Technology Policy (OSTP) are the strategy proponents within the inner circle.

The key opponents of any technology strategy are the Office of Management and Budget (OMB), the Council of Economic Advisors and until recently the bureaucrats, responsbile for anti-trust measures within the Department of Justice, authors of dismantling AT&T a decade ago and involved more recently in attempts to do the same with IBM.

The retreat of DOC in funding of HDTV and the removal of the DARPA head last year, indicate that the opponents of intervention have been gaining an upper hand in the Bush administration.

Within the U.S. Congress, calls for strengthening the U.S. technological capability have been heard recently from the Democrats. For instance, in the current

House debate on the budget, the Democrats propose a new "competitiveness" package, with additional funding for technology agencies such as DARPA, NIST, National Science Foundation and National Institutes of Health.

The Office of Technology Assessment (OTA) of the U.S. Congress has been a strong proponent of U.S. technological strategy throughout the years.

In the absence of clearly formulated strategy at the federal level, a number of individual states had formulated, by mid-1980s, their own technological strategies. Michigan, Tennessee, Kentucky, Ohio, Pennsylvania and Massachussetts are some of the examples.

Government and the Factor Determinant

The U.S. government has been significantly influencing the factor endowment of U.S. competitors -- in capital resources, in human resources, as well as in knowledge resources.

The federal government influences significantly the stocks of **capital** in the U.S.. Unfortunately, mostly in a negative way. The chronic annual government budget deficit siphons away over $300 billion of capital a year, capital that could otherwise be deployed to a competitive advantage of U.S. firms. The government thirst for capital adds to the U.S.'s high cost of capital.

Furthermore, investors see their capital gains, even on long-term, taxed at the rate of 33 percent, while in Japan, Germany and many other countries they are exempt. The Bush Administration proposes to correct the situation by introducing graduated/reductions of tax on longer-term capital gains.

On the other hand, more positively, the Tax Reform of 1986 reduced rates of corporation tax from 46 to 34 percent. There is no special tax treatment for software product companies, or for any other type of high tech companies, for that matter.

The U.S. Federal government helps the industry generously to finance its R&D. In 1988, one third of industry's R&D was financed by the government. The policy instruments used in the 1980s were grants (about one third) and above all tax concessions (about two thirds). All direct labour and material costs are deductible. In 1990, the administration committed itself to further support R&D through a permanent tax credit, of 20 percent of the level of R&D outlays in excess of a four-year base period for expenditures.

In human resources, an increased need for a larger quantity and quality of the university - educated software workforce, is more and more perceived throughout the U.S.. Overall pressures on the federal government to catalyze the whole educational system, after the state and local efforts have proven themselves inadequate, have been increasing over the last five to six years.

Skilled personnel shortages are creating pressures on the employees to upgrade the skills of the workforce on the job. Companies themselves are faced with investing more in their employees and seeing them more as human capital rather than a mere factor of production.

The Job Training Partnership Act of 1985 is the most important training program, funded by the U.S. Federal Government. The U.S. Congress reviewed some years ago several other programs on training and retraining, including the Work Incentive Program Credit (WIN), National Individual Training Account (NITA) and the National Training Incentive, which provide tax incentives to both employers and employees to enter into training programs.

The U.S. federal government influences very directly **knowledge resources**. For 1992, the administration proposes to spend US$76 billion on R&D.

Traditionally, all the early major computer technology projects were supported by government and military users. The government continued to play a large role in high-end computing, but had little direct role in the low-end computing. It played, of course a huge role indirectly, by financing the development of universities. Federal support for computer R&D shifted during the 1980s to support for more basic and pre-commercial research and for leading-edge concepts and technologies. In FY 1990, the Department of Defense (DOD) spent US$37 billion on R&D. The Defense Advanced Research Project Agency (DARPA) has been the main conduit for financing of the U.S. advances in

computing in the Strategic Computing Initiative of mid-1980s, with over US$100 million a year in funding. In FY 1990 about US$1.1 billion went to DARPA.

The Office of the Secretary of Defence (OSD) promoted ADA in 1970s, and the STARS software program in 1984. The centrepiece of defence research has been the Strategic Defence Initiative (SDI), with 1990 funding of US$3.8 billion. The DOD role in computing has been less emphasised lately, as civilian technologies are becoming more advanced than much of defense technology.

Promotion of non-defense basic and pre-competitive research is largely the domain of the National Science Foundation (NSF). To put it in perspective, its whole budget for FY 1990 was over US$2 billion, about 5 percent of DOD R&D. NSF supports four Advanced Scientific Computing Centres and 41 technology transfer centers, called Industry-University Cooperative Centers.

The Department of Commerce was recently assigned new responsibilities for strengthening technological competitiveness of U.S. firms.

The Technology Administration (TA) was established in 1988 to coordinate science and technology activities and the National Bureau of Standards was renamed the National Institute of Standards and Technology (NIST), to be responsible for dissemination of new technologies. The NIST has a mission to assist and support U.S. firms. Again, the perspective: its budget is US$170 million in 1990, less than a half of

one percent of DOD's R&D budget. The Advanced Technology Program of NIST supports the development of new technologies by smaller firms or consortia of smaller firms.

In summary, even a brief overview indicates that the role of U.S. federal government in influencing this determinant of industry's success in all the three major factors, has been quite extensive.

Government and the Demand Determinant

The U.S. government has influenced the "demand" determinant of the industry - by its procurement and by stimulation of exports.

As already mentioned, the procurement of the U.S. Department of Defense has played and is playing a very important role in the software sector in the U.S., especially in the state-of-the art market subsegments. The U.S. Army Computer Systems Selection and Acquisition Agency administers the procurement in this area, amounting to billions of dollars.

Other U.S. government departments and agencies have been huge consumers of software. Table 3.6 demonstrates the magnitude of the software procured by the U.S. government in the critical years of the industry's growth in the early 1980s.

Table 3.6 US Government : Major Contracts

Agency	Project	Total Cost (US$ Billion)
Federal Aviation Agency	Air Traffic Control and Navigation System	9
Postal Service	Operations	3
Postal Service	Payroll	1
Social Security Administration	Claims Processing	1
Patent Office	Records Storage & Retrieval	.750
Justice	Investigation Support	.215

(Source: Fortune)

The Small Business Administration (SBA) helps small and medium-sized firms solve problems that may arise in the drawing up of procurement contracts and informing them on public purchasing procedures. This is done through SBA offices located in the main Federal Government purchasing centres. These offices certify enterprises, and assist them in obtaining contracts with State governments. The SBA also encourages public supply agencies to reserve certain categories of purchases to small and medium-sized firms.

For stimulation of exports, in the United States, there is a wide range of programs to encourage enterprises to export. Through the International Trade Administration, the Department of Commerce provides extensive help for marketing American goods. Furthermore, the International Trade Administration provides information about export possibilities in particular regions or countries. The Small Business

Administration also maintains several export-related loan programmes and provides a variety of business development and counselling services. Other federal agencies providing support for overseas trade, include the Export-Import Bank, the United States Department of State, the United States Trade and Development Program and the Office of the United States Trade Representative. Numerous state and local economic development agencies offers further assistance to software product firms.

Four recent major initiatives helped to stimulate exports, even if indirectly.

The Omnibus Trade and Competitiveness Act of 1988 increased the power of Executive Branch to negotiate on trade-related issues, to ensure greater opening of foreign markets to U.S. exporters. In the Super 301 section, it allowed the labelling of targetted competing countries as "unfair".

In the efforts to open the Japanese market, the 301 was used in the case of supercomputers. The software product companies benefitted by piggy-backing on the forced sales of supercomputer platforms. Another very recent example of similar support might be found in initiatives, such as the April 1991 Japan Corporate Program. The 1988 Act's Section 301 helped also in a partial opening of a closed Brazilian market.

The second initiative facilitating U.S. exports was the implementation of the Canada - US Free Trade Agreement (FTA). On January 1, 1989, the low or negligible tariffs for computer equipment were eliminated, somewhat strengthening are already

strong demand for U.S. hardware and software products in Canada. U.S. exporters benefitted above all from the opening of the procurement by the Government of Canada. U.S. companies are now allowed to offer their services to the government in contracts over $25,000. Furthermore, the special Annex, dealing with Enhanced Telecommunications and Computer Services, made the movement of the personnel of U.S. SP firms across the border easier.

The third, smaller initiative, under the 1990 SEED Act, to help Eastern and Central Europe, contains export credit programmes by agencies such as the Overseas Private Investment Corporation (OPIC), the Export-Import Bank, and a special Enterprise Fund, to encourage US exports to Poland and Hungary.

Finally, the latest initiative, to reconstruct Kuwait, could be a yet another scheme, that will help generate revenue for better positioned US firms, involved in the software products.

Government and Structure Determinant

The U.S. government has influenced the structure ("rivalry") determinant of the SP industry, directly or indirectly, in at least two interconnected ways: strengthening the industry on one side and protecting it on the other.

The strengthening of the "home team" started with removal of the handicap. The U.S. powerful anti-trust policy, based on Sherman and Clayton Acts, originally designed for a domestically-oriented economy, had to adapt over the last decade to an increasingly globalized economy and to new powerful foreign competitors, such as keiretsu, chaebol or gruppe. The evolution of the U.S. anti-trust policy includes initiatives such as:

- The Export Trading Act (1982), making joint export ventures immune from antitrust laws.

- The Antitrust Merger Guidelines (1984), recognizing that mergers may often generate efficiencies and be beneficial to consumers.

- The National Co-operative Research Act (1984), encouraging co-operative R&D ventures.

- The Antitrust Enforcement Guidelines for International Operations (1988), determining that criteria for antitrust action should be global, rather than U.S. only, competition.

- The Joint Production legislation (1990), encouraging cooperative production ventures.

As a result of the 1984 NCRA law, by 1990, there were 245 U.S. R&D consortia. Table 3.7 lists the five most relevant consortia.

Table 3.7 Key U.S. R&D Consortia

Name	1990 Funding US$ Millions	Purpose
Bell Communications Research (Bellcore)	1,100	Compatible technology for nationwide telecommunications
Microelectronics & Computer Technology Corp. (MCC)	65	Computer and information sciences and technologies
Semiconductor Research Corp. (SRC)	34	Generic science underlying semiconductors for electronics manufacturers
Semiconductor Manufacturing Technology Initiative (Sematech)	200	Technology for producing integrated circuits
Software Productivity Consortium	17	Software process engineering innovations for members, mostly software companies

(Source: Business Week)

The tide of U.S. protectionism against foreign direct investment has increased with every consecutive year since 1985, when the foreign investment in the United States exceeded the U.S. investments abroad.

In general, the United States looks favourably on foreign direct investment as a means of promoting domestic growth, transferring technology and management skills

to US business, expanding employment and increasing productivity.

However, section 5021 of the Trade Act of 1988, the "Exon Florio" amendment, authorises the President, where he finds the existence of a danger to national security, to suspend or prohibit any acquisition, merger or take-over involving foreign firms, or to seek divestment in the courts.

Reviews and investigations are carried out on behalf of the President by the Committee on Foreign Investment in the United States (CFIUS). Since the adoption of the Trade Act, the CFIUS has looked into over 250 proposed mergers and acquisitions. Only in one case, the President ordered divestment of the transaction, not in the SP area.

Nevertheless, the existence of Exon Florio amendment serves as a definite deterrent to any future predatory takeovers of U.S. firms.

Government and Related Industries Determinant

The SP industry's strength is most vulnerable to any weakness in the underlying industries, that provide many of the components that the industry depends upon, including microelectronics, integrated circuit fabrication equipment and facilities, electronic packaging and several manufacturing technologies. The U.S. also lags in printers and optical storage.

The U.S. leadership in computer hardware is under assault. The U.S. balance of trade in computers has deteriorated substantially over the last decade.

Only time will till whether the government initiatives in this area, such as MCC, SRC, Sematech or managed trade arrangements such as the US-Japan Semiconductor Agreement 1986 or more recent Structural Impediment Initiative, will stop the erosion.

The review of the influences of the U.S. government on all the four determinants of success of the software product industry shows that the influences of the federal government is substantial. Most of the time, it has been beneficial to the industry.

IN CONCLUSION: U.S. COMPETITIVE POSITION

A succint comparative analysis of global competitiveness of the U.S. software product industry might be attempted by a quasi-systematic evaluation of U.S. competitive position as compared to other G-5 competitors (Japan, Germany, France, U.K.) carried along at least these dimensions:

Table 3.8 U.S. Competitive Position

Determinants	U.S. Position				Other G-5 Competitors			
	Strong	Competitive	Weak	Lost	Strong	Competitive	Weak	Lost
FACTOR CONDITIONS	X					X----	---X	
• Knowledge Resources	■					■----	----■	
• Human Resources	■					■----	----■	
• Capital Resources	■					■----	----■	
• Physical Resources	■						■	
• Infrastructure	■					■		
DEMAND CONDITIONS	X					X-----	----X	
• Defense Procurement	■						■	
• Hardware Firms	■					■----	----■	
• Own Multinationals	■					■----	----■	
• Supranational Agencies	■					■		
• Role of Universities	■					■----	----■	
• Exports	■						■	
RIVALRY	X					X----	---X	
• Domestic Rivalry	■					■----	----■	
• Internat. Rivalry	■					■----	----■	
• Coop. R&D	■					■----	----■	
RELATED/SUPPORT INDUSTRIES	X					X----	----X	
• Computer Hardware		■			■----	----------	----	----■
• Media	■					■----	----■	
ROLE OF GOVERNMENT		X				X	X	
• Factors		■				■		
• Demand	■					■----	----■	
• Rivalry	■					■----	----■	
• Related Industries		■--->			■----	----------	----■	
SP INDUSTRY	■					■	■	

In conclusion, in U.S. software product industry, underlying determinants of U.S. advantage are all present. The U.S. government was able to reinforce them in most crucial aspects, except for undermining U.S. capital resources by chronic budgetary deficits.

As a result, the U.S. SP industry is today in a leading world position. The position is not invulnerable. After all, there exist definite weaknesses in underlying industries, such as in microelectronics and computer hardware. The U.S. will undoubtedly face challenges in all computer-related areas. Nevertheless, the U.S. SP industry does not seem to be in danger of loosing their world leading position in the next five years.

SECTION FOUR

OVERVIEW OF CANADIAN SOFTWARE PRODUCT INDUSTRY

Canada is the third most intensively computerized country of the world, after the United States and the U.K. The special 1988 Survey of Software by Statistics Canada, done for and funded by ISTC, provides the best publicly available picture of the software product market and industry to date.

The subsequent 1990 Statistics Canada Special Report on Software reflects the great definitional and methodological difficulties of determining the size and composition of the supply and demand situation in software products in Canada.

CANADIAN MARKET

In rough numbers, the size of Canadian market was close to C$ 1.5 billion in that year. A good one third - C$ 460 million was supplied by hardware manufacturers, mostly from the U.S. IBM, Unisys and DEC are the leading software vendors. Of the total independent software product market of C$ 1 billion, only about a half was supplied by Canadian software producers. The other half was imported in one way or the other, mostly from the U.S.. The three leading U.S. vendors were Oracle Software, Computer Associates and Microsoft.

Regionally, the overall software product sales of close to C$ 1.5 billion were split in the following way, shown on Table 4.1.

Table 4.1 Regional Distribution of SP Sales (1988)

Region	(C$ M)	(%)
Ontario	1,233	85
Quebec	121	8
Prairies	64	4
B.C.	34	2
Maritimes	9	1
Canada	1,461	100

(Source: Statistics Canada, Cat. 63-015, April 1990)

Since the majority of foreign software distributors are headquartered in Ontario, nearly all foreign-produced software is shown as Ontario sales.

CANADIAN SP INDUSTRY: STRUCTURE

According to Statistics Canada (Catalogue 63-227), the 1988 revenues of the Canadian SP industry reached C$ 640 million. Canadian independents supplied over a half a billion dollars - C$ 524 million - of software products to Canadian clients and exported C$ 306 million of software products in that year, to a total of C$ 830 million. The C$ 306 million of software exports includes, however, software produced by IBM Research Laboratory (Catalogue 63-015).

Geographically, more than a half of these revenues came from Ontario, no more than a quarter from Quebec, one fifth from the West and the little that is left, from the Maritimes.

According to private market research companies IDC and INPUT, Canadian software product revenues, in 1990 totalled slightly less than C$ 1.1 billion - C$ 1,087 or C$ 1,090 million, respectively. This figure represents a 13 percent growth over the 1989 revenues of C$ 965 million.

According to input 1991, of the 1990 total, C$ 465 million (43 percent) of revenues was for systems software and C$ 625 (57 percent) for applications software, confirming an increasing share of application software products in total SP revenues. Table 4.2 provides more detail.

Table 4.2 Canadian SP Revenues in 1990 (In C$ Million)

Platform	Systems	Applications	Total
Mainframe	325	**350**	675
Minicomputer	110	215	335
Workstations/PC	30	60	90
All Platforms	**465**	**625**	**1,090**

(Source: Input, 1991)

The companies employ over 17 thousand people. Of this number, some one eighth are software developers.

Canadian firms have been generally considered as relatively weak in R&D. For instance, a 1990 Ernst & Young survey indicated that 1989 R&D outlays did not exceed 6 percent, about half of U.S. levels. It is, therefore, a pleasant surprise to find that the 1988 Statistics Canada "uncovered" impressive C$ 140 million of software R&D in the Canadian computer services industry. The upcoming 1989 Statistics Canada survey will hopefully either confirm or correct this important finding.

The Catalogue 63-015 of Statistics Canada implies that the industry was composed of 1,721 companies in 1988. Only 721 largest companies were surveyed in 1988. These were geographically located approximately as follows: 53 percent in Ontario, 24 percent in Quebec, 12 percent on Prairies, 9 percent in B.C., with 2 percent in the Maritimes. There are many more minuscule companies throughout Canada,

according to observers of the industry. According to ISTC estimates, there are in fact over 3 thousand firms in the country by 1991.

Compared to the U.S., there are no giant companies in Canadian industry. There is one first-tier vendor, Cognos Inc. There is also a group of about 30 second-tier companies. Corel is an example of companies in this group. There are more than a hundred third-tier firms. Simultaneously, there is a very large number of the very small and minuscule vendors in this industry, most of them fighting for survival. In the group of companies with annual sales below C$ 2 million in 1988, 379 were above and 1200 below the C$ 250 thousand level. By size, Canadian firms in this industry might be classified to the following six categories of the Table 4.3.

Table 4.3 Classification of Canadian SP Firms

Type	Annual Revenues (C$)	Number in Class (1988)
Very large (giants)	More than 1B	0
Large (first - tier)	100M - 1B	1
Medium (second - tier)	10M - 100M	30
Small (third - tier)	2M - 10M	100
Very small	Less than 2M	379 (approx.)
Miniscule	Less than 250K	1,200 (approx.)
Canadian SP Industry	Total	1,700 (approx.)

(Source: Statistics Canada) Cat. 63-015)

The group of top 31 companies accounts for two thirds of revenues of the whole Canadian industry.

The Canadian industry is also a fragmented industry. The reasons for fragmentation are identical with the reasons for fragmentation of the U.S. software product industry (See Section Two, page 32). Of those, the two major reasons are low barriers to entry on the supply side, and a high fragmentation of demand on the demand side.

CANADIAN SP INDUSTRY: DYNAMICS

IDC and INPUT expect the industry to continue growing, at compound annual growth rates of around 13 percent, to above C$2 billion by 1995.

For more details of one such forecast, see Table 4.4. Please note that the 1988 base of IDC is slightly higher than that given by Statistics Canada for that year.

Table 4.4 Software Product Industry Revenues Forecast

1988	1989	1990	1991	1992	1993	1994
847	963	1,087	1,237	1,400	1,582	1,784
	13.6%	12.8%	13.8%	13.2%	13.0%	12.8%

(Source: IDC)

The growth rates of individual segments vary from the slowest growth of 9 percent for systems software for mainframes, to the fastest growth of 21 percent for applications software for PCs and Workstations. Table 4.5 provides more details.

Table 4.5 Expected Rates of Growth 1990–1995

Platform	Systems Software Products	Application Software Products
	CAGR (Percent)	
Mainframes	9	12
Minicomputer	11	18
PC/workstation	20	21
All platforms	10	15

(Source: Input, 1991)

If these revenues grew as forecast, by 1995 the industry composition will change from the present picture, provided in Table 4.2. Table 4.6 shows how. Of the 1995 total, 37.5 percent will be for systems software, and 62.5 for applications software.

Table 4.6 SP Industry Revenues in 1995

Platform	Systems	Applications	Total
Mainframe	500	620	1,120
Minicomputer	180	495	675
Workstation/PC	70	155	225
All Platforms	**760**	**1,280**	**2,020**

(Source: Input 1991)

The most interesting result of the 1991 INPUT survey, from which Tables 4.4 and 4.5 are constructed, is a small share of applications software products for Workstation/PC category, compared to the U.S.. While in the U.S. industry this segment is close to 30 percent, in Canada it is about 10 percent.

Consequently, there seems to be unfulfilled demand for PC/Workstation application software. The users call for increased availability of this type of software products, according to the survey.

Restructuring

The merger & acquisition (M&A) activity in Canada has traced the patterns of M&A activities elsewhere in the changing global business. This pattern will probably continue for at least several years, if the continuing company/product shakeout of a maturing industry unfolds according to observers' expectations.

First of all, there are casualties. One example for many: Canada Remote Systems of Mississauga, Ontario, went into receivership in 1990. In a number of cases, larger U.S. companies have acquired smaller, sometimes very good, Canadian firms. Some of the recent U.S. acquisitions of Canadian software firms are listed in Table 4.7. In each case, a giant or a large U.S. company acquired a third-tier Canadian one.

Table 4.7 Recent U.S. Takeovers of Canadian SP Firms

Date	U.S. Firm	Employees	Canadian Firm	Employees	Product
7/3/1990	SCO	1,000	HCR	65	UNIX Tools
31/12/1990	Hayes	600	Waterloo Microsystems	35	LAN
1/1/1991	MDI	500	Softkey Software Products	35	System Software Distribution
6/3/1991	Microsoft	5,635	Consumers	70	E-Mail
25/ 3/1991	Sybase	560	Deft	22	CASE

(Source: Computing Canada)

Several Canadian independents are also being taken over by larger Canadian firms. Sometimes, the partners are from within computer industry. Recent examples here include their purchase of bankrupt Jonas & Erickson Software Technology Inc. (140 employees) by Geac Computer Corporation Ltd.. Sometimes, the partners came from the well-heeled financial services or utility businesses. An example here might be Transalta Utilities Corporation's financial rescue of Keyword Office Technology Ltd. of Calgary.

By 1991, a significant number of Canadian software product companies have entered into some form of strategic alliance with larger partners. Propelled by pressures of recession, the changing industry continues restructuring, as it entered the 1990s.

SECTION FIVE

COMPETITIVE ASSESSMENT OF THE CANADIAN SOFTWARE PRODUCT INDUSTRY

The following strategic assessment of strengths and weaknesses of the Canadian Software Product industry is based on a systematic evaluation of the most critical determinants of Canadian national competitive advantage, that shape the environment in which local firms compete. Again, the methodology of Porter's Diamond (for more on the Diamond, see the Appendix) is being used for the following analysis.

ADVANCED FACTOR CONDITIONS

In this section, the Canadian position in advanced factor endowment is analyzed in the following categories - knowledge resources, human resources, capital resources, physical resources and infrastructure. As with the U.S. case, only the first three can be discussed at length. So far, Canadian companies have faced some difficulties in mixing these factors for their competitive advantage.

Knowledge Resources

Canadian knowledge resources, relevant to software products, have been accumulated in the country's universities and colleges, in government research laboratories, in private research facilities, and in the statistical establishment. The body of scientific and industry literature is limited. Several Canadian and more recently U.S. specialised firms provide reports and data bases about the software trends, industry and markets.

Universities and Colleges

Canada entered the 1990s with a solid, although underfinanced, university and college system, for a medium-sized country. Over 795 thousand students are enrolled in 266 institutions of higher learning, of these 68 are universities. The students are taught by 59 thousand faculty members. Canada spent on education over US$32 billion, 7.25 percent of GNP in 1988.

Canada has several good to excellent computer-related educational programs. The top programs are (alphabetically) University of Alberta, University of British Columbia, Carlton University, Dalhousie University, McGill University, Universite de Montreal, Queen's University, Simon Fraser University, University of Toronto and University of Waterloo. The universities attract graduate students from abroad, mostly from Asia.

Government Research Institutes

The new department of Industry, Science and Technology Canada (ISTC), Information Technologies Industry Branch is the locus of knowledge about the software product industry in Canada.

The National Research Council (NRC) is the federal government's central scientific research organization, with over 3,000 employees and a budget of approximately $400 million. NRC has several units with expertise in software and administers the Canadian Institute for Scientific and Technical Information (CISTI). Council's Industry Development Program IRAP is of major importance for the SP industry. The focus of software expertise in NRC is the new Institute for Information Technology, with 120 personnel.

Major government laboratories with software expertise include those of the Canadian Centre for Remote Sensing of the Department of Energy, Mines and Resources (EMR). Within the Department of Communications (DOC), WPARC is an agency with a focused software-related expertise.

Other federal agencies with software-related expertise can be found in:

- Agriculture Canada
- Atomic Energy of Canada Ltd.

- CIDA
- Fisheries and Oceans
- Health and Welfare Canada
- IDRC
- National Defence (DND)
- Transport Canada

Within Statistics Canada, Science and Technology Division has conducted first-ever publicly-funded surveys of software production and distribution, as well as of software R&D in Canada. The agency has four experts knowledgeable on industry and market trends.

There are also some puddles of software expertise in the eight provincial research organizations:

- Nova Scotia Research Foundation
- New Brunswick Research and Productivity Council
- Centre de Recherche Industrielle du Quebec

  (Software-related expertize is focused in CRIM)
- Ortech International
- Manitoba Research Council
- Saskatchewan Research Council
- Alberta Research Council

- British Columbia Research Corporation

Private Research Institutes

The 1988 Statistics Canada survey of software R&D in Canadian industry revealed that close to 1,300 Canadian firms performed C$1 billion R&D in software, in fact more than the total revenues of Canadian software product industry revenues. Close to $450 million was performed by a score of telecommunications laboratories and about $160 million by a dozen of computer hardware manufacturer labs.

Bell Northern Research and IBM Software Laboratory are the two leading software knowledge resources. The Canadian Institute for Advanced Research (CIAR) is a private organization established to stimulate leading-edge research in several areas, including artificial intelligence and robotics.

Private Market Research and Information Provider Firms

In addition to a small number of substantial consulting companies, lead by international firms, such as (alphabetically) Arthur Andersen & Co., Coopers & Lybrand, Deloitte & Touche, Ernst & Young, KPMG Peat Marwick Thorne and Price Waterhouse, there are about a dozen research companies in Canada that analyze the computer industry and markets, including software products. The Canadian companies range from medium companies, such as Evans Research Corporation, to small boutiques, such as

ZZ International, with a couple of persons. One of the largest U.S. companies, International Data Corporation has an office in Toronto. In addition, several other U.S. companies, such as INPUT and Gartner are providing industry/market reports as well. One of the U.S. companies tracking venture capital industry and start-ups, Venture Economics, is also present in Toronto.

Major U.S. information retrieval services, with access to hundreds of computerized databases, such as Compuserve, Dialog, Dow Jones News, Orbit, Mead (Nexis), Reuters, or The Source, are also available in Canada. I.P. Sharp, a fine Canadian company in this area, was acquired by Reuters.

Publications

Canada does not have outstanding technical publishers, such as McGraw Hill, Prentice Hall, Addison Wesley or Harper & Row. Instead, it relies on U.S. capabilities.

Only a few Canadian computer magazines and newspapers, with very small circulation serve the Canadian computer software community. Examples here are Canadian Datasystems (monthly) from Maclean Hunter, CIPS Revue (bi-monthly) from CIPS and Computing Canada (bi-weekly) from Plesman Publications. Among important Canadian academic journals one can mention INFOR and Computational Intelligence. In addition, there are several newsletters that focus on specific aspects of the computer industry.

To sum up, Canada possesses goods knowledge resources, corresponding to the country's size, and to her history of relatively early adoption of computers.

Human Resources

Canada has developed an important pool of computer-educated professionals. Estimates of a number of software professionals differ widely. Conventional wisdom had it that there were 120-130 thousand software professionals working in Canada. Recent studies suggest that these figures may be substantially higher, perhaps even twice as much.

Large pools of software talent are to be found in governments and in user companies, working on a demand side of the market place. Estimates of the totals vary, ranging from 75 to 125 thousand.

On a supply side, by 1991, total employment in computer services, which is mostly software, was 54,700. Largest pools of software development expertise are found in telecommunication and in computer hardware manufacturing companies. In telecommunications, there are at least 5-6 thousand people involved in developing software. In computer hardware companies there might be a couple of thousand software developers. IBM Canada alone employs 1,500 people in software development, but there are also important pools elsewhere. NCR Canada has a pool of 200 software experts in banking automation, for instance.

The employment picture in this area is not very clear. The task force on Software in Canadian Economy, sponsored by Employment and Immigration Canada, will hopefully provide a better picture of Canadian human resources in this field, by summer 1991.

The present recession, coupled with the industry's restructuring, softened demand in computer-related workplace. Companies are downsizing, and out-sourcing. The 1991 supply exceeds demand for software specialists. At present, there are estimated 3,500 systems analysts and computers programmers collecting unemployment insurance. This situation is expected to continue throughout the rest of the recession, according to placement services, such as Technical Service Council.

The placement agencies report that most people out of work are recent graduates and juniors. During the recession, there is little demand for software development specialists. Consulting companies are by and large not hiring. There is also practically no demand for technical management positions.

On the other hand, there is a continuous demand for experienced senior professionals and for programmer-analysts. The demand is mostly for very specific skills, such as SQL, for example. Increased customer support trends stimulate the demand for computer experts with excellent interpersonal skills.

Canada faces a critical shortage of software product entrepreneurs with a good business sense. There is also a perceived shortage of software managers with a strong business orientation.

The resulting picture points out at a mismatch of excess supply of undifferentiated skills, with critical shortages in very specific labour market niches.

In 1991, approximately 2.5 thousand students will be graduating in computer-related fields from about two scores of university programs (B.Sc., B.C.Sc., Eng. degrees). The biggest supplier of graduates is the University of Waterloo, with 250 graduates. The post-secondary enrolment has declined by 25-30 percent since 1984, from a peak of 17 thousand university and 13 thousand college students. This reflects, at least partially, the Baby Boom wave passing through the university system. Nevertheless, there seems to be also less enthusiasm for computers - seen increasingly as a mere tool, rather than a medium of a career. If the reduced supply continues, software personnel shortages in medium- and long-term loom on the horizon.

Last but not least, a very important Canadian human resource asset is the pool of North American-trained multilingual software experts. Six million French-speaking Canadians from Quebec, but also from other provinces, are the pool from which a comparative advantage for Francophonie markets of over 100 million people can be drawn.

To sum up, Canadian SP industry may draw from a good pool of well-trained human resources, perhaps limited in numbers, but not in quality.

Capital Resources

Canadian capital resources are a degree of magnitude smaller than in the U.S.. They are characterized by a significantly larger presence of government funds.

By 1989, the pool of funds for venture capital investments in Canada has reached C$3.3 billion, roughly one tenth of the capital pools in the U.S.A. Of this figure, C$550 million, fully one sixth, were public funds.

The disbursements in 1989, were $343 million, in 359 investments, in about 300 companies, about a one tenth of disbursements in the U.S..

In Canada, the four main types of risk capital market players are: individual investors, private venture capital (VC) investment funds, public venture (VC) capital investment funds and large companies. Only the first three will be discussed below.

Individual Investors

Half of the risk capital, received in the late 1980s by Canadian companies, came from wealthy individuals. These several hundred individuals contributed more than

any other investor group. These persons bring to the recipient company not only funds but also, most of the time, knowledge of technology/industry/market trends. In Canada, they are virtually the only source of early stage (incubation, seed, start-up) financing.

The Canadian Opportunities Investment Network (COIN) is a service, operated by Chambers of Commerce in cooperation with senior governments, to match individual investors with emerging businesses.

Private Funds

The Canadian venture capital funds industry is formed by about seventy venture capital companies. Most are members of the Association of Canadian Venture Capital Companies, which has sixty full members, and over C$2 billion under administration. In 1989, the funds disbursed 30 percent of total investments, about C$103 million. Some of the most active firms of mid-1980s are listed in Table 5.1.

The private funds have increasingly focussed on the expansion stage and on buyout ventures, while withdrawing from early stage financing. They are now virtually absent there. Canadian SP companies have to and do obtain their financing from the U.S. venture capital firms.

Table 5.1 Selected Canadian Venture Capital Firms

Firms	Paid-in Capital (C$M)	1983 Disbursements (C$M/Yr.)	Location
Vencap Equities Alberta Ltd.	240	N.A.	Edmonton
GT Management	N.A.	30	Calgary
Venture West Capital Ltd.	26	10	Vancouver
Canwest Capital Corp.	50	50	Winnipeg
Canadian Corp. Funding Ltd.	20	6.5	Toronto
Cavendish Investing Ltd.	126	N.A.	Toronto
North American Ventures Fund	58	9	Toronto
Sharwood & Co. Ltd.	N.A.	107	Toronto
Vengrowth Capital Funds	34	10	Toronto
Altamira Capital Corp.	30	N.A.	Montreal
Innocan Investments Ltd.	70	N.A.	Montreal
Investissements Novacap Inc.	20	1.8	Montreal
Societe D'Investissement Desjardins	60	12	Montreal

(Source Venture:
Magazine for Entrepreneurs)

Public Funds

Public funds play an increasing role in the VC industry. In 1989, the public pools reached C$550 million, one sixth of the total stock. In that year, they invested into 85 ventures a total of C$35 million, over ten percent of all risk investments in the country.

The main player on the federal level is Federal Business Development Bank. Several provincial governments run their own venture capital funds. Some examples are Innovation Ontario and Saskatchewan Economic Development Corporation.

VC and Software Firms

In 1989, venture capital invested in 24 deals C$14 million into software firms. About 30 percent of investment dollars went into early stage, 60 percent into expansion stage and the rest into other stages in that year.

Until 1988, about a half of invested dollars went into systems software each year. However, in 1989, over 90 percent of invested funds went into applications software. It is interesting to note that about half of the 1987 investments into software companies was by public funds, responsible for a quarter of all disbursements of that year.

Some form of equity financing by the venture capital industry is a sine qua non for a success of Canadian software companies. Alternatives are takeovers by larger companies (from inside or outside the software industry) or failure.

Physical Resources

Proximity to the United States is a strong competitive advantage for the Canadian SP industry.

Canadians are among the earliest adopters of the developments on the U.S. scene. Overflow of U.S. mass media and technical publications helps to keep Canadians abreast with the latest technological change. Proximity facilitates easy communications and transportation. English language and compatibility of culture facilitates business interchange.

On the other side of the coin, proximity to the prevalently - English speaking market of 250 million people provides Canadian companies with access to the continent-sized, more or less homogenous, marketing space. The access, enhanced by NAFTA, provides a hitherto unique comparative advantage vis-a-vis Asian and European competitors.

Canadian metropolises offer software companies rich cultural milieu and pleasant lifestyle. It is no coincidence that most of the software companies are located in Toronto, Montreal, Vancouver and Ottawa.

Infrastructure

Canada offers any company locating here a decent infrastructure.

For swift transportation, a company has an access to a network of over 61 airports with scheduled flights, with a number of connections to key U.S. cities. There are good connections to Pacific Asia and to Europe. The Canadian airline system offers an annual capacity of 53 billion passenger - km, and 1.2 billion ton-km of cargo.

A company can plug into a nationwide telecommunication network of over 20 million of access lines of working telephones, available in every part of the country. Canada has pioneered in integration of geostationary satellites into the network and in introduction of digital exchanges. Canada had the world's first nationwide digital data networks (Dataroute, Infonet). Today, Canada has a full range of sophisticated voice and data digitally-switched business services. Canada ranks fourth in the world in terms of telephone density.

The use of fax quadrupled between 1985 - 1989, and is used everywhere.

Regrettably, Canadian telephone long-distance rates are from 20 to 40 percent higher than those of United States. This generated so called "bypass" of the Canadian telecommunications system - using for instance, private lines from Toronto to Buffalo and then switching to the cheaper U.S. networks.

Canada also lags in the construction of a national digital fibre optic network, behind developments in the U.S.

Canada Post Corporation, traditionally a source of complaints, has improved their service. Major cities, such as Toronto, offer over 160 courier services, many operating continent -and world-wide.

In Canada, it is very easy to transfer funds, more or less instaneously. Flexibility of operations, offered by the credit card system, is superior to those in Japan or Western Europe.

To sum up, in business infrastructure, Canada is competitive with any other OECD country.

DEMAND CONDITIONS

The second broad determinant of competitive advantage of Canadian Software Products industry is demand for its products.

Limited Domestic Market Size

The size of Canadian market and particular patterns of growth of country's demand for software products have not reinforced Canadian industry's competitive

advantages.

The Canadian domestic market is relatively small. The population base of Canada is approximately one tenth of the U.S.A., one fifth of Japan and about half of Germany, U.K., France or Italy.

In fact, the Canadian market, when compared to the U.S., is even smaller than the ratio of the two population bases. Canada also has a smaller installed base of computer power. In 1988, the US : Canadian ratio of installed computer power was 2.4:1 (132 MIPS/1000:55 MIPS/1000). As a result, the Canadian apparent market was in that year only 1/23 of the U.S. market (US$1.3 billion/US$30 billion).

Furthermore, the Canadian market is fractured along the linguistic "fault" into two de facto different English and French markets, approximately in 3:1 - 4:1 ratio.

Domestic Demand Quality

Canadian firms have gained relatively solid competitive positions, because they are supplying domestic buyers, who are second only to the U.S. in sophistication and discrimination in purchasing their products. This sophistication comes from the proximity of the U.S. market.

In installed computer base, Canada is the third most computerized country of the world. Although well behind the U.S., and slightly lagging behind the U.K., Canada was still ahead of Japan, Germany or France, by a small margin, by the end of 1980s.

Canadian industry, however, is handicapped by not having domestic equivalents of most voracious (and sophisticated) buyers of software products in the U.S.. The Department of National Defence (DND) is by two degrees of magnitude a smaller consumer of software products than the U.S. Department of Defense (DOD). While the precise figures are impossible to come by, the purchases by U.S. computer hardware manufacturers of Canadian software products are a mere fraction of U.S. purchases, even in relative terms.

The absence of giant corporate users is a yet another handicap for Canadian software industry. Canada simply does not have equivalents of giant users of computing power, such as found in the U.S.. There is no Canadian corporate user that could compare with the top five U.S. users, listed in Table 3.4 of the Section Three.

Even the largest Canadian corporate user, Royal Bank of Canada, represents no more than two thirds of computer demand of its opposite number in financial services, Citicorp. The same is probably true for Credit Agricole, Barclays or Deutsche Bank, never mind Dai-Ichi Kangyo.

Finally, Canada has some sophisticated buyers among distributors, whether large or small. ComputerLand Canada, is the largest reseller, with US$300 million of revenue in 1988. The distributors are not only substantial, but also discerning buyers.

RIVALRY

The third broad determinant of competitive advantage of Canadian software product firms is their competitive rivalry, coming primarily from U.S. competitors.

As mentioned in Section Three, domestic rivalry is a superior engine of competitiveness, when compared with international rivalry. In Canada, the rivalry is international. The competitors come both from a more aggressive marketing and sales environment of the United States, and from environments of Western Europe, which although commercially less aggressive do demand very high quality. Strong international competition continues to pressure Canadian firms to sell aggressively abroad.

Geographical concentration of foreign and local rivals in several Canadian regions both reflects and augments these benefits. Toronto, Ottawa, Montreal and Vancouver are prime examples of concentration in software product companies.

RELATED AND SUPPORTING INDUSTRIES

The fourth and the last broad determinant of competitive advantage of Canadian software product firms is the presence or absence of industries that supply and support this young industry.

This is the weak aspect of the Canadian software product industry. The industry can build on only a few domestic companies in the underlying industries, which provide components and computer hardware equipment. The industry's competitive advantage is strengthened by a good working relationship between the U.S. world-class hardware suppliers and Canadian software product firms. Some Canadian companies do serve as test sites for development work.

Canadian software developers, however, may not have direct access or are slower to obtain the newest models of computer hardware, on which to develop their software, often several months after their U.S. competition.

Canadian companies in this industry do benefit from superior U.S. advertising media, but again only to a point. Canada does not have promoters of the calibre of Regis McKenna Inc. in advertising. The U.S. public relations companies, such as Burston-Marsteller or Hill & Knowlton have offices in Toronto, but may be out of price range for smaller Canadian companies. The leading Canadian public relations firms are substantially smaller than their U.S. counterparts.

To sum up, in most respects, the Canadian software product industry is more or less disadvantaged vis-a-vis the U.S., but perhaps at par with other competitors, competing from home bases overseas.

THE ROLE OF CANADIAN GOVERNMENT

The performance of the industry is significantly influenced in a number of ways by actions of or lack of them by Canadian Government.

A series of institutional changes have been introduced since 1986. One was the creation of Industry, Science and Technology Canada. Under InnovAction strategy, the new department aims at supporting strategic technologies, industrial sector competitiveness initiatives and business information and development services.

Government and the Factor Determinant

The Canadian government has been significantly influencing the factor endowment of Canadian software firms -- in capital resources, in human resources, as well as in knowledge resources.

The federal government influences significantly the stocks of **capital** in Canada, by taxation, by direct provision of capital, by monetary policy and by fiscal policy.

The broad lines of the first phase of the tax reform, introduced by the government in late 1987, aim at broadening the tax base and reducing tax rates. The general base rate of federal corporation tax was lowered gradually from 36 to 23 percent, while the preferential rate applying to small enterprises has been reduced to 12 percent. There is no special tax rate treatment for software companies. Firms performing research, receive tax incentives of Scientific Research Tax Credit (SRITC), which provide companies with financial rebates on any R&D, financed by the company. According to 1988 Statistics Canada survey, Canadian companies performed C$1 billion of software R&D in that year. According to Doyletech, SP industry's R&D tax credit claims were in the order of C$68 million in 1987.

Canadian-based software companies are also eligible for special tax credits designed to meet regional development objectives, which although reduced, still remain in place.

Investors into SP firms are subject to capital gains tax. In 1988, the rate for both long-term and short-term capital gains was 17.51 percent. Compared to Japan, Germany and other countries, where the tax is exempt, this is a competitive disadvantage. Compared to the U.S. where the tax stood in 1988 at 33 percent, it is a relative advantage in a North American context.

Eligibility of Canadian individual investors for C$500,000 capital gains exemptions brings funding to software product firms in the early stage of development of

emerging companies. In 1989, over a half of all venture capital disbursements were by individual investors in Canada, according to Doyletech.

The Canadian government provides high tech firms not only with tax concessions but also with financing in the form of repayable contributions. Examples are Microelectronics and Systems Development Program (MSDP), Defense Industry Procurement Program (DIPP) and Industrial Research Assistance Programs (IRAP). According to the 1991 Doyletech report, total funding from these three programs was C$384 million in 1990. Unfortunately, neither MSDP nor DIPP fund the SP companies, for the most part. Software is not even eligible for MSDP. On the other hand, IRAP program has been used by SP companies most frequently.

Governments have also evolved into suppliers of venture capital, through the Federal Business Development Bank (FBDB) at the federal level, and agencies, such as Innovation Ontario, at the provincial level. Public funds provided some 60 percent of the total risk capital disbursed to software firms in 1990.

The policies at macro level impact the industry negatively. Bank of Canada's monetary policy, that keeps the present exchange rate of Canadian dollar to U.S. dollar at above .85 level, probably hurts exports of Canadian software products.

The fiscal policies of the senior governments that produce chronic deficits year after year, affect the industry indirectly. Budget deficits siphon away tens of billions

dollars from the productive Canadian economic system. As a result, the cost of capital in Canada is more expensive than in Pacific Asia, and even the U.S..

In human resources, the recent funding constraints in higher education have kept computer-related university enrolment flat, even where there is excess of demand, as at the University of Waterloo. Potential supply shortages of university graduates in medium- and long-term are being created.

It is beyond the scope of this paper to cover numerous provincial initiatives in education and training. Among the recent relevant federal initiatives, Canada Scholarship Program to encourage outstanding students to pursue undergraduate science degrees could be mentioned. The National Industrial Training Program should be mentioned as well.

Under the new 1991 Labour Force Development Strategy, Employment and Immigration Canada is in the process of mapping the manpower supply/demand situation in the so called "Software Professionals in Canadian Economy" initiative.

The Canadian government influences substantially the **knowledge resources**, relevant to SP industry.

It is well known that with GERD/GDP at 1.36 percent, Canada lags behind other leading OECD competitors. In 1990/91, Federal government expenditures on R&D

will total C$3.1 billion.

Several new or enhanced initiatives should be mentioned. The National Advisory Board on Science and Technology (NABST) was established in February 1986 by Prime Minister Mulroney with the following mandate: "to assess and to help develop national science and technology goals and policies and their application to Canada's economy, in so far as they relate to the development and exploitation of industrial technology". The NABST consists of representatives of the private sector, the academic community and labour organizations.

Under the InnovAction priorities framework of 1987, at least three recent government initiatives, hopefully leading towards enhancing the knowledge resources of Canada. Most of the programs and initiatives apply to all industrial sectors. While software companies can avail themselves of these programs, they have so far not done so in a major way. It is fair to observe that the direct impact of such initiatives has been to date modest.

- The Networks of Centres of Excellence Program (C$240 million). During 1989 and 1990 fifteen networks, representing a cross-section of the natural and medical sciences and engineering, were selected by a peer review committee of international scientists as well as an advisory committee of eminent Canadians. These selected networks have industrial linkages which will reach into manufacturing, resource and high

technology sectors and businesses across Canada. An evaluation framework for the Networks of Centres of Excellence has also been established. In several of them, there is explicitly or implicitly a software application-related activity present.

- The Strategic Technologies Program (STP) aims to support R&D alliances and to design and develop new capabilities and applications in co-operation with universities and corporations. It provides financial assistance for the development and application of among others information technologies. The program supports co-operative R&D, such as Precarn Associates (see below).

- Public Awareness of Science and Technology (C$5 million). In the InnovAction strategy, it was recognised that the success of a new national approach to science and technology will depend significantly on shifts in the Canadian cultural outlook towards science and technology. The Science Culture Canada programme and the Public Awareness Campaign were established to help Canadians better understand S&T developments, become more aware of national achievements in science and technology, foster better communications between scientists and non-scientists and encourage more young people to consider S&T careers.

- The Technology Outreach Program (TOP) aims at promoting productivity and competitiveness in Canadian industry through a support infrastructure (technological centres) with a view to speeding up the acquisition, development and diffusion of technology and relevant skills in Canadian small and medium companies.

Two other relevant special programs, administered by EAITC, in principle enhance the knowledge resources, available to the industry.

- The Technology Inflow Program (with a $5.6 million funding) promotes the acquisition of foreign technological innovation needed to develop new or improved Canadian products, processes, or services. It does this by making use of Canadian government offices abroad to locate and facilitate linkages with foreign sources of technology and by providing financial support to help Canadian organisations acquire foreign technologies relevant to their needs. To support this, EAITC created two networks with 30 officers: the Science and Technology Counsellors Network and Technology Development Network.

- Canada-U.S. Defence Development Sharing Program does offer financial assistance for approved projects. Canadian companies are reimbursed 100 percent of their costs for the research and development phase of U.S. military projects. Funds are provided by the participating U.S. Department

of Defense agency and up to 50 percent by the Canadian government, through the Defence Industry Productivity Program (DIPP).

Government and the Demand Determinant

Canadian government has influenced the "demand" determinant of the industry - by its procurement and by stimulation of exports.

Procurement

According to 1988 Statistics Canada survey, governments purchased in that year C$150 million worth of software products. In 1988/1989, the Young and Wiltohire survey of 29 federal government organizations implied the purchases of the federal government in the order of C$90-100 million. The 1990 Branham survey found that the 1989 purchases totalled $107 million (excluding DOD). If federal procurement represented 40 percent of the total government's demand (ISTC estimates), then the government demand by all three levels of government might be in fact higher than Statcan surveyors say, in the C$250 million range.

Supply and Services are federal procurement gatekeepers, responsible for government purchasing regulations. This procurement "pull" of course pales in comparison with purchasing power of even a single U.S. government agency, the Department of Defense (DOD). Purchases of DOD are 40-45 times larger than the

purchases of the whole governance system of Canada.

For **stimulation of exports**, Canada's federal and provincial governments have a number of export assistance programs, available to Canadian software product companies. Info Export is a guide to all the export and services of the federal government.

The main federal government organizations involved in the delivery of export-related and financing services are:

External Affairs and International Trade Canada (EAITC)

Trade Commissioners Abroad

International Trade Centres

Industry, Science and Technology Canada (ISTC)

Export Development Corporation

Canadian Commercial Corporation

Canadian International Development Agency

Centres for International Business Studies

Of particular usefulness is EAITC's worldwide network of trade commissioners to assist companies seeking export markets, with over 400 officers in more than 90 Canadian embassies, high commissions and consulates. There are some excellent people within the network. In Canada, there is a network of International Trade Centres

providing export counselling and market opportunities information to potential exporters.

The World Information Network for Exports (WIN Exports) is a micro-computer-based information system designed to assist development officers located in federal offices around the world and in Canada to respond more quickly to the opportunities they have identified in their territories. EAITC is particularly keen to help in the exports of high tech products, such as software.

Companies are encouraged to have their capabilities listed in WIN Exports by registering with the Business Opportunities Sourcing System (BOSS), operated by Industry, Science and Technology Canada. Registration in WIN Exports or BOSS is required for access to PEMD funding, the most popular universal export promotion program.

Program for Export Market Development (PEMD) offers assistance to Canadian businesses to participate in or undertake various types of export promotion activities. PEMD covers projects, initiated by both industry and government, and is designed to assist companies regardless of size. The delivery of PEMD is handled by the International Trade Centres as well as headquarters' branches of ISTC and EAITC.

PEMD government-initiated activities involve trade missions and trade fairs, where firms are invited to participate. PEMD assistance covers both trade missions abroad and foreign business and government officials' trips to Canada or to another

approved location.

PEMD industry - initiated activities have involved:

- Participation in recognized trade fairs outside Canada.
- Visits outside Canada to identify markets, and visits of foreign buyers to Canada or to another approved location.
- Project bidding, or proposal preparation, at the pre-contractual stage, for projects outside Canada involving international competition and formal bidding procedures.
- The establishment of export consortia.
- The establishment of permanent sales offices abroad (excluding the U.S.) to undertake sustained marketing efforts outside Canada. ISTC expanded PEMD to cover U.S. as well.

PEMD is complemented by other export support programs on a provincial level, such as Export Success Fund in Ontario.

Canada-U.S. Defence Production Sharing Arrangement gives Canadian firms the opportunity to provide defence supplies and services to the U.S. military, in competition with U.S. industry.

Under this program, Canadian firms can compete because, in most cases, the U.S. government has waived customs duties and its Buy America Act. Although improving market access for Canadian businesses, the program does not provide financial assistance.

Various forms of export financing help are available to Canadian SP firms though the Export Development Corporation (EDC), the Canadian International Development Corporation (CIDA) and to a smaller extent the Canadian Commercial Corporation (CCC).

EDC is the only federal government agency responsible for export financing. EDC also provides insurance and guarantees for Canadian exporters.

CIDA provides long-term assistance to 120 Third World countries. The agency's 1990/91 budget is over C$2 billion. CIDA's assistance to Canadian exporters is focused in the Industrial Cooperation Program. CCC acts as prime contractor for purchases of Canadian products by foreign government and/or international agencies.

The major initiative intended to stimulate Canadian exports was the implementation of **Canada – US Free Trade Agreement (FTA)**. On January 1, 1989 already low or negligible tariffs for computers were eliminated. Tariffs on software products were already nil. The access to huge U.S. market for Canadian software products was facilitated in two interesting ways. Canadian companies may now offer their

products and services to the U.S. government, in contracts over $25,000. The special Annex, dealing with Enhanced Telecommunications and Computer Services, made the movement of the personnel of SP firms across the border easier.

The reaction of Canadian SP industry to NAFTA has been so far neutral-to-positive. Although a vocal minority has expressed fears of increased U.S. competition (with superior capability and better market recognition) in the home market and fears of possible customer flight to the U.S., most of the industry, according to ISTC, welcomes new opportunities opening up south of the border.

Government and the Structure Determinant

The 1986 Competition Act has not influenced the structure of the industry in any way, because the law is much narrower in scope and effectiveness than corresponding legislation in the U.S. and the attention to anti-trust issue is not as strong. In any case, only one SP case was investigated by the Bureau of Competition Policy and no case involving SP industry went to trial before the Competition Tribunal.

The government encouraged the creation of a not-for-profit research consortium of 33 partners, called Precarn Associates Inc. in 1987, which it also co-funded (C$10 million) in 1989. Precarn is a collective program of long-term, pre-competitive research in artificial intelligence and intelligent robotics. So far, there is little empirical evidence, that Precarn or similar consortia in the future affect the structures of the

industry. Some have argued that such collaborative efforts tend to decrease levels of domestic rivalry.

In 1986, the Canadian government has helped to increase international rivalry in the home market by creating Investment Canada, a federal agency mandated to review foreign takeovers of Canadian companies and to attract foreign direct investment. As a result, the inflows of foreign direct investment more than doubled in the first years of new agency's operations.

The most recent government's influence has been the Canada-U.S. free Trade Agreement, in place since 1989. It has facilitated an entry to Canada of a number of U.S. software companies, who would have probably located in the country anyway, due to need for sales offices close to regional markets.

Government and Related Industries Determinant

The SP industry's strength is most vulnerable to any weakness in the underlying industries, that provide many of the segments that the industry depends upon, including microelectronics, and computer hardware manufacturing. The Canadian balance of trade in computer - related equipment has deteriorated substantially over the last decade.

Only time will tell whether the government initiatives in this area, such as development of Strategic Technologies under InnovAction, will reverse the erosion.

The review of the influences of the government on all the four determinants of success of the software products industry show that the influences of the federal government do exists. Most of the time, even if not always, they have been beneficial to the industry.

IN CONCLUSION: CANADIAN COMPETITIVE POSITION

A brief comparative analysis of global competitiveness of the Canadian software product industry might be attempted by a quasi-systematic evaluation of Canadian competitive position as compared to non-US G-5 competitors (Japan, Germany, France, U.K.) carried along dimensions, similar to those in the analysis of U.S. competitive position (Section Three):

Table 5.1 Canadian Competitive Position

Determinants	Canadian Position				Non U.S. G-5 Competitors			
	Strong	Competitive	Weak	Lost	Strong	Competitive	Weak	Lost
FACTOR CONDITIONS		X				X----	---X	
• Knowledge Resources		■				■----	---■	
• Human Resources		■				■----	---■	
• Capital Resources		■				■----	---■	
• Physical Resources		■					■	
• Infrastructure		■				■		
DEMAND CONDITIONS		X------	---X			X----	---X	
• Defense Procurement			■				■	
• Hardware Firms			■			■----	---■	
• Own Multinationals		■				■----	---■	
• Supranational Agencies		■				■		
• Role of Universities		■				■----	---■	
• Exports		■					■	
RIVALRY			X			X----	---X	
• Domestic Rivalry			■			■----	---■	
• Internat. Rivalry		■				■----	---■	
• Coop. R&D			■			■----	---■	
RELATED/SUPPORT INDUSTRIES			X			X----	---X	
• Computer Hardware				■	■----	----------	-----	---■
• Media			■			■----	---■	
ROLE OF GOVERNMENT			X			X	X	
• Factors			■			■		
• Demand			■			■----	---■	
• Rivalry			■			■----	---■	
• Related Industries				■	■----	----------	---■	
SP INDUSTRY		■-----	---■			■----	---■	

In conclusion, Canadian SP industry cannot be fairly compared iwth its U.S. counterpart. The U.S. industry forms a class of its own, apart from all after world's competitors.

On the other hand, in the Canadian software products industry, the underlying determinants of Canadian competitiveness display parity or even a modest competitive advantage, when compared with other non-U.S. G-5 competitors.

The closeness to the U.S. market, the presence of several excellent university programs and a very strong position in SP exports, are some of the assets on which the government's sustainable strategy could be built. The brain drain to the U.S. and the lack of indigenous related industries are the weakest comparative disadvantages of the industry.

The agenda for government policy makers is challenging. Devising strategies that would build on relative strengths, leveraging them to the fullest, will not be easy. Overcoming competitive disadvantages will be even more challenging. The importance of software in a modern economy makes it imperative that the challenge is faced.

APPENDIX

THE DIAMOND OF NATIONAL ADVANTAGE

The Diamond of National Advantage

Why are certain companies based in certain nations capable of consistent innovation? Why do they ruthlessly pursue improvements, seeking an ever-more sophisticated source of competitive advantage? Why are they able to overcome the substantial barriers to change and innovation that so often accompany success?

The answer lies in four broad attributes of a nation, attributes that individually and as a system constitute the diamond of national advantage, the playing field that each nation establishes and operates for its industries. These attributes are:

1. **Factor Conditions**. The nation's position in factors of production, such as skilled labor or infrastructure, necessary to compete in a given industry.

2. **Demand Conditions**. The nature of home-market demand for the industry's product or service.

3. **Related and Supporting Industries**. The presence or absence in the nation of supplier industries and other related industries that are internationally competitive.

4. **Firm Strategy, Structure, and Rivalry**. The conditions in the nation governing how companies are created, organized, and managed, as well as the nature of domestic rivalry.

These determinants create the national environment in which companies are born and learn how to compete. Each point on the diamond - and the diamond a system - affects essential ingredients for achieving international competitive success: the availability of resources and skills necessary for competitive advantage in an industry; the information that shapes the opportunities that companies perceive and the directions in which they deploy their resources and skills; the goals of the owners, managers, and individuals in companies; and most important, the pressures on companies to invest and innovate.

(Excerpted From Porter M.E.:
"The Competitive Advantage of Nations"
Harvard Business Review, March-April 1990)

Determinants of National Competitive Advantage