A REVIEW OF THE CANADIAN COMPUTER BASED SERVICES INDUSTRY

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GENERAL INDEX

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NOTES

1. Numbering

   A. Major Chapters
      I Sections
         1. First Level Sub-section
            (a) Second Level Sub-section
               (i) Third Level Sub-section

2. References

   References shown as "(Reference 1)" are contained in a Table of References (Appendix F).

3. Figures and Tables

   Information presented as "Figure 1" or "Table 1" in this report are supported by Background Tables found in the List of Tables (Appendix G). Some gaps in numbering have resulted from deletions during final draft.

4. Glossary

   The text is written for readers with a basic knowledge of computer and data processing terminology. Items in the text marked (≠) are further explained in the Glossary of Terms (Appendix H).

INTRODUCTION

INTRODUCTION

Although 59% of the Canadian economy's output is in services, and the services sector accounts for 61% of the nation's labour force (Reference 1), this sector has lagged behind in its productivity as compared to the manufacturing industry. One of the major factors in the increase in productivity in the manufacturing industry has been technological innovation (Reference 2).

The purpose of this study is to examine the impact of technological innovation on productivity in the Canadian computer-based services industry (henceforth referred to as CBSI), its effect on the market and on employment, and to recommend some basic government and industrial policies required to enhance this segment of the services industry.

In August 1972, Tennant, Song & Associates Ltd. were retained by the Office of Science and Technology of the Department of Industry, Trade and Commerce to review and report on the CBSI.

In accordance with the outline to the study provided by the Department, we, as a group directly involved in the industry, have attempted to present an intuitive feel for the industry in terms of structure, performance, level of technology and the types of services provided.

We do not present this report as a definitive study of the computer-related service industry (this would have been impossible in the 330 man-hours allocated to the project). It also became apparent, at an early stage of our work, that the lack of relevant statistics for this industry would

hamper us in drawing well supported conclusions and projecting trends at a satisfactory level of confidence. However, in formulating our opinions, we have consulted with senior executives of selected companies in the industry to obtain their views. We have drawn on statistics already gathered for other studies, most notable and relevant of which are the background studies supporting the Computer Communications Task Force (CCC/TF) "Branching Out" report (Reference 3).

This study is an examination of a relatively small segment of the computer industry. Another interesting and relevant fact to observe at the outset is that an analysis of this sort relates to a very small portion of the total services industry. Figure 1 describes the relationship between the CBSI and other service industries. The expected effect of changes is the computer industry on other industries in Canada could be very significant. The impact of these changes is, and should continue to be, a subject of intensive analysis.

The computer industry has over the last fifteen to twenty years been in a continuous state of fluctuation. As computer technology advances, present segments of the CBSI will decline in importance. For example, users may go to data centres to develop, test and implement new systems. As volumes of work increase, and as their personnel becomes more proficient, they often install their own terminals or computers. The "industry" therefore serves as a training ground for people who later evolve to more independent operations.

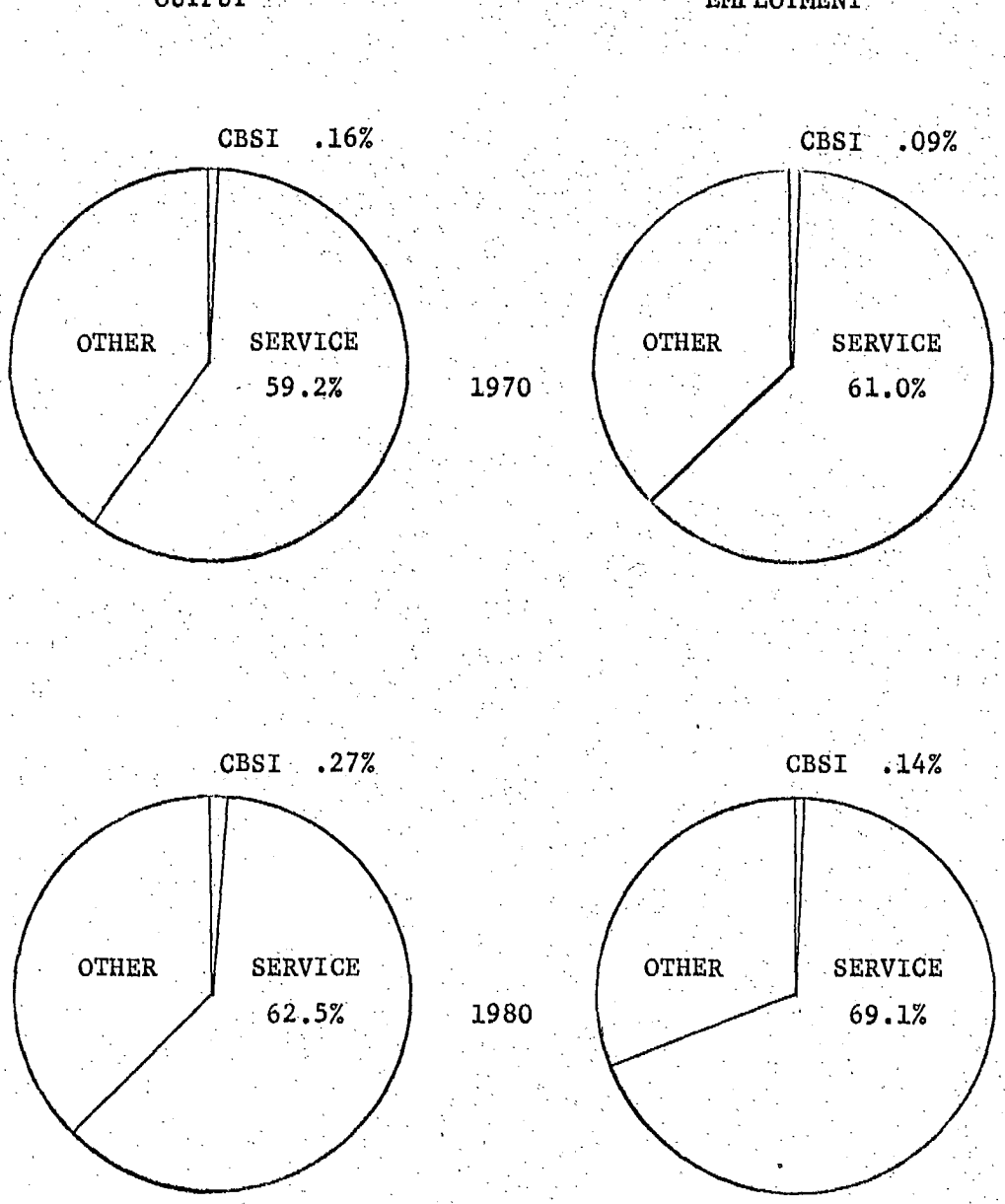


FIGURE 1

ORIENTATION TO CANADA'S
COMPUTER BASED SERVICE INDUSTRY (CBSI)

SOURCE: Economic Council of Canada,
CCC/TF, and
TS&A

It is hoped that the following work will contribute to a basis for Canadian government policy development in the near future related to the impact of computers in this and other segments of our economy.

Computer installations may be categorized into three broad types, i.e.:

1. Users with in-house computer installations, utilizing their hardware, software and labour resources for their own requirements,
2. Users with in-house computer installations utilizing their resources for their own requirements, but also making their hardware, software and/or labour resources available to outsiders on a shared basis, (Chartered banks using their computers to provide data centre work for customers and others are included in this category), and
3. Computer installations existing for the sole purpose of providing data centre (service bureau) services to their customers.

The scope of this study was restricted to the services provided by the Canadian CBSI. We have expressed our assessment of the CBSI by briefly examining:

1. <u>The past, present and future technology of each component making up the industry, and the diffusion of technology within the components</u>: We have attempted to answer questions relating to whether the service is capital or labour intensive, market needs for each component, significance of developments in technology, and major productivity factors impacted by such developments.
2. <u>The characteristics and potential of the domestic and international markets for computer-related services</u>: Detailed statistics relating to

value of computer-related services generated, import and export activities, and other market factors are difficult to extract at present. In an attempt to obtain some indication for sources of statistics, we interviewed a senior economic analyst of one of the major data processing suppliers in Canada. We were told that such statistics were not gathered either officially or privately. We therefore resorted to subjective opinions in attempting to answer many questions.

3. The employment within the various components of this industry segment: Employment statistics for this industry are also virtually non-existent. In considering questions such as employment patterns, rate of growth, earnings level, performance, impact of technological innovation, and the significance of employment within the Canadian unemployment problem, we were hampered since no official or unofficial statistics (segregating the CBSI from other services) were available. As a result, questions relating to employment in the industry were answered subjectively.

4. The basic Government and industrial R & D policies required to enhance the CBSI: These suggestions were based on a number of interviews we conducted with officals of selected companies providing computer-related services, other studies related to research in Canada, together with our opinion.

PART A

TECHNOLOGY AND PRODUCTIVITY

I THE COMPUTER-BASED SERVICES INDUSTRY

For the purposes of this study, the definition of the "computer-based service industry", (CBSI), used is based on the one developed and set our as the "Services Suppliers" segment of the CCC/TF report "Branching Out" (Reference 4).

The industry provides services to computer users with their own equipment and to those without their own equipment. The industry is dominated by Service Bureaux. Other service organizations involved are software firms, management consultants, facilities management firms, data preparatiion firms, and education organizations.

The scope of our study does not include the segment of the industry defined by the "Branching Out" report as "Other Product Suppliers".

Specifically, the segments of the computer industry examined are:

1. Computer Services
2. Software Services
3. Management Services

The compositions and inter-relationships of these segments are shown in Figures 2 and 3.

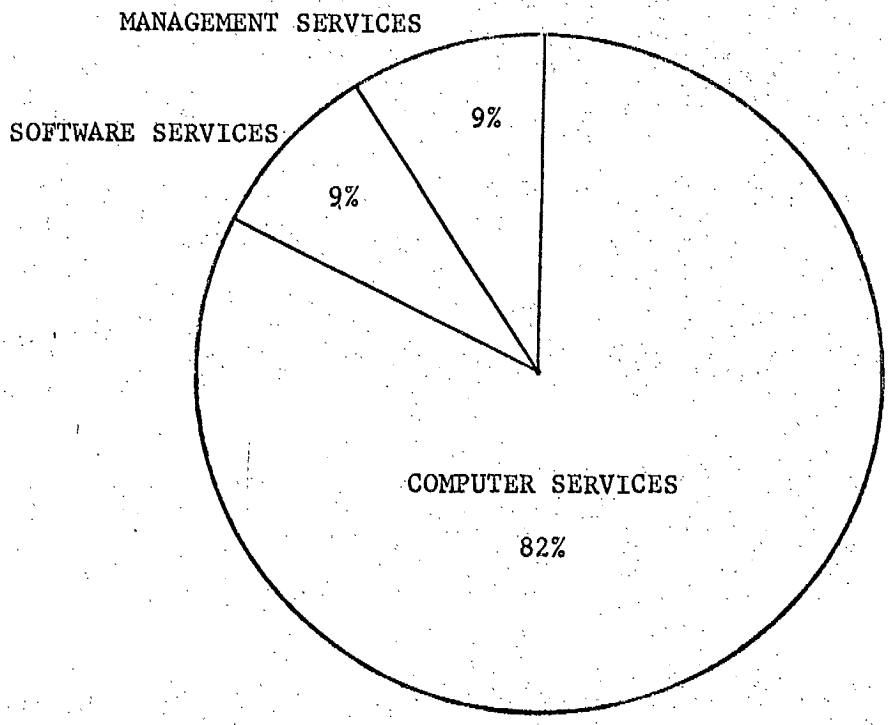


FIGURE 2

COMPUTER BASED SERVICE INDUSTRY COMPONENTS

SOURCE: TS&A

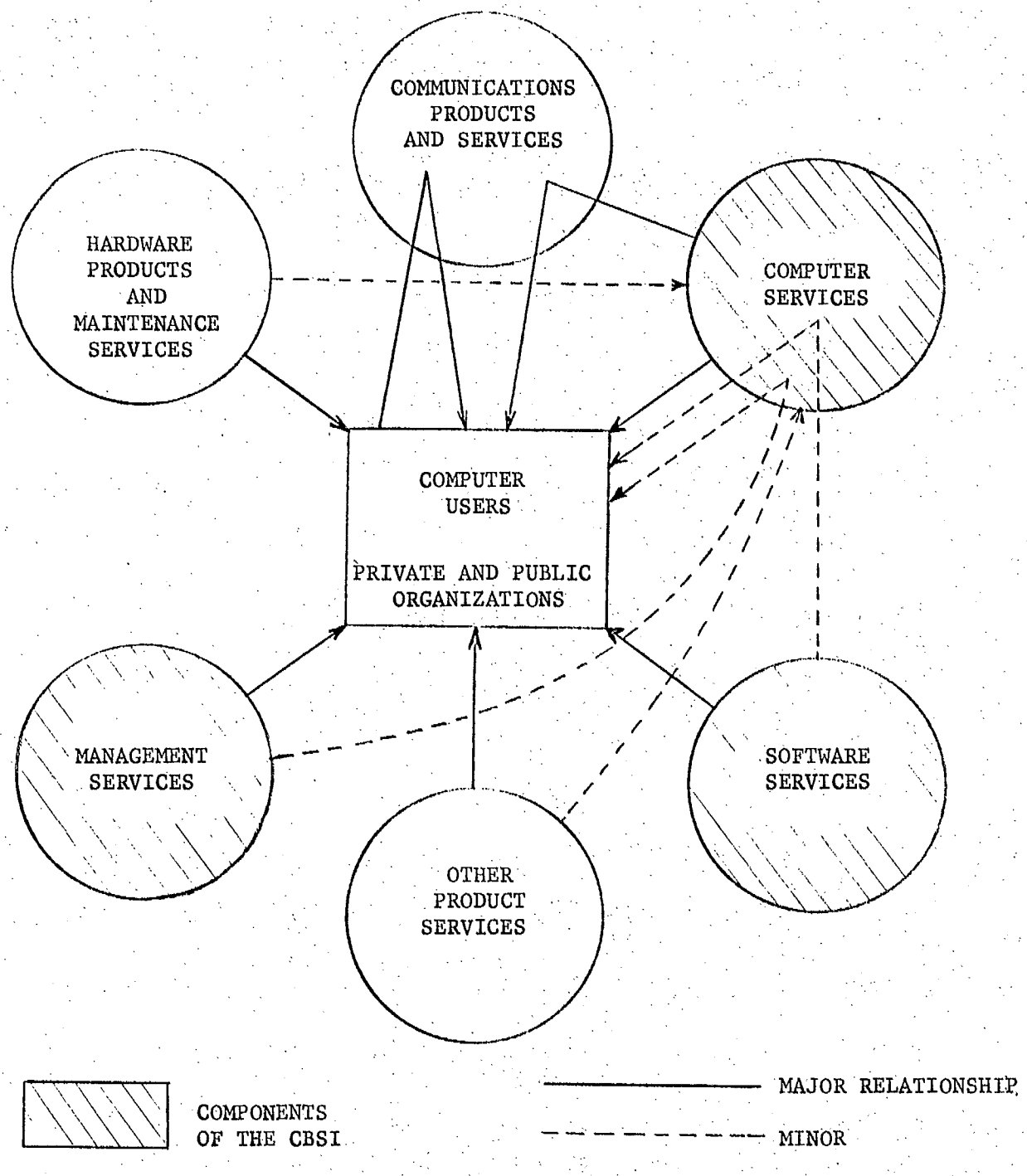


FIGURE 3

COMPUTER INDUSTRY INTERACTION OF COMPONENTS

SOURCE: TS&A

1. Computer Services is that segment of the CBSI that provides commercial or scientific computer processing to its customers. Our definition of the computer services segment is based on one developed by EDP Industry Report (Reference 5). This definition was chosen because of its comprehensity and its simplicity.

Computer Services are analyzed by two elements; the access method, and the application. Each of these elements is further broken down into three sub-elements:

Access Method can be classified as either:

Local Batch
Remote Batch
Remote Access-Immediate Response

Application or function can be segregated into:

Raw Power
Transaction Based
Data Base Inquiry

A matrix (3 x 3) can be formed using these sub-elements as headings to classify all computer services. This matrix is shown as Table 4. This figure also contains the estimated percentage revenues of each component. To further explain this classification, we have described each components in more detail.

ACCESS METHOD / APPLICATION	LOCAL BATCH	REMOTE BATCH	REMOTE ACCESS IMMEDIATE RESPONSE (RAIR)	TOTALS
RAW POWER	10	15	10	35
TRANSACTION	58	2	1	61
DATA BASE	2	1	1	4
TOTALS	70	18	12	100

TABLE 4

ESTIMATED PERCENTAGES OF PRESENT COMPUTER SERVICES REVENUE (EXCLUDING INPUT/OUTPUT SERVICES)

SOURCE: TS&A

(a) Local Batch Processing: is where the computer work is performed by the service bureau. There is no computer communication link with the customer.

(i) Raw Power: includes the sale of raw computer time and the processing of custom programmed applications. The customer supplies the data and owns and is responsible for the programs used. The customer is charged on the basis of computer time and capacity used.

(ii) Transaction Processing: consists of the processing of transaction oriented systems using application software proprietory to the Service Bureau. The customer provides the data. An example would be an inventory accounting package with transactions in the form of changes to the item's status. The customer is billed on the number of transactions rather than on the time used. Other application areas that are serviced by packaged or non-custom software include Payrolls, General Ledger Accounting, Sales Analysis or Financial Statements, Municipal Assessment and Tax Notices, Student Scheduling and Grade Reporting.

(iii) Data Base: provides a local, batched inquiry into a computerized data bank or data base owned and maintained by the Service Bureau. Here the customer is charged on the number of accesses made to the data. One example of such a system is the availability of geological data maintained by

firms such as Riley's Data Share International Ltd.

(b) Remote Batch Processing: involves the customer entering data and initiating the computer program via a terminal and a computer-communications link.

(i) Raw Power: provides the same processing services as in (a) (i) above except that the computer processing is initiated from a remote installation via communications facilities. The viability of this service can often depend on the cost reductions provided by a large computer to more than make up for the added communications cost. The processing of certain management science techniques, which use large amounts of computer calculation, is an example of this type of use.

(ii) Transaction Processing: consists basically of the same application areas as (a) (ii) above, again with the qualification that the processing of the jobs are initiated remotely. With lower cost communications and terminal hardware, this will be a significant growth area for Service Bureaux.

(iii) Data Base: provides the type of services that are in (a) (iii) above where the inquiries are batched and initiated remotely. This subsegment is presently the smallest, but has growth potential.

(c) Remote Access-Immediate-Response (RAIR): involves customer access with a terminal via a computer-communication link operating in an inter-active mode.(≠)

(i) Raw Power: in this mode is usually called timesharing. Several remote users, each with their own type-writer-like terminals, can make use of a Service Bureau's computer simultaneously on an interactive or immediate response basis.

(ii) Transaction Processing: is a very small part of present revenues, but an area that offers significant potential. Included in this segment will be packaged applications such as billing services where invoices could be prepared on the customer's terminal using the Service Bureaux computers for their calculating and storage capabilities.

(iii) Data Base: typical of this type of service is the stock market information network which allows brokers to inquire about latest stock prices. Other services might give access availability of theatre tickets, hotel rooms, or corporate financial data. While this subsegment probably accounts for a very small percentage of total revenues, it also can be expected to grow significantly.

Because of the high percentage of the CBSI falling into this segment, special emphasis is given to developments effecting "Service Bureaux" in the report.

(d) Input/Output Services: provide the necessary 'off-line' conversion of source documents into computer-processable form. Most common of the input services is keypunch and verifying. Others include key-to-tape, key-to-shared computer, and optical character recognition. Output services include computer output microfilm. (≠)

Users of computer systems who sell computer services to other users, do not at present constitute a measurable part of the industry. However, some users such as Banks, large private data processing consortia (i.e. - mergers of several users' data processing facilites), and shared computer installations for local governments, could have a significant impact on the Computer Services segment in the future.

2. Software Services - Computer suppliers, service bureuax, independent software firms, consultants, and user companies all provide computer programming services. These products and services are grouped and described below.

(a) Operating Systems Software: are programming systems that are necessary or facilitate the operation of computers. They include executive monitors or control systems, data management programs, user program compilers, utility programs, and communications handlers. Computer suppliers provide extensive operating systems software. This area should really be considered as part of the hardware market place by virtue of its domination by equipment suppliers.

(b) Custom Software: are programs that have been written for a specific customer and are unique.

(c) Non-Custom Software: or packaged software products are programs written for use by more than one customer. They tend to be generalized in nature but concentrate on specific application areas. Application packages such as payroll, sales analysis, inventory control, etc., or file management systems such as GIS II or Mark IV are examples.

3. Management Services are oriented toward advising or assisting management in performing their functions of planning, control and monitoring development. In the computer industry, these services are mainly provided by management consultants, computer suppliers, and independent service organizations. The services in this segment are grouped and described below.

(a) Studies: comprise problem definition, analysis, and recommendations. They can be further broken down into:

(i) Feasibility Studies: which examine technical or economic justification of projects.

(ii) Equipment Evaluation Studies: which compare and evaluate alternative equipment or services in relation to customer requirements. This can be expanded to include software studies.

(iii) Design and Analysis Studies: which comprises definition of requirements and design of information processing systems to satisfy specific customer requirements. In a growing number of cases, the use of management science techniques are involved. (e.g. - Simulation)

(iv) Efficiency Studies: which involve the review of existing or planned systems and recommendations to ensure effective operation.

(v) Security Studies: which examine and make recommendations on the physical security of the computer installation and of data and programs within the installation.

(b) Implementation Services: include such activities as project management, conversion assistance, and all inclusive "turn-key" contracts.

(c) Facilities Management: which provide management or operations services to owners of computer facilities. These services are provided mainly by independent firms who specialize in installation management.

(d) Education: which involves the education of user management personnel in computer concepts, computer applications and their implications, and introduction to new techniques.

Also included in this section are education and training of the following groups:

(a) Systems Analysts

(b) Programmers

(c) Computer Equipment Operators. This group includes key input operators, computer console operators, and computer input/output handlers.

(e) Personnel Placement: which consists of an employment service in the computer industry.

II IMPACT OF TECHNOLOGY ON PRODUCTIVITY

There can be no question of the impact of computers on business and private citizens during the past decade. Computers are playing an increasingly important role in doing business, to the extent that some of our traditional concepts of production, distribution, and record-keeping are being revised. It would also be true to say that computers are now touching the private lives of every individual in Canada: social security records, income tax records, and other personal data is to be found on Government and other agencies' computer files; credit information and other private information is maintained in computer records of private installations; business transactions are recorded on the computer files of banks, brokerage houses and department stores. We have become so dependent on computers that, in the event of, say, 100 government and private installations being even temporarily disabled, Canadian Government, industrial, business and personal activities would be seriously curtailed.

In the scientific sector, the role of computers has been even more spectacular - some of the major breakthroughs in human endeavour, such as the creation of nuclear fission and space exploration, would not have been possible without the aid of computers. This has been well documented in the press and trade literature.

What are the underlying reasons which brought us to the present state of dependence on what is basically a single innovation? In our opinion, the most important cause is the impact of technology within the computer field. Surely had Univac I never been developed beyond its concepts

of the 1950's much of what we are doing today would not have been possible.

The impact of technological innovation on the CBSI is examined as follows:

- Definition of Technology and Technological Innovation (Section II, 1 & 2)
- The Product Cycle (Section II, 3)
- Measurement of Productivity (Section II, 4)
- Inter-relationship of Prices, Wages and Productivity (Section II, 5)
- Relationship of Technology, Productivity and Level of Demand (Section II, 6)
- Historical Pattern of Technological Development (Section III)
- Rate of Technological Innovation (Section IV)
- Future Developments (Section V)
- Spin-off Effects (Section VI)

1. "Technology" can briefly be defined as the science (or body of knowledge) applicable to the production of goods or services.

   Thus, computers are a product of scientific technology, and computer-based services such as those provided by service bureaux, software services, etc., are a product of computer technology.

2. "Technological Innovation" is the practical implementation of scientific and technological knowledge to provide new or improved goods

or services. Technological innovation can be described as comprising of three key activities: (Reference 7)

(a) Invention, which occurs when feasibility of a new product or service is established.

(b) Original innovation, which occurs with the first sale of a new product or service with a resulting commercial success.

Innovation within computer technology includes hardware or software products and services. These can be termed "hardware innovation". Innovation can also be based on the knowledge of human resources or "social technology". Specifically, improved managerial methods or changes to institutions and organizational structures to provide new and better services, can be termed "social innovation".

Thus, technological innovation should include the following examples of social innovation as well as the better known examples of improved computer hardware:

- creation of data processing consortia
- changes in the banking institution to provide data processing services to its customers
- formation of facilities management companies
- contracting of "turn-key" or packaged implementation programs
- purchase and subsequent lease-back of computer systems

(c) Diffusion of innovation, whereby the better product or service is adopted by a wider number of firms.

3. The product cycle concept (Reference 8), is useful in providing a framework for analysis of the diffusion of technological innovation. Briefly, the concept can be described by the graph shown as Figure 5 and by the characteristics of each stage.

Certain computer technolgical innovations can be described according to the stage of diffusion they have reached. For example, the COBOL programming language originally introduced in 1960 and probably the most widely used programming language in North America is in the Stage 3 level of diffusion. Virtual memory hardware technology although first introduced in 1965, is now only being applied and is classified as in the Stage 2 level of diffusion. Each technological innovation must be examined individually for its level of diffusion.

A list of technological innovations relating to the CBSI, describing their level of diffusion is given later in this report as Table 8.

4. Measurement of Productivity - the 'per capita output' method of measurement is essentially a quasi-accounting method of calculating productivity. It does not take into account the role played by technological innovation.

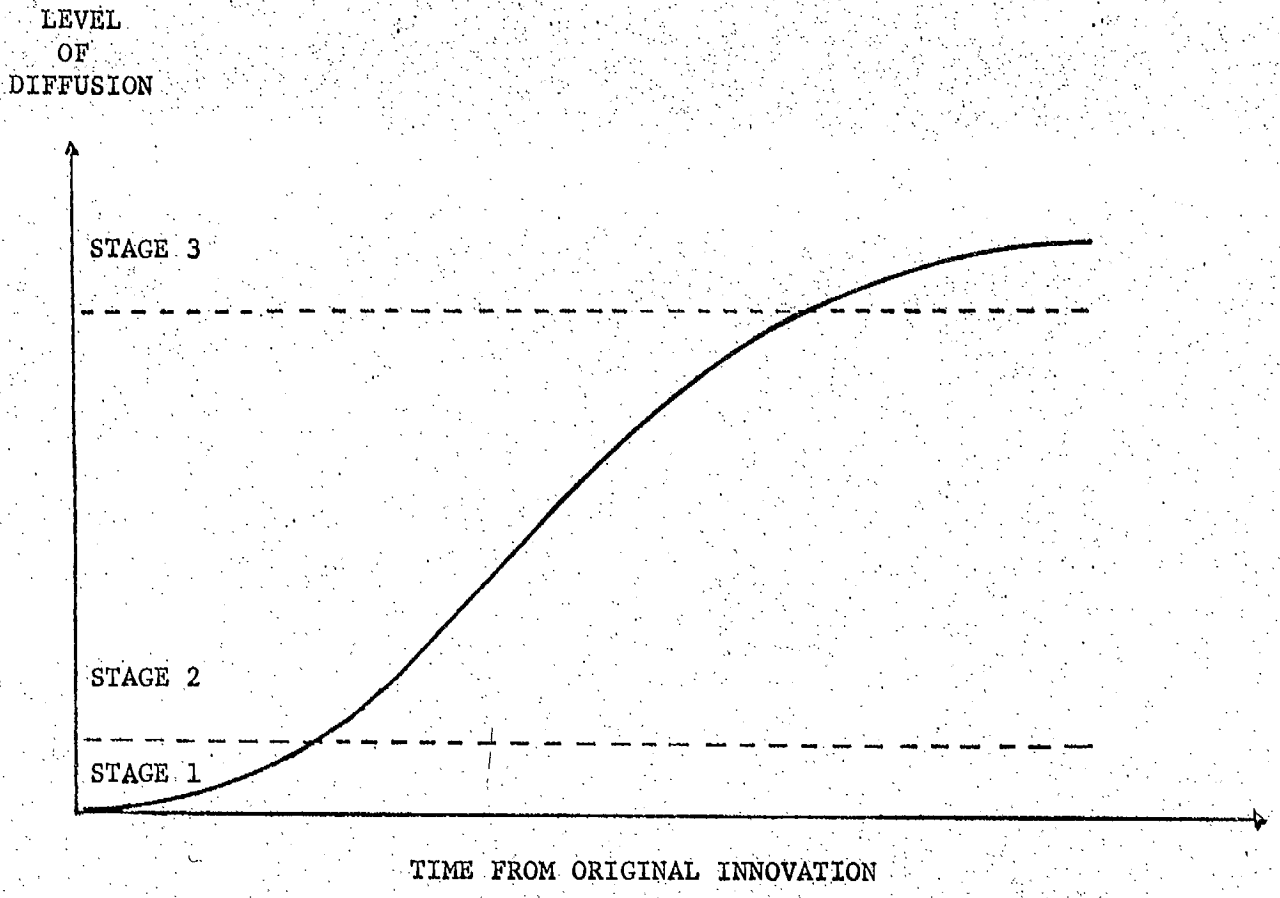


FIGURE 5

PRODUCT CYCLE CONCEPT RELATED
TO COMPUTER TECHNOLOGY

STAGE 1	SLOW BUT ACCELERATED GROWTH;LARGE MARKETING EXPENSES;HEAVY INVOLVEMENT OF HIGHLY SKILLED PEOPLE FREQUENT TECHNOLOGICAL CHANGE
STAGE 2	DEMAND INCREASES RAPIDLY;EFFECTIVE MANAGEMENT ESSENTIAL;COMPETITION INCREASES;FOLLOW-ON TECHNOLOGY SLOWS
STAGE 3	DEMAND SLOWS OR DECLINES;COMPETITION INCREASES, SUBSTITUTES APPEAR;LOWER LEVEL OF PERSONNEL SKILLS REQUIRED;; STABILIZATION OF TECHNOLOGY

SOURCE: OECD (Reference 8)

The 'age of capital' concept in ascertaining increased productivity as a result of technological innovation pre-supposes that entrepreneurs will continuously be on the watch for more efficient, and thus less costly, means of production, and will upgrade the software/hardware factors as new and better methods become available. The problem is to be able to obtain an accurate estimate of how long hardware and software have been in use before they were upgraded or replaced. This can only be done through a detailed census of all data centres.

The computer service segment, which accounts for an estimated 85% of output of the CBSI, is predominantly capital-intensive. The nature of the industry is also such that the factors of labour and capital are closely related for increased output. The available improved hardware will not, on its own, necessarily produce a higher output. For example, if a card sorter operator is given a faster sorter, the productivity in that department will increase. Similarly, if a computer programmer is provided with a more powerful high-level programming language, his output will increase. Man and machine have therefore to be considered as a combined factor of production. The level of skill also has an important effect on output. At any given level of technological sophistication, a more highly skilled machine operator or programmer will be able to extract more production than an "average" worker. At present, there is a critical lack of highly skilled human resources to take full advantage of the available level of technology (Reference 9). Human skills are therefore lagging behind as compared with the tools available.

It has been suggested (Reference 10) that increases in productivity as a function of improved technology, may be measured by the unexplained increases in per capita output over and above the expected increases as a result of additional per capita input. This assumes that the entrepreneur, who constantly seeks to maximize his profit, will inject additional doses of capital, management, and level of skills of his employees as and when these factors become available, in quantities calculated to yield him additional output and thus increase his profits. He would have already taken into account the expected increases in productivity before he makes his investment. The unexplained increases, if any, may therefore be a result of the technological changes he introduced.

In addition to technology, there are other influences which will effect productivity. Natural growth by itself, because of economies of scale, will eventually increase productivity. Changes in the quality of labour, changes in the proportions of the various factors, better organization and more skilful management, and social, phychological, cultural and political factors will each have its effect on productivity. Like technological changes, they exert their influences on productivity irregularly and unevenly.

The classical concept of measuring productivity relates the output of goods and services to the input of the factors of production. In the production of computer services within the definition of the CBSI, labour and capital will account for the dominant proportion of the total cost (Table 6).

1. Labour	35%
2. Hardware and Software Rental and/or Depreciation	30%
3. Direct Production Supplies, maintenance of hardware and software, communications, quality control	10%
4. Overheads	12%
5. Profits	13%
	100%

NOTES: 1. The foregoing is based on Local Batch installation. In a predominantly "raw power" or remote job entry environment, labour will decrease and hardware/ software increase.

TABLE 6

ESTIMATED PERCENTAGE SERVICE BUREAUX COSTS

SOURCE: TS&A

For the purposes of this discussion, labour costs are regarded as wages and salaries paid to operating managers, supervisors, systems analysts, programmers, computer operators, operators of all data preparation, input and communication devices, management consultants, and all personnel providing management and educational services.

Capital costs may be divided into hardware and software costs. This represents the investment in machines, and software necessary in the production of the services. Where hardware is purchased, the cost is the depreciation of the equipment; where the hardware is leased, the cost is the rental.

Similarly, where proprietary software is purchased, or software packages are developed on an in-house basis, this capital investment should be amortized over a three to five-year period; royalties paid for use of proprietary software packages becomes rental costs.

There are, however, two categories of costs which do not fit conveniently into either labour or capital costs, namely, direct production costs and indirect or overhead costs.

Direct production costs include communications, quality control, supplies, and hardware and software maintenance.

Indirect or overhead costs include management, property taxes, space rental, business taxes, clerical staff costs, utilities, insurance, legal, accounting, and other overhead expenses.

The last category of "cost" is the profit accruing to the shareholders or owners after deduction of income taxes.

The total dollar value of the output of the CBSI may then be considered as the sum of:

Labour costs
Capital costs
Direct production costs
Overhead costs, and
Profit

The total dollar output is equivalent to the total sales of all computer services, software services, and management services which make up the CBSI.

A rough measure of the per capita productivity in this service industry may therefore be defined as the ratio of the total dollar value of the output of services to the labour force employed in rendering these services within a given time frame.

This method of measuring productivity will give an average per capita dollar output of services within the given time, e.g. - a year.

Provided the total of the output was $133 million (Reference 11) in a given year, and a labour force of 7,500 was employed during the same year, the productivity per man in that year, by this definition,

would be:

$$\frac{\$133,000,000}{7,500} \quad \text{or Per Capita Productivity of } \$17,750$$

If the total dollar output of services, and the labour force within the industry is available over a number of years, then an approximate measure of changes in productivity may be obtained.

The foregoing assumes that the production and sale of the services operate in a free-enterprise systems, with prices being set by competitive forces. Labour is rewarded with a fair wage (otherwise employees will seek employment in other industries) invested capital rewarded with a fair return and enterprise with a fair profit (otherwise the owners will seek alternative sources for investment).

In the context of the CBSI, the impact of technological innovation is computer hardware and computer-related devices, and computer and communications software, has had, and continues to have, a major effect on the productivity (Reference 12) of this industry which will probably apply equally to the other service industries. The application of these technological innovations in the CBSI has the pervading effect of increasing productivity by lowering the costs of services provided by the industry. This has two important consequences: first, it increases the revenue producing capacity of an estimated 85% of this industry (Reference 13) and second, because of the lower cost of the service, it brings computer processing within the reach of many organizations who would not have found the service economically feas-

ible. These factors combined result in increased demand for such services.

Before attempting to answer the specific questions relating to this portion of our study, some thoughts on productivity and its inter-relationship with other economic factors may be pertinent.

5. Inter-relationship of Prices, Wages and Productivity - In an industry, it could be expected that over the long term, substantial increases in real wages would be accompanied by correspondingly large increases in productivity. This is not true in the case of the CBSI. In any event, the industry as such, which is only about ten to fifteen years old, can hardly be viewed from its "long term" history. People engaged in the industry may roughly be divided into three categories: those involved in the creative and technical concepts development, those working on application and general problem solving, and the general pool of hardware operators, including keypunch and computer operators. The real and money wages of the first two categories increased dramatically up to about five years ago. The high wages they commanded were not related in the short term to productivity, but rather to the supply of people with the skills they possessed. The CBSI competed, and continues to compete, with the general pool of skilled people in the overall computer industry.

Even with its short history, the CBSI has demonstrated that in the absence of increases in the labour productivity, a stable price level is inconsistent with continuous increases in money wages. The inability to adjust prices to compensate for high wage levels has been a contributing factor in a number of data centres getting into severe financial difficulties.

There are exceptions to this general rule. Input/output service firms such as those offering keypunch services have experienced rising wage levels without a corresponding increase in productivity. They have been able to increase their prices to offset higher wages paid to keypunch operators (Table 7).

There has, however, been an overall increase in productivity in the CBSI in the past decade, mainly as a result of technological innovation in the Computer Industry. This has brought with it a reduction in costs, which in turn resulted in price reduction of services. This factor, combined with the additional demand for the services partially created as a result of the lower prices, enabled the industry to support the higher wage levels.

In established industries where the products or services are comparatively insensitive to price changes, we would expect an increase in labour productivity to reduce employment. As a generalization, it may be stated that the CBSI is not sensitive to price changes except perhaps in the segments providing low power. Rather the CBSI as a whole could be described as "service sensitive".

YEAR	AVERAGE HOURLY EARNING OF KEY-PUNCH OPERATORS	AVERAGE HOURLY CHARGE-OUT RATES
1968	$2.00 to $2.50	$6.00 to $6.50
1969	$2.25 to $2.50	$6.50 to $7.00
1970	$2,25 to $2.50	$7.00 to $7.00
1971	$2.75 to $2.85	$7.00 to $8.00
1972	$2.85 to $3.10	$7.50 to $8.00

TABLE 7

NOTE: THE PRODUCTIVITY OF KEYPUNCH OPERATORS AS A WHOLE HAS NOT INCREASED SIGNIFICANTLY SINCE 1968 DESPITE THE INTRODUCTION OF MACHINES WITH BUFFERING FEATURES SUCH AS THE UNIVAC 1710 AND IBM 129.

SOURCE: ELAN DATAMAKERS LTD., VANCOUVER
CANADA MANPOWER, VANCOUVER

Despite the increase in productivity, employment has not been reduced. This is due largely to the expansionary nature of the industry, which has tended to mask this effect. However, as the industry reaches a plateau of stability, and a high level of the existing market saturation is reached, employment might well be reduced, unless new segments of services (i.e. - new applications for computer technology) not in existence at present, are introduced to create another wave of expansion within the industry.

Another interesting observation can be made. Wage increases in the CBSI could bring about an increase in productivity in an unexpected way by encouraging entrepreneurs to substitute capital (and other factors of production) for labour. In the example of the keypunch bureaux, the price of this service can only be increased to a certain level, after which it becomes unacceptable. The search will then be intensified for alternative methods of input, e.g. - optical character recognition, point-of-transaction entry, etc. (Table 7)

Given the present range of services, markets, and continuing technological enhancement, we envisage a situation in the next decade in which there is a stabilization of wages for those engaged in the application, conversion and problem solving area accompanied by a relative decline in employment, a relative decline in wages and employment for people employed as programmers and operators of hardware and a progressive increase in the earnings of those engaged in the high level technical/creative development processes.

6. Relationship of Technology, Productivity, Level of Demand - The components of a relationship can be described in a narrative equation such as: "Technological Invention is a function of Research."

This can be written as:

Technological Invention = f (Research)

Similarily:

Technological Innovation = f (Application of Knowledge, Managerial Skill)

Using this type of expression, we will identify the components involved with the rate of technological innovation, productivity, revenue capacity and level of demand.

Rate of Technological Diffusion = f (Managerial Skill,
Education,
Degree of Cost/Benefit Incentive,
Availability of Purchase Capital,
Number of Suppliers,
Reputation and Financial Stability of Suppliers,
Level of Service Provided,
Production Capacity,
Time)

Productivity = f (Capital, Labour, Enterprise, Technological Innovation)

As discussed earlier, the major impact of increased productivity is providing an increase in the revenue capacity of the industry segment concerned. Thus,

Revenue Capacity = f (Productivity, Number of Suppliers, Price)

The level of demand or level of sales can expand only to the revenue capacity of the segment. Other factors also influence the level of demand. Thus,

Level of Demand = f (Revenue Capacity)

or Level of Demand = f (Market Size, Price, Rate of Technological Diffusion, Productivity)

A quantitiative analysis of the relationships involved with the level of demand is outside the scope of this study. Statistical information relating to the productivity or rate of diffusion is not available. However, we can weigh the factors to intuitively quantify the relationship. These numerical weights should be considered as an indication of the relative sensitivity of the factor in contributing to the level of demand. Thus, factors ranked in importance (to a maximum value of 1.0) are chosen to be:

Level of Demand $\approx$ .75 Revenue Capacity

or Level of Demand $\approx$ .5 Market Size

plus .5 Price

plus .75 Rate of Technological Diffusion

plus .7 Productivity

Where Productivity factors are:

- .4 Capital
- .4 Labour
- .5 Enterprise
- .7 Technological Innovation

And where Rate of Technological Diffusion factors are:

- .8 Managerial Skills
- .8 Education
- .8 Degree of Cost/Benefit
- .5 Availability of Capital
- .3 Number of Suppliers
- .6 Reputation
- .8 Level of Service
- .75 Production Capacity
- 1.00 Time

The value of this functional equation is to identify those components that have significant effect on the level of demand. Specifically these are:

Technological Innovation
Education Level of Buyer
Managerial Skill of Supplier
Degree of Cost/Benefit Incentive
Level of Service Offered
Time

Accelerating the level of demand for particular services can be obtained by paying particular attention to these components.

A more accurate quantification of these relationships should be the subject of further study.

III HISTORICAL PATTERN OF TECHNOLOGICAL DEVELOPMENT AND ITS RATE OF INNOVATION

The pattern of technological development of the CBSI's performance in introducing new technology is shown in Table 8. We have listed past (going back approximately 10 years) and present technology, their present stage of diffusion as related to the product cycle concept, the factor of productivity impacted, a measure of the significance or amount of impact, and other pertinent comments. General observations and discussions of the rate of innovation follow this table.

Figure 9 shows the rapid increase in the speed of computing
Figure 10 shows the reduction in main memory costs and,
Figure 11 shows the remarkable reduction in unit storage costs

These figures are included to illustrate the rate and extent of technological innovation in the computer industry.

TABLE 8 (1)

TECHNOLOGICAL INNOVATION	DATE	STAGE OF DIFFUSION	PRODUCTIVITY IMPACT I.E. Increase in Revenue Capacity or Reduced Costs	SIGNIFICANCE * Slight ** Moderate *** Very Importa **** New Generati of Computing	COMMENTS RELATIVE TO COMPUTER BASED SERVICE INDUSTRY
FORTRAN COMPILER	1954	3	REDUCED DEVELOPMENT COSTS INCREASED PROGRAMMER'S OUTPUT CAPACITY	***	FIRST HIGH LEVEL LANGUAGE. INCREASED DRAMATICALLY THE NUMBER OF PROGRAMMERS BY ALLOWING SCIENTISTS, ENGINEERS, TECHNICIANS, EDUCATORS, ETC. TO WRITE COMPUTER PROGRAMS QUICKLY AND EASILY.
HIGH SPEED IMPACT PRINTER	1954	3	LOWER PRODUCTION COSTS BY RELEASING MORE C.P.U. TIME FROM I/O	*	START OF TREND TOWARDS MASSIVE VOLUMES OF PRINTED OUTPUT.
FERRITE CORE MEMORY	1956	3	LOWER UNIT COST. LARGER MEMORIES ALLOWED LARGER PROBLEMS TO BE SOLVED	**	
TRANSISTORIZED COMPUTERS	1958	3	LOWER UNIT PRODUCTION COSTS THROUGH FASTER COMPUTING	****	GROWTH OF LARGE UNIVERSITY COMPUTER "SERVICE BUREAUX" SPURRED CORRESPONDING NEED FOR COMMERCIALLY ORIENTED SERVICE BUREAUX.
MULTIPROGRAMMING SOFTWARE	1960	3	LOWER PER UNIT COSTS BY INCREASED UTILIZATION OF C.P.U.	***	INCREASED THE TREND TO LARGE COMPUTERS CAPABLE OF RUNNING MULTIPROGRAMMING SOFTWARE.
OPERATING SYSTEMS SOFTWARE	1960	2	REDUCED JOB TO JOB PRODUCTION COST AND INCREASED AVAILABLE C.P.U. TIME	**	PARTICULARLY VALUABLE TO SERVICE BUREAUX PROCESSING MANY SHORT DURATION BATCH JOBS.
COBOL COMPILER	1960	3	REDUCED DEVELOPMENT COSTS INCREASED PROGRAMMER'S OUTPUT CAPACITY	**	ACCOMPLISHED FOR COMMERCIAL USERS IN PART WHAT FORTAN HAD BENEFITED SCIENTIFIC USERS. IMPACT NOT AS GREAT BECAUSE GREATER AMOUNT OF TRAINING WAS REQUIRED.
DIRECT ACCESS DATA STORAGE	1963	3	REDUCED PRODUCTIONS COSTS. FASTER PROCESSING	***	CONCEPT OF "ON-LINE" DATA STARTED PRACTICAL IMPLEMENTATION ENCOMPASSING "MANAGEMENT INFORMATION SYSTEMS". THE RESULTING DISENCHANTMENT LEAD TO SIMPLER APPROACHES AND GROWTH OF SERVICE BUREAUX PROCESSING.

TABLE 8 (2)

TECHNOLOGICAL INNOVATION	DATE	STAGE OF DIFFUSION	PRODUCTIVITY IMPACT I.E. Increase in Revenue Capacity or Reduced Costs	SIGNIFICANCE * Slight ** Moderate *** Very Important **** New Generation of Computing	COMMENTS RELATIVE TO COMPUTER BASED SERVICE INDUSTRY
FAMILIES OF COMPUTERS AND INTEGRATED CIRCUITRY	1963	2	PROTECTED INVESTMENT IN PROGRAMS. COMBINED SCIENTIFIC AND COMMERCIAL MARKETS. LOWER UNIT PRODUCTION COSTS THROUGH FASTER COMPUTING AND BETTER UTILIZATION OF C.P.U.	****	THE INTEGRATION OF HARDWARE AND SOFTWARE TO PRODUCE LOWER COST COMPUTING CREATED DEMANDS FOR NEW SOFTWARE. COMBINED SCIENTIFIC-COMMERCIAL INCREASED SERVICE BUREAUX MARKET INCREASED COMPLEXITY AND PROBLEMS, CREATED COMPUTER CONSULTING
PAPER TAPE INPUT	1963	3	REDUCED INPUT COSTS AND INCREASED FEASIBILITY. NEW APPLICATIONS	**	REDUCED SERVICE BUREAUX INPUT REVENUES BUT GREATLY EXPANDED SERVICE BUREAUX PROCESSING REVENUES.
VIRTUAL MEMORY	1965	2	REDUCED APPLICATION DEVELOPMENT COST	*	GREATER USE OF VIRTUAL MEMORY WILL ALLOW SERVICE BUREAUX TO OFFER GREATER VARIETY OF NEW SERVICES.
PACKAGED APPLICATION SOFTWARE	1966	2	REDUCED APPLICATION DEVELOPMENT COST	**	SPURRED GROWTH IN SERVICE BUREAUX TRANSACTION PROCESSING TO POINT WHERE 50% BUSINESS WAS WITH PACKAGED SOFTWARE.
DATA COMMUNICATIONS SOFTWARE, TERMINALS, TRANSMISSION LINES	1966	2	NEW SERVICES	***	INTEGRATION OF COMPUTERS AND COMMUNICATIONS OPENED NEW MARKETS AND DEMANDED ADDITIONAL SPECIALIZED SOFTWARE REMOTE BATCH AND RAIR APPLICATIONS NOW ACCOUNT FOR 25% OF REVENUE.
EXECUTIVE PROGRAMMING LANGUAGES SOFTWARE	1968	2	REDUCED APPLICATION DEVELOPMENT COSTS	**	COULD LEAD TO SAME DEGREE OF USE AMONG COMMERCIAL AS FORTRAN IN SCIENTIFIC AREA.
MINI-COMPUTERS	1968	2	REDUCED PROCESSING COSTS	*	SHIFTING OF SERVICE BUREAUX APPLICATION TO IN HOUSE COULD REDUCE COMPUTER SERVICES REVENUE. CREATES NEED FOR APPLICATION SOFTWARE.
TIME-SHARING SOFTWARE	1968	2	NEW SERVICE	**	SIGNIFICANT NEW MARKET FOR SERVICE BUREAUX.

TABLE 8 (3)

TECHNOLOGICAL INNOVATION	DATE	STAGE OF DIFFUSION	PRODUCTIVITY IMPACT I.E. Increase in Revenue Capacity or Reduced Costs	SIGNIFICANCE * Slight ** Moderate *** Very Important **** New Generation of Computing	COMMENTS RELATIVE TO COMPUTER BASED SERVICE INDUSTRY
DATA BASE MANAGEMENT	1968	2	REDUCED APPLICATION DEVELOPMENT COSTS. REDUCED PROGRAM MAINTENANCE COSTS	***	ALONG WITH EXECUTIVE LANGUAGE COMPILERS AND LOW COST ON-LINE DATA STORAGE OFFERS HOPE FOR EFFECTIVE TOTAL "INFORMATION SYSTEMS".
COMPUTER LEASEBACK	1968	3	REDUCED PRODUCTION COSTS	*	TENDS TO STABILIZE TECHNOLOGICAL INNOVATION DUE TO LONG TERM NATURE OF LEASEBACK CONTRACTS.
FACILITIES MANAGEMENT	1968	2	REDUCED LABOUR COSTS. NEW SERVICE	*	NEW MARKET FOR CONSULTANTS AND NEW SPECIALIZED COMPANIES.
ONE-LINE PROGRAM DEVELOPMENT SOFTWARE	1968	1	REDUCED APPLICATION DEVELOPMENT COSTS. INCREASED PROGRAMMER CAPACITY	**	NEW SERVICE FOR SERVICE BUREAUX.
DISTRIBUTIVE DATA ENTRY	1969	1	REDUCED INPUT COSTS	*	TENDENCY TO REDUCE SERVICE BUREAUX INPUT REVENUE.
LARGE SCALE INTEGRATED CIRCUITRY	1971	1	REDUCED UNIT PRODUCTION COSTS THROUGH FASTER COMPUTING AND LOWER UNIT COST MEMORY	****	PROMISES OF MORE INTELLIGENT TERMINALS OPENS NEW MARKETS FOR SERVICE BUREAUX, APPLICATION SOFTWARE
APPLICATION COMPILERS SOFTWARE	1971	1	REDUCED PROGRAMMING COSTS, NEW SERVICE	***	DIRECTLY REDUCES SOFTWARE REVENUES.
DATA PROCESSING CONSORTIA	1971	1	REDUCED UNIT PRODUCTION COSTS THROUGH ECONOMIES OF SCALE	*	REDUCES SERVICE BUREAU MARKET AND OPENS DIRECT COMPETITION.
DIGITAL DATA COMMUNICATIONS	1972	1	REDUCED TRANSMISSION UNIT COSTS	**	REDUCTION OF DISTANCE TRANSMISSION COST DIFFERENTIAL WILL CREATE STRONG TENDENCY FOR ALL SERVICE BUREAUX RAW POWER COMPUTING TO GO TO LARGEST SYSTEM (I.E. BEST PRICE PERFORMANCE).

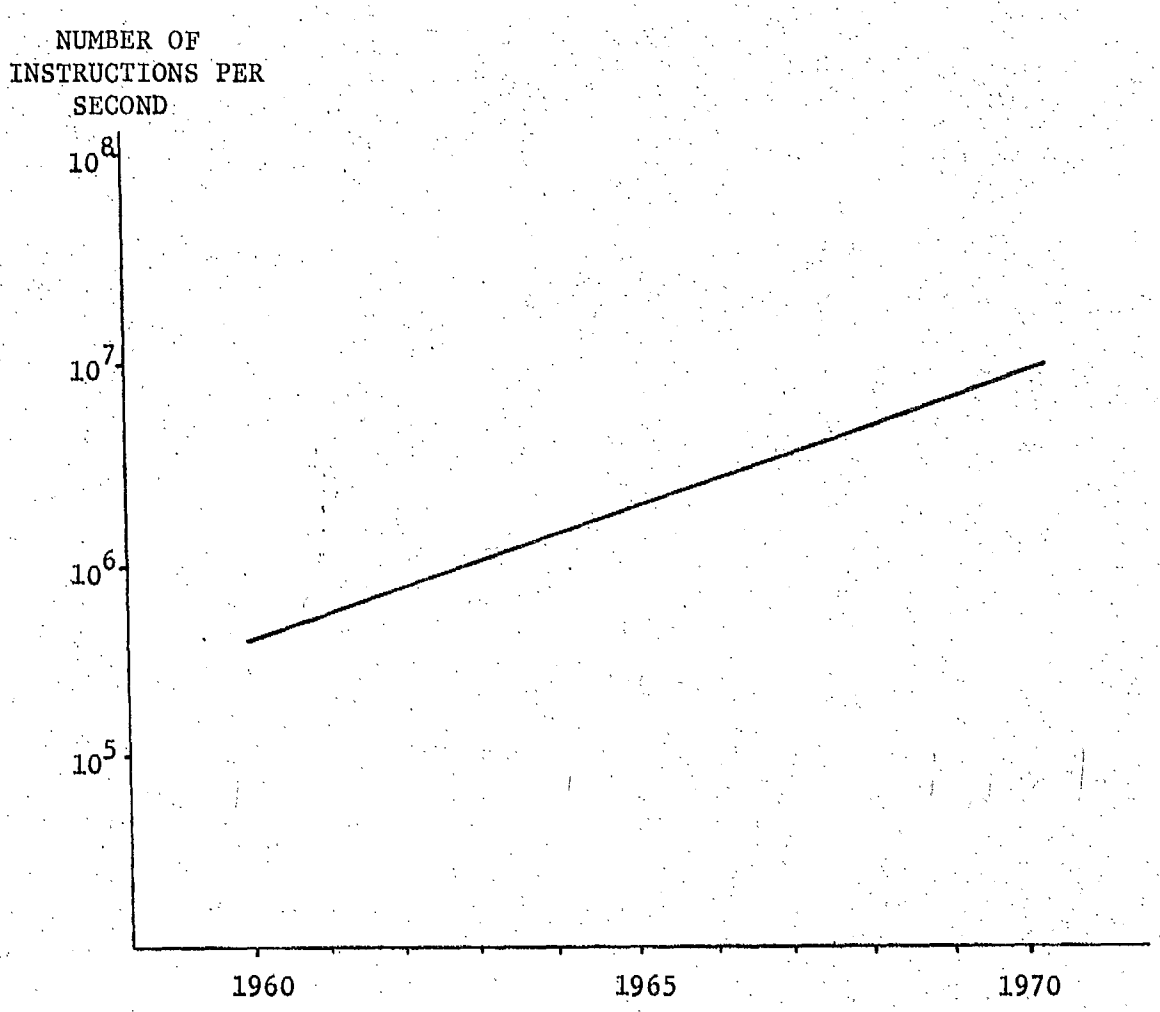


FIGURE 9

REPRESENTATION OF INCREASE
IN COMPUTATIONAL SPEED
OF COMPUTERS

SOURCE: TS&A, and
DOC (Reference 15)

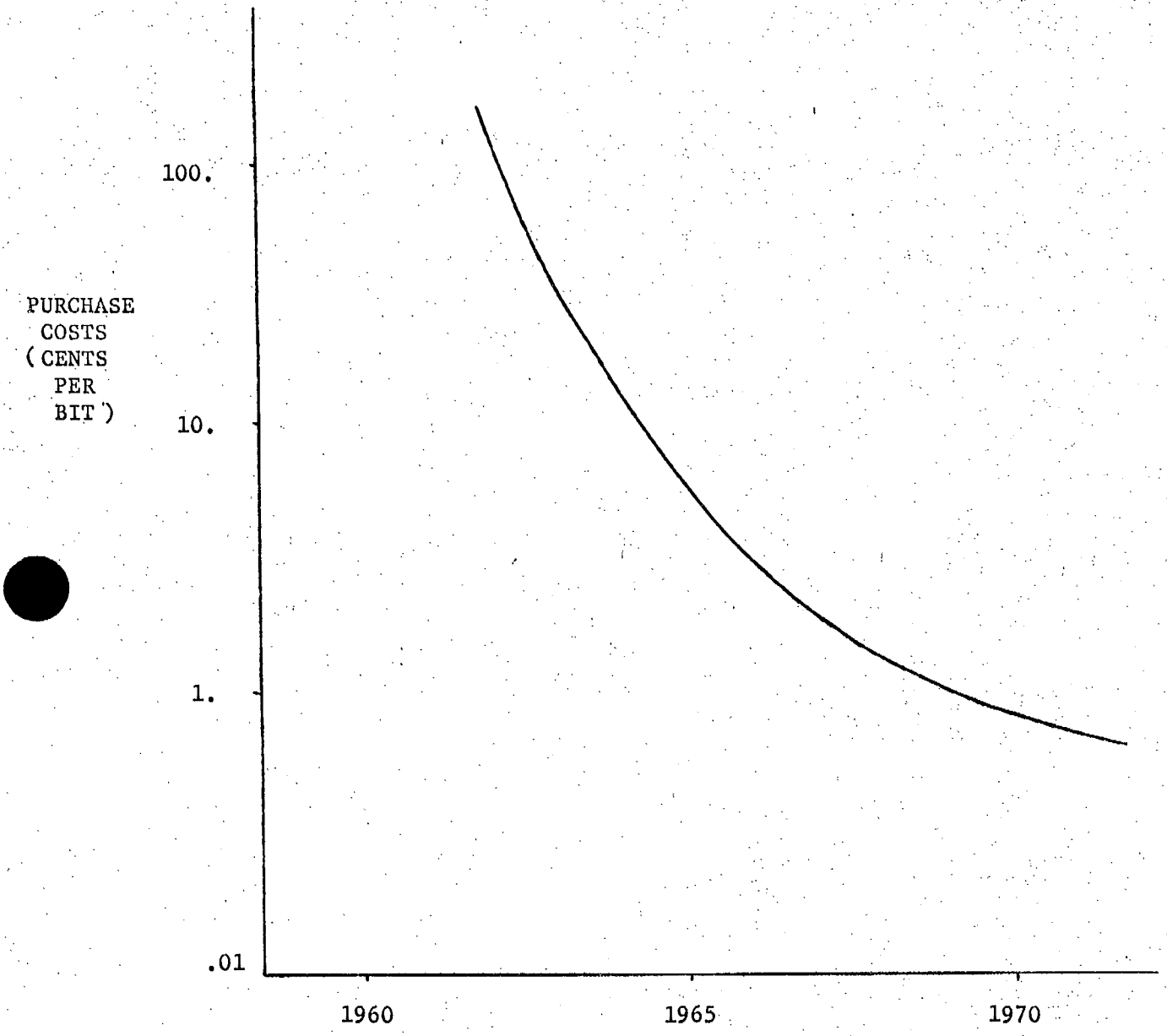


FIGURE 10

MAIN MEMORY COST REDUCTION

SOURCE: DOC (Reference 16), and TS&A

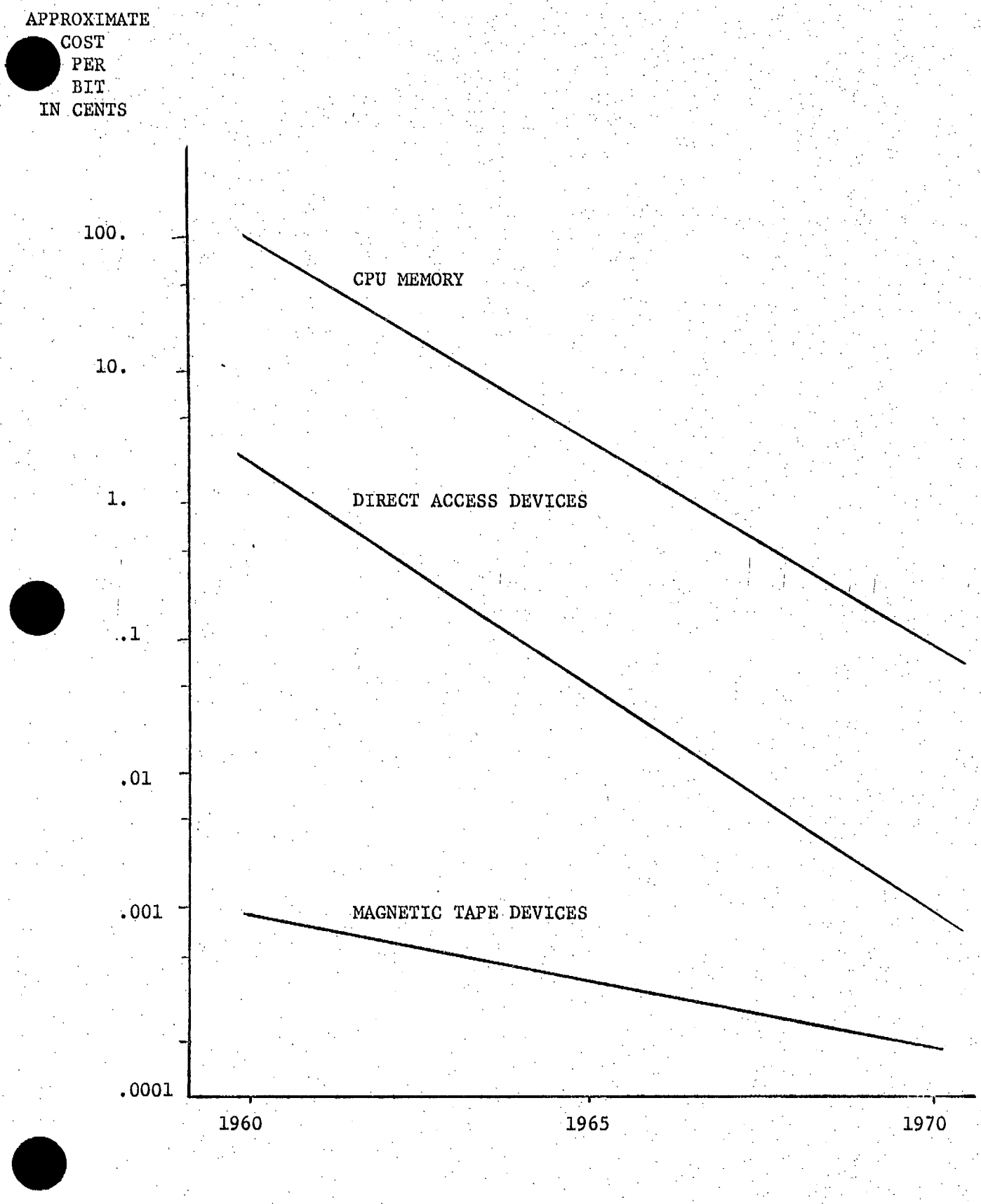


FIGURE 11

TREND IN COST PER UNIT OF COMPUTER STORAGE

SOURCE: DOC (Reference 17), and TS&A

Most of the technological innovations listed were introduced to benefit the large market of private computer users. Service Bureaux or suppliers of Computer Services, took advantage of these innovations, as did the private users. The innovations that created the largest increases in the level of demand were packaged software, data communications capabilities, and timesharing. All these innovations directly created new markets. In our opinion, the impact of improved hardware price/performance has not been as significant in the creation of these new markets.

The present rate of innovation within the raw power subsegment of computer services is believed to be greater than in any other segment of the industry. This is due to competitive pressures and the need to react quickly to customers demands. A basically unstable situation is most evident in those products or services where many suppliers are marketing inter-compatible services. In other areas where the Service Bureau can "lock-in" its customer with software, unique data bases, or high levels of service, the rate of innovation and diffusion of new technology is much more leisurely and unpressured. As EDP Industry Report (Reference 14) comments, "as the industry grows, the computer technology that allows it to exist becomes more incidental." The primary ingredient is service, i.e. - "knowing the customer and giving him what he wants".

The emphasis on software development can be seen from the fact that 11 out of 25 innovations noted were primarily software innovations. The present development thrust is more in the areas related to software than to hardware. Most software innovations were directed at selling hardware

by reducing application costs and thereby increasing the computer market size. The extent of the effort in producing the software involved is so large as to exclude all but companies with large pools of programming skills, abundant financial resources, and widespread marketing capability. These tend to be the hardware suppliers. Figure 11, shows the extent of software development costs related to other system component costs.

The productivity of the Management Services segment seems to be the least affected by any particular technological development. Management consultants tend to be diffusers and appliers of technology. Their influence on the rate of diffusion can be significant if they are involved in projects of wide potential application. Management consultants sell their experience and are as sensitive to potential new customers as are hardware suppliers. The level of demand for consulting is directly related to the general level of diffusion of computer technology within the industry. As such, the growth of management services is an indicator of the rate of diffusion of computer innovations. Education services also are not affected significantly by any one technological innovation. Their revenue capacity and their level of demand increase with every new technological innovation introduced.

V RATE OF TECHNOLOGICAL INNOVATION

The pace of technological invention within the computer industry is overwhelming. No sooner has one supplier introduced an innovation than another supplier is offering similar items with improvements. The choice presented to users is staggering. The rate of innovation may now be actually holding back the diffusion of technology. In many cases, users have simply delayed purchasing decisions because they feel new technology is soon to be introduced, obsoleting the technology they have before them. Another factor retarding the diffusion is the "3rd party leasing" business. Because it is primarily a financial service, it is excluded from this study, but its effect in retarding diffusion may be significant. This may be a stability factor introduced into a volatile industry.

A measure of the rate of innovation within the CBSI is difficult. The "average age of capital" approach requires a detailed analysis of all major service bureau installations. The benefit provided by the answer must be greater than the cost in obtaining it. We have therefore not tried to quantify the average age of capital in this study.

Other indicators are available that do provide a measure of the diffusion of innovation within the industry. A measure of the market penetration of innovation or diffusion is perhaps more meaningful than the rate of innovation itself. Typical diffusion indicators are growth in number of computers, increase in computer capital expenditures (i.e. - equivalent rental costs), growth of computer consulting revenues.

Figure 12 presents a graphical measure of some of these indicators. Individually, each of these measures may be questioned. Their value is that they consistently point towards the same trend, an approximate measure of the rate of technological diffusion.

Figure 13 relates Canadian performance to other countries.

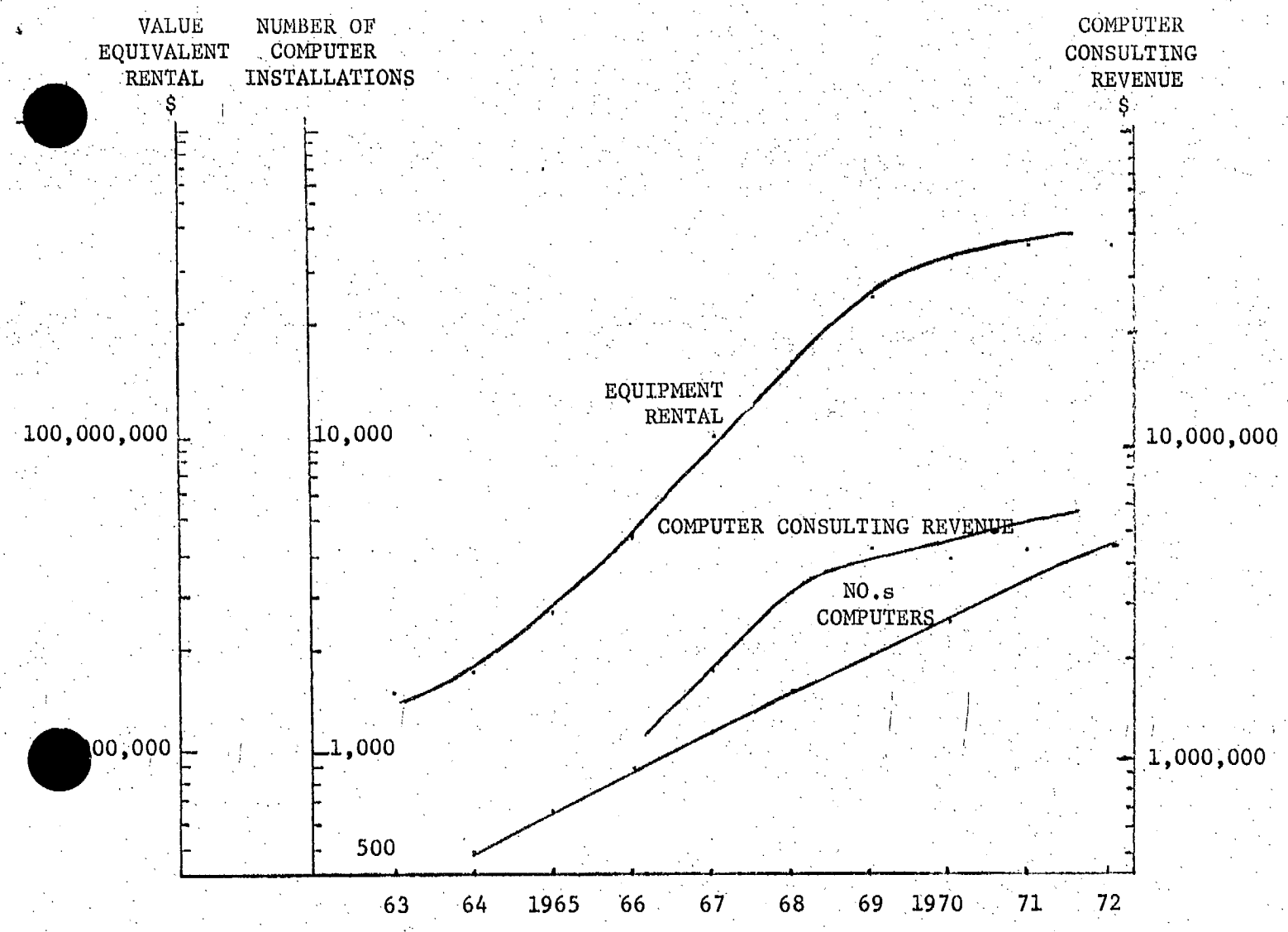


FIGURE 12

INDICATORS OF RATE OF DIFFUSION OF
COMPUTER TECHNOLOGY IN CANADA

SOURCE: CCC/TF
CANADIAN INFORMATION PROCESSING SOCIETY
CANADIAN ASSOCIATION OF MANAGEMENT CONSULTANTS

FACTOR / COUNTRY	POPULATION IN MILLIONS	EDP VALUE IN MILLIONS	EDP VALUE PER CAPITA IN $
UNITED STATES	200	15,000	75.00
CANADA	22	600	27.30
WEST GERMANY	60	1,500	25.00
SWITZERLAND	6	150	25.00
NETHERLANDS	12	300	25.00
UNITED KINGDOM	56	1,350	24.10
FRANCE	50	1,050	21.00
SWEDEN	8	150	18.75
BELGIUM	10	150	15.00
JAPAN	104	1,500	14.40
AUSTRALIA	12	150	12.50
ITALY	52	600	11.50
USSR	240	750	3.15

FIGURE 13

LEVEL OF DIFFUSION OF COMPUTER TECHNOLOGY

SOURCE: BRIEFING SESSION THE COMPUTER INDUSTRY, AMERICANA HOTEL, NEW YORK, MAY 11, 1972

V FUTURE DEVELOPMENTS

Table 8, the table of technological innovations, includes developments that will influence the foreseeable future. These are innovations that are in the first or early second stage of diffusion. Brief comments are included on the chart. However, some of the significant innovations deserve further discussion:

1. Virtual Memory (≠)

This technology is now being made available on small and medium-sized computer systems. The impact will be to reduce capital costs to Service Bureaux and allow them to more easily enter the Remote Batch and Rair application areas. In the past, significant capital was required for addition computer main memory size for resident software to handle terminal applications. Virtual memory will allow remote application software to "float" in and out of main storage as required rather than be resident.

There are two notable disadvantages to the use of virtual memory.

a. It tends to utilize extra computer cycles and hence adds to cost.

b. It tends to tie up computer capacity.

With the continuing increases in computer cycles per dollar and reductions in cost per bit of memory used, however, we tend to feel that the freedom of design that the concept implies is of more value than these temporary constraints imposed on current hardware.

Thus, Service Bureaux will more flexibly utilize their equipment, in effect increasing the revenue capacity of their suervice at a disproportionate cost in invested capital. Remote Batch and Rair applications, the fastest growing subsegements, will thus be serviced by smaller Service Bureaux who will probably tend to specialize by application, such as wholesaler billing systems. They will tend to fill their present excess computing capacity, and be in a position to transfer their work from present over-the-counter mode to remote processing.

2. On-line Program Development (≠)

This capability reduces labour costs in writing and testing computer programs. Productivity increases of up to 600% (average 200%) are reported with a capital cost of implementation requiring a productivity increase of about 10% in order to be financially justified in most large installations. Presently, this assumes that large computer facilities are available. Virtual memory will provide "large" computers and tend to make the advantages of on-line program development more widespread. We foresee extensive diffusion of this technology. Service Bureaux and software development firms can take advantage of this innovation to reduce labour cost, increase the programmers revenue capacity or increase profits.

3. Executive Programming Software and Data Base Management Software (≠)

Together, these allow reduced labour costs in developing new data processing applications. Perhaps more importantly, they will significantly reduce labour costs in the maintenance of application systems by

allowing improvements and additions to be made less expensively. Thus, a relatively small capital expenditure tending to be in the form of a monthly lease cost, will provide significant labour productivity increases to all users, including Service Bureaux. Service Bureaux systems and programming personnel will be able to implement applications at lower cost thereby increasing their capacity to attract more revenue or to improve Service Bureaux profits by staff reduction. In the Canadian market place, savings may be passed on to the clients to increase market penetration.

Such software products will continue to be supplied by hardware suppliers and large independent software firms. Since programming will become easier, i.e. - require less technically trained programmers, the demand for custom developed software should proportionately decline. Non-custom or packaged application software services will find that this increased programmer productivity will benefit computer users more than themselves and will tend to reduce their revenue capacity by reducing market size.

4. Mini-Computers

The entry of mini-computers into commercial application areas brings users reduced operating costs and offers Service Bureau customers an alternative method of processing. Competition will force Service Bureaux to innovate, to reduce prices to the user while maintaining profitability, or suffer loss of revenue. The capabilities of the Service Bureaux to reduce prices profitably, are constrained by their technical skills, the price performance capability of their

hardware, and their present profitability. The general inability to overcome these constraints could cause a significant reduction in Service Bureaux revenue, perhaps as much as 10% by 1985. The major Service Bureaux to feel this squeeze will be the medium-sized installations offering monthly batch-transaction processing on non "written-down" equipment.

Mini-computers will create increased market size for software, management and education services, proportional to the extent of diffusion, which probably will be up to about 55% of all computers and to 5% of computer hardware revenue by 1980. (Reference 18)

5. Facilities Management

This is an excellent example of social innovation. It is a fairly new service in Canada that is designed to reduce client direct and indirect computer operations or capital production costs. It takes advantage of economies of scale by spreading costs of highly skilled technical people over a number of computer sites, and by reducing unit costs of such items as computers, input services, overhead, programming, etc. Through better utilization and by obtaining lower costs on supplies through increased purchasing power, economies are effected.

Diffusion is limited by user uncertainty in such areas as extent of user control, supplier financial stability, and loss of talented in-house computer personnel. These factors will tend to slow down the growth of this innovation.

6. Distributive Data Entry

This concept transfers the point of data capture of computer readable input to the originator of the data himself. As a byproduct of doing the job itself, computer readable input is produced. Since key entry departments usually constitute about 25% of labour costs, their reduction or replacement constitutes significant cost savings.

Techniques include optical character readers which will read typewriter or handwritten data, and on-line or off-line terminals that are part of a computer based application. This is a major trend in data processing. Service Bureaux must be in the forefront of offering these services if they hope to remain competitive in the future. Although distributive data entry could reduce present input services revenue, it presents a greatly expanded market for the CBSI.

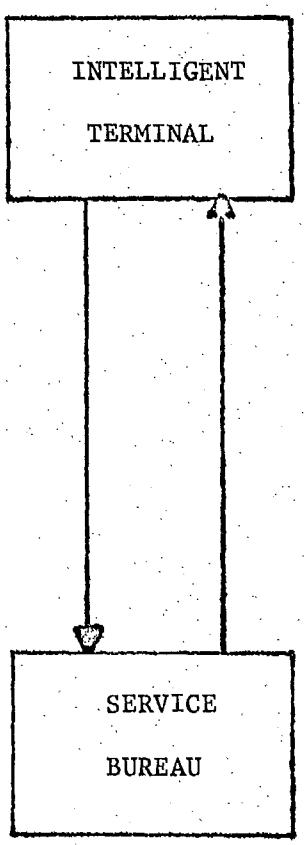
7. Large Scale Integrated Circuitry

This circuitry combined with electronic memory probably constitutes the much promised "fourth generation" of computers. The unit cost savings associated with LSI will provide increased profit, or, at existing levels of expenditures, a significant increase in revenue capacity. These productivity increased will be important to the Computer Services segment, as have other generations of computers.

The wider application of this technology in the area of "intelligent terminals" will also have an effect on Computer Services revenue. An example is shown schematically in Figure 14.

FIGURE 14

PERFORMS MINUTE BY MINUTE PROCESSING CONTROL OF SUCH APPLICATIONS AS BILLING, ACCOUNTS RECEIVABLE, INVENTORY CONTROL, ETC.



DAILY TRANSMISSION OF OPERATING AND PROFITABILITY SUMMARIES, UPDATED DATA FILES, PROGRAMMING CHANGES.

DAILY TRANSMISSION OF TRANSACTIONS AND FILE CHANGES.

PERFORMS FILE UPDATING AND REORGANIZATION, PRODUCES PROFITABILITY AND ANY REQUESTED REPORTS ON NIGHTLY BATCH PROCESSING BASIS, LARGE VOLUME REPORTING ON WEEKLY OR MONTHLY BASIS, VIA DELIVERY SERVICE.

This type of remote processing will be typical of the trend in Service Bureaux. By 1985, the Remote and Rair applications subsegments will be a significant revenue producer, estimated to account for 60% of all Computer Services revenue.

The "fourth generation" of computers will also directly impact Software Services. Present operating systems software will likely be hardware oriented, that is, the executive operating systems, compilers, communications software, utilities, etc., will be considered part of the circuitry. This will provide increased performance to the users, but will tend to eclipse the operating systems subsegments of Software Services.

As this subsegment is almost entirely controlled by hardware suppliers, it becomes a transfer of revenue to another part of the computer industry.

8. Data Processing Consortia

This social innovation consists of the merger of two or more users' data processing into one mutually owned facility. It takes advantage of the economies of scale to provide a lower unit costs processing and permits direct entry into the computer services segment. User consortia could become strong competition to existing Service Bureaux. They could offer the benefit of their own user experience to others, low cost computing, financial stability, an initial base load of work, and mature management. The formation of these consortia will be constrained by difficulties in finding suitable partners, high costs to

convert from their present systems, and a lack of profitability in the Computer Services segment. For these reasons, entry of data processing consortia into the Computer Services segment is not expected to be significant.

Perhaps more significant to the Service Bureaux will be consortia of present Service Bureaux users, merging their requirements on to a mutually owned and operated computer system. This would provide them with lower capital operating costs and direct control of their specialized processing. If a trend in this direction developed, the Service Bureaux would lose significant revenue. Among those who are now Service Bureaux users who could take advantage of this type of consortia are municipalities and rural districts, school boards, hospitals, associations of professionals, i.e. - accountants, lawyers, engineers, and union co-operatives. The above list of users now accounts for as much as 15% of all Service Bureaux revenues. The diffusion of this innovation is constrained by the political difficulties in bringing numbers of parties together. However, the incentive of reduced cost to supported organizations should help resolve these difficulties. We foresee significant loss of Service Bureaux potential revenue to 1985 as a result of this innovation.

9. Application Compilers

Application compilers will impact Software Services most significantly. By 1985, they could account for 50% of Software Services revenue while substantially reducing the subsegment's programmer employment in Canada. Application compilers will also have a negative effect on Education Services as the technical need for "know how" reduces. Systems will be installed by users themselves.

Skilled employees of hardware suppliers who are replaced by automation in the computer manufacturing process, will likely be offset in number by other skilled personnel developing industry oriented applications compilers. We can expect to see a continuous introduction of increasingly more sophisticated applications compilers between now and 1985. They will significantly reduce user's labour costs and increase the market size of potential users by greatly reducing development costs. It will allow Service Bureaux to reduce costs or increase their analysts revenue capacity.

10. Digital Data Communications

The application of this new communications technology will result in higher quality and in lower cost data transmission. The extent of the cost savings, will directly determine the extent of additional data transmitted. With all computer application trends pointing toward more use of communications facilities, the cost of communications becomes one of the most important future technological factors impacting computer usage growth in Canada. Many applications are presently economically unjustified because of the present high costs of data transmission. This is particularly significant in Canada with its unique population geography. Without lower cost communications facilities, Canada will lag behind in taking advantage of the full productivity benefits of computers. However, if these lower cost facilities are not made available in Canada, Canadian users will undoubtably take advantage of the fact that most large Canadian centres are within short reach of existing, much lower cost U.S. communications networks, and proceed to design computer-communications systems using

U.S. facilites. Lower costs data transmission could also attract signigicant amounts of remote processing to huge, low computing cost U.S. based Service Bureaux.

The installation of a national "packet switching" digital network would provide transmission costs that were primarily dependent on the volume of data and not on the distance transmitted. (Reference 19). The large capital cost required to install a packet switching network and the relatively small direct financial return to the communications supplier, will make the installation of this type of facility, by a profit oriented common carrier, extremely unlikely (especially a predominantly U.S. controlled common carrier who would receive the data transmission revenues diverted to it by Canadians who did not have their own networks).

Our intention here is not to recommend what facilities should be available, but to emphasize the dependence of our ability to benefit from productivity increases resulting from future computer/communication applications, on the availability of any type of lower cost data transmission service. The subject is amply covered in "Branching Out". The implications to the CBSI of a Canadian Network are substantial, but the probability of a packet switched Canadian network by 1985 is rated low.

11. The Computer Utility

In the foreseeable future, looms the possibility of the computer utility. However, computing is more than raw computer power. It involves manipulation of user data and the skill of the user. The dependence on specialized, responsive, individual service suggests the large computer utility would be primarily the Raw Computer Power supplier. This type of service, once available, will diminish in relative importance giving way to the more service intensive applications involving transaction or data base processing.

The other key factor in computing is data. Efficient processing demands that large data files be located at the computer site. This raises the question of data confidentiality and physical data security. We recognize that data security is not a problem peculiar to a computer utility - this problem is as prevalent for an in-house installation. Would private companies entrust the utility with all their data or would they keep "sensitive" data in-house? The probable need to physicall separate data may make company data bases or "company information systems" impractical to implement on a remote utility. If companies do evolve in large numbers away from in-house information systems, they will probably still use an in-house "intelligent terminal" to process "sensitive data" at least until the end of the 1970's. If only part of their processing can be run on the utility, the financial incentive to use the utility rather than on total in-house computers could be greatly reduced until confidence in the confidentiality of remotely stored data can meet the test of confidence by the users and swing the volume of processing over to the utility. As confidentiality and physical security of in-house computer records becomes of greater significance, the relative

balance of concern could well tip towards the remote utility wherein the risk of physical distruction may become less because of remoteness from employees and better security procedures.

However, the most significant reason that huge computer utilities may not come to be is the fact that the cost of in-house computing power is lowering at approximately the same rate. Even if utilities can provide extremely inexpensive computing power, the cost difference, weighed against the potential problems that exist in using a utility will inhibit diffusion for some time. To the user, the problems of response, exposure (if data security is broken) and the time and the cost of communicating new requirements to someone else rather than doing it yourself will be strong negative factors.

For these reasons, we do not foresee a single huge computer utility taking form in the period to 1985. Rather, we expect the continued proliferation of separate regional service bureaux large enough to provide satisfactory price/performance computing but specialized enough to know their customers and give them what they want. An example of this regionalized approach is the DATEL network in use in West Germany (Reference 20). This private/public consortium of computer centres and communications lines was started around the West Germany Post Office and may be the beginning of a gradual move toward the national utility by that country.

VI SPIN-OFF EFFECTS

For this study, we have defined "spin-off effects" as the creation of (or the increase in) demand for other products in other industries, as a direct result of the application of technological innovation in the CBSI.

Some examples of this type of "spin-off" effect are:

1. Companies or individuals offering services that involve significant amounts of computing obtained from Service Bureaux. Examples might be statistical analysis services, financial portfolio management services, tax accounting services, data bank inquiry services, technical information retrieval and disemination services and business strategy services. These will generate additional sale of terminal equipment and specialized input-output "hardware".

2. Service Bureaux involvement in CATV systems. The two way communication systems will probably require computer logic in editing, control and switching of the two way communication. Computer Assisted Learning has large potential in the industry penetration of the "home" market. Again, specialized hardware sales will be created for "Television Terminals".

3. The "Cashless Society". The CBSI are unlikely to provide the computer power that the banks will use to provide this service. More interesting is the probability that if the "cashless society" is adopted, a very large part of the Banking Industry will become

part of the CBSI. That is, if computers did not exist, would the "cashless" banking industry exist. At that point in time, money will become information on the "drawing rights" or financial value of the individual or company involved.

If this re-definition is accepted, then the revenue capacity future of the "new CBSI" is exceedingly large. The "cashless society" is technically feasible today. However, since there appears little advantage to the individual or corporate user, implementation will be delayed until attitudes change (or paper processing costs become prohibitive).

Spin-offs created as services to the CBSI, the services development effect, are not predicted to be great. The CBSI makes use of standard hardware and software products. Sales of terminals to Service Bureaux users, however, will increase in proportion to the marke penetration in the RAIR applications and could represent a significant hardware market.

A potential for innovative Canadian-developed terminal units exists, which could well be stimulated as a spin-off of CBSI activites. While much effort is being directed at this manufacturing market by U.S. equipment manufacturers, the potential for unique valuable terminal development in Canada may be favoured in the CATV segment in particular, because of the relatively more concentrated nature of CATV networks in Canada. This should continue to be a closely studied area.

In our opinion, this CATV development area, because of its newness and relatively heavy sales penetration within Canada as compared to the U.S., represents a current "window of opportunity" for export sales of both services and related innovative hardware.

PART B

THE MARKET

In the foregoing sections we reviewed technological innovation within the CBSI and attempted to relate it to productivity. Increases in productivity have resulted in either:

- Increased revenue capacity by the creation of new services (e.g. - Time - sharing), by better computer utilization, or by improved labour performance, or

- A reduction in production costs by lowering the amount of labour employed, or by the reduction of hardware and software costs.

Increased revenue capacity results in the capacity of the individual or organization to provide the service being raised. The increase in the actual level of demand depends on:

- the size of the market, and
- the skill of the supplier to sell and implement the service.

Reduced production costs are translated into:

- increased profits for the entrepreneur,
- reduced prices to the user
- or a combination of the two alternatives.

The decision on how the reduced costs are to be apportioned depends on the competitive factors in the market place and on the price sensitivity of the products or services offered.

VII THE DOMESTIC MARKET

With the foregoing background, we will now attempt to relate the effects of changes in productivity on the domestic market in:

1. Computer Services
2. Software Services, and
3. Management Services.

reviewing the following aspects for each segment:

(a) The Market Characteristics
(b) Past Developments
(c) Constraints
(d) Long Terms Prospects

. Computer Services

(a) Market Characteristics

(i) Industry Profile: There are an estimated 180 computer service bureaux operating in Canada today. They range from small card-oriented batch processors catering to the simple needs of small retailers to very large installations offering RJE and time-sharing services to large corporations and government agencies. As a segment of the CBSI, they account for an estimated 85% of the output of the industry. (Reference 21)

The majority of service bureau customers are small to medium-sized firms with sales in the $½ million to $10 million categories. Their requirements are relatively simple and are generally for accounting-oriented applications.

Larger firms who use computer service bureaux may use packages, but will normally utilize custom developed programs. Customers in this category generally have larger volumes together with more sophisticated requirements and use the bureau for the Remote Batch, RAIR or large storage and processing capabilities offered. Some customers in this category will have computers of their own and use service bureaux as temporary overload facilites or to take advantage of the large scale systems for special projects or solving complex technical problems.

(ii) Services: A wide range of services are offered by the service bureaux. Much of the processing at present is done through packages which cater to the needs of the small to medium-sized users. The majority of packages, which are increasing year by year, consists of accounts receivable, sales analysis, payroll, inventory reporting, general ledger, and a few specialized industry packages such as automobile dealerships and stock brokers applications. Some bureaux also offer systems design, programming and keypunch services as part of their services to customers.

(iii) Competition: Competition within this segment of the industry has been intense, probably as a result of considerable excess capacity. The "independent" service bureaux not only face competition from other Service Bureaux, but from centres operated by computer suppliers, from in-house installations with excess capacity (e.g. - Banks), accounting firms with computer installations, and increasingly from the sale and installation of more sophisticated electronic accounting machines and mini-computers.

(iv) Price Sensitivity: Despite the severe competition, we do not consider this segment of the industry to be price sensitive. Price has an influence when work is developed initially, but once a customer has selected a service bureau, it seldom changes, even if prices are subsequently increased. Special knowledge, accuracy and the ability to meet turnaround schedules play a more important part than price. We would therefore consider service bureaux to be "service sensitive". The exeception to this is in the sale of raw computer power, where price is the

predominant consideration. Users with their own programs, files and staff are in an extremely "portable" situation and can change from one bureau to another without any real inconvenience.

(b) Past Developments

(i) Industry Problems: Historically, service bureaux suffered from growth pains associated with a fast growing, fast changing and immature industry. In the early sixties, they projected an image of poor service. However, the concept of a "computer utility" became technically feasible with large computer installations. Once they caught the public imagination, service bureau companies which went public became the glamour stocks of the speculative market. Expectations of quick riches did, however, not always materialize. Service Bureaux have been notorious for failures. The reasons for this seem to have been:

- An over-optimistic estimate of the market potential
- Inadequate financing to sustain them during their growth period
- Weak management - due to heavy emphasis on technically-oriented personnel lacking in financial and administrative skills
- Staffing problems - personnel drawn from in-house computer installations often lacked the appreciation of the demands of the service industry. A relatively high staff turn-over ratio added to the problems

As a result, the customers' lack of faith in the service bureau's

ability to provide a high level of service changed to a general concern for the financial stability of the bureau and its continuation to remain in business. This aspect of the industry seemed to have settled down by the early 1970's.

(ii) Technology: Service Bureaux, as a group, have generally taken advantage of technological changes. Examples are the use of more efficient data entry methods, and the utilization of later generation computers characterized by large memories, faster cycle times, on-line storage techniques and faster printers. This was done in order to stay competitive and at the same time to increase their revenue earning capacity. Productivity has increased, and the resulting reductions in cost were utilized to stabilize prices and contribute toward the not-too-bright profits picture of Service Bureaux.

As a result of economic growth, service bureau customers and potential customers felt the pressure for more information, quicker processing and lower fixed overheads. These factors, coupled to the aggressive marketing approaches by the Service Bureaux, and a better level in the quality of the service being offered, have resulted in a sustained increase in demand for such services.

(c) Constraints

The present constraints in the further development of the Service

Bureau segment of the industry, in our opinion, consists of both technological, economic and human factors. The following are some of these constraints, not necessarily in order of importance.

(i) Technical Skill: Computer hardware (and to some extent, software) technology has now been developed to a stage where their intelligent application is lagging behind. The systems designer, analyst and programmer now has to measure up to a much higher level of technical skill than in the past in order to optimize the use of the tools at their disposal.

(ii) Financial Support: Because of the spotted, uneven and often unpredictable nature of the past history of this industry, investors are still hesitant to commit the large amounts of capital necessary to take full advantage of the possiblities.

(iii) Cost of Communications: Although technically feasible, it is still economically difficult to justify the relatively high costs of communications which could bring the full benefits of a suitably large, but remotely located service bureau to a potential user. While communications costs are relatively high, the amount of use of communications will remain low, favouring regional service centres.

(iv) The Knowledge Barrier: Many business executives at the decision making level still lack the appreciation of the sophisticated techniques available to them in the operation of their businesses. Although they may be familiar with terms such as corporate model-

ling and financial simulations, and economic order quantity determination and exponential smoothing techniques as applied to inventory control systems, they do not fully realize how these concepts could be applied to solving their problems in these areas.

(v) User Resistance: There can be little doubt that many in-house facilities could be econmically replaced by Service Bureaux. This is true not only of computer installations, but also installations of large electronic accounting machines, and large key-punch departments. Companies often resist switching to Service Bureaux even when the benefits of the change can clearly be demonstrated. The most frequently sited reasons are:

- Loss of control
- Maintenance of confidentiality of information
- Security of data
- Reaction time to special requests
- Priorities vis-a-vis other customers
- Lack of backup facilities in emergencies, and
- Stability of the Service Bureau

There are other deep-seated reasons which, while they are not always overtly stated, are very real in the minds of various people:

- Management: the prestige of having its own computer installation
- Staff: the feeling of security in systems and an environment with which they are familiar

- Data Processing Manager: the prestige of managing and controlling an installation and staff

(d) Long Term Prospects

The long term prospects of the Service Bureaux, in spite of the foregoing, seem assured. The constraints will gradually be removed: Technical competence will increase, financial support will be made available as the industry matures, communications costs will hopefully with the co-operation of the Government and the private sector be reduced; executives will become more knowledgeable with the help of concerted marketing and education programs waged by manufacturers, Service Bureaux and consultants; and users resistance will gradually give way to a more rational approach by sheer economic necessity.

Although profits have not been significant in this industry, they appear to have stabilized to the point where entrepreneurs are confidently predicting reasonable returns in the medium-to-long term future. The growth of this sub-segment of the CBSI is predicted to move from an estimated $133 million in 1970-71 to an estimated $436 million by 1980 (Reference 22), and increase by 3.85 times. The estimated revenue segments are shown in Table 15.

If services (not in existence at present) such as computer utilities and the "cashless society" become realities by 1985, and their reve-

nues are categorized with this segment of the CBSI, computer services might well become the economic giant of the Eighties.

ACCESS METHOD / APPLICATION	LOCAL BATCH	REMOTE BATCH	REMOTE ACCESS IMMEDIATE RESPONSE (RAIR)	TOTALS
RAW POWER	4%	20%	10%	34%
TRANSACTION	20%	25%	10%	55%
DATA BASE	2%	3%	6%	11%
TOTALS	26%	48%	26%	100%

TABLE 15

ESTIMATED PERCENTAGES OF 1985
COMPUTER SERVICES REVENUE
(EXCLUDING INPUT/OUTPUT SERVICES)

SOURCE: TS&A

2. Software Services

(a) Market Characteristics

(i) Industry Profile: The software services segment of the CBSI, with a total annual revenue estimated at between $5 million and $10 million, is largely dominated by computer manufacturers. The majority of operating systems software, application packages, and high-level language packages are imported, mainly from the U.S. The number of Canadian companies engaged in supplying software services as a major part of their business is estimated at between 25 and 35, but if other suppliers such as computer service bureaux, hardware manufacturers and management consultants are included, the number could be between 200 and 250, (Reference 21).

Entry into this business does not need high initial capital outlay and no special qualifications are needed. As a result, many firms were, and can still be started by a few principals with backgrounds in systems design and programming. However, in order to compete successfully in this project-oriented business with the established firms, they need to be more than just average in skill, creativity and sales ability.

The work produced by Canadian software houses have been of a consistently high quality, and in our opinion, is second to none. The skill and productivity of Canadians engaged in this type of work can stand comparison with the best anywhere.

(ii) Services: Suppliers of software services are often called upon to complement a company's own staff temporarily on an "overload" basis. This could happen when the company is faced with a major conversion project and does not have sufficient people to achieve the desired results within the time specified. Their main emphasis is, however, on the development of operating systems software, application packages, (e.g. - the automobile dealers or the stockbrokers' packages) and the development of custom programs tailored to a particular customer's needs.

The principle stages in the installation of a new computer-based system may be broken down into:

- Feasibility study
- Systems design
- Programming, which consists of coding and testing, and
- Implementation, which consists of integration with other programs in the system, and parallel run

Although a supplier of software services is technically only concerned with the programming phase, more often than not he will participate in the preceding and succeeding phases of the work.

(iii) Competition & Price Sensitivity: While the competition in the software services segment is not as marked as in computer services, it nevertheless exists. Computer manufacturers, management consultants, computer service bureaux, and independent "free-lancers" with negligible overheads all compete in the same limited domestic market for custom programs and package development.

Contacts in the data processing industry are a valuable asset in obtaining assignments. The prospective client will, however, base his ultimate decision on the reputation of the firm and its people. Experience in a particular application or a specific programming language, the ability to produce work of high quality, and the ability to complete an assignment on time are valuable references. Price, although an important factor, plays a secondary role in software services. In this respect, we do not consider this segment of the industry to be price sensitive, but rather quality and service sensitive. Users of software services seek first to determine the experience and competence of the personnel contracting and consider price secondary.

Custom programs are normally costed on a man-hour basis and contracted for at a fixed price. Custom programs being developed for a specific user may, however, be found to be useful for other potential users in the same industry. With some modifications, they may evolve into application packages. In such a case, it would not be unusual for the software house to agree with the original customer to split the development

cost. Depending on the arrangements made, ownership of the package may rest with either the software house or the customer, and further arrangements would then be agreed on regarding the revenue derived from the use of the programs by others.

Development of application packages usually requires a substantial financial commitment. Because of the lack of capital resources in the average software firm, this type of development is normally undertaken by the computer manufacturers, who dominate this aspect of the market. It is too expensive for "independents" to compete.

(b) Past Developments

(i) Industry Problems: While there is no marked shortage of analysts and programmers with average skills, there is a serious lack of such people with outstanding creative and technical talents. Personnel is relatively expensive, resulting in correspondingly high software development costs. This segment of the CBSI is also noted for the relatively high staff turnover.

The demand for software services and software development projects fluctuates in sympathy with the general mood of the country's economy. Businessmen are prone to "make do" with existing systems, and to postpone development projects during periods of economic uncertainty. As in other project-oriented industries, there always looms the problem of a constant revenue flow. Because of the relatively limited Canadian market for general

and specialized applications software packages, and the high cost of development and marketing these services and products, this industry has not been exploited to its maximum potential on the domestic market.

The average software supply firm, because of its limited capital resources, simply cannot afford to develop packages on the speculation that a potential user or buyer may eventually turn this expectation into cash.

(ii) Technology: The most significant technological innovations effecting the software services segment of the CBSI in recent years, in approximate chronological sequence, have been:

- Multi-programming
- Operating systems
- The COBOL compiler
- Packaged applications
- Data communications
- Executive programming languages (such as Mark IV, GIS II)
- Applications compilers, and
- On-line programming

Although all these innovations originated in the U.S., the diffusion of technology to Canada was quite rapid. In our opinion, Canadian software firms have availed themselves of these developments to the extent allowable by the comparatively limited domestic demands and relatively thin computer population.

We also believe that, as a result of these technological innovations, productivity in the software services sector of the CBSI has improved, but perhaps not to the same extent as in the U.S. with their considerably larger market for software services and their much larger number of computers installed.

(c) Constraints

The factors outlined as industry problems under "Past Developments", namely:

- Shortage of outstanding creative and technical talent
- Relatively high personnel costs
- High rate of staff turnover
- Dependence on economic climate
- Lack of regular cash flow
- Limited domestic market size
- High cost of development and marketing
- Limited capital resources

continue to act as constraints on the further development of this segment of the CBSI.

In addition, three other constraints are worth noting:

- Proximity and access to computer hardware manufacturers are important for the development of certain types of software where the software has an intimate and direct relationship to hardware technology. Examples of this are in the areas of operating systems software and communications

interface software. As we do not have any major Canadian owned and controlled computer mainframe manufacturing facilities (and there appears to be no prospect of this changing in the foreseeable future), Canadian software firms are at a severe disadvantage vis-a-vis their U.S. counterparts in this respect. This is one of the important factors explaining the U.S. domination in one of the key areas of software development.

- Many proven software packages, developed at substantial costs, are available, but are restricted to the Canadian market due to major differences in overall systems concepts and requirements between Canada and other countries. Payroll and banking packages, for instance, require major modifications if they are to be adapted for use in other countries.

- Packages (which generally are developed for a particular type and size of computer) find limited applications on the domestic market which consists of a proliferation of dissimilar sizes, types and families of computers.

(d) Long Term Prospects

Some of the problems touched on when discussing problems of the software service industry, particularly the lack of highly skilled personnel, high rate of staff turnover and high personnel costs are also being experienced by other computer users. For these reasons, we can foresee an increasing trend for users to supplement their in-house staff with outside high level software expertise.

The advent of the "naked mini" (low priced mini-computers with little or no software accompanying it) has substantially increased the possibility of participation of software firms in the development of application compilers, custom and packaged programs for these machines. Manufacturers of this class of computers appear to concentrate on sale of hardware and do not seem inclined to get involved in extensive software development.

The Canadian software services industry has the talent and ability to participate in the growing needs of the computer industry. In order to do so, they should attempt to:

- Obtain contracts with U.S. manufacturers of terminals and other communications hardware to develop the interface software needed.

- Obtain financial support for development of application packages which market research shows to be viable in Canada, application compilers, high level

executive languages, and packet switching software.

Analysts and programmers will have to be suitably equipped with a high degree of technical expertise in order to meet these requirements. The importance of custom programming as it is know today will decline with the emergence of powerful high level executive programming languages and application compilers. These software aids will require a level of applications competence and maturity greater than that of today's programmers and analysts.

Due to the very substantial growth predicted for the Canadian computer population, the domestic demand for software services will, in our opinion, grow at a corresponding rate.

3. Management Services

(a) Market Characteristics

(i) Industry Profile: The management services sub-segment of the CBSI accounted for an estimated $11.7 million in total revenue for 1972 (Reference 23). The industry consists mainly of Canadian firms or affiliates of international firms with Canadian autonomy. The Canadian Association of Management Consultnats, the formal professional association in Canada, has 13 member firms (1972) of which 10 are consulting arms of firms of Chartered Accountants. The Association estimates that its member firms accounted for 80% of management consulting in Canada. The Association's members aggregated $22.1 million in gross billings in 1971, of which $4.3 million was in respect of "computer applications". (See Figure 16)

The number of firms supplying computer-related management services is difficult to estimate. In addition to the 73 offices of the CAMC member firms, other organizations, such as firms specializing in computer consulting, software firms, computer and other hardware manufacturers, and computer service bureaux all supply management services to a greater or lesser degree.

Users of management services embrace all levels of government, non-profit organizations such as hospitals, educational institutions and trade associations, and all sectors of private

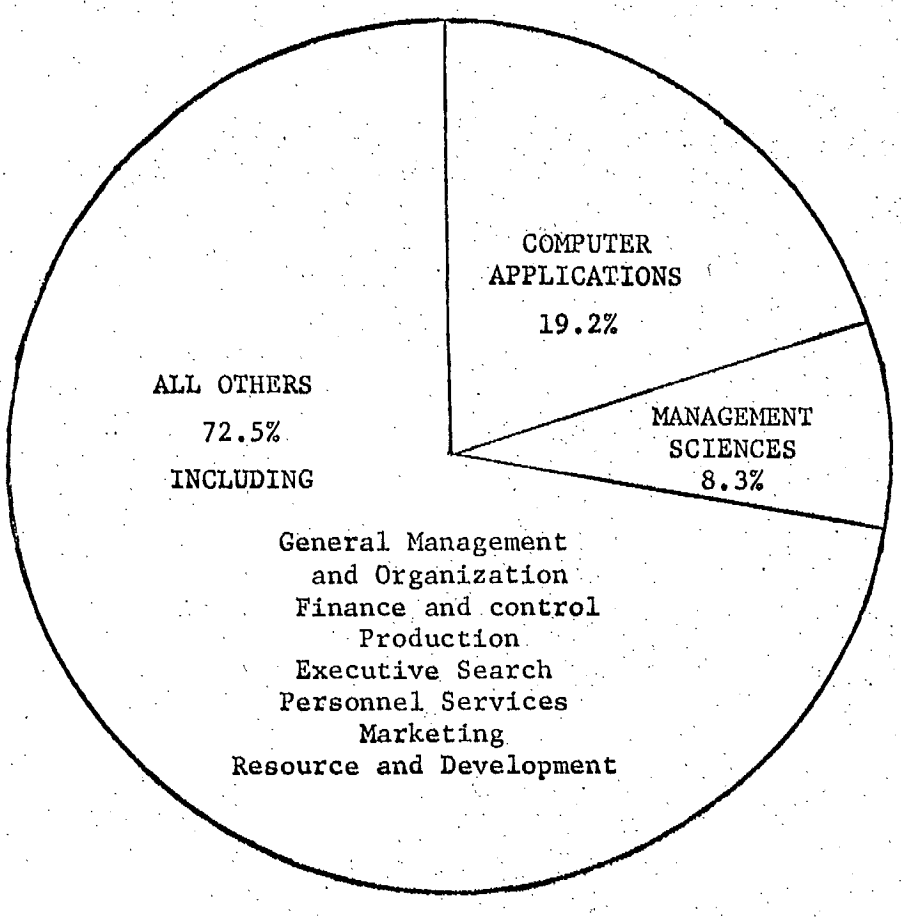


FIGURE 16

PORTION OF MANAGEMENT CONSULTING REVENUE
GENERATED BY COMPUTER BASED ACTIVITIES

SOURCE: Canadian Association of Management Consultants - 1972

industry including the resource industries, manufacturing and the distribution industry.

The independent consultant is frequently called in by a company who is considering the use of computers or data centre services for the first time. In such cases, the consultant would assist the company's management in the evaluation of the alternatives, selection of equipment or a service bureau, and then probably continue to design and implement the system. The larger assignments usually come from companies who already have installations of their own and wish to upgrade their hardware and/or software, convert existing systems, or to undertake a new or special development project.

The present level of quality of service provided is of a high standard, and, in our opinion, Canadian management consultants can hold their own internationally.

Government, institutions and private industry use consultants for their computer personnel "overload" requirements or for the consultant's experise, but they are most valued for their objective and impartial judgement in rendering their services.

(ii) Services: Management Services, as it is related to the CBSI, may be summarized as follows:

Studies: Feasibility, efficiency, security

Evaluation and Selection: of computer hardware, software, and service bureaux

Systems Analysis and Design

Implementation Projects: systems implementation and conversion, project management, and "turnkey" projects

Facilities Management: a relatively new service in Canada

Education: primarily of management personnel in the areas of data processing appreciation and techniques and application of management science techniques

Personnel Placement: of data processing personnel

(iii) Competition and Price Sensitivity: Consultants may, from time to time, be "imported" (especially by U.S. subsidiaries) for special projects, but this is becoming less frequent. On the basis of our awareness of management services activities in Canada, we do not consider the amount of work awarded to foreign independent consultants to be significant. Equipment manufacturers and distributors supply product oriented management services either as part of their marketing activities or in the form of systems analysis, design, and implementation. Computer service bureaux and software firms likewise compete against management consultants and computer suppliers for systems analysis, design and implementation projects. Equipment manufacturers and consultants share the market for the education and training of user personnel.

Areas in which the management consultant has a clear advantage are feasibility studies and equipment evaluation and selection, where management might prefer the objectivity and impartiality of an uninvolved party instead of relying on a manufacturer's proposal, the objective of which is to sell his equipment.

The reputation, experience and competence of the consultant and the abilities of the consultant's staff are prime factors when purchasing consulting services.

The majority of the CAMC members are "departments" of major auditing firms. They have an advantage in that they are known to their audit clients and consequently do not have to establish their credibility. However, the audit staff, who are doing the field work, are either too preoccupied or are not able to recognize a client's needs for management services. Even where the need is known, some audit firms do not always agressively persue this type of work since they value the annuity aspect of their relationship above a non-recurring consulting project. This causes a certain amount of "client portability" within the consulting industry.

Fees for management services are normally calculated on the man-hour basis, with a quoted maximum fee for a given project. Fees generally range from $20 per hour to $50 per hour or more depending on the complexity of the project and level of skill required

Except in rare instances where the terms of reference and the final "product" are precisely defined and fully documented, it is virtually impossible to choose a consultant on the basis of price. We therefore do not consider management services price sensitive.

(b) Past Developments

(i) Industry Problems: The provision of management services in Canada is a relatively young profession. Management consulting as it exists today commenced in the late 1950's with the advent of the application of computer techniques to the commercial environment.

While there are no formal qualifications required to become a consultant, and entrance into the industry (or profession) is easy, the practitioner of the 1970's is generally much better qualified than his predecessors. Many have university degrees and/or professional qualifications, and/or have spent some years with a manufacturer or user of computers. The early practitioners, some of whom came from outside of Canada, were commonly referred to as "efficiency experts". They created a somewhat questionable image and left an impression which is some instances could be best described as rather tarnished. Unfortunately, some of the bad taste of earlier times still lingers on, and on occasion, the consultant of today still has to convince the prospective client that he belongs to a different breed.

Except for the area of facilities management, which for all practical purposes may be disregarded as insignificant in Canada at present, management services is essentially a project-oriented industry. Consultants face the problems of feast or famine and the business problems related to erratic cash flow.

While the industry is sensitive to the country's economic climate and generally tends to prosper in times of economic bouyancy, the point can be made that in times of recession and financial stringency, all sectors of the economy, public and private will seek higher efficiency and lower costs. Consultants are qualified to assist management in achieving these objectives.

(ii) Technology: Developments in computer technology have had the effect of forcing the consultant to keep pace with the developments and to increase his skills in order to service his clients better. We estimate, that in order to do this, a consultant has to spend up to 20% of his time reading journals, attending seminars and trade shows, product research, and in continuing education. There is also a tendency to specialize in particular areas, as opposed to being a generalist.

In providing management services, the consultant acts as an interpreter between management requirements and available technology - he is in essence a diffuser of technology. Except in the areas of programming, where high level languages have made their appearances, we do not think developments in technol

ogy have improved productivity in this segment of the industry per se. In his capacity as a diffuser of technology, however, he plays a direct role in helping his client to attain improved productivity. Technological developments have also opened up new areas of service for consultants - e.g. - advising clients as to the relative merits of competitive high level programming languages.

(c) Constraints

Apart from the items discussed under "Industry Problems" we do not know of any significant constraints which have the effect of impeding the development of management services.

(d) Long Term Prospects

Businesses, large and small, and all levels of government, are using management services at an increasing rate (See Figure 16.1 Table 16). Computer-based services, because of its high technological content, is bound to be one of the fastest growing sub-segments of the profession. This fact alone is sufficient to ensure the healthy development of computer-related management services in the future. At the present rate of growth, we predict that the computer-related management services will exceed $30 million by 1985 (Reference 24).

Canada is rapidly becoming a part of the international consulting scene. The CAMC was asked to co-sponsor the 4th International Conference of Management Consultants in Copenhagen in 1972. The Assoc-

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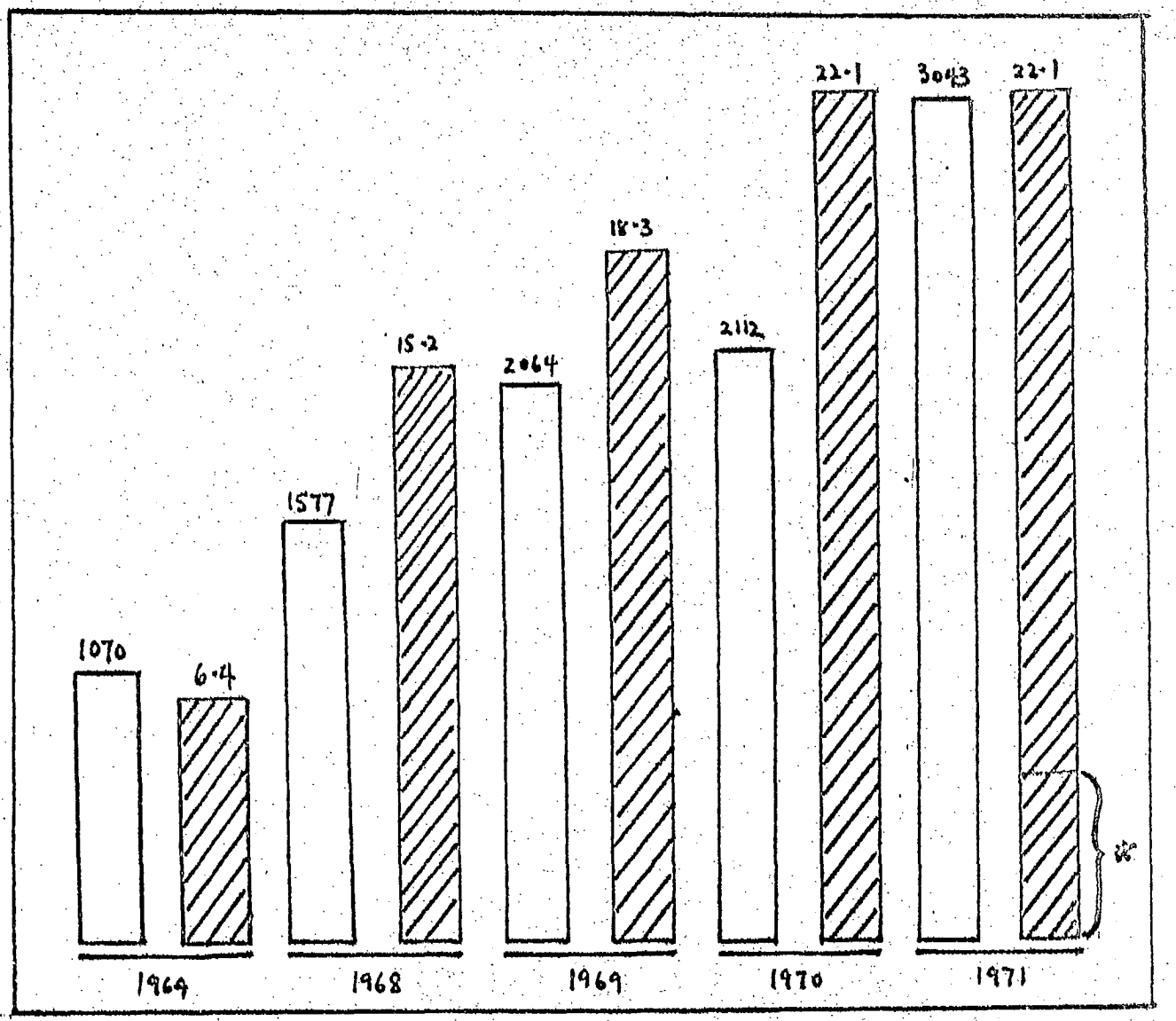
FIGURE ~~TABLE~~ 16.1

MANAGEMENT CONSULTING IN CANADA

MEMBER FIRMS OF CAMC



SOURCE : CAMC ANNUAL REPORT 1972

iation was the co-sponsor of the 1st North American Conference of Management Consultants, held in New York in January 1972, and will again co-sponsor the 1973 Conference.

The 1972 Annual Report of the CAMC noted that "Member firms report a marked increase in export services."

Canada has the technology, skills, and people to render management services. The country also enjoys the political neutrality and respect of developing nations. We can see no reason why Canada could not export substantial amounts of management services to the rest of the world in the future.

VIII THE INTERNATIONAL MARKET

Canada's performance in competing with other country supplied computer based services, determines the extent of imports used on the domestic market and the level of sales it achieves in providing services in other countries. The difference between import and export levels is the CBSI contribution to the Canadian balance of payments.

We will examine this performance using the following outline:

For services imported into Canada, a review of

- the projects and services imported,
- the estimated level of imports,
- the vulnerability of the domestic market to import competition, and
- the future trend

For services exported from Canada, a review of

- the market characteristics,
- the present constraints
- the Canadian advantages, and
- the long term prospects

For Balance of Payments, an estimate of

- the present level, and
- the possible future levels

In all of these major areas, an accurate quantitative analysis has been impossible. No import or export statistics are available for the Canadian CBSI. We have included our estimates of the present level of demand. However, we can attach no statistical level of confidence to these estimates.

(a) Import Market

All segments of the CBSI include significant levels of imports. Computer Services and Software Services have higher percentages of imports than the Management Services segment.

The characteristics of the import market are the same as those outlined in the domestic market.

(i) Computer Services: In the Computer Services segment, Remote Batch and Rair processing account for almost all direct import. At present, the value of these services is estimated at $3,000,000. Raw Power applications such as time-sharing and management science processing predominate but with some Data Base processing in the areas of stock quotation systems and insurance information systems.

The long term vulnerability of the Canadian domestic market is high. United States communication costs are already well below Canadian costs (they average about 40% less) and digital data communication is already underway and will likely

be in place by 1975 and further reduce costs by a factor of two. This could create a very significant cost differential and attract much of the Canadian data communication and any associated Computer Services business. Canada can compete only by offering cost competitive data transmission services in Canada.

As well as lower data communication costs, United States Service Bureaux offer significantly lower cost raw computing power. This is because of lower hardware costs, and their ability to justify larger, better price/performance computer systems. The reason that Canada has not experienced greater levels of direct United States import of Computer Services is that the whole Canadian Computer Services segment represents approximately 4% of total United States computer services demand. The Canadian export market to the United States is just not significant enought to justify an extensive marketing effort by U.S. firms. The only way to protect this vulnerability is to allow the Canadian Service Bureaux to be as price competitive as possible. It is possible that consideration should be given to eliminating hardware import tariffs for Canadian owned service bureaux (see Export Market).

(ii) Software Services: In the Software Services segment, direct import accounts for an estimated $1,000,000 or about 10% of software revenue. We have included in the estimate, direct import and lease costs of software offered by Canadian hardware

manufacturing subsidiaries. The Canadian market is particularly vulnerable to computer manufacturer software services and they are expected to become an increasingly larger percentage of total software services. Computer manufacturers will be placing increased emphasis on their software offerings and it is an area where independent Canadian software firms find difficulty in competing because of the high development costs involved. Import of application packages from the U.S. is also expected to increase significantly over present levels.

(iii) Management Services: The import of Management Services in the CBSI has been estimated at $250,000 or .04% of segment revenues. Foreign management consultants who possess specific skills or experience, or who are brought into consulting situations involving Canadian subsidiaries by the foreign parent company, represent the majority of foreign consulting imports. The Canadian Management Services market is not considered particularly vulnerable to foreign competition and this level of import can continue to be expected.

(b) Export Market

As with imports, all segments do participate in exporting, but in all cases the value of the export trade is not a significant amount when compared to the domestic revenue. What perhaps is more important, is to identify some of the opportunities open to Canadian suppliers to expand export sales.

(i) Computer Services: The export market for this segment, is limited by the cost and extent of data communication facilities. At the present time, the United States represents almost the entire export market.

The basic characteristics of the market place are not drastically different from those encountered in the domestic market. Remote Batch and Remote Access-Immediate Response are the services provided. The emphasis is still on service, price, and reputation. Canadian Service Bureaux face greater problems in satisfying these market needs, because of their location. Some of these constraints are:

- high data communication costs in Canada incurred in transmitting data to their Canadian computer centres
- high marketing (travelling) costs required to compete in a more vigourously competitive market and to establish credibility and reputation
- higher computer hardware cost, (approximately 17% higher in Canada for identical computer systems) contribute to generally higher prices charged than competition
- higher levels of innovation required to offer competitive prices
- higher costs incurred in offering higher levels of service required to offset price differences

The estimated level of present export revenue is $300,000 annually or approximately .003

The main advantage that Canadians have competing in the U.S. market is lower domestic labour costs. This tends to partially offset higher hardware capital costs. Since higher hardware costs are caused mainly by federal sales tax and customs duties, relief from these costs for Service Bureaux who compete internationally, would provide a Canadian advantage. Such a move could precipitate a rash of spin-off subsidiaries from in-house computer users.

As the cost of continental data communication lowers, the export of Computer Services to the rest of the world becomes more viable. This would open huge potential markets for Canadian based services. Canada's political position and reputation among other countries would be a significant advantage in obtaining a large share of any international computer services revenue.

However, there are constraints to this future revenue:

- availability of inter-continental, low cost data communications networks.
- who would be the main users of such networks? On the business side, these would tend to be the large multinational companies whose head offices are concentrated in the United States, Europe and Japan. Canadian share of that business would be small. In the [illegible] areas, developing countries would access

huge amounts of raw computer power via satellite at a fraction of the costs it would be available at in their own countries. Another major area could provide for the computer based collection and dissemination of sociological and technological information to all countries. Canada would certainly participate in these opportunities, but it is not clear that its participation would represent a significant surplus of export revenues.

- ownership of satellite communications facilities. Would the owners of such facilities, among them, large multinational companies offering international computer services themselves, allow direct competition? If not, th cost of duplicating facilities could be prohibitive.

- political considerations. Would foreign governments allow computer based services to be provided within their countries? Consideration would be made for employment, control, technological independence, the value of rapid technological advancement, national pride, etc. Would export of computer services be considered as trading in strategic goods? Our relationship with the U.S. could be a key consideration. The political considerations involved could be the deciding factor.

For these reasons, we do not see long term large growth in the levels of inter-continential exports of Computer Services.

Export growth within the U.S. market should increase, but it will only become significant if more Canadian Service Bureaux enter the U.S. market. Relief from federal taxes and duties and financial assistance in the early stages of marketing would provide greater incentives to Canadian controlled companies to enter this market.

Even without assistance, Canadian owned firms with aggressive marketing (e.g. SDL) have been capable of selling in the U.S. But because credibility is often associated with size, and most Canadian firms tend to be smaller and less well capitalized, the relative success has been limited to this point in time. We re-iterate our belief that service remains the most important factor.

(ii) Software Services: Software represents an ever increasing portion of the computer industry, both domestically and internationally. Again, many of the market characteristics outlined for the domestic situation apply to the export market. Again, the major market area is the United States.

Most of any Operating Systems Software written by independent software firms in Canada is exported. It is usually written for foreign computer manufacturers on a contract basis. However, software is becoming integrated with hardware, and the development of operating systems software is more and more determined by hardware design and

and new hardware technology. Thus, these export markets will tend to remain the same or reduce as computer manufacturers assume more and more of the operating systems software development.

The international market for Custom Software services is also reducing as programming becomes easier and less expensive. Higher level languages, data management software, and applications compilers, will all reduce the need for specialized skills and services.

The development and marketing of application packages, or non-custom software, requires large commitments of labour and capital. However, this area offers the greatest potential for significant Canadian exports. Competition from computer manufacturers and large, established, foreign software firms is difficult. But the market need to reduce computer application development costs is large and is international.

Application Compilers now being developed will go a long way in meeting these user needs. Canadian software firms should enter this market area to provide Application Compilers that would directly compete with those produced by others. Canadian success in these areas will be limited by the Canadian companies' ability to attract sufficient venture capital, by its technical skills, by its marketing ability, and overall, by the courage and forward thinking that it brings to its plans.

In those areas where software is divorced from hardware dependencies, there is no reason why Canadian software firms cannot compete directly and successfully. We are urged to remember that in spite of greater marketing (travel) costs, the U.S. and other international markets are very large and Canadian software specialist costs are presently lower.

The export of Software Services represents an estimated $400,000 or .05 of estimated domestic segment revenues. The long term estimate depends on whether Canadian firms choose to compete in the large application oriented software areas or not.

(iii) Management Services: Management Services in the export market are offered mainly by management consultants. Canadian consultants highly regarded and possess technical capabilities equivalent to United States consultants and ahead of those of their European counterparts. Of the thirteen members of the Canadian Association of Management Consultants, eight are members of large international consulting firms. Consulting business available in other countries would not likely be open to these Canadian firms, as it would be assigned to and serviced by other affiliated firms responsible for those areas. In this way, a large proportion of international consulting business is restricted for Canadian consultants.

The high cost of marketing and responding to requests for proposals when large travel and living expenses are involved, is a probl and a deterrent to consulting in a foreign country.

The present revenue generated in the export market computer-based management services is approximately $250,000 per year, which represents about .04 of estimated domestic segment revenue.

Canadian consultants do have an advantage over United States consultants in countries where North American technology is sought but where United States representatives are not politically welcomed. These countries could include Iron Curtain countries, and certain South American countries, African countries and Commonwealth countries. Some European countries are requiring that any foreign aid projects also include use of consulting services. Canada could adopt similar policies that would allow our consultants to increase the scope of their operations, make themselves better known in other countries, and attract follow-on consulting busi[illegible]. The fact that Canadian companies tend to be smaller than U.S. companies should provide Canadian consultants with experience more closely related in scale to the needs of emerging countries than the training possessed by their U.S. counterparts.

Although prospects for increased business are good, the long term level of export demand for this segment is expected to be significant but still comparatively small in terms of total export trade.

In summary, the projected total level of demand for the three sub-segments is shown in Figure 16 (2). The shape of the total curve reflects our assessment of the marked growth on the basis of the foregoing discussion.

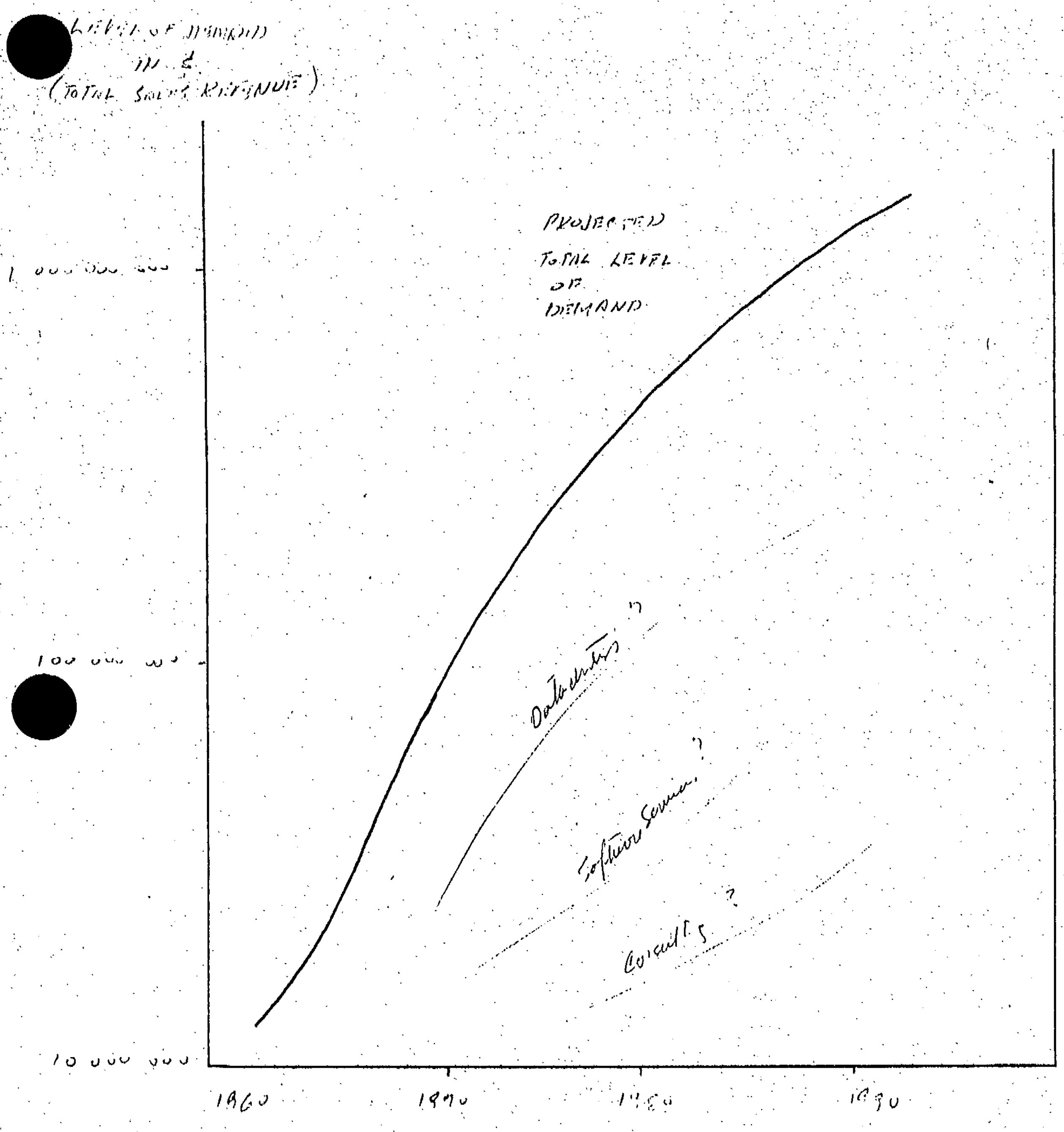


Figure 16.2

PROJECTED
LEVEL
OF
DEMAND

Source: TSQA and
ISO. (ref. 349)

(c) Balance of Payments

As we mentioned earlier, statistics relating to levels of imports and exports are not available. Accurate calculation of balance of payments is not possible. Speculation, based on estimates of current levels of import and export, is shown as Table 17.

The only meaningful conclusion that we can draw is that the level of balance of payments for the industry is insignificant when included in the total Canadian balance of payments situation.

By 1985, the balance of payments could be as in Table 18. Again, the only significant observation we can make is that contribution of the CBSI to the balance of payments, even at its most pessimistic levels, will only be of minor significance when compared to the total situation.

SEGMENT	ESTIMATED IMPORTS (-) (MILLIONS $)	ESTIMATED EXPORTS (+) (MILLIONS $)	ESTIMATED BALANCE OF PAYMENTS (MILLIONS $)
COMPUTER SERVICES	$ 3.00	.30	- 2.70
SOFTWARE SERVICES	1.00	.40	- .60
MANAGEMENT SERVICES	.25	.25	0.00
TOTAL	4.25	.95	- 3.30

TABLE 17

ESTIMATE OF PRESENT BALANCE OF PAYMENTS POSITION OF CBSI

SOURCE: TS&A

TABLE 18

ESTIMATE OF BALANCE OF PAYMENTS - 1985
(BASED ON ESTIMATED CBSI REVENUE OF $800 MILLION)

(IN MILLIONS $)

SEGMENT	ESTIMATED (-) IMPORTS	ESTIMATED (+) EXPORTS	ESTIMATED BALANCE OF PAYMENTS
COMPUTER SERVICES	35. / 160.	80. / 10.	+ 45. / - 150.
SOFTWARE SERVICES	35. / 40.	5. / 1.	- 30. / - 39.
MANAGEMENT SERVICES	5. / 5.	10. / 5.	+ 5. / 0.
TOTAL	75. / 205.	95. / 16.	+ 20. / - 189.

OPTIMISTIC / PESSIMISTIC

PART C

EMPLOYMENT

EMPLOYMENT

Productivity determines the level of employment. Industry will hire additional workers only if their contribution to productivity is greater than their wage cost. The improvements to productivity, as embodied in technology, can result in lower employment levels or in higher revenue capacity per employee. The choice between the two being determined by market characteristics.

What has taken place in the CBSI over the last ten years is a combination of these factors, that is, the rapid growth in revenue has been accompanied by a good but disproportionate growth in employment. The industry has shown a strong tendency to become more capital intensive; software service firms tend to migrate to installing their own computer to become service bureaux; they install terminals or other processing equipment (e.g. COM) or they purchase high level package software. The percentage of revenue from programming or directly people related services, thus, decreases.

We will discuss the CBSI employment picture using the following outline:

1. The structure of employment in terms of the quality and the number of persons employed
2. The pattern of employment growth with performance comparisons to other service industries
3. The level of employment necessary to sustain present supply
4. The prediction of future employment levels
5. The significance of the CBSI to Canadian employment

1. Structure of Employment

The employment components of the industry are shown as Figure 19. A measure of the quality of employment as it is found in each segment of the industry is given in Table 21.

Approximately 78% of workers are rated as "skilled" or better. Education levels are high with a majority of personnel attaining at least post secondary levels.

As for the employment of specific skills: "Canada has a critical skill shortage in making the computer work. And all the signs are that the position will become worse, not better. Top computer executives are facing - and will continue to face - critical staff shortages in attempting to service general management well."

A skill profile by segment has also been attempted (See Figure 20). These curves are based broadly on the study statistics (Reference 25). They are shown to indicate the relating difference in skills between industry segments.

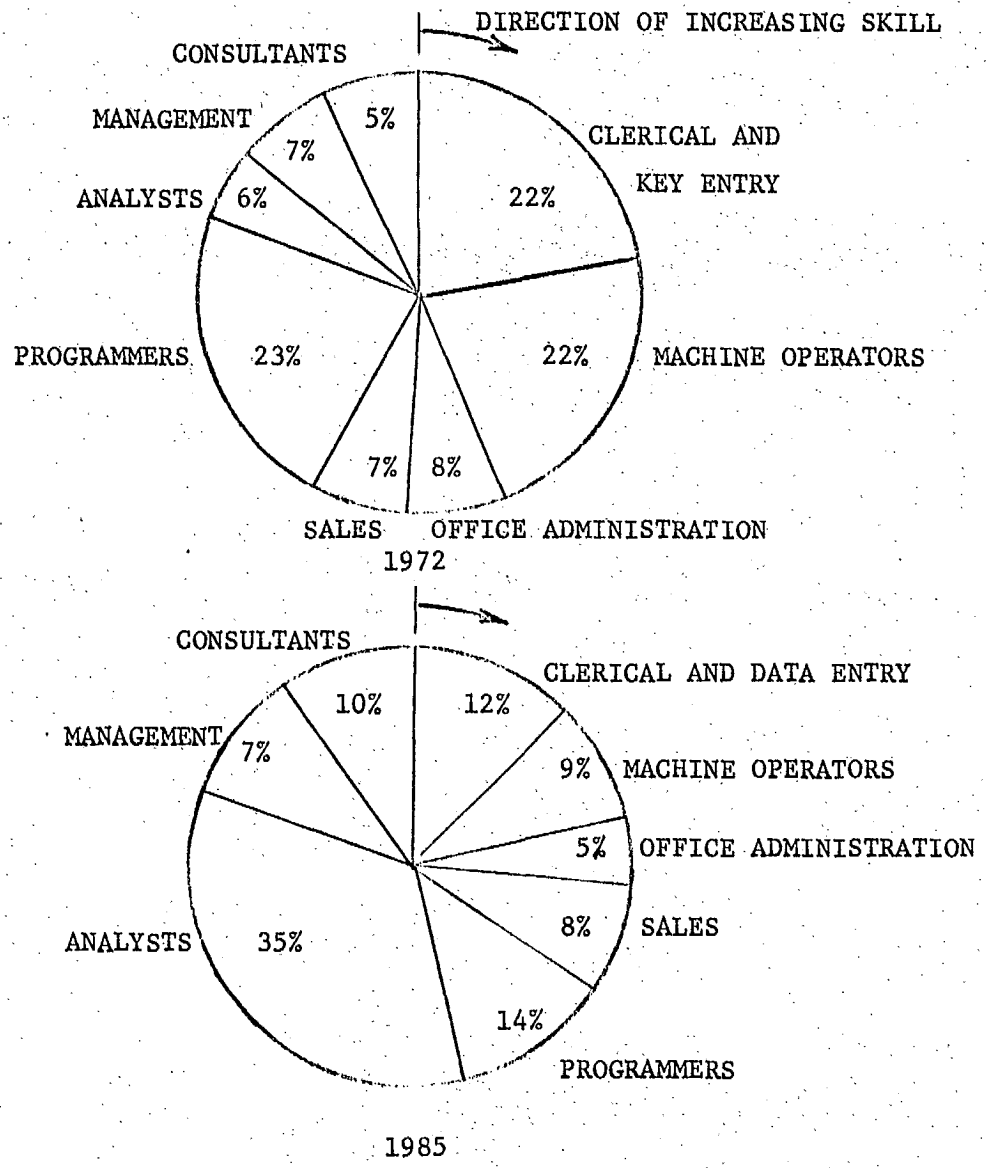


FIGURE 19

EMPLOYMENT COMPONENTS OF THE CBSI
ORGANIZED BY INCREASING LEVEL OF SKILL

SOURCE: TS&A

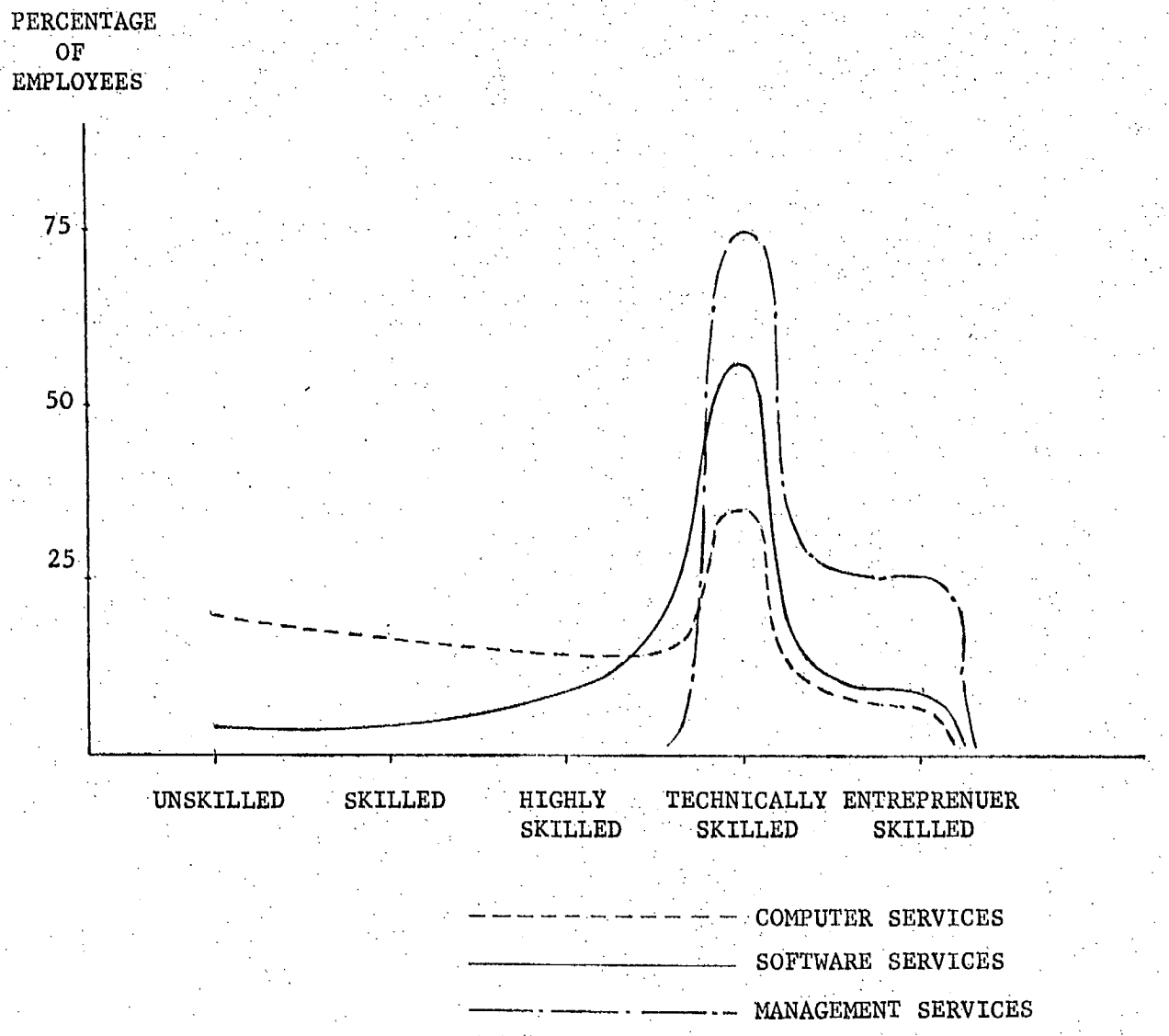


FIGURE 20

RELATIVE SKILLS PROFILE OF SEGMENTS OF CBSI

SOURCE: TS&A, and
FORSYTH (Reference 26)

TABLE 21

STRUCTURE OF EMPLOYMENT

QUALITY OF LABOUR

SEGMENT BY POSITION	PREDOMINANT EDUCATION LEVEL	SKILL CLASSIFICATION
COMPUTER SERVICES		
MANAGEMENT	UNIVERSITY	ENTREPRENEUR
SALES	UNIVERSITY	HIGHLY SKILLED
SYSTEMS ANALYST	POST SECONDARY	TECHNICAL
PROGRAMMER	POST SECONDARY	TECHNICAL
MACHINE OPERATOR	SECONDARY	SKILLED
KEYPUNCH OPERATOR	SECONDARY	UNSKILLED
SOFTWARE SERVICES		
MANAGEMENT	UNIVERSITY	ENTREPRENEUR
SALES	UNIVERSITY	HIGHLY SKILLED
PROGRAMMER	UNIVERSITY	TECHNICAL
MANAGEMENT SERVICES		
ADVISORY CONSULTANT	UNIVERSITY	ENTREPRENEUR
ANALYST CONSULTANT	UNIVERSITY	TECHNICAL
MANAGEMENT	UNIVERSITY	ENTREPRENEUR
EDUCATION SERVICES		
MANAGEMENT	UNIVERSITY	ENTREPRENEUR
INSTRUCTORS	UNIVERSITY	TECHNICAL

The level of employment in the industry has grown from an estimated 1,000 employees in 1960, to approximately 7,500 persons in 1971. However, the accuracy of these employment statistics is questionable. The revenue of the CBSI can be broken down as follows:

Total Revenue		$133,000,000
Less Hardware/Software Costs	$51,000,000	
Less Communications Costs	18,000,000	
Less Other Products Costs	12,000,000	
	$81,000,000	$ 52,000,000

Part of Revenue that includes Labour, Costs, Rent, Other Overhead, Profits	$ 52,000,000

For analysis, let us assume that direct labour wages and labour overhead amount to $50,000,000.

Therefore, average wage cost:

$$\frac{\text{Wages (including fringe benefits)}}{\text{Number of Employees}} = \frac{\$50,000,000}{\$7,500} = \$6,700 \text{ per year}$$

Consider the cost of a keypunch operator, whom we have classified as an "unskilled" employee:

Average monthly wage plus 15% fringe benefits is $500 + $75 or $575

Average yearly wage cost = $6,900

The known "average" wage for one of the lowest wage cost components of the industry is already higher than the "average" wage calculated from the "Branching Out" report (Reference 27).

We must conclude that either the revenue or the employment statistics are in serious error.

From our experience in the industry, we would expect an average annual wage cost of at least $9,500. Using this average and assuming the inter-segment trade revenues are reasonably accurate, the CBSI employment could be as low as 5,250 or revenue could be as high as $155,000,000

Although in our study, we have used the statistics of 7,500 people and $133,000,000 industry revenue, we feel that a low level of confidence should be attached to these statistics.

2. Pattern of Employment Growth

Growth within each component has varied over the years. Clerical, Key Entry, and Machine Operators levels have grown slowly. Technological innovations have had strong effects in reducing these types of labour costs and this trend will continue. The sales, office administration and management components have grown in normal proportions to revenues.

Analyst and programmer levels have shown increasing rates of growth. In the past, this strong demand combined with a small supply of computer skilled personnel, created high salary levels and high turnover

rates. Recently, with general levels of computer activity lower, the market situation for these skills has stabilized. However, the trends in employment created by technology will definitely increase the proportion of the analyst and programmer component. The total industry employment growth rate is not expected to be significant.

3. Level of Employment Necessary to Sustain Present Supply

The estimate of the future impact of technology on employment can be shown by predicting the level of employment needed by 1985 assuming the same level of revenue but taking advantage of any technological innovations. Our estimate is given in Figure 22. We feel that 13 years of technology to 1985 could reduce employment by a factor of three if supply is held constant.

For example, the use of application compilers and high level software will increase programmer productivity and the move to user terminal input will reduce the need for Key Entry operators and Machine operators.

4. Future Employment Levels

Employment within the industry will be a function of the level of demand for the whole industry. The total industry employment growth rate is not expected to be significant. The graph shown as Figure 23 represents our forecast of the number of jobs, related to forecast revenues. These curves are shown together to illustrate our assessment that the CBSI employment levels will begin to decease in relationship to the growth of the CBSI as the affects of the technological innovations previously discussed take hold. Figure 24 shows our estimate of employment by sub-segment.

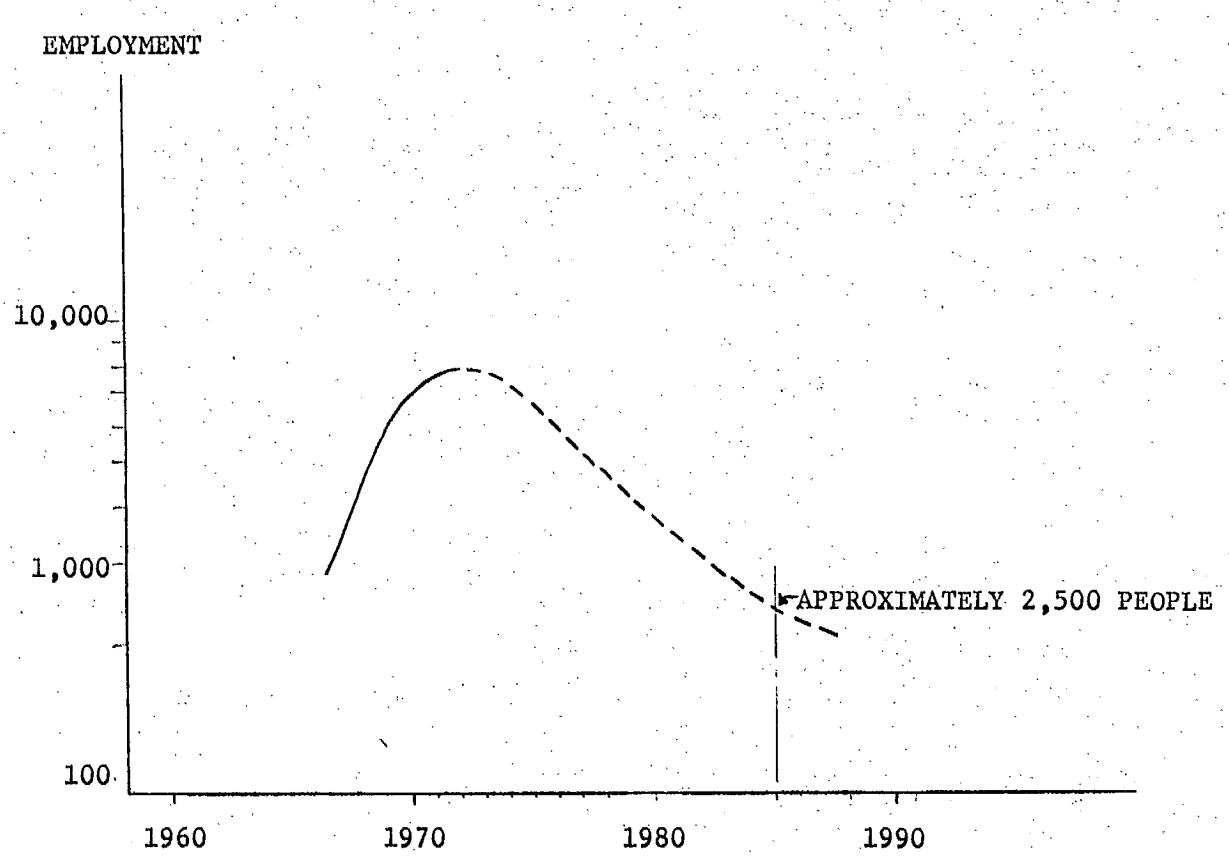


FIGURE 22

ESTIMATED LEVEL OF EMPLOYMENT NECESSARY
TO SUSTAIN PRESENT LEVEL OF DEMAND

SOURCE: TS&A

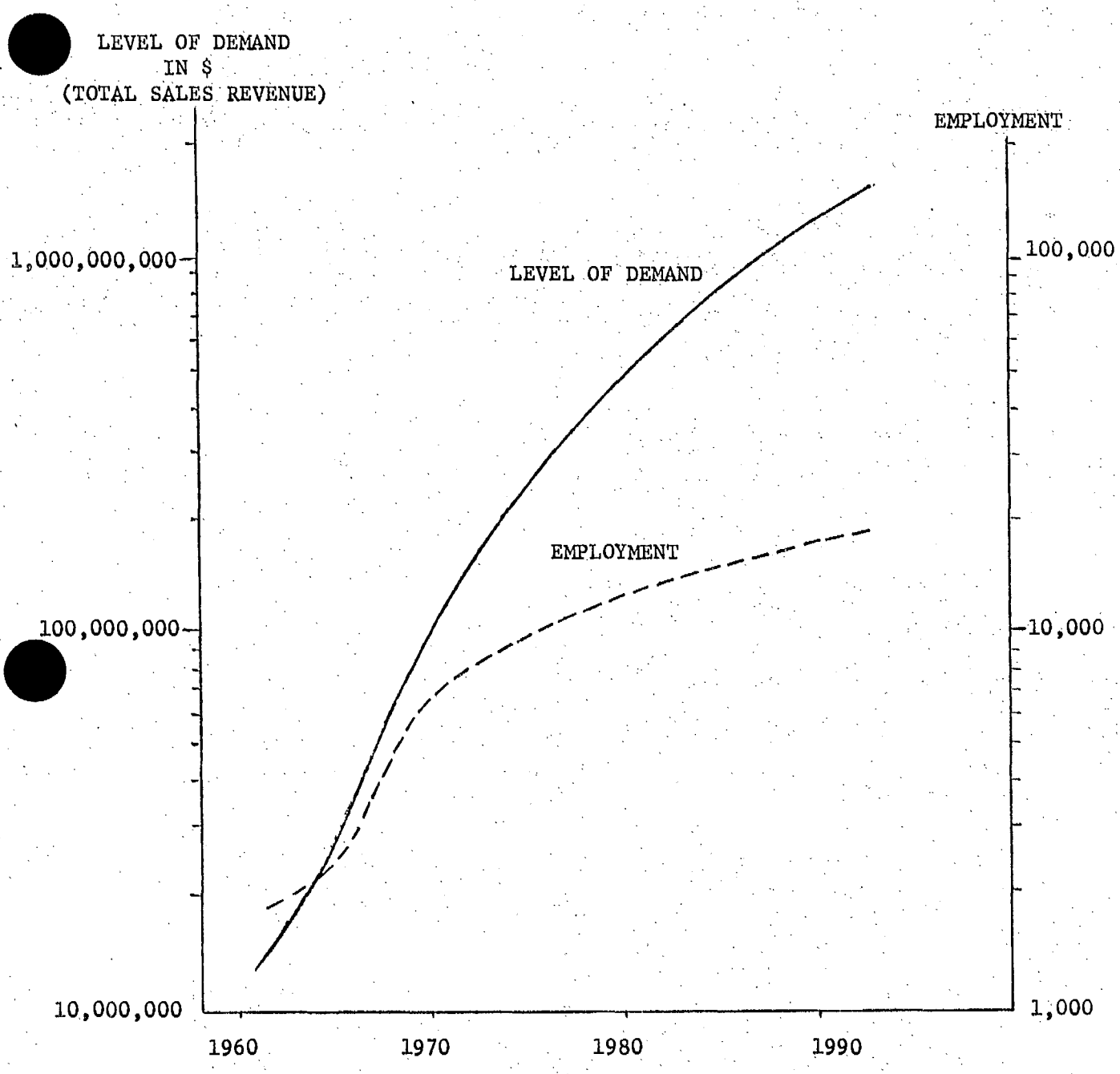


FIGURE 23

ESTIMATED RELATIONSHIP OF EMPLOYMENT
TO
LEVEL OF DEMAND

SOURCE: TS&A, and
B.O. (Reference 27)

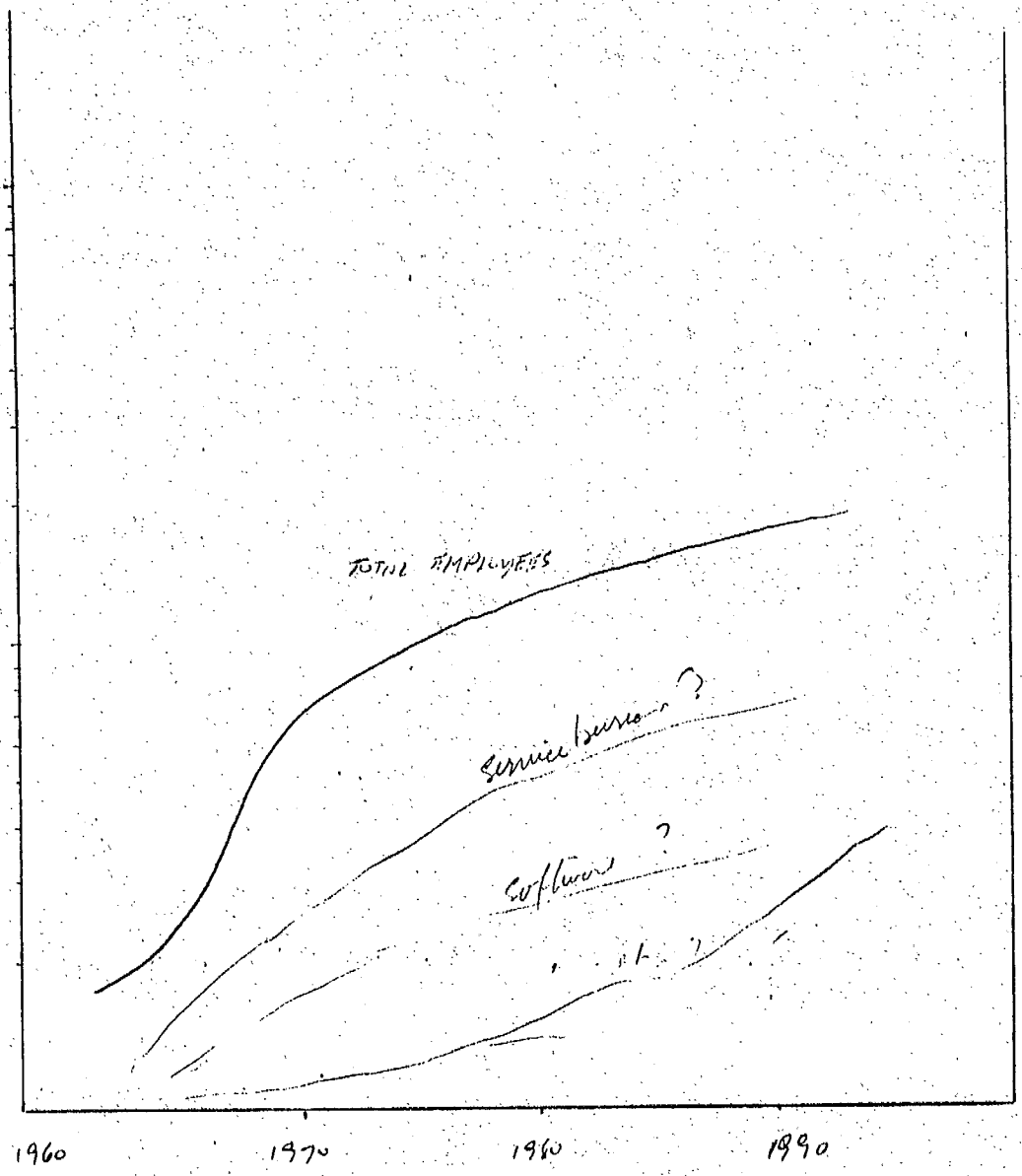


Figure 29

ESTIMATED FUTURE EMPLOYMENT LEVELS WITHIN CBSI

Source: TS+A

Productivity indexes (output per man hour) has steadily increased in most other industries. Using 1960 as 100, the productivity index in the "Total Commercial Industries", which could presumably include the CBSI, increased from 125 in 1966 to 141 in 1970 (Reference 28). In our opinion, the CBSI has probably kept pace or exceeded this growth.

Productivity measures selected in this study, compare revenue to number employed generating that revenue.

This index of average revenue output is given by each segment;

Computer Services	$19,500	per person per year
Software Services	$18,600	per person per year
Management Services	$28,400	per person per year

These indices are based on statistics given in the Forsyth Study (Reference 29), and in the Canadian Association of Management Consultants Annual Report (Reference 30).

The industry index generated using the "Branching Out" report statistics gives a measure of $17,750 per person per year.

We are unable to draw employment productivity comparisons with foreign competitors. Intuitively, we feel that with essentially comparable know-how, there is no reason why Canadian productivity should not equal that of any Western country.

We feel employment will grow slightly and disproportionately with the rate of increase of revenue.

figures 22, 23 and 24

These curves are based on our estimate of the effect of new technology on productivity. We attach no statistical confidence to our predictions.

It is important to realize that computer personnel employment within computer user organizations in other industries should expand significantly. This increased application of computer technology will probably have a negative effect on the total employment levels in Canada. The analysis of the extent of this effect is beyond the scope of this report.

5. Significance of CBSI Employment

Accelerating the growth of the CBSI would not significantly reduce Canada's sensitive unemployment problem.

Firstly, even if computer users began contracting much of their systems programming or computer requirements, the source of skilled people to provide these services would come from users computer departments. Even if this increased labour productivity, it would be a transfer of existing employed people, rather than the creation of new jobs.

Secondly, the number of people employed is insignificant when compared to the total labour force in Canada. The CBSI represents roughly

.09% $\left[\frac{7,500}{(8,400,000)}\right]$ of the total labour force. It could double, triple, quadruple or disappear without creating a significant impact on Canadian level of employment.

PART D

GOVERNMENT AND INDUSTRIAL R & D POLICIES

X THE BASIC GOVERNMENT AND INDUSTRIAL R & D POLICIES REQUIRED TO ENHANCE THE CANADIAN COMPUTER SERVICES INDUSTRY

The foregoing chapters have described the growth of the computer industry in Canada and have explained the nature of the related computer services sector. In the discussion related to the future prospects for the industry, several major points were presented. Among these were the following:

1. The computer services industry is highly dependent upon growth and development in the computer hardware field, which is in turn highly dependent upon U.S. based technological innovation. Prospects for hardware or software research breakthroughs in Canada are remote if this classical development pattern continues.

2. As pointed out in "Branching Out", Canada's size and geography favour the development of a nationally co-ordinated communications network to facilitate computer use nationally. Further research regarding policy is anticipated in this area as a result of the observations of the CCC/TF.

3. Since performance in hardware varies directly with size of equipment, a long term trend is seen toward the larger service bureau (utility). Research is needed to confirm Canada's policy regarding a nationally sponsored computer utility.

It is apparent then, that further analysis is needed in many facets of the computer related industries to further understand the best policy positions to take nationally. Whether these subjects are directly related to the future growth of the services segment is not in question, they are; but they also have more important implications well beyond this service sector and should probably be related to the total growth potential for the nation, not just a small sector of the service industries. Further major research related to the CBSI only is considered by us too narrow and too small a field to be cost justifiable.

Addressing ourselves specifically to the computer services sector, several observations can be made:

1. The CCC/TF identifies a number of areas for suggested research into the use of computer/communications (Reference 31). We are in basic agreement with them all. The significant point in the present context, however, is that such research into application development for the emerging computer related technologies should be directed to the computer services industry to conduct on behalf of other Canadian industries as opposed to programs for direct stimulus to the computer services segment itself. It is apparent that insufficient data is presently available in this small and fragmented service sector to quantitatively assess the future effects of technological innovation on Canadian service industry development in total.

   If it becomes the policy of the country to initiate creative exportable computer services, a more clearly defined set of national priority

projects is needed. The computer services industry is the natural vehicle to define these goals as evidenced in "Branching Out".

Our observation would be that there is no strong case for continued research into programs to stimulate the CBSI. But, we would strongly recommend that the facilities within the CBSI be utilized in programs directed toward understanding the future impact of computer technology in a number of areas affecting Canada such as:

(a) The impact of computer technology on other service industries
(b) The impact of computer technology on Canadian manufacturing industry
(c) The impact of computer technology on the individual
(d) The feasibility of a national computer utility
(e) Information privacy and security in a computer utility environment

2. Because the CBSI is small, fragmented, but expanding in proportion to the general penetration of computer hardware in the country, specific stimulus by government is not suggested to keep it alive. However, bold new national programs are needed if it is to become a world reputation exportable Canadian centre of skill. If one accepts that the relationship between computing power and size is going to continue and that significant innovation is likely to occur on the most sophisticated equipment, then the urge to provide a national computer/communications utility is strong as a basis for stimulating this industry. Certainly, justification for moving in this direction cannot be based

on CBSI needs alone, (given the expected size of the CBSI) but the influence of such a profound national development would provide a very great development boost in the short term to all segments of the CBSI (except the standard batch services bureaux with long term write-off needs for obsolescent hardware and third party lessors of small central processing units).

The impact of such a national goal on other industry and on the individual would, however, be infinitely more significant. This type of project ties in closely with the development of a national computer/communications network (Reference 32).

Another related project with national scope which [illegible]urther serious analysis is the preparation of computerized information systems for scientific and technical data in Canada. This is well outlined in the special study (No. 8) prepared by the Science Council (Reference 33), and would extend and complement the activities of the National Research Council's Technical Information Service and the National Science Library.

The Organization for Economic Co-operation and Development (OECD) which compiles R & D statistics on a number of countries notes that at the time of its last publication (1970) as a result of its Paris meeting of member countries, statistics available from Canada (1964) placed the country's total R & D expenditures at about 1.1% of GNP. This compared with 3.4% for the U.S. and 2.3% for the U.K. Canada also trailed several other industrialized countries in R & D expenditures (France, Germany, Japan, Netherlands, Sweden, W.W.C.M.). (Reference 34)

In terms of percentage of population engaged in research activities, Canada has lagged in a similar fashion.

It may be that more current statisitcs would show a recent change in emphasis. However, the overwhelming impact of U.S. R & D cannot be ignored. The gross R & D expenditures in the U.S. were over $21 billion in the survey period compared to $460 million for Canada. If it is reasonable to expect that something close to this ratio still exists and that the ratio also applies to computer related R & D, then we can conclude that original computer development from the U.S. is happening at some 46 times the rate being experienced in Canada.

Since about 62% of U.S. electrical and electronic related R & D is government sponsored compared with 22% in Canada, there is cause to suggest that increased government expenditures for computer related research would be worth consideration if a national goal is to be made of exporting significant amounts of computer related expertise to other countries.

3. We are of the opinion that no serious constraints exist to the development of the CBSI. The definition of specific national goals related to computer technology development will enhance the computer services industry's unique development related to other countries, in particular, the United States. The West German Datel consortium (Reference 35 is an example of an imaginative approach to industry/government co-operation which shows promise of permitting that country a unique capability. Apparently, Canada has lagged behind such other highly indus-

trialized nations in supporting innovation and research as a percentage of GNP because of different national priorities or goals. This is not a criticism of government support, but a suggestion to continuously monitor priorites in a changing world.

The import of computer services and products from the U.S. poses an inhibiting effect upon original development within Canada, but it is felt that this is less a threat than are the factors of:

(a) Economies of scale and geography favouring development for the U.S. market place first.

(b) Service sector development being tied closely to the source of hardware development (i.e. - the U.S.).

One could argue that the lack of specific tariff barriers is hurting original research and development. We prefer to feel that national support of development could provide all the stimulus needed for original work within the capability of the country's present manpower trained for computer related R & D.

The use of the computer as a tool in other university and industry related research is, in fact, being encouraged by government university aid programs, but is outside the scope of this analysis.

PART E

CONCLUSIONS AND RECOMMENDATIONS

XI GENERAL CONCLUSIONS

1. In terms of the GNP, The CBSI is small. The impact of computer services on Canadian industry however, could be substantial. (page)

2. As the CBSI matures, certain segments will decline in importance as users gain more expertise in software, hardware and other techniques. (page)

3. With lower cost communications and terminal hardware, remote processing will become a significant growth area for service bureaux. (page)

4. The data-base sub-segment of computer services accounts for a very small portion of the CBSI revenue at present, but can be expected to grow significantly. (page)

5. Human skills are lagging behind in the CBSI as compared with the tools available. (page)

6. The CBSI has demonstrated that in the absence of increases in productivity, a stable price level is inconsistent with continuous increases in money wages. (page)

7. The dramatic increases in earnings in the CBSI were not as a result of high productivity, but of a scarcity of skills. Earnings have

now reached a point of stabilization as a result of supply catching up with demand. (page)

8. The CBSI is not sensitive to price changes except perhaps in the segments providing raw power; it could be described as "service sensitive". (page)

9. As the industry reaches a plateau of stability and a high level of saturation is reached in the existing market, employment will be reduced, unless new services are introduced to create another wave of expansion in the industry. (page)

10. The technological innovations that created the largest increases in the level of demand were packaged software, data communications capabilities and time-sharing. These innovations directly created new markets. (page)

11. In areas where the Service Bureaux can "lock in" their customers with software, unique data bases, unique equipment, or high levels of service, the rate of innovation and diffusion of new technology is much more leisurely and unpressured. (page)

12. With the exception of custom software, the extent of effort in producing high level software is so large as to exclude all but the companies with large pools of programming skills, abundant financial resources, and widespread marketing capabilities. These companies tend to be hardware suppliers. (page)

13. The level of demand for management services is directly related to the general level of computer technology within the industry . As such, the growth of management services is an indicator of the rate of diffusion of computer innovation. (page)

14. The rate of innovation is now believed to be holding back the diffusion of technology. In many cases, users have simply delayed purchasing decisions because they feel new technology is soon to be introduced, obsoleting the technology they have before them. (page

15. Virtual memory will provide "large" computers and tend to make the advantages of on-line program development more widespread. (page)

16. With executive programming software and data base management software, a relatively low monthly lease cost will provide significant labour productivity increase to all users. (page)

17. The inability of service bureaux to meet the challenge of mini-computers could cause a reduction in their revenue. The hardest hit will be medium-sized installations offering monthly batch/transaction processing. (page)

18. Mini-computers will create new markets for software, management and education services. (page)

25. The "cashless society" is technically feasible today, but as this has little advantage for the individual or corporate user, diffusion of this technology will be held off until attitudes change or paper processing costs become prohibitive. (page)

26. Although profits have not been significant in the CBSI, they appear to have stabilized to the point where entrepreneurs are confidently predicting reasonable returns in the medium-to-longe term. (page)

27. Provided concepts not in existence at present, such as the "cashless society" or computer utilities become realities by 1985, and provided their revenues become categorized with this segment of the CBSI, the computer services could well become the economic giant of the Eighties. (page)

28. The work produced by Canadians in the software services has been of a consistently high quality and can stand comparison to the best anywhere. Productivity, however, may not have increased to the same extent as in the U.S. where the larger markets for software and the number of computers installed provide significant economies of scale. (page)

29. In the management services sub-segment of the CBSI, the quality of service provided is of a high standard; Canadian management consultants can hold their own internationally. (page)

19. In order for service bureaux to survive in future, they must be in the forefront in offering services such as optical character recognition (OCR) and on-line and off-line terminal operation. (page)

20. By 1985, Remote and RAIR applications will account for an estimated 60% of all computer services revenue. (page)

21. Data processing consortia of municipalities, rural districts, school boards, professional and labour associations could result in a significant loss of revenue to service bureaux by 1985. (page)

22. The most significant impact on software services will be the advent of application compilers. By 1985, they could account for 50% of this sub-segment's revenues, while substantially reducing programmer employment. (page)

23. The introduction of more sophisticated applications compilers between now and 1985 will significantly reduce the user's software costs and increase the market for potential users by greatly reducing software development costs. (page)

24. Without lower cost communications facilities, Canada will lag behind the U.S. in applying digital data communications technology to take full advantage of computer productivity. This will cause Canadian users to design computer-communications systems using U.S. facilities. (page)

30. The productivity as such of the management consultant has, in our opinion, not increased as a result of developments in technology but, as a diffuser of technology, he plays a direct role in helping his client to attain improved productivity. (page)

31. Computer-related services, because of their high technological content, are bound to be one of the fastest growing areas of management consulting. (page)

32. For firms without representation in foreign countries, the high cost of marketing and responding to requests for proposals, when large travel and living expenses are involved, is a problem and a deterrent to consulting in a foreign country. (page)

33. The total industry employment growth rate is not expected to be significant. In fact, we feel that 13 years of technology to 1985 could reduce employment to one-fifth its present level if demand is held constant. (page)

34. Accelerating the growth of the CBSI will not significantly reduce Canada's unemployment problem. (page)

35. A "window of Opportunity" for technological export may presently exist in Canada in the CATV area. (page)

RECOMMENDATIONS

The foregoing analysis of the CBSI in Canada results in a number of suggestions and recommendations for consideration:

1. The impact of computer technology will be strongly felt in every industry in Canada. We strongly recommend:

   That the facilities within the CBSI be utilized in programs directed toward understanding the future impact of computer technology in a number of areas effecting Canada such as:

   - The impact of computer technology on other service industries
   - The impact of computer technology on Canadian manufacturing industry
   - The impact of computer technology on the individual
   - The feasibility of a national computer utility
   - Information privacy and security in a computer utility environment
   - The impact of computer technology on the CATV industry

2. The Federal Government represents the largest single user of computers in Canada. It can, through its policies, substantially influence the entry of new companies into the CBSI and the long range planning of existing organizations. We recommend:

That Canadian Federal Government policy on matters concerning:

- Digital communication and networks
- Computer utilities
- Computer-based R & D
- Purchasing policy as regards computer-based services

be announced in the White Papers to allow industry planning and final industry inputs to policy.

Further,

That the Federal Government should consider in its purchasing policy for computer-based services:

- Using Canadian Service Bureaux services as alternatives to the acquisition of additional in-house computer systems
- Using Canadian Software and Canadian Management services whenever possible, and economically feasible.

Further,

That the Federal Government should plan to gradually de-emphasize standard computer programming and computer machine operations as career path for Canadians in favour of more emphasis on more generalized systems analysis training.

3. During the course of our study, we were prevented from satisfactory quantitative analysis due to the lack of relevant data. Considering that the Computer Industry, of which the CBSI is a significant part, is projected to be 2% of the GNP by 1980, (Reference 35), B.O., page 58), the lack of information will seriously hamper effective analysis and planning.

We therefore recommend that a statistics gathering system be set in place by Statistics Canada to record:

Level of Demand
Employment by Type
Imports
Exports

By Sub-segment of CBSI

Until this system is operational, a survey of all CBSI companies should be conducted to obtain the above statistics.
We have detailed the information that we feel should be collected as Table _ in the Appendix.

4. The CBSI Balance of Payments position can be improved by continuing to encourage Canadian firms to market and export their services. In order to make Canadian suppliers of Computer Services more competitive, we recommend:

That tax incentives be granted to Service Bureaux proportional to their level of export of Computer Services. This could be accomplished by allowing tax deductions of Federal Customs Duty and Federal Sales Tax imposed on hardware systems used, in the amount of the proportion of export revenues compared to total revenues.

5. In the Management Services area, we recommend:

That foreign aid to developing countries specify that Canadian management consultants be used in projects involving new technology.

This policy would help to establish Canadian consulting operations abroad, lead to our recognition of competence, and generate follow-on contracts.

6. Canada's technological dependence on the United States has to a great measure resulted in the development of the "branch plant economy". The Canadian computer industry is no exception. We recommend:

That the Federal Government should study mechanisms to regulate flow and impact of foreign computer technology in Canada. The policy should motivate Canadian technological nationalism as a means to build Canadian competence and confidence in dealing with technological change.

With the cost of innovating and developing new computer technology so very high, what role can Canadians play? What identity can we achieve in this age of technology? The answer could be evident if we re-examine our definition of technological innovation. We included social innovation as the use of social technology, that body of knowledge that relates to how human beings affect and are effected by such phenomena as change. Technology requires change and change requires social technology.

Computer based systems are introduced largely to make the complex activities in our lives happen faster, more accurately, or less expensively. Systems are referred to as "tools". People, as the users of these tools, are always involved interfacing with these computer based systems. This promises to become more significant as "terminals" become as prolific as telephones.

Not always, and in fact very infrequently, is careful consideration of values made in designing and implementing computer based systems. Too often the principles of "assembly line" attitudes take precedence over personal pride and feelings of doing a job wherein one can contribute more than his physical dexterity or his superficial thought. The rules of business, of return on investment, of reduced cost and greater centralized control, usually win out. We do not suggest that this is not as it should be, but there is a growing awareness that the value of creativity and enthusiasm must be considered in the return-on-investment calculations. The need therefore exists for research and development in the human application of computer systems. Canada could concentrate on this need by encouraging research projects, funding pilot application systems, supporting educational and development programs. Canada's role could become that of a leader helping emerging nations better control the impact and benefit of new technology by assisting in interfacing computer based systems more skilfully with people.

We recommend:

That the Federal Government policy regarding technology could stress and support the role of Canadians as being leaders in the international human or social considerations involved in the implementation of computer based systems.

Part of Federal Government R & D funding should be in the form of special computer application projects where:

- There is an established need (where public involvement has helped determine the need)
- The resulting systems would benefit people as a whole
- The state of the art for social technology in computer applications is advanced
- The applications have export potential to meet similar needs in other countries

Further, that the project teams be:

- Multi-disciplinary
- Include Canadian equipment manufacturers as these develop
- Include Canadian management consultants
- Include Canadian software company services
- Make use of Canadian Computer Services organizations where possible or economically feasible

That the Federal Government grant funds to Canadian universities to study and develop national education programs for Systems Analysts. Such programs should lead up to a masters or doctorate level and would:

- Develop high level analyst skills in the design and introduction of change
- Stress social responsiblities and multi-disciplinary approaches
- Further the diffusion of truly "effective" computer based systems design

Once developed, the program could be marketed to other countries through their respective universities, using Canadian teachers. This diffusion of technical knowledge would also build Canada's computing reputation and provide possible export potential for Canadian services.

APPENDIX F

LIST OF REFERENCES

REFERENCES

FORMAT

Author, "Title of Article", Publication Underlined, Date, Pages Referred

REFERENCE	PAGE	
1	1	Economic Council of Canada, "A Review of the Years to 1980", Ninth Annual Review, 1972
2	1	Ironfield, Department of Industry, Trade and Commerce
3	2	Government of Canada, Department of Communications "Branching Out", Report of the Canadian Computer/ Communications Task Force, May 1972, Pages 40,45
4	5	Same as Reference 3, Page 39
5	6	International Data Corporation, "Volume 7, No. 21" EDP Industry Report, September 15, 1972
7	16	The Organization for Economic Co-operation and Development (OECD), "Comparisons Between Member Countries in Education, Research, and Development, Technological Innovation, International Economic Exchanges", Gaps in Technology, 1970, Page 183
8	17	Same as Reference 7, Page 224

REFERENCE	PAGE	
9	18	A. Adams, "Critical Skill Shortage in EDP", Office Equipment and Methods, September, 1972, Page 54
10	19	Same as Reference 7, Page 225, Paragraph 135
11	21	Same as Reference 3, Page 40
14	31	EDP Industry Report, "Volume 7, No. 22", Sept. 25, 1972
15	Figure 9	Government of Canada, Department of Communications "Technological Review of Computer/Communications", Background Paper to Branching Out (see Reference 3), May 1972, Page 28 of Draft supplied
16	Figure 10	Same as Reference 15, Page 48 of Draft supplied
17	Figure 11	Same as Reference 15, Page 49 of Draft supplied
18	38	Same as Reference 3, Page 54, 56
19	43	"Report #13", Science Council of Canada, Aug. 1971, Page 19
20	45	"Datel's Network Pays Off", Computer Weekly International, Oct. 19, 1972, Page 2
21	50	"Canadian Computer Reference Manual 1973", Canadian Datasystems, December 1972, Page 61 See also, "Buyers Guide 1973", Office Equipment and Methods, December 1972
22	56	Same as Reference 3, Page 59. Figures quoted in report are 82% of industry estimates given in Reference

REFERENCE	PAGE	
23	67	See Appendix D, Background Table to Figure 2
24	73	
25	88	G.R. Forsyth, "The Canadian Computer Supply Industry Study", Canadian Computer Communications Task Force, February 1972. Table 46, Page 107 of Draft supplied
26	Figure 20	See Background Table to Table 20
27	90	Same as Reference 3, Pages 40, 41, 45
28	92	
29	92	Same as Reference 25
30	92	Canadian Association of Management Consultants, "Annual Report 1972"
31	96	Same as Reference 3, Pages 151 - 168
32	98	Same as Reference 20
33	98	Science Council of Canada "Scientific and Technical Information in Canada, Part II, Chapter 2", Special Study No. 8, 1969
34	98	Same as Reference 7, Page 120
35	109	Same as Reference 3, Page 58

APPENDIX G

LIST OF TABLES

	OUTPUT		SOURCE
1970	GNP	84,500,000	Economic Council of Canada
	CBSI	133,000,000	Branching Out
	Service	59.2%	Economic Council of Canada
1980	GNP	189,200,000	Economic Council of Canada
	CBSI	513,000,000	Branching Out
	Service	62.5%	Economic Council of Canada

	EMPLOYMENT		
1970	Labour Force	8,374,000	Economic Council of Canada
	CBSI	7,500	Branching Out
	Service	61.0%	Economic Council of Canada
1980	Labour Force	10,906,000	Economic Council of Canada
	CBSI	15,000	Tennant, Song & Associates
	Service	69.1%	Economic Council of Canada

BACKGROUND TABLE TO FIGURE 1

ORIENTATION TO CANADA'S COMPUTER BASED SERVICE INDUSTRY

SEGMENT \ SOURCE	FORSYTH REPORT Background to Branching Out	BRANCHING OUT	4% OF KNOWN U.S. COMPUTER SERVICES *	TS&A ESTIMATES **		TS&A COMPONENT %
Computer Services						
Local Batch				57,0		
Remote Batch	90,6		59,0	20,0	105,	82%
Rair				13,0		
Input/Output			18,0	15,0		
Software						
Operating Systems				,8		
Custom	8,4		16,0	9,0	12,	9%
Non-Custom	.3			2,2		
Management Services						
nsulting	4,6			5,2		
acilities Management				4,5	11,7	9%
Education			6,5	2,0		
TOTALS	104,0	133,0	99,5	129,		100%

BACKGROUND TABLE TO FIGURE 2

CBSI COMPONENTS
(IN MILLIONS $)

URCE: EDP INDUSTRY REPORT

** INDUSTRY KNOWLEDGE, CANADIAN ASSOCIATION OF MANAGEMENT CONSULTANTS

U.S. COMPUTER SERVICES PERCENTAGES

SOURCE METHOD / APPLICATION	LOCAL BATCH	REMOTE BATCH	REMOTE ACCESS IMMEDIATE RESPONSE (RAIR)	TOTALS
RAW POWER	7.	7.	12.	26.
TRANSACTION	66.	1.5	3.	70.5
DATE BASE	1.8	.7	1.	3.5
TOTAL	74.8	9.2	16.	100.0

BACKGROUND TABLE TO TABLE 4

ESTIMATED PERCENTAGES OF PRESENT COMPUTER SERVICES REVENUE (EXCLUDING INPUT/OUTPUT SERVICES)

SOURCE: EDP INDUSTRY REPORTS, SEPT. 15, 1972

PROJECTED CANADIAN PERCENTAGES DERIVED BY TS&A FROM INDUSTRY KNOWLEDGE

TABLE 6

ESTIMATED PERCENTAGE SERVICE BUREAUX COSTS

THIS TABLE IS COMPILED FROM AVERAGES OBTAINED From A Survey of ~~AFTER BRIEF~~ TYPICAL SERVICE BUREAUX COMPANIES IN THE VANCOUVER AREA.

TABLE 8

HISTORICAL DEVELOPMENT OF
TECHNOLOGICAL INNOVATION

SOURCE: OECD, Reference , Page 190. ADDITIONS BY TENNANT, SONG & ASSOCIATES BASED ON INDUSTRY KNOWLEDGE.

YEAR	INDICATOR * NUMBER OF COMPUTERS	** EQUIVALENT RENTAL VALUE (IN MILLION $)	*** COMPUTER CONSULTING REVENUE (IN MILLION $)
1972	4,406	---	------
1971	3,548	375	4.330
1970	2,700	330	4.176
1969	2,037	250	4.755
1968	1,613	170	3.186
1967	1,279	105	1.800
1966	948	55	-----
1965	710	30	-----
1964	502	20	-----
1963	-----	15	-----
1962	----	10	-----

BACKGROUND TABLE TO FIGURE 12

INDICATORS OF RATE OF DIFFUSION
OF COMPUTER TECHNOLOGY IN CANADA

* SOURCE: CANADIAN INFORMATION PROCESSING SOCIETY
** SOURCE: BRANCHING OUT, REFERENCE 3, Page 45
*** SOURCE: CANADIAN ASSOCIATION OF MANAGEMENT CONSULTANTS, 1972

FACTOR COMPONENT	REVENUE (IN MILLION $)	PERCENTAGE
General Management and Organization	4.881	21.6 %
Computer Applications	4.331	19.2 %
Finance & Control	2.874	12.8 %
Executive Search	2.584	11.5 %
Production	2.441	10.9 %
Management Sciences	1.859	8.3 %
Personnel Services	1.683	7.5 %
Marketing	1.280	5.7 %
Resource and Development	.557	2.5 %
TOTALS	22.100	100.0 %

BACKGROUND TABLE TO FIGURE 16

PORTION OF MANAGEMENT CONSULTING
REVENUE GENERATED BY
COMPUTER BASED ACTIVITIES

SOURCE: CANADIAN ASSOCIATION OF MANAGEMENT CONSULTANTS - 1972 ANNUAL REPORT

Position \ Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Clerical & Key Entry	1650 22	1740 22	1870 22	1930 21	2000 20	2030 19	2030 18	2020 17	1980 16	1920 15	1860 14	1790 13	1730 12	1800 12	1870 12
Machine Operators	1650 22	1740 22	1780 21	1840 20	1900 19	1930 18	1920 17	1910 16	1860 15	1790 14	1600 12	1520 11	1440 10	1500 10	1400 9
Office Administration	600 8	630 8	680 8	740 8	800 8	750 7	790 7	830 7	870 7	900 7	930 7	970 7	1010 7	900 6	790 5
Sales	525 7	550 7	600 7	640 7	700 7	860 8	910 8	950 8	990 8	1020 8	1060 8	1100 8	1150 8	1200 8	1250 8
Analyst	435 6	470 6	600 7	740 8	1000 10	1280 12	1700 15	2030 17	2480 20	2950 23	3330 25	3860 28	4460 31	4800 32	5460 35
Programmers	1740 23	1820 23	1950 23	2120 23	2300 23	2350 22	2370 21	2380 20	2360 19	2300 18	2390 18	2350 17	2300 16	2250 15	2180 14
Management	525 7	550 7	600 7	640 7	700 7	750 7	790 7	830 7	870 7	900 7	930 7	970 7	1010 7	1050 7	1090 7
Consultants	375 5	400 5	420 5	550 6	600 6	750 7	790 7	950 8	990 8	1020 8	1200 9	1240 9	1300 9	1500 10	1560 10
TOTALS	7500	7900	8500	9200	10000	10700	11300	11900	12400	12800	13300	13800	14400	15000	15600

BACKGROUND TABLE TO FIGURE 19 AND FIGURE 23

SOURCE: TS&A

KEY

NUMBER
% OF TOTAL

	FORSYTH STUDY SAMPLE STATISTICS *						TS&A ESTIMATES	
	COMPUTER SERVICES (By No. of Persons)	SOFTWARE SERVICES (By No. of Persons)	MANAGEMENT SERVICES (By No. Persons)	TOTALS	PERCENTAGE	PERCENTAGE APPLIED TO TOTAL CBSI EMPLOYMENT i.e. 7,500	ESTIMATED PERCENTAGE	PERCENTAGE APPLIED TOTAL CBSI EMPLOYMENT i.e. 7,500
Clerical and Key Entry	61.0	2.9	----	63.9	18.5	1390	22.0	1650
Machine Operators	65.5	.9	----	66.4	19.1	1430	22.0	1650
Office Administration	40.8	1.4	----	42.2	12.2	915	8.0	600
Sales	19.1	.9	----	20.0	5.8	435	7.0	525
Analyst (A) and Programmer (P)	86.0	12.6	----	98.6	28.5	2140	29.0	A 435 P 1740 2175
Management	22.7	1.9	----	24.6	7.1	530	7.0	525
Consultants	----	----	30.0	30.0	8.7	650	5.0	375
Total	295.1	20.6	30.0	345.7	100.0%	7490	100.0%	7500

BACKGROUND TABLE TO FIGURE 19

EMPLOYMENT COMPONENTS OF THE CBSI

ORGANIZED BY INCREASING LEVEL OF SKILL

* SOURCE: FORSYTH STUDY, REFERENCE [illegible], TABLE 46
NOTE - NUMBER OF PERSONS USED WAS OBTAINED FROM THE FORSYTH STUDY

SEGMENT / SKILL	COMPUTER SERVICES %	SOFTWARE SERVICES %	MANAGEMENT SERVICES %
UNSKILLED			
Clerical and Key Entry	21 %	14 %	--
SKILLED	22 %	4 %	--
Machine Operators			
HIGHLY SKILLED	20 %	11 %	--
Sales Office Administration			
TECHNICALLY SKILLED	30 %	62 %	75 %
Systems Analysts and Programmers			
Analyst Consultants			
ENTREPRENEUR SKILLED	7 %	9 %	25 %
Management			
Advisory Consultants			
TOTAL	100 %	100 %	100 %

BACKGROUND TABLE TO TABLE 20

RELATIVE SKILLS PROFILE OF CBSI SEGMENTS

NOTE: % BASED ON TABLE 19
TS&A STATISTICS

YEAR	LEVEL OF DEMAND TOTAL SALES REVENUE IN MILLIONS	NUMBER OF CBSI EMPLOYEES
1971	$ 133	7,500
1972	155	7,900
1973	180	8,500
1974	210	9,200
1975	250	10,000
1976	290	10,700
1977	330	11,300
1978	380	11,900
1979	440	12,400
1980	510	12,800
1981	580	13,300
1982	650	13,800
1983	730	14,400
1984	800	15,000
1985	850	15,600

BACKGROUND TABLE TO FIGURE 23

ESTIMATED RELATIONSHIP OF EMPLOYMENT TO LEVEL OF DEMAND

SOURCE: Branching Out, Reference 3, Page 98)

APPENDIX H

GLOSSARY

GLOSSARY

1. Application Compilers are programs that generate other application processing systems and programs from specifications chosen by the user. Terminals used in an interactive mode will likely be used to interface with the compilers in designing these applications.

2. Application Software is the collection of programs that are used to process specific applications. It includes custom and non-custom software.

3. CPU or central processing unit of a computer system provides the calculation capability.

4. COBOL or Common Business Oriented Language is a high level language used primarily for commercial applications.

5. Computer Output Microfilm (COM) is printing information directly from the computer on microfilm. Speeds up to forty times faster than printing on paper are achieved along with lower costs. Access to the information is made by microfilm viewers.

6. Computer Services, see page

7. Computer Utility, see page

8. Data Base Inquiry Processing, see page

9. Data Base Management Software provides a structure, an access method, and a maintenance facility, for computer data files. Using this technique data banks can be developed independent of the programs using the data. Thus, changes can be made to data files or programs without the need to change the other. This substantially reduces the "maintenance" programming costs involved in making changes or improvements to existing systems.

10. Data Processing Consortia, see page

11. Digital Data Communications is transmission where the data is "digital" rather than converted to analogue signals as used in present voice transmission lines. The advantages are in increased transmission speeds, improved quality and reduced cost.

12. Direct Access Storage or disk or drum storage permits the retrieval or writing of data in a direct or random sequence. Access of data stored on magnetic tape is termed sequential.

13. Distributive Data Entry discribes the capture of computer input data at the source or creation of that data. Terminals or optical character readers are usually involved in entering the data directly into computer files.

14. Executive Programming Software refers to higher level programming languages than COBOL or Fortran. They facilitate computer use by people not as highly trained in computer programming, and they usually provide capabilities to provide "one time" or report "queries" to be made easily and quickly into data files.

15. Facilities Management F.M. are contracted services which provide Data Processing facilities and services to companies. In most cases management of the computer operations is provided, often programming and systems services are included.

16. Families of Computers is a term that describes a series of computer systems manufactured by one supplier that share the same internal "architecture". This standardizing allows greater degrees of compatibility; that is, programs written for one member of the family can be easily processed on another member of the family. These families of computing protect the user's programming investment when growth in data processing volumes required larger computer systems.

17. Ferrite Core Storage used tiny donut-shaped iron pieces that could be individually magnetized and sensed. Each core represented either an "on-off" or a "0 - 1" binary representation.

18. File Management Systems, see Data Base Management Software

19. Fortran, or FORmula TRANslation, is a high level language. It is used primarily in scientific applications.

20. Hardware refers to the physical circuits and devices which perform the calculation, manipulation, display or storage of data.

21. Input/Output Services, see page

22. Intelligent Terminals, see Large Scale Integration below.

23. Inter-active Mode of processing requires user responses from a terminal during the processing of the application.

24. Large Scale Integration (LSI) is generally accepted as the fourth generation of computer circuitry. It provides a further order of magnitude reduction in size and cost of circuitry. Present computing capabilities of medium-sized computers can now be reduced to the size of one LSI circuit board. The inclusion of this computing capability on terminals will provide "intelligent" terminals capable of computing and communicating at comparitively low costs.

25. Local Batch Processing, see page

26. Management Science is the collection of techniques used to solve complex management problems. They include, among others, optimizing packages such as linear programming, continuous or discrete simulation programming, forecsting algorithms, and decision analysis techniques.

27. Mini-Computers are small computers that have substantial computing capability. Their rental is usually less than $1000 per month. Initially, they were used in scientific applications where dedicated computing was required. Their installation in commercial applications is growing as applications software support becomes available.

28. Multi-Programming is a technique that better utilizes the high speed of the CPU. The multiprogramming software allows more than one program to reside or share the main memory and switches the computing capability among resident programs at electronic speeds.

29. Non-Custom Software, see page

30. On-line Program Development is where the programmer writes and tests computer programs from a terminal. Due to the ease of making changes and availability of test time and test procedures, programmer productivity is greatly increased (up to 600%).

31. Optical Character Recognition (O.C.R.) is the term used to describe the technique of reading printed or handwritten characters as direct input into the computer.

32. Packaged Software, see page

33. Packet Switching is a form of digital data communications where information is organized in packages each with the receiver's address. These packages are then "switched" by a computer to the proper destination. It is roughly analogeous to the Post Office system where letters are dropped in a mail box and are "switched" or sorted and delivered to the proper destination. "packet switching" has the advantage of its cost being based on the number of packets sent rather than on the distance transmitted.

34. Point of Transaction Data Entry, see Distributive Data Entry

35. Raw Power, see page

36. Remote Access-Immediate Response Processing, see page

37. Remote Batch Processing, see page

38. Software refers to the collection of programs that enable the use of computers. Hardware or the computer itself can be visualized as "dead". It is brought to "life" by the programs or software.

39. Third Party Leasing describes the financial service of outright purchase of computer systems and the subsequent re-leasing of these systems to users, usually on a long term lease (1 to 8 years). Because the finance companies are amortizing their investment over a longer time period than are hardwar manufacturers, they can offer substantial "discounts" in rental prices. The long term leases have tended to stabilize the tendency to install the latest computer systems as soon as they are available.

40. Time-Sharing, see page

41. Transaction Processing, see page

42. Video Display Terminals usually combine a keyboard for data entry with a television-like screen for display of printed output.

43, Virtual Memory is a hardware feature that provides the allusion of very large amounts of main computer memory (16,000,000 positions) even thought the computer itself is aonly equipped with a relatively small amount of actual main memory (say 128,000 positions). The programmer can plan and develop programs up to the limits of the "virtual" memory without real concern for the actual memory size.

A REVIEW OF THE CANADIAN COMPUTER BASED SERVICES INDUSTRY.