MANAGING INFORMATION TECHNOLOGY:
A CORPORATE INFORMATION SYSTEMS STRATEGY
FOR THE CITY OF WINNIPEG

by

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ABSTRACT

This study examines the issues involved in managing information technology in local government, using the City of Winnipeg as its central focus. The objective of the study is to develop a number of policy recommendations for the City's corporate information systems strategy. Two of the major issues facing the City are the fast pace of information technology change and end-user computing. These issues are highlighted by examining the organizational impact of microcomputers, which forms the principal focus of the thesis. In addition, current literature on managing information technology, data integration, and centralized versus decentralized computing are also examined. The policies of other municipal jurisdictions, as well as the current policies of the City of Winnipeg, either stated explicitly in documents, or implied through action, are investigated. This study concludes by recommending a policy of distributed data processing and a stronger departmental role in managing information technology.

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CHAPTER 1.
INTRODUCTION

This study examines the issues involved in managing information technology in local governments. The study focuses on the City of Winnipeg, and the problems it has encountered as a result of changes in information technology. The City's current information technology policies and direction will also be examined and commented on in relation to the information technology issues. The objective of this thesis is to develop a corporate information systems strategy for the City of Winnipeg. This strategy will be presented in the form of policy and organizational change recommendations for the City of Winnipeg to realize the new information technology opportunities. Information technology includes the computer hardware (machines and peripheral equipment such as printers), and software (computer programs) used to support computer-based information processing.

RESEARCH METHODOLOGY

The following summarizes the key information sources which were used in the development of this thesis:

1. Literature Review: The literature dealing with the impacts of microcomputers on organizations, distributed data processing, information management, and organization change resulting from new technology was reviewed. This information covered both the public and private sectors, although the emphasis was on the public sector and the issues which are common to both.

2. Existing Policy: The existing computer policy and long range computer strategy for the City of Winnipeg was examined. This

included explicit policy stated in documents and implicit policy based on actions and events. An examination of information management policy in a limited number of other municipal jurisdictions was also conducted for a comparative basis.

3. Specific Interviews: Interviews were conducted with key personnel in both the computer department and user departments to solicit their views on a corporate information management policies. Departments were selected based on their experience with information processing.

4. Personal Involvement: Information for this study was also based on my personal experience gained from working for a "user department" - Environmental Planning - developing microcomputer systems and dealing with the Computer Services Department. My current employment with the Computer Services Department has also provided an insight into the issues of managing information technology from a "central service department."

CITY OF WINNIPEG - BACKGROUND INFORMATION

The population of the City of Winnipeg at present stands at about 600,000. In 1972 the City of Winnipeg Act established the present structure of the City of Winnipeg by combining a number of surrounding municipalities with the former City of Winnipeg, and the Metropolitan Corporation of Greater Winnipeg into a unified City of Winnipeg.

The City of Winnipeg Act provides that the powers of the City shall be exercised by Council and further provides that Council may delegate its powers and duties to the Executive Policy Committee or any Standing Committee established by Council. The administration of the City is delegated to the Board of Commissioners. The Executive Policy Committee gives direction to the Board of Commissioners on policies relating to the civic personnel which include changes in the civic establishment.

The Board of Commissioners consists of five administrative divisions headed by a Commissioners. Each division consists of the following departments:

1. The Chief Commissioner's Division
   a. Budget Bureau
   b. City Clerk's Department
   c. Law Department

2. Finance and Administration
   a. Assessment Department
   b. Civic Properties Department
   c. Computer Services Department
   d. Finance Department
   e. Land Surveys and Real Estate Department
   f. Personnel Department
   g. Purchasing Department

3. Planning and Community Services Division
   a. Environmental Planning Department
   b. Health Department
   c. Library Department
   d. Social Services Department

4. Protection, Parks and Culture Division
   a. Ambulance Services Department
   b. Fire Department
   c. Parks and Recreation Department
   d. Police Department

5. Works and Operations Division
   a. Hydro Electric Department
   b. Operations Department
   c. Streets and Transportation Department
   d. Transit Department
   e. Waterworks Waste and Disposal Department

As the focus of this thesis is on managing information technology, the only City department which is of particular interest is the Computer Services Department. This study will focus on the policy direction or actions of the Computer Services Department and the Board of Commissioers, which sets official City direction, in relation to managing information technology. The Computer Services Department's mandate is to "develop, coordinate, maintain and control computer systems and maintain data bases for the City as well as provide microcomputer facilities and appropriate office automation and data communication environment." (1)

The Computer Services Department is divided into four main branches: Application Development and Support, Operations, Technical Services, and Corporate Data Resources.

Two of the major issues facing the City of Winnipeg regarding the management of information technology are the fast pace of information technology change and end-user computing expectations. These two issues are discussed in more detail in the following sections to provide some background to the current issues facing the City of Winnipeg in this field.

CHANGES IN INFORMATION TECHNOLOGY

Information technology started as punched card tabulators and sorters in the mid 1950's and evolved into the first primitive computers in the early 1960s. As technology advanced, more sophisticated computers were developed and used in local government for large financial based systems such as tax collection and payroll processing. Computers were used in local governments to either reduce costs or undertake new activities which could not otherwise be accomplished. "This technological evolution transformed public administration that had, over time, become a collection of geographically and functionally dispersed, manually supported activities, into operations that had, as their main support, remote centralized monolithic computing operations." (2)

The early large mainframe computers, which required a team of experts to operate, occupied a large climate controlled area, and were very costly to purchase and operate. These factors combined with the desire for efficiency required that a centralized information management authority be established and located where the information was processed. This authority was typically located in the finance department, as the early computer systems were based around financial transactions. Eventually, the computer operation was split into an independent unit reporting to the chief executive officer.

The City of Winnipeg's historical computer development is similar to this scenario. The City acquired its first large computer in 1956, which was managed in the Accounting Branch of the Finance Department. The Computer Services Department became a separate department in 1972. At this time staff was combined with other computer operations resulting from the combination of a number of municipal jurisdictions. The Computer Services Department was not assigned to report to the Chief Commissioner (the chief executive officer) until 1978. However, in 1987, the reporting relationship of Computer Services Department was changed to the Commissioner of Finance.

Winnipeg's computing experience and its strong reliance on mainframe computers is not unique. Other local governments have followed a similar computer processing development:

> Large computer mainframes have predominated in computing use by local government since the first computers were introduced in the early 1950s and, despite the introduction of small less expensive computers, they will continue to figure high on the agenda of computing decision making throughout much of the 1980s. This is because the purchase of a mainframe is still costly and usually represents a major decision affecting the near future of the computing activity. (3)

During the late 1970's and early 1980's, research in miniaturization and large-scale circuit integration led to the development of electronic chips and microcircuitry. These two developments, combined with improvements in telecommunications led to the introduction of mini and microcomputers which have the capability of being "networked" together to exchange data and share software. The development of microcomputers has resulted in fundamental changes in the way computers and information are used in local government. This development of inexpensive, small computers has enabled the distribution of computing power to City departments, which can provide a number of their local computer requirements economically without relying on computer resourses located centrally in the Computer Services Department. The development of microcomputers has opened up new opportunities for information processing and automating office functions (i.e. word processing), which because of

their scale, were not economical on the central mainframe computer. Recent advances in data communications have enabled these distributed microcomputers to not only be connected to each other in "local area networks" (LANS), but also to communicate with the central mainframe computer.

Minicomputers are also starting to play a large role in local government information processing and communications by serving as intermediaries in communication networks. When first developed, minicomputers were only used as "stand alone" smaller versions of mainframe computers. However, in the City of Winnipeg's case, minicomputers have not typically been purchased for stand alone departmental systems, partly due to their cost, but mainly because the City's direction has been to consolidate computing on the mainframe computer in a single centralized computing installation. However, some minicomputers have been purchased for specialized departmental functions such as Police Computer Aided Dispatching (CAD) and Transit's Telebus system.

One positive condition in the information processing industry is the continued reduction in the cost, and increase in speed of both computers and storage devices. "These decreasing unit costs are remarkable in an economy in which virtually every other sector is experiencing only cost escalations." (4) This increased capability and cost reduction has fueled the demand for computer applications on the different ranges of computers - micro, mini or mainframe. Other computer developments are also fueling the demand: user-friendly fourth generation programs (software), devices for sophisticated information storage and retrieval (such as laser disks), and image and voice handling capabilities. Traditional information processing (data processing) is also undergoing its own rapidly developing technology as indicated by its merger with communications, text, and graphics processing technologies.

Because the information technology is changing rapidly, it is difficult for the Computer Services Department to keep up with the knowledge required to manage it, while at the same time responding to

pressures for system development. It is also difficult to plan for new system implementation and second guess what technology platform to use.

> Today, managers may start a project on a mainframe; part way through the technology and economics change they start looking for distributed mini-computers. Within one or two years or even a few months, they can look at networked microcomputers or supermicros to do the same job they originally would have to do on the mainframe. (5)

Sometimes the opportunities of new information technology are overlooked because of resistance to change among computer systems personnel, who prefer to develop systems on the mainframe computer where they are comfortable with the technology. In addition, opportunities could also be overlooked because of senior management's ignorance of information technology and its potential uses. (6) However, even if new information technology is applied as rapidly as it is developed, the problems do not disappear. As the use of information technology increases in organizations, problems with the technology and its impacts also increase. "Local governments with the most advanced uses and the most comprehensive policies for managing information technology generally have greater payoffs from their system, but they also have the most problems with and from these uses." (7)

The one area of information technology which has potentially had the greatest impact on information processing, and end-user computing in the City of Winnipeg is the microcomputer. The use of microcomputers is relatively new in the City of Winnipeg and policies for its use are still evolving. Microcomputers have had a significant impact on departmental storage and processing of information, which until recently was restricted entirely to mainframes. One of the major issues in the management of microcomputers is the scope of the systems that are being developed. Microcomputers have the advantage of being independent of the mainframe computer and the weakness of lacking access to central corporate data. For example, if many departments need access to a system or the information contained in the computer, the microcomputer is not the best information technology tool to use. This issue of information

access and user independence creates problems of control and management of the systems which are developed on microcomputers. Management has to make some difficult choices and establish rules for corporate systems. The introduction of microcomputers in the City of Winnipeg is not as simple as purchasing the equipment and letting users develop systems.

> The problem is that we have no rules to follow which can tell us how to build and link the right systems. We are coming to realize that the answers lie not in the imposition of ever more highly technological solutions but in an intelligent application of available technology to the process of government, which will permit the optimum movement of data within a network of public administration systems. Our current organizations to manage this change are probably not adequate. (8)

END-USER COMPUTING

The development of "end-user computing", which enables users to develop their own applications independent from the central computing department, has had a significant impact on the traditional "specialist" development of computer systems. Several factors have led to the development of end-user computing.

Prior to the 1970's the use of computers was reserved for the "computer specialists" who developed computer applications more or less in isolation from the "users". Contact with the computer was also restricted by the input medium of the day - punch cards. At the end of the 1970s, with the initial distribution of so-called "dumb" terminals, users could gain access to centrally located information. However, because the forerunners of today's user-friendly languages were not available, the users had to learn complex commands to perform even the simplest functions. When problems were encountered, or when complex inquiries were required, users had to rely upon the central computing department. By the early 1980s many user-friendly mainframe languages were developed to allow users easier access their data.

The most significant developments towards end-user computing also occurred in the early 1980s with the development of the microcomputer.

End-user computing or personal computing emerged outside central computer departments, as users independently purchased their first low-cost hardware and software. The new microcomputer systems were easy to learn, and users did not have to rely upon the central computer department to develop computer applications. However, the lack of communications capability on the first microcomputers meant that users could not exchange data with other microcomputers, nor could they freely access and manipulate data on the organization's mainframe. (9) Recent developments in communication technology have rectified this initial shortcoming.

> The question whether the technology or the user has been the driving force arose early and often in the discussions. To this time it seems fair to say that the "technologists" along with the technology have been the driving force. In government, computers have in the main been applied to existing standard operations such as payroll, financial reports, social welfare payments, tax collection, research calculations and the support of weather forecasting. The operations were there to see and key persons familiar with them came also to have a familiarity with and a keen interest in computer technology, thus becoming technologists for purposes of this argument. They then devote their energies to convincing those in authority of the advantages, if not the utter necessity, of conversion to computers. (10)

Whether the user of the technology has been the driving force in development and implementation of information technology in the City is not important. What is important is a recognition that the industry has moved towards end-user computing because, "in the final analysis, it is the only strategy that will meet the growth in systems demand by end-users." (11) Some cities have already recognized this trend and have made the main feature of their overall information strategy the development and support of end-user computing. The City of Toronto, for example, has recognized the benefits of end-user computing and adopted policies to provide users with:

- the skills and knowledge to make effective use of the technology.
- an accessible hardware and software network.
- the means to manipulate and update their own data.
- the ability to access and work with corporate data. (12)

The impact of rapid developments in information technology combined with increases in user expectations and awareness brought on by end-user computing, indicate the need for a Corporate Information Systems Strategy for the City of Winnipeg. This strategy should address the impacts of changes in information technology and its application on the City's organization and information management direction (or lack thereof). Some of the specific developments which have had a significant impact on the City of Winnipeg are:

1. The development of the microcomputer, and its impacts on system development in departments which formerly required development by computer system experts;

2. The changes in business software such as "4th generation" and "user friendly" software both on the mainframe and microcomputer, which give more tools to non-data processing personnel.

3. The technology has created more options for computer processing and data access such as "distributed processing" where microcomputers and minicomputers can be used for local processing needs in a Department, as opposed to a centralized mainframe environment.

4. Users have become more knowledgeable in computer technology and are demanding more access to the technology.

5. Some departments have developed internal computer competence and resources with the capability to develop systems independent from the Computer Services Department.

End-user expectations are increasing as users gain more understanding of computers and information technology. This increase in end-user expectations without a City wide strategy and direction could lead to a number of problems. End-users expect early results from computer systems which puts pressure on the systems developers located

in the central computer department. (13) System developers are also facing pressures to reduce the cost of systems development, implementation and maintenance to satisfy the organization's demand for efficiency. This demand for new systems requires that an implementation and prioritization plan be developed for computer systems. This plan should also address the sharing and integration of information. The number of end-users will increase as more of the City's functions are automated, which will in turn increase the demand for more computer services. An additional problem which impacts on the ability of the computer department to respond to the increased user demand is that systems developers spend more and more time monitoring and controlling systems. "More time is needed for maintenance and, as the use of systems expands, many budgets come to have a major maintenance component that leaves little for new systems development - another squeeze to contend with." (14) A fundamental risk is not recognizing "end-user" concerns when developing new computer systems. This could result in the development of expensive systems which do not meet the needs of the organization.

> With the recognition of the value of the technology, and its integration into the workplace, the use of micros, minis, and time sharing terminals is growing rampantly, and the demand for data processing services is beyond the capacity of the available data processing resources. Not only is there a demand for more on-line services, there is also an increased demand for data sharing and integration of systems requiring more centralized control. Into this environment enters a more sophisticated but frustrated user, who wants more of the data processing services, wants improved access to information, but also wants more control of his or her data processing destiny. (15)

In addition to the internal pressures brought on by rapid developments in information technology and end-user computing, the City also faces external pressures. Like other government bodies, the City of Winnipeg is under heavy pressure to rationalize its services, reduce operating costs and increase the effectiveness and quality of the programs it delivers to the taxpayers. (16) The City will face even more constraints while trying to meet ever-escalating demands for service or demands for the same level of service, while also facing demands to keep tax increases at a minimum. In order for the City to

survive in this environment and keep services up and costs down it will require efficiency enhancements. The requirement for improved efficiency will inevitably have an impact on all parts of the City, including how it manages its information.

> It is clear that the public sector situation presents a scene where there is a great need for streamlined, efficient information management systems, the greater exploitation of automation and the enhanced ability to move with rapidly changing technology. Such a scene demands effective strategic systems planning. The main purpose of any strategic plan is to set the direction in which the organization wishes to go. Once this overriding direction is set, it becomes easier to assign priorities (and resources) to the organization's various tasks. (17)

THESIS OUTLINE

One of the principal focuses of this thesis is on the organizational impacts of microcomputers which have had the most influence on the recent direction of information technology. The introduction of microcomputers into civic departments represents the movement of information technology from one central mainframe computer in the Computer Services Department to a number of computers distributed throughout the City departments. With the movement of the computer hardware also comes the local development of computer systems and the end of the reliance upon the programmers in the Computer Services Department to develop systems. This technology transfer is also creating, or has the potential to create, a number of organizational problems within the departments. The distribution of information technology to departments raises issues such as the importance of corporate versus departmental data, and the necessity of central data processing. This distributed information technology also raises the issue of the need for central "corporate" information technology policies and control versus departmental independence.

This study goes beyond the impacts of microcomputer acquisition to examine some of the broader corporate information management issues associated with corporate data bases, and integrated systems. These issues are discussed in Chapter 2 to provide some background information

on the need for information management. These broad themes frequently reappear in subsequent chapters.

Chapter 3 provides background information on the advent of microcomputer technology. It also introduces the impacts of microcomputers on organizations. Some of the issues discussed in the chapter arise with respect to forms of information technology other than microcomputers. The introduction of microcomputers into a large number of City departments will probably bring the following issues to the surface:

1. The organizational impacts of technology such as staff changes, management's use of the technology, and the need for local control,

2. Human resource issues such as stress issues, staff reductions, training needs, and possible effects on classification and pay,

3. Union concerns and bargaining issues.

Chapter 4 discusses the problems of uncontrolled microcomputer proliferation and the need for City wide central control. This Chapter presents examples of problems encountered by a City Department in dealing with the introduction of microcomputers. In addition, the need for local management involvement, and their requirements to manage the information technology, specifically regarding the introduction of microcomputers are also discussed.

The distribution of information technology in the form of microcomputers to Civic departments has resulted in alternate data processing arrangements such as centralized versus decentralized processing and distributed processing (computer staff and equipment located in "user departments"). These alternatives are examined in Chapter 5.

Chapter 6 examines the City's existing information technology policies, such as the Long Range Plan for information systems development. In addition, the City's policy on corporate information and data integration, office automation and microcomputers, and the location of computer programming personnel are also reviewed.

Finally, recommendations for a corporate information systems strategy for the City of Winnipeg are presented in Chapter 7 based on the findings of the preceding chapters. Particular structures and processes for the management of information technology, it will be argued, should be part of a system-wide strategic plan for information management within the City. The case for a Corporate Information Systems Strategy will be presented.

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16. Alain Godbout, "The Assessment of Organizational Performance: the Experience of Office Automation and Bureaucracy", Optimum, Vol. 17. No. 1., Minister of Supply and Services Canada, 1986, p. 8.

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CHAPTER 2.

INFORMATION MANAGEMENT AND INTEGRATION

INFORMATION MANAGEMENT

DEFINITION OF INFORMATION MANAGEMENT

> Over the last several years, researchers and experts on local government computing have argued that two major reorientations should take place in development and use of computer technology. First, they have recommended that local governments integrate and standardize their data-processing activities in order to make it possible to use one or a few large data bases for all government data needs. Second, they have argued that data gathered for operational purposes also be formatted and processed in such a way that they are available for management purposes. In other words these experts have recommended that government data resources be consolidated and organized in such a way to serve both management and planning needs of the local government. This concept has come to be called "information management." (1)

Information management is the concept of managing information as an organizational asset and considering information as a resource similar to capital and personnel. Information management is not restricted to traditional data processing systems but also covers other information sources such as office automation systems and records management. The information management function is based on four guiding principles:

1. The integration of content - so that elements from any one database are available for appropriate combination and manipulation with data elements from other databases - internal and external; text and numeric; with hard and soft data.

2. The integration of technology - so that the machines and systems can "talk" to one another;

3. The segmentation of information - so that it is unnecessary to pick one's way through the universe of data; and

4. The filtering of information - so that the user can selectively access specific, relevant information. (2)

The objective behind information management is to make available to public administrators the information required for policy, management

and operational purposes even though the information may originate from different locations and different operational systems. Under the information management concept, a local government would define a data base that satisfies not only operational, but also management and policy information needs. The data flowing through the local government would be rationalized to provide for these information needs. The role of the central computer department would be to automate the appropriate data into a database, coordinate the operations that update the data, and ensure that users have computer capability that allows for retrieval of data. "This concept is simple in theory, but it has proven much more difficult to implement than anticipated due to the complexity of local government operations and their data requirements, the still-emerging state of the technology, and a lack of practical knowledge about how to build systems around the information management concept." (3) Governments are however, behind the private sector in implementation of the concept of information management.

> Some large private sector corporations, notably General Motors, often a progenitor of management concepts that are subsequently adopted by governments, have embarked upon the creation of corporate architectures that are intended to embrace all aspects of their information management. Each government is, in a sense, a corporation and it may be expected that at least large government will come to see the necessity for a corporate information architecture for cross-government electronic communication and access to central data bases. (4)

Information management techniques could potentially permit managers to get information more quickly and also to shape data files into new forms as needed. The old methods force managers to spend a considerable amount of time searching for and extracting data from a number of independent operationally designed computer systems and data files. By consolidating information from a variety of independent computer files, managers can essentially create new information which can provide solutions to problems or help in the coordination of department planning efforts. These tasks are presently impossible to accomplish. Information management and associated technology affect the cost of searching for information, by improving the generation and evaluation of alternatives,

as well as reducing the transaction costs of interdepartmental coordination. In this regard, information management improves efficiency and effectiveness of the organization by reducing the effects of "bounded rationality" of individual and group decision making. (5) "Bounded rationality", advanced by March and Simon, has been a major concept of organizational theory. This theory has been applied to the benefits of information management and technology:

> We propose that the construct of "bounded rationality" provides a major link between information technology and organizational design. Bounded rationality at the individual level refers to neurophysiological limitations to the information processing capacities (memory, computation and communication) of an individual. It is demonstrated in limits on the complexity and size of problems that can be solved by humans. Information technology can directly affect the computational and communication abilities of a decision-maker, thus shifting the limits of rationality. (6)

It is important to note that while information technology may stretch the analytical and decision-making capabilities of individuals and organizations there will never be complete information or full comprehensive analysis. In other words there will always be "bounded rationality."

NEW TECHNIQUES FOR MANAGING INFORMATION

The traditional techniques which have been used to design data processing systems are not suitable for designing systems intended to produce corporate information as their final product. The typical design of data processing or information systems begins with studies of the users and their requirements. These requirements are frequently gathered for the operational level of the organization and also conducted separately within each department. The systems which evolved automated the department(s) at the operational level (i.e. printing of tax and assessment notices). The information and analysis of data required by management (such as the impact on mill rates resulting from changes in assessment policy) are not defined as requirements, and therefore, not built into the computer system.

> The analysis of organizational structures and systems is based on the conceptual division of three basic position types, clerical, professional and managerial. The typical diagram of an organizational structure is the pyramid, with managerial positions at the top, professional positions in the centre and clerical (or operational) positions at the bottom. Considering the pyramid configuration of the organization, the relative expenditures for office equipment indicate that the majority of the equipment installed in organizations is for the support of operational systems. (7)

The different eras of information system development reflect the progression that has occurred in the philosophy of the information processing profession. The previous discussion focused on the problems resulting from Era I, which reflect the majority of computer systems existing in the City of Winnipeg. The following are the eras which have been defined:

> ERA I - Automation of the Back Office. Traditional forms of automation are used to improve clerical efficiency of transaction processing. The goal is the displacement of current clerical costs.
>
> ERA II: - Professional Productivity Enhancement. Management Information Systems and Decision Support Systems are used to increase the efficiency of professionals and middle managers in performing tasks and managing resource allocation. The goal is cost avoidance and increased managerial effectiveness in internal administration.
>
> ERA III: - Information Systems as a Strategic Resource. Information systems are extended to provide support to all levels of the organization, including direct support of constituencies outside the administrative structure. The goal is to provide more effective support of overall municipal infrastructure, broadly defined. (8)

The City of Winnipeg needs to recognize that the needs of the organization have changed from traditional computer management, as reflected in Eras I and II, to "data resource management" or information management, in Era III, which recognizes information as a strategic resource.

CORPORATE VERSUS DEPARTMENTAL INFORMATION

All City of Winnipeg information does not need to be defined as a corporate resource and managed centrally. Some information will be used

strictly for the purpose of running a department, and not required outside of the department. Within a department, there are essentially three sources of information:

1. data a department obtains from another department which is in a better position to collect the data from the environment;

2. data a department collects from the environment for use by its own staff and other authorized departments;

3. data a department collects from the environment for strictly private use. (9)

The third type of data which is intended for strictly private use could be maintained on a departmental system and does not need to be made available city wide. Whereas, the first and second data types should be defined as corporate data and managed accordingly.

> Probably the most important factor is the balancing of departmental systems and corporate data and systems. Departmental systems are systems that serve the needs of a single department, and involve limited sharing of data between systems such as cost systems, facility management systems, etc. Corporate data systems are systems that are for corporate use, or more importantly use or create data that is used by a number of departments, such as land related information systems, financial systems, human resource systems and material management systems. The more a department is corporate oriented, or deals with corporate data, the more central coordination is required. (10)

In order for the City of Winnipeg to succeed in implementing information management, it must first identify the corporate information resources and then adopt the information technology which will bring the information together through systems integration efforts, database management, or communications. A corporate information resource direction is similar to any corporate decision on capital expenditures. There is a need for clear strategies for long range system planning and investment, as opposed to short term ad hoc decisions.

The following quotation from the City of Calgary illustrates the central management and coordination of corporate information using geographic information as an example:

> All civic data, including geographic information, is considered a corporate resource, and as such, is centrally managed. The Geoprocessing Services Group within the Data Processing Services Department serves as the corporate resource and coordination unit for computer mapping. Projects are designed in this area, with individual departments and users assuming the responsibility for the input, maintenance and integrity of departmental design files and non-graphic data. This centralized coordination ensures the minimization of duplication of effort and the realization of the system benefits and increased efficiency. As the trend to decentralized data input continues to develop, and the number of departments willing to participate in the computer mapping and geoprocessing project continues to increase, the need for centralized coordination becomes imperative. (11)

DATA BASE TECHNOLOGIES

Early data processing methods in the City of Winnipeg led to the creation of non-standard data files to support each individual application. The City now has many files containing different (and sometimes the same) data, stored in different locations and frequently not in an easily accessible form. Even though a great majority of the City's data exists on computer, there is not a central database repository of this information. This makes it difficult to combine this information for management and planning purposes.

The ever-increasing quantity of information, combined with its growing use in the City, emphasizes the need for the City to view information itself as a corporate resource requiring a high level of management attention. (12) With the introduction of data base technology, an important shift in emphasis occurs from managing the computer to managing the City's data resources. The implementation of data base technologies could provide consistent access to this information as well as providing a solution to the high cost of producing new computer application programs, or modifying the City's existing ones. "The objective of data base technology is to accelerate computer application development, reduce application maintenance costs, and provide end users with the data they need for doing their job as efficiently as possible." (13) The adoption of database technologies for local governments is

already being achieved in some jurisdictions, like the City of Toronto for example, which has adopted the following policy:

> Adopt and implement Data Base Technologies as the future predominate data management method for the City of Toronto in recognition of the value of data as a Corporate resource.
>
> Implement clear, consistent and coherent policy concerning corporate data standards and information requirements. (14)

The City of Toronto has recognized that data items do not exist in isolation but are associated with one another. The City of Toronto plans to define data models, or the necessary linkages between data items. They also plan to use a data dictionary to list all data items, their definitions, how and when they are used, and who is responsible for them. (15) "These dictionaries are catalogues of the data collected, processed, stored and distributed by data processing departments; and they keep track of which systems and departments originate and use what data and information." (16)

Because information is a necessary and important ingredient in City corporate planning, decision support systems, and control activities, an Information Manager should be established within the Computer Services Department. This individual will be involved in defining information requirements with senior management and departmental information coordinators throughout the City. As the data in the information system would be stored in databases, using a database management system (DBMS), the functions of the Information Manager would also include the control of the Database Management System. The Information Manager position, because of its close association with the database management system, is often referred to as the Database (or Data) Administrator. The Data Administrator deals primarily with the City's data dictionary, which is the most important tool for managing the corporate data resources. There is also a need for other management and control functions because the information systems include people, procedures, techniques, and other resources for converting data into information for decision-making. (17)

The City of Toronto has recognized the need for a Data Base Administrator to manage the corporate data on the City's Database Management System. The City of Toronto recommended the establishment of a data management implementation team, which would include representatives from end user departments as well as the Computer Department, to manage the City's transition to a data base environment:

> A project team, headed by a Data Base Administrator (DBA), will define and model the City's corporate data in close consultation with end users. Agreement on common definitions and data structures needs to be established before the data can be put into a shared data base which can serve multiple users as effectively as possible. In addition, the implementation team will subsequently require data base designers and analysts to physically design the City's corporate data base. (18)

INTEGRATION

DEPARTMENTAL RESISTANCE TO INTEGRATION

The integration of existing (and future) computer systems and databases is the first step after recognizing that information should be treated as a corporate resource. Once a database management system is established, the existing computer systems and databases have to be integrated together so that information can be shared City wide. "Integration refers to the linking together of information processing systems and data bases so that many systems can use the same data base (or bases), and outputs of one system serve as inputs for others." (19)

However, there are a number of long established road blocks to integration of departmental computer systems and data into corporate systems. As the City grew and developed, and the organization grew, it was divided along functional lines into departments.

> Each department develops subgoals to which its members become committed. Skills and motivation are focused on those goals, and organization wide goals become secondary. Conflict often develops at the interface between departments. (20)

This conflict is evident as the staff of the different departments begin resisting each other's ideas, suggestions or requests for information. Department's start viewing their information as being strictly theirs to control and do not perceive it as a corporate resource to be shared City wide. "In an attempt to maintain as much freedom of action as possible, the department initially resisting the other evades the rules and procedures whenever it can and conceals as much information as it can." (21)

Departmental managers have to be convinced that through better coordination and information exchange, operations can be made more efficient to the benefit of all participants. In addition, the information technology tools available today, such as relational databases, can ensure the security of departmental data. Departments can share only the information which is not confidential, and protect the security of other information. In the past, because access was allowed to either the entire database (computer file) or none of it, departments concerned about confidential information typically opted to release none of the information.

INTEGRATING INFORMATION TECHNOLOGY

One of the major problems facing the ability to integrate data is the situation that information does not reside in one place or in a standard format. The proliferation of machines, protocols, software packages, raw data bases, and so on, makes integration difficult if not impossible. Even though the information is automated, and made available to users, it is difficult to combine. Users get frustrated with the complex technology and their inability to get at the information they know is there. (22) Because of these problems, it is important that the City of Winnipeg move towards unified management of all elements of information technology within the City. Traditionally, the three elements of information technology - data processing, telecommunications and office automation - have not been linked under a common control. "There was little reason why they should have been when

telecommunication was almost synonymous with voice communication by telephone and teletype and occasionally facsimile, when office automation was the typing pool tentatively trying the new word processor, and EDP was just the big machine in the special room with the whirling tape drives." (23)

The main issue has been the relationship between office automation and data processing. Office automation is focused on microcomputers, decentralization, and some communications to other computers. Data processing in the past has dealt mostly with large, centralized mainframe computers, and corporate data. Ultimately, these two information processing streams must be combined under one corporate direction to enable integrated information systems. "In terms of present control, surveys have shown that data processing personnel are generally in overall control with the comparatively smaller office automation staffs, where they exist at all, reporting to data processing departments." (24) This is the case with the City of Winnipeg, where an Information Centre section is responsible for "office automation" located within the Computer Services Department.

The location of the information, on either micro, mini or mainframe computer should not determine whether the information is individual, departmental or corporate. Ideally, all this information could be tied together through communications and distributed databases. An "architecture" could be established which would permit access to any level of information from a desktop workstation:

> Some observers envisage a general evolution in office automation toward an architecture that would have three tiers. The individual worker would have a work station that could provide personal computing functions including word processing, personal files, personal databases, personal administrative and communications capabilities. A second tier might be called the "office system" and would provide electronic mail, group filing, shared administrative support, shared communications and access to other shared features or devices. The third tier would tie into larger mainframe computers for corporate database access, large-scale computing and access to large communications networks. This architecture is

technological and bears no necessary relationship to vertical organizational hierarchies. (25)

DATA INTEGRATION PLANNING

The concept of data integration is becoming more common in the City of Winnipeg. A number of departments have requested, and are receiving where possible, information from other department's computer systems. However, major system integration has been focused on the functional areas of government rather than on the whole government. The Financial Reporting System, which is on the City's mainframe computer, and accessed by all departments, is an example of a system integrated through the whole government. This system ties together a number of accounting functions, purchasing and inventory control, and budgeting. Other systems, such as a City wide "human resources" system and a joint water and hydro customer billing system are in the planning stages. One integration problem has been caused by the fact that the majority of systems were developed at the functional or operational level to meet the specific requirements of Departments. Because there are no consistent standards in place, it is very difficult to integrate these departmental systems.

In order for the integration to be planned and properly implemented, there must be a single authority responsible for the integrity of the function. This role has typically been within the Computer Services Department, as this is where the majority of the computer systems are developed within the City. This integration has, however, been piecemeal with little overall planning and direction. Full City wide integration needs to be properly planned and studied. This study should examine the "business" functions and determine the City's requirements for integration across functions regardless of whether they are at present automated. Typically, this study might involve the following steps:

1. Examine the areas involved - identify the business needs and determine which are candidates for automation.

2. Describe the candidates - characterize each potential application, looking at both quantitative and qualitative aspects.

3. Isolate common and unique applications across function and division lines and determine whether any of these applications already exist within the company, such as on the mainframe computer. (26)

Having examined some of the broad, general issues of data management and integration in this Chapter, the next two chapters will examine the organization impacts of microcomputers, and their influence on the direction of information technology.

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CHAPTER 3.

THE IMPACTS OF MICROCOMPUTERS IN THE CITY

INTRODUCTION

The microcomputer or Personal Computer (PC), as it is sometimes called, has had a great impact on information technology in the City of Winnipeg. This technology has essentially brought the power of computers to the City's departments. Whereas prior to the introduction of microcomputers, departments had to rely solely upon the Computer Services Department for their computing and system development. With this distributed computing power comes the organizational problems associated with managing computer resources. Even though computer systems are developed on a microcomputer, they still have to be planned properly and the data stored on the computer has to be monitored for integrity. As the introduction of microcomputers into City departments is a first step towards distributed computer processing, some of the organizational issues discussed are applicable to the issues of "distributed computer processing" discussed in a later chapter.

This chapter will examine the issues associated with the introduction of microcomputers in the City of Winnipeg. A number of the issues which will be covered, such as union concerns, also apply to the impacts of information technology in general. This discussion starts with a brief overview of the history of the development of the microcomputer to illustrate the rapid development of this technology.

HISTORICAL DEVELOPMENT

> We are living through a second industrial revolution, propelled and shaped by the computer. This powerful new technology - particularly in the tiny, cheap form of the microchip - is transforming us from the mechanical age into the computer age. Just as the machines of the industrial revolution replaced manual labour and extended the power of muscles, so the computer is replacing - through automation - mechanical routine labour and extending the power of the brain. (1)

The current electronic revolution is building on a series of technological revolutions which started as early as the invention of electricity. Electricity was used to drive manual calculating machines - the forerunner of the computer - by using electromagnet relays. This technology was used by Herman Hollerith in 1890 to tabulate the American Census. The success of this machine, capable of reading punch cards, led to the formulation of the Computing Tabulating and Recording Company, which was later named International Business Machines (IBM). Electromagnet relay technology was replaced by vacuum tube machines which were originally developed to decode messages during the second world war.

The major technological breakthrough came in 1947 when Bell Laboratories developed the transistor to replace vacuum tubes as the switching mechanisms. The transistor consisted of layers of silicon combined with a semiconductor material to make it conduct electricity. This breakthrough overcame the physical size of the vacuum tube computers. Twelve years later in 1959, the integrated circuit was developed simultaneously by Texas Instruments and Fourchild Semiconductors. This development essentially "super miniaturized" the transistor on a piece of silicon. Initially, only a handful of logical gates (or transistors) were etched on the surface of one piece of silicon. However, by 1970, large scale integrated circuits were developed with thousands of components or logical gates per chip.

The production of large scale integrated circuits led to the development of the microprocessor in 1971 by Intel Corporation. Intel took a large scale integrated circuit (a chip with many switches on it) and interrelated those switched so that they could function in accordance with a series of predetermined patterns. This first Intel chip (the 4040) could handle 46 instructions and perform 100,000 calculations per second. (2) In 1973, this chip was replaced with the Intel 8080 chip, which was a true computer on a chip capable of handling 75 instructions at 500,000 calculations per second. This chip was used in the development of the first home microcomputer called the MITS Altair which was available in kit form and advertised in the January 1975 edition of

Popular Science. In the same year, the first fully assembled home microcomputer was developed by Tandy Corporation (the TRS-80). The prototype for the famous Apple computer was developed one year later by two hobbyist in 1976. Its open architecture encouraged others to write and sell programs to run on the Apple computer. This was the beginning of the independent (or third-party) software business which later became a multi-million dollar industry.

Some businesses were early to recognize the benefits of microcomputers, however, the early machines were mostly used as home computers. The late entry of IBM in the production of microcomputers in 1981, marked the beginning of business viewing the microcomputer as a serious office machine. The impact of the IBM-PC was enormous. Overnight they became the industry standard, and by 1985 had captured over 75 percent of the microcomputer market (this has since fallen to less than 50 percent). Their impact was so great that competitors were forced to adopt the "IBM compatible" standard to sell machines.

The microcomputer market changed in 1987 with the introduction of IBM's new line of microcomputers - "the Personal Systems" (PS) line. These microcomputers, dubbed "the clone killers", represented IBM's attempt to regain control of the microcomputer market. These new systems offered a function called "multi-tasking" which had only been available on larger computers (mini's and mainframes). This function permited the users to run a number of applications simultaneously. In addition, the speed and "on-line" processing power have increased with these machines. The introduction of IBM's new proprietary operating system (OS/2) for these computers, threw the market place into turmoil, as this system is not compatible with other brands of microcomputers. Businesses are now faced with the difficult decision regarding which direction to take in establishing a standard microcomputer product line.

The early generations of computers started with 16 KB (thousand bytes or characters) of internal computer memory (called RAM for random access memory). This memory jumped to 64 KB, and then to 640 KB, now the

limit is reaching 2000 KB on some of the bigger machines. In addition the storage capabilities of these machines are also increasing. The early generations of microcomputers started with about 500 thousand bytes (KB) of "floppy disk" storage space available. The development of the "hard disk" increased this to 10 million bytes (MB). Microcomputers are now capable of accessing over 100 million bytes of storage. These capabilities were only available on large mainframe computers as recently as ten years ago. It is accepted that microcomputers will become even more powerful. "These machines may well be more powerful and versatile than many of today's minicomputers; they will certainly enable users to perform several different tasks at the same time (multitasking) and use much of the software now used in mainframe and minicomputer environments." (3)

The "microcomputer technology" actually represents a number of separate information technologies which encompass diverse elements such as keyboards, keypads, scanners, sensors, computers, disks, tapes, other memory devices, coaxial and optical fibers, networks, cathode ray and other displays, printers and copiers. (4) In addition to the "hardware" components, are a number of easy to use computer programs which have been developed for the microcomputer. The most popular microcomputer programs are:

Electronic spreadsheet - used to automate repetitive computations and display data the way a financially oriented individual normally looks at data...rows and columns with totals and subtotals.

Word processing - an extension of the typewriter; used to electronically type, edit, change sentences and reposition blocks of text.

Data base - used to organize, store and facilitate retrieval of large amounts of data; akin to an electronic filing cabinet.

Graphics - used to depict graphically numerical relationships: pie charts, bar and line graphs, and so on.

Communication - used to connect or link the microcomputer to another computer.

Accounting system - used to process business transactions: general ledger, accounts receivable, accounts payable, and so on.

Integrated - combinations of two or more of the programs described above. (5)

The widespread success of microcomputers can be attributed to the fact that these machines are "user-friendly." Individuals with no data processing background are able to use microcomputers with relatively little training. The "user-friendly" aspects of microcomputer are also being enhanced by devices designed to allow users access to the computer with minimal keyboard usage. Some of these "user-friendly" devices are:

Mouse: - a small box-shaped device, connected to a microcomputer via a cable (or tail) that allows a microcomputer user to move the cursor or data displayed on a monitor and make menu selections by moving the mouse across a flat surface and pressing one or more buttons.

Touch-sensitive screen: - technology that allows a microcomputer user to move the cursor or data and make menu selections by touching (pointing to) the appropriate place on the monitor screen.

Icons: - technology that enables a microcomputer user to perform certain functions by moving a cursor to a visual representation of that function... for example, moving the cursor to a picture of a wastebasket indicates the user wishes to delete or remove data. (6)

The microcomputer has evolved into a very powerful "desktop computer". The word microcomputer summarizes the technology, and the term "personal computer" emphasises the fact that these tools are for individual use. Just ten years ago a machine with similar computing power once occupied an entire room. Recently, the size and speed of available microcomputer hardware has improved to the point where the distinction among micro, minis and mainframes has become blurred. Many of the software packages coming on the market are conversions from mainframe software (e.g. SPSS is a recent convert). In addition, the merging of the microcomputer with communication capabilities have changed them from "stand alone" personal computers to "intelligent terminals" that can operate as a self contained computer or as a terminal linked to a remote computer.

Additional communication or networking capabilities called Local Area Networks (LANS) have made it possible for many micros to be linked together to share common data files or software. Local Area Networks consist of several microcomputers that are directly connected together and also share peripheral equipment, such as hard disks and printers. This networking capability has led to the development of software called "electronic mail", which promises to revolutionize the traditional office functions. Electronic mail is a "store and forward" messaging system that uses electronic mailboxes tied together using computer linkages. This software promises to eliminate a multitude of small memos, and reduce "telephone tag" (i.e. unanswered messages continuing in circles). It also features a calendar/appointment booking capability.

Developments in the area of data communications offer great potential for productivity gains using the microcomputer. It is becoming more common to link microcomputers with other micros, minis or mainframe computers. This enables the user to transfer (or download) large volumes of data from larger computers to microcomputers. This has eliminated the need to re-input data for microcomputer applications, which was common with the first generations of microcomputers not supporting communications. "Thus, in addition to bringing so-called "stand-alone" computer power to the office desktop, these small computers can be used in concert with more powerful computers to facilitate the efficient movement and distribution of information throughout the entire business organization." (7)

Recent developments and future prospects indicate that the microcomputer is becoming more powerful, capable of integrating a number of functions into one package and becoming more "user friendly." Some of the trends in microcomputer technology, which will have an impact on office procedures, are the development of the following computer software enhancements:

1) Artificial intelligence or expert systems: A true expert system (AI) is based on the knowledge of an expert and contains a program that can modify itself in response to

experience and can also tell the user the reasons for the answers it gives. (8)

2) Decision support systems: This is a combination of different functions such as interactive graphics, statistical modeling and communications utilizing a user friendly query language based on natural language. For example, a manager can query the computer with the question: find me all the customers with incomes over $25,000.

IMPACTS OF MICROCOMPUTERS

INITIAL BENEFITS OF MICROCOMPUTERS

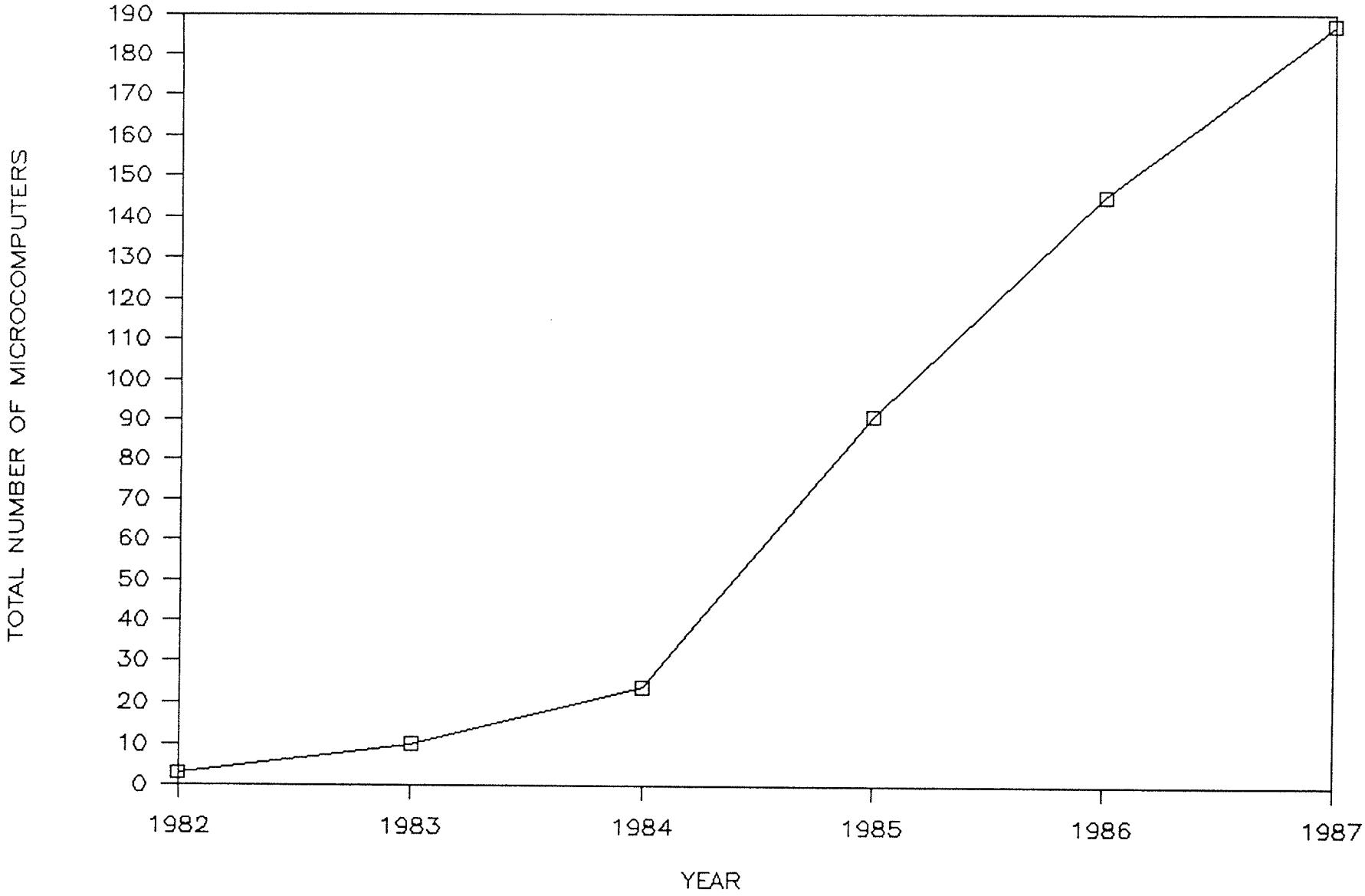
Corporate data was originally centralized within the mainframe computer which was managed by the Computer Services Department. The Computer Services Department was solely responsible for all systems development. The recent development of the microcomputer has created the potential for computer and system development decentralization.

> User departments can now obtain their own computing capability, in some cases without the knowledge of top management or the central data processing department, and in other cases by arguing that the cost is so low that the economic benefits in favor of centralization no longer apply. Widespread use of small computers can provide highly individualistic service to all the departments needing computing, allow users to establish and maintain autonomy in their operations using their own equipment, and provide hands-on opportunity to enjoy computing use while improving departmental productivity. (9)

Microcomputers or Personal Computers (PCs) first started to appear in civic offices in the early 1980's primarily outside the Computer Services Department. As of December 1987, the City of Winnipeg had 187 microcomputers installed in 22 Civic Departments. It is estimated that this has grown to well over 200 microcomputers (1988). A large number (67) of these were acquired in 1985 (see graph showing the growth in microcomputer acquisition). This increase in microcomputers in the City of Winnipeg has had and will continue to have an impact on the operation of the City and various departments.

CITY OF WINNIPEG

GROWTH IN MICROCOMPUTER ACQUISITION



Microcomputers provided departments with the opportunity to independently purchase their first low cost computer hardware and software. Part of their popularity was fueled by user frustrations with traditional mainframe computer operations. This frustration was compounded by large system development backlogs within Computer Services combined with a growing demand for new systems. The City's Long Range Plan for system development, developed in the early 1980's, identified a nine year waiting period for new computer systems. This waiting period was increased to 14 - 19 years for some systems when the Board of Commissioners requested that the annual expenditure estimated in the Long Range Plan be reduced. Users could not wait this length of time for their systems to be developed. Microcomputers were being used to fill a tremendous need not being met by the Computer Services Department.

A number of potential mainframe systems identified in the City's Long Range Plan were developed by users to run on microcomputers, and thus avoided the long waiting period for mainframe system development. Microcomputers were also ideal for small office systems, which because of their size were not appropriate for mainframe or mini data processing. The benefits that the City and departments were realizing resulting from microcomputer development over the traditional mainframe development are summarized in the following quotation:

1. Measures to boost productivity and cost savings are implemented more quickly than the traditional IS (Information Services or Computer Services) route in which users translate their needs to IS and wait years for their application to emerge from the backlog.

2. Users can tailor computer applications to their needs.

3. The quality of information throughout the company can improve as more people have access to corporate data bases as well as to each others PC based data and programs. (10)

Even with all the potential benefits and new office applications, the use of microcomputers in the City is still very new. Few departments have taken full advantage of the opportunities offered by office automation. In some departments, office automation is still widely

thought of only in terms of word processing. "Office automation has historically made its inroads into the organization through word processing, meaning that clerical staff have generally been the first to experience the new office technology." (11) Some departments are not aware that microcomputers can be used to simplify, replace, or improve on present office and business management functions. Most of the word processing tasks involve clerical and secretarial workers. However, the most beneficial applications are applied to the professional and managerial tasks. "This is where computers offer the greatest leverage for companies to gain a real competitive advantage." (12)

Microcomputers have the ability to increase both the efficiency and effectiveness of office operations. Efficiency is another term for productivity where the savings are realized by mechanizing or automating routine and structured tasks (such as word processing applications). Effectiveness, sometimes called "value added", enables people to do better work or allows them to do things that were previously impossible or impracticable.

> Value added benefits typically are significant in both size and relevance than administrative efficiency. Because managers and professionals represent the largest part of an organization's white collar wage bill, they provide the richest opportunities for productivity gains. (13)

DETERMINING THE BENEFITS OF MICROCOMPUTERS

The costs of information technology (i.e. microcomputers and peripherals) are easy to determine, but the benefits of acquiring this technology are difficult to predict as they are often qualitative. Assessing the benefits of office automation for justification is difficult, especially if the application supports professional work (planning, analysis, and communications) rather than clerical processes (word processing). "When an application produces no direct cost savings but, say, allows a financial planner to examine more alternatives, any cost based justification is inappropriate, yet a qualitative analysis is not grounded in economic terms." (14)

An additional problem associated with requiring users to estimate benefits is that usually, only the factors which are measurable are indicated. However, this may hide the more substantial benefits of automation. The benefits attributed to word processing serve as a good example of this. The real performance improvement attributed to word processing is not in the clerical staff, but in the work of the professionals and managers who originate the word processing textual material.

> Typically, word processing gives these text originators enormously valued capabilities such as seeing rough drafts in printed form, and the freedom to revise and polish their material without any need to be concerned about support staff time and effort. This time and effort is minimal once original entry has been done and this is clearly a benefit for support staff directly as well as for text originators. Revisions can continue to be made to within minutes of deadlines. (15)

A considerable amount of importance is placed on the ability to save time in clerical information tasks in the implementation of information systems. One of the reasons for this emphasis, is that it is easy to measure the inputs and outputs of the clerical tasks. Whereas the activities, which have the largest payback, are those which contribute to the quality of information, and thus allow individuals to make better decisions. Therefore, justification of microcomputers should not be based solely on reducing the time required to perform information processing tasks, but rather should include benefits which improve the quality of the information. The problem is that increases in information quality are not easily measurable through the traditional benefit methods. These benefits are typically classified as intangible benefits, although they may be the most important to the organization.

> Benefits are categorized as tangible and intangible. The former are those where a definite value can be established and the relationship between that value and the system is clear. On the other hand, intangible benefits are difficult to define and may have only a vague relationship to the system. (16)

Office automation can best be measured where office work most resembles factory work such as repetitive duties involved in some word processing applications. Increase in productivity brought on by word

processing applications is a tangible benefit which can be measured. Tangible benefits are usually divided into cost reduction and cost avoidance opportunities. Normally, tangible benefits are used to justify new computer systems as they are easily measured. However, intangible benefits, which are much more difficult to assess or quantify, usually provide the most significant improvement to the organization - examples are improved communication, better decision making, or enhanced appearance. Therefore, a decision to purchase software or hardware should emphasize the complete business justification, even of the intangible benefits. A combination of both tangible and intangible benefits could be used in an evaluation of a proposed microcomputer system by using the following benefit categories:

1. Work eliminated
2. Cost avoided
3. Return on time
4. Improved decision making
5. Improved services
6. Competitive edge
7. Quality of work life
8. Spin-offs (17)

Even using the categories described above does not solve the most basic problem that it is difficult to measure productivity in an office environment. "One can not simply count the number of widgets produced daily, or determine quality by simple observation." (18) The other problem is the fallacy that productivity is fundamentally changed with the introduction of office automation. Improvements in productivity will result only if the office automation system is properly implemented and used by properly trained people.

Potential increases in office productivity can be realized with the introduction of microcomputers into civic offices. However, if the organizational, human, and management issues are ignored, considerable turmoil will be created. Without an awareness of these issues and proper planning, office automation itself has the potential to create its own problems which may cancel the expected benefits.

> In light of the speed and degree of change in the field of microprocessor technology, it is not surprising that many local government officials and professionals simply feel overwhelmed. Yet the change exists, it is real, and it must be dealt with. Microcomputers and the information age are here, and ignoring these forces will not make them go away. Changes are occurring, and the man or woman who does not keep up will be left behind. (19)

ORGANIZATIONAL IMPACTS

ORGANIZATIONAL CHANGE

Organizations must realize that office automation will not only change the efficiency with which work is done, but will also change the nature and definition of work. The introduction of microcomputers has the greatest impact on the organization of the office. The introduction of new methodologies resulting from automation will shake up structural frameworks. Computers can change jobs and workers in fundamental ways, but these changes are difficult to predict and quantify. Changes in one person's job resulting from office automation can create a chain reaction by reducing jobs or changing the structure of work and information flows throughout the organization. "Changes might be felt in skill requirements; the nature and quality of social interaction; management style; the composition of the work force, and even in the products and services of the organization." (20) The successful application of information technology may require a change in the way a department conducts its business. This may include reorganizing program and branch structures, responsibilities and functions to create new work and information flows. In addition changes may also have to be made in staff deployments, office configurations and job descriptions. "Important changes in the fundamental nature of work and the structure of organizations are needed, so that better use of information technology will become the backbone of corporations." (21)

Unfortunately, because the impact of computers as change catalysts is not recognized in some Departments, the opportunities for change are lost. Technology creates opportunities for doing new things in new ways. Therefore, the relationship between the microcomputer and job design has

to be considered. The changes brought on by office automation have to be closely monitored as "proper job design begins with an understanding of the organization and the direction in which it is moving." (22) For example, a microcomputer system can be used as an opportunity to increase the skill variety of the job. However, it can also be used to decrease job skill and variety by creating positions that specialize in certain activities (e.g. changing from a personal secretary to a word processing operator).

An issue for management is to minimize the disruption that results when new technology is placed into an organization. This disruption results from changes in the flow of information and procedures which can also change the organizational structure. It is also associated with employee resistance resulting from any number of fears such as: job displacement anxieties, concern over doing old jobs in new ways, and fear of loss of identity with their work. Management must be as open as possible and help change people's perceptions of the situation. The main issues of the impacts of microcomputers on organizations are not technical but organizational:

> Technology does not have either a direct positive or a direct negative impact on worker well-being. Instead the results are seen as contingent upon the type of computer equipment selected and on the means of training and implementation. (23)

If the introduction of new technology is not managed carefully, there could be a negative result to office automation. Personnel are concerned that computers will yield jobs that are more routine, computer paced and monitored, and allow less flexibility and social contact. These concerns, which mainly relate to clerical jobs, have become a big issue facing unionized office workers. The unions are pressing for more input into the office automation implementation. The specific concerns of the City's largest union (over 6,000 members) - the Canadian Union of Public Employees (CUPE) - Local 500, which represents the interests of the office workers (except management and professional), will be discussed in detail later. However some of the general contract demands of CUPE are as follows:

1) advance notice of the introduction of new equipment;
2) some say in the selection and installation process;
3) a limit to hours spent working on terminals;
4) extra breaks during on-terminal hours;
5) job and pay protection; and
6) the option for pregnant women to refuse VDT work without loss of pay so long as the jury was out on emission hazards. (24)

One main concern is the use of computers for "electronic surveillance." This is where a supervisor monitors the employee working on a computer by measuring key strokes, errors or away time. An additional employee concern is the breaking up of a job into smaller components or specialization of job functions. This may happen where a secretary performing a variety of tasks is assigned to a "word processing pool" to strictly type documents. The productivity gains of job specialization may be eliminated by increases in turnover, low morale, resistance and absenteeism resulting from employee dissatisfaction.

STAFFING ISSUES

An organizational problem which may be encountered within the City is high turnover in occupations related to microcomputers. There could be an outflow of experienced staff to the private sector or other civic departments (who can offer a better salary). This problem could result in shortages of experienced personnel as departments try to convert to microcomputer systems. This problem is also compounded by City cut backs and restraint programs, which make it difficult to hire additional personnel. The need to retrain existing personnel is especially important because the loss of personnel means a loss of knowledge of particular computer systems. As turnovers occur there is not going to be a lot of knowledge remaining; existing or new staff will have to be taught how to use the computer systems. These possible personnel shortage problems indicate the need for proper "human resource planning."

> Human resource planning is the process of identifying and analyzing an organization's human resource needs under changing conditions and developing the strategies and actions necessary to satisfy these needs. An electronic office creates sufficient change to warrant an anticipatory approach to human resource management,

particularly in the areas of human resource availability, recruitment and training. (25)

The temptation to buy some new gadgets to put in the office just to see what happens should be avoided. The true costs associated with microcomputer systems such as training, software, peripherals, office infrastructure and maintenance must be considered. So called small projects can become out of control. Some of the specific issues to be aware of are:

1. The allocation of personnel and resources to work the new technology;
2. The specific front end cost of the initial phases of system development;
3. Data base changeover from manual to electronic media;
4. The assessment of ongoing costs to run computer systems; and
5. The selection of timetables for office automation implementation. (26)

MANAGEMENT'S USE OF INFORMATION TECHNOLOGY

Senior management has remained largely untouched by information technology and office automation. The senior managers and policy makers are mainly dependent on paper produced in traditional ways. The exception to this is their secretary's use of a word processor to produce their reports faster. "There has been a revolution in government information handling but its effect on the government pyramid had been confined almost exclusively to its lower layers, its operational programs and its financial, personnel and administrative services." (27) The reason for this disinterest at the senior level is that senior management often view the computer equipment as a replacement for a manual operation, for example, a word processor replaced a typewriter, a spread sheet computer program replaced a calculator. A senior manager may feel uncomfortable about a personal lack of understanding of the new information technology, and thus find it difficult to communicate with the "computer people".

> It is safe to say that the senior ranks of the public service are not yet comfortable with the informatics revolution. With somewhat less assurance one could speculate that they have less real interest in and knowledge of its capabilities than their counterparts in the private sector. For the latter, the application of informatics technology is likely to be a key element in restraining costs and maintaining a competitive position. The former consideration has less relevance for senior officials in government, and the latter not relevant at all. The senior managers of industry are faced with the need to improve productivity as matter of survival. (28)

The literature on office automation suggests, however, that there are advantages for the senior manager. Managers can access the organization's databases directly without having a dependence on staff for information and analysis. In addition, the tools available on the computer will enable the manager to perform data analysis without having to worry about the biases and preconceptions of staff. Electronic mail also offers the potential to speed up communication and therefore reduce the managers pressure on time. (29)

Despite the promised benefits, managers are still reluctant to use the information technology. Surveys have indicated that the use of information systems and office automation has been smallest with managers and executives. (30). A reason for this is that the majority of existing office automation systems are not as suitable for the nature of the manager's job than they are for jobs at the professional and support staff levels. Senior managers find it easier and quicker to call on an assistant or a secretary to get information, or to make an appointment, than to use the technology. Paper documents are preferred over documents stored on a computer screen, of which any over two pages in length are hard to read, impossible to scan quickly, or add comments in the margins. In addition, information in a computer is not transportable to meetings or even home for catch-up reading. "The executive will certainly not attempt to read a voluminous report on a visual display screen: that is just too inconvenient compared with a portable, bound report printed on paper." (31) Even electronic mail or messaging is foreign to a senior executive who prefers to use informal conversations and meetings to receive information.

The lack of time to learn to use the system and the reluctance of managers to use a keyboard, have also been suggested as reasons for the lack of managerial interest. At the management level, it is difficult to find even the initial investment of time necessary to learn the system. Despite the claims of systems being user friendly, the new information technology is not easy to learn for someone with no related training. Learning even the basics of operating a terminal or sending an electronic message, requires a considerable investment of time for training and practice. The other reason for the reluctance may be cultural:

> Keyboards are identified in the executive's mind with secretaries and accounting clerks. Just as real men do not eat quiche, real executives do not touch keyboards. To go further, it may be implicitly held by some that it is not a disadvantage to have to rely on others for the gathering and analysis of data; it is rather a prerogative of high office. To most senior executives, fingering a keyboard, would smack of manual labour. Informatics needs friendly users. (32)

At a minimum, senior management should acquire a basic knowledge about the machine's capabilities, in order to be able to set policies and guidelines for their use. Managers do not need to be experts to know about the available microcomputer features. They also do not have to be system analysts to be able to predict the impact of microcomputers on their organization. However, managers should know how their organizations function in order to understand the impacts of microcomputers on their organization and where they would be the most beneficial. It would be helpful, although not entirely necessary, for managers to develop an understanding of what a microcomputer can do. This would enable managers to have a better understanding when communicating with "technical experts" or negotiating with the Computer Services Department.

The lack of knowledge of senior management is capable of being overcome through education and training. However one roadblock to overcome is the City's lack of commitment to the continuing education of its senior executives. The next generation of senior managers will probably have a better knowledge of information technology. Although the issue will then be keeping this knowledge current.

> As an alternative one could wait until the present crop of executives, and possibly the next one as well, is succeeded by others who will come to these senior posts with real experience in the use of the equipment and thus free of the cultural aversion to it. The use of computers in universities and in many of the professions will produce such people in time. However in the interim, the current crop of senior executives have to face the problems of managing the introduction of the technology in their areas of responsibility and it is difficult to see how they can do that well without greater knowledge. (33)

LOCAL CONTROL

A lack of a departmental policy on microcomputers may lead to problems such as users being at the mercy of vendors or so-called "consultants", who are generally novices themselves. An additional problem is departmental microcomputer systems being created without any documentation or standards. In addition, because of the portability of the data storage media, it is easier to lose or destroy and security is a problem. (34) The lack of policy on information handling and microcomputer acquisition could also create a competitive environment among different divisions or branches in a civic department. There are a number of arguments against this "free-for-all" approach to the acquisition of microcomputers:

1. reinventing the wheel - spending valuable resources on developing systems already envisioned or partially developed elsewhere;

2. localized database development - creating pockets of information to such limited needs rather than common data banks accessible to the widest number of users;

3. parallel innovation - getting divergent results from separate approaches to the same problem, with attendant incompatibility and inconsistency between systems within a department; and

4. loss of decision making and policy setting power - as decentralized centres of information and knowledge are developed in response to specific problems. (35)

There should be an individual or group of individuals within a departments whose task is to coordinate the introduction of new technology as well as managing the computerization of information. This

concept has been expressed in the literature regarding the private sector: "The line organization should assign an individual project manager to be responsible for the use of microcomputers in the operating division." (36) "There is a need for "information middlemen" who are designed to improve the information workers capacity to deal with functional specialists in the administrative bureaucracies."(37)

An additional reason for appointing a local computer coordinator is to avoid the potential of two or more divisions competing with each other for "microcomputer supremacy" within a civic department. This infighting could be avoided with the appointment of an individual or group of individuals within the department whose task is to coordinate microcomputer purchases and system development. This local information coordinator would help a department avoid the problems associated with the proliferation of microcomputers by establishing standards for computer system design and documentation. In addition, training and education could be arranged on a departmental basis. The coordinator of the microcomputer/information systems section should have a direct reporting relationship to the department's director or senior manager. This would allow senior management to control and plan for the introduction of microcomputers in the department and approve system development based on the advise of the Coordinator. The development of departmental information systems expertise was beneficial to the Environmental Planning Department in a number of ways:

1) It provided independence from the Computer Services Department in terms of day-to-day management of jobs;

2) It provided more sound basis for evaluating systems development methods proposed by Computer Services; and

3) It facilitated the implementation of small utility systems which would have been impossible to consider if the Planning Department were forced to rely upon the Computer Services Department. (38)

Within the City of Winnipeg, the local information systems coordinator could also handle communication on technical matters with the Computer Services Department regarding mainframe systems and

microcomputer standards. With this approach the external data processing needs of a department could be better coordinated in addition to the internal data processing needs. This organizational structure also avoids the potential of a number of individuals in a department, all communicating with Computer Services without prior regard for departmental priorities.

Only a small number of City departments have recognized the need to appoint an individual or section responsible for microcomputers. This will be expanded upon in a latter chapter discussing distributed processing. Recommendations to create this position will also be discussed in the final chapter.

HUMAN IMPACTS

STRESS FACTORS

The human reaction to technological change is unpredictable. Resistance to change is possibly one of the biggest social problems in automating the office. Therefore, it is important to identify the human impacts before an investment is made in new technology. Productivity may be lost due to high employee absenteeism and turnover resulting from dull, stressful jobs.

> Studies have found the highest stress levels in clerical users of video terminals (VDT's) and the lowest levels in professional VDT users. Clerical users jobs are characterized by tasks that are repetitive, oversimplified and lacking control, status and participation. While professional users tasks are flexible and controllable, utilizing worker's education and provide satisfaction and pride with the end product. Clerical users perceive technology as taking the meaning out of work, raising their workload and increasing anxiety about being replaced by a machine. Professional workers view it as a tool to enhance the end product of their work. (39)

New office technology has created new opportunities in the collection of performance data for management. "Experience from pilot projects indicates that unions are quick to perceive machine generated performance data as a threat." (40) The issue is not the gathering of

performance data, but how this data is used by management. Management's attitude to the new technology's use in relation to employees, emphasizes that the new technology is not the culprit in worker management problems. The problems often relate to management philosophies and values regarding work and workers. This philosophy is being reflected in the implementation of technology.

STAFF REDUCTIONS

It is unlikely that microcomputers or office automation will result in significant staff reductions. Typically, increases in efficiency resulting in time savings are quickly absorbed by other tasks or projects. An additional reason why increases in productivity at the professional or managerial level do not necessarily lead to staff reductions is that most professionals and managers are accountable for goal achievements, not for the activities or behaviors which are used to effect those achievements. (41) On the other hand, research has indicated that the greatest performance gains from office information systems are in clerical jobs. These performance gains could result, under some circumstances, in a reduction in the number of clerical positions needed. However, most often office automation results in improvements in existing tasks, or the addition of new tasks, which does not translate into staff reductions. The strategy of attempting to use microcomputers to reduce the numbers of clerical personnel has not been very successful. The microcomputer and its corresponding capabilities create demands for new applications which could in turn create demands on the existing personnel. In addition, clerical and administrative labour may also have to be employed to deal with errors and inconsistencies in the data which is being automated. As government programs change, the "exception cases" will appear and require modification as the microcomputer systems fail to adjust to an ever increasing number of special conditions. The variety of "exceptions", and/or further demands for enhancements on the system will increase over time. Even a well designed system will invariably consume large quantities of expensive

labour in the form of maintenance personnel, who are required to ensure that the system continues to be beneficial to the organization.

However, there are differences of opinion on whether office automation will not result in staff reductions at both the clerical and managerial level:

> Over the past five years, however, there has been a shift. The new gloom and doom prophets foresee that an improvement in productivity due to office automation will be accompanied by some displacement of office support personnel. More drastically, an increase in the efficiency of knowledge manipulation through direct access to data banks, commonly held information, and powerful spread sheet software will reduce the need for middle managers. (42)

The City's "unwritten" policy direction is a reluctance to approve computer expenditures unless the costs can be justified with similar savings in costs, which usually come from staff reductions. As this strategy is not always very successful, the City will have to dispense with the "staff reduction" mentality in justifying microcomputers. Instead, the microcomputer should be used to increase the existing personnel's productivity.

> The promises of increased productivity, better quality workmanship and accurate information came as revelations to most managers. Automation offered the light at the end of the management cutback tunnel. It offered a survival kit to escape the dungeons of downsizing. (43)

Within the last few years, partially due to the poor economic situation, the introduction of new office technology into the public sector has helped to reduce the impacts of government cut backs while retaining the same level of service. Also the introduction of new technology has enabled government offices to keep up with demands for increased service without increasing staff. "It is nearly universally agreed that in the absence of information technologies, municipal employment would have had to expand in order just to keep up with increasing demands." (44)

Municipal governments have been facing financial pressures from a decade of inflation and tax limiting initiatives. In response to these pressures, local officials and administrators have concentrated on improving productivity as an alternative to reducing services. Local government managers and supervisors have been caught between the pressures of financial limitations and little or no increase in office productivity. More often the introduction of microcomputers is used to keep up with increased demand for better information to the public and politicians. In addition there is a demand to maintain existing service levels in light of employee losses through attrition from government restraint programs. Thus, using microcomputers to increase organizational productivity has become essential.

> A strategy of this sort can reveal opportunities for restructuring jobs so as to utilize employee capabilities in a new and better way, creating new career structures, and improve the quality of work life, as well as reduce costs. (45)

USER INVOLVEMENT

Adequate information and support to workers should be provided as part of the microcomputer acquisition strategy. If adequate worker support is not included the staff may turn against the new system and productivity will decrease instead of increase. This can be avoided by involving workers in application design decisions and in the changes that will occur in the organization and office procedures. Workers are also being consulted and notified of technological change through their Union, because of clauses negotiated in their contract regarding technological change (these issues will be addressed in the next section). Worker involvement is effective in overcoming resistance to change in that employees are involved in making decisions about their future. Additional benefits resulting from worker consultation include the prevention of design flaws, as workers involved in a procedure to be automated are usually the most familiar with its operation.

The involvement of the eventual computer system "user" has also gained acceptance in the Data Processing profession. One of the main

reasons for the increased involvement of users is the diffusion of computing into many aspect of work, which is mainly the result of microcomputers. This "end-user computing" has resulted in the development of a new type of computer person or "hybrids" who either possess strong computer skills and are literate about business applications, or the reverse. (46) In other words, professionals and managers in civic departments are doubling as programmers by using microcomputers to develop both personal and departmental applications.

> The reflection of user needs in systems, the participation of users in systems designs and implementation, and the effective communication between the users - the great unwashed - and the technologists - the high priests - is essential for the orderly progression of the informatics revolution. It may be that the microcomputer, the user friendliness of some of the more advanced technology, the increasing familiarity with informatics by the end users, and the new breed of users who had the opportunity to use computers at school are all lessening the technology gap and the gulf between what used to be two antagonistic solitudes. (47)

There has been a general shift in the computer industry as users become more involved in developing computer systems, either on their own using microcomputers or as project managers directing computer programmers. It has been predicted that most application development will eventually shift from central programming staff to the users of microcomputers. "As IBM points out, the number of trained systems professionals is shrinking, while the number of computer end users grow apace." (48)

Educated users with microcomputers could even facilitate the development of large mainframe computer systems. Departmental users could provide some of the initial parts of the application development process such as system definition and design by prototyping the application on their microcomputers. Packaged microcomputer software and development tools are available to make this possible. After the prototype is complete, the computer professionals in the Computer Services Department review and refine the user's work to ensure maximum efficiency and connectivity to other systems. End-user application development for either stand alone microcomputer applications or for

prototyping larger mainframe systems could provide a way to reduce the City's application backlog. In addition, the involvement of users either in the development of microcomputer or mainframe computer systems will not only help with reducing resistance to new technology by also eliminate the possibility of users changing the system specifications while the system is being developed.

TRAINING

> The impact of new technology creates a need for training and educating employees to utilize and operate the new equipment. There is no fail safe course of study that will equip everyone for the computerized work place of the future. But acquiring a general knowledge of and familiarity with computer based systems is a good starting point. (49)

Unfortunately, proper training is often an overlooked factor in the acquisition of microcomputers. However, training is probably the most important factor in ensuring that microcomputers are used properly. Even though formal training can be expensive, inadequate or nonexistent training is even more expensive. Employees lose productive time while training themselves ineffectively through trial and error. The other route often taken is to provide staff with on the job training from experienced users. This type of training is frequently application-specific and therefore does not provide the user with the flexibility needed to use the microcomputer for other applications. "The burden on more experienced users often becomes severe and most tedious, as more and more users ask to receive instruction from "the expert." (50)

Governments in general do not provide a great deal of training and education in information technology in comparison to the private sector:

> The lack of training for senior public servants was noted, not just in this field but in general. There has been an insufficient recognition of the uniqueness of the government service and its ever-growing significance. Government budgets for the training of their senior people were said to compare unfavorably with those of large and successful private sector companies. (51)

Although the above quotation is made in reference to the Federal Government, it is applicable to the City of Winnipeg. The City's computer training has fallen under the responsibility of the Computer Services Department. The Personnel Department, although possessing an "official" training branch and facilities, is not used for computer training. At one time, the Computer Services Department sponsored a mixture of "technical" microcomputer courses, focusing mainly on specific software packages. However, these courses have not been run for over a year due to staff changes. This has left departments to fend for themselves. In addition. there have not been any internal courses provided for senior management to introduce them to information technology.

The little training that does exist in information technology is a mixture of supplier-provided technology awareness and concept orientation courses for executive management, some specialized microcomputer courses, and some in-house technical training programs for operators of equipment. There does not appear to be a consistent stream of courses available to employees who would benefit from the training. Even when good courses are available, the attitude expressed most often by managers is that development training is a privilege and used as a reward, rather than as an investment in personnel development. "A large part of the problem is attitudinal; there is a fear that spending money on training and education may be viewed by the public as an expenditure on frivolous pursuits and hence difficult to justify." (52)

In the absence of good internal courses, there presently exists a variety of computer introduction courses provided by universities, community colleges and other institutions. Many of these courses are offered at night so that they are accessible to most office workers. Employees wishing to advance in the office should take computer courses even before the need to do so has been identified. Managers and supervisors should also be aware of the changes in job expectations and skill requirements needed for particular tasks, and where possible communicate these to their employees.

The City' s largest union (CUPE) is also concerned with the City's responsibility to retrain employees when microcomputers are introduced into the office:

> Because microelectronics is changing the skill requirements for many jobs, improved training programs will be needed to help workers who are no longer required or no longer qualified to perform jobs affected by this technology. Rather than displacing existing employees and hiring other employees who already possess the new skills, employees should be provided with the necessary training to allow them to operate the new equipment or perform the new method of work before additional staff is hired. (53)

This concern has merit when dealing with lower skilled computer data entry, word processing type jobs. However, highly technical skills such as system designing and computer programming cannot be economically taught to every employee, especially when universities and colleges are better equipped to teach computer courses. In many cases, the introduction of microcomputers necessitates job skills which are not anticipated. A new system may require new skills which go beyond the capabilities of the intended users and no amount of training will upgrade the skill potential of users; that requires long-term education or change of people. (54) The employee who already has these skills will have an advantage in advancing to a position created by the introduction of microcomputers. This would also reduce the necessity of employers to hire from outside the organization to fill more highly skilled computer related positions. The senior applicant from inside the organization may not possess the aptitude or desire to learn computer programming skills. If an attempt is made to teach this individual computer programming frustrations could result from management and the employee. An employee should prove his/her abilities by completing a recognized course in computer programming from a post-secondary learning institution.

Recommendations for a comprehensive training policy will be discussed later in the final chapter.

CLASSIFICATION SYSTEM

An additional human issue which is impacted by information technology is the classification system existing in local government organizations. "Classification provides a framework for the equitable management of human resources, through appropriate pay for appropriate work and a suitable scheme for the evolution of authority and delegation of responsibilities." (55) In order for classification systems to be successful, a climate of relative stability and consistent work interrelationships must exist. However, the existing job classification system is becoming severely strained due to the instability that has resulted from the introduction of microcomputers.

In the early stages of computerization, classification was a marginal issue as new jobs such as analysts, programmers, data capture clerks, and terminal and mainframe operators came into existence. The reason for the minimal disruption was that these new jobs were created within one department, namely Computer Services. Increasingly, however, new information technology, such as the microcomputer, has transformed existing work processes and job functions thereby creating entirely new jobs in departments throughout the City. Changes in information technology can either make existing jobs easier, or increase their complexity. The rigid classification system which exists in government cannot easily handle these changes to job functions.

> The question of appropriate remuneration, therefore, would be hard to handle within a rigid structure as the changes are too insidious to measure. Unless we can develop a classification system that can be open-ended and flexible, the end result, at least in the short term, could be industrial unrest. Unfortunately, open-endedness and flexibility are the very antithesis of current classification systems. (56)

The City's classification system has been constructed in such a way that the general office and data processing occupations have remained separate. "As technology converts the office typewriter into a multipurpose workstation capable of both word processing and data processing, the rationale for present classification groups will become increasingly

tenuous and may break down completely." (57) If this problem is not soon addressed, varying wage scales and contractual disparities may become a significant barrier to the introduction of microcomputer equipment. Existing job classifications may also constrain employee advancement resulting from new jobs created by microcomputers. The difficulties in the City's job classification system are due to the highly defined standards that exist. The continued use of the present classification groups may break down without the inclusion of data processing skills. "One option for resolving this potential classification problem and preserving the integrity of pay scales and reclassification system is to clearly define the responsibility that occurs to each job." (58)

If the job description or classification does not clearly indicate the "computer skills" required, in the advent of a vacancy in the position, the employer may be forced to fill the position with an employee who does not possess the necessary skills for the job. Most union positions within the City are filled based on the seniority of the applicant and their ability to meet the minimum requirements of the job description. Even if the job is filled with an existing employee who is adequate, other problems may occur. "Failure to reward staff for their contribution will predictably lead to a deterioration in cooperation and performance, union disputes, the loss of trained staff and failure to recruit competent staff." (59)

A solution to the current classification problem is that the City could develop more flexible job classifications, evaluation and pay scales which recognize the job skills and responsibilities required by changes in information technology.

UNION CONCERNS

OVERVIEW OF GENERAL CONCERNS

The uncertainty associated with technological change, combined with the lack of City policy (administrative and personnel) has resulted in unions pressing for greater participation in, and negotiation of techno-

logical change affecting their members. This is expressed in new plans involving retraining, alternative employment, notification of change, compensation, job security and other measures for those who may face dislocation as a result of technological change. (60) The use of microcomputers has raised many fears as a result of the uncertainties associated with the introduction of this new technology. The City's main union, the Canadian Union of Public Employees - Local 500 (CUPE) has raised the following concerns:

> Where microelectronics is being introduced into the work place, it is being done so in a way which:
> - reduces the skill content of many jobs
> - restricts advancement
> - creates a wide range of health problems
> - increases work related stress
> - threatens job security (61)

One of the union's main concerns is that of staff reductions and job security as a result of technological change. However, case studies within the public sector have illustrated that economic considerations, rather than new technology are the main reasons for civic staff reductions or cutbacks. The use of microcomputers on municipal employment was studied in three Ontario cities where it was found that the use of new technology did not result in any job losses or layoffs:

> In departments affected by automation, the number of employees first increased slightly, then leveled off and remained stable later, despite sometimes quite substantial increases in workload handled. Displacement rather than unemployment was the rule for municipal employees in the departments which adopted the new technologies. Redundant jobs were usually eliminated by attrition or lateral transfers of affected employees. Overtime was reduced, but no outright firings of permanent employees were reported. (62)

CUPE's concern is that machines should not be introduced simply to replace people lost due to cutbacks and employee reductions from attrition. The union's solution to reductions is to "negotiate shorter work weeks, longer vacations, more days off, better leaves of absence provisions and earlier voluntary retirement." All these measures would only serve to reduce or eliminate the productivity gains from the introduction of microcomputers.

HEALTH AND SAFETY ISSUES

An additional concern expressed by unions has been one of worker health related to the operation of Video Display Terminals (VDT's). Tests have proven that there is no radiation danger from VDT operation. The most significant concern is the stress resulting from poorly designed office equipment and settings which can result in eye strain, headaches, and backaches. The health concerns associated with VDT's will compound the problems already existing in offices such as badly designed furniture, poor lighting, excessive noise, and poor ventilation. Although scientists have stated that VDT's will not lead to deterioration of vision, they will however bring any existing problems to the surface. Often VDT operators are forced to sit in front of the terminals for long periods of time, thus resulting in eyestrain. VDT's can also cause physical problems related to bad "ergonomics" (the design of the work place for the person and the machine) planning of the office. (63) In addition to these "health" related risks, the amount of work and the pacing of the work can promote psychological stress in an operation. VDT clerks have the highest rate of stress due to their job perceptions - boring, unimaginative and out of their control. As a staff relations issue, stress factors have resulted in a trend toward limiting the number of hours an employee is obligated to use a VDT. It therefore appears likely that unless stress factors are overcome, through better equipment and job design, limitations on the use of VDT's may become a major labour relations issue. CUPE recommends that a period of no longer than four hours a day be taken up on VDT's in addition to a twenty minute break every hour in a place where employees can relax.

The City and CUPE do not have any specific clause in their agreement dealing with health and safety issues. However, in June 1984, the Board of Commissioners adopted a "Policy on Visual Display Terminals", which addresses health and safety issues. This policy is very extensive, and includes work schedules to be arranged which allow at least a 15 minute break for every two and one half hours continuously worked on a VDT, regular eye examinations of employees in positions which have

significant VDT components, and provisions to allow for reassignment of pregnant operators. In addition, management is required to involve the Employee Occupational Safety and Health Office at the planning stage of the introduction of VDT equipment. They will inspect the physical work environment for adequate space, illumination, excess noise, humidity, and the availability of adjustable chairs, document holders, foot rests, and sufficient work surface:

> In all cases where VDT equipment is introduced to a Civic workplace, the department(s) responsible for the installation will involve the E.O.S.H. Division in the planning phase and will seek an inspection from the E.O.S.H. Division prior to commencement of regular full operation of the VDT workplace. (64)

However, this policy is not being enforced or adhered to by many departments. Departments have enough trouble getting approval for the microcomputers without a further level of approval required by an outside agency. One of the problems is the lack of funding made available to departments to provide extra office equipment.

TECHNOLOGICAL CHANGE PROVISIONS

The City of Winnipeg's present technological change provisions with CUPE (local 500) are limited. Technological change is defined as changes in methods of operation which affect the conditions of employment, wage rates, or work loads. In the event of this "technological change", the City is to provide the Union with ninety (90) days notice. This is consistent with the Manitoba Labour Relations Act which requires a ninety day notice of technological change if a significant number of employees are affected. The City Union's clause also provides the following dismissal and training allowances:

> Insofar as it is practical and possible, no permanent employee shall be dismissed by the City because of mechanization or technological change provided he has availed himself of the City's retraining program as soon as such retraining is available. An employee who is displaced will be given the opportunity to fill other vacancies related to his skills and qualifications according to his seniority in the Department. No additional employees shall

be hired by the City on a permanent basis until those employees concerned are notified of the proposed changes and allowed a reasonable training period to acquire the necessary knowledge and skills required for retention of their employment. (65)

CUPE has proposed the inclusion of further technological change provisions in their collective agreements. For example a proposed amendment to CUPE - Local 500's definition of technological change, which was submitted in the 1984-85 contract negotiations, included the following:

a) the introduction of equipment, material or processes different in nature, type or quality from that previously utilized;

b) in work methods, organization, operations or processes affecting one or more employees;

c) in the location at which the work undertaken or business operates;

d) in the work, undertaking or business carried on by the City including any change in function performed and including the removal of any part of the work, undertaking or business. (66)

This definition, in effect, covers all aspects of the operation of an office and can include any technology change, minor or major. For example, a technological change such as a microcomputer, affecting the procedures of one employee would potentially have to be negotiated with the Union. Management would have to notify the Union ninety days before any purchase (or intended purchase) of a microcomputer. Presently, the purchase of a few microcomputers are not considered to affect a "significant" number of employees, and therefore notification to the Union is not required. The Union's request for advance notice of all types of change in an office could add considerable time delays to the implementation of this technology. The impact of this time delay has the potential to be greater if the Union's demands for one hundred and eighty (180) days notice before the introduction of technological change is accepted.

This time period dictating the government's ability to use the new equipment will be extended beyond the "advance notice period" if CUPE's

training demands are also considered. CUPE has requested that the City provide intensive training in order that employees may qualify for new jobs created as a result of technological change:

> Where new or greater skills are required than are already possessed by affected employees under the present methods of operation, such employees shall, at the expense of the City, be given a period of time not to exceed two (2) years during which they may perfect or acquire the skills necessary by the new methods of operation. (67)

CUPE wants this training to be provided during working hours, and the time devoted to training be considered as time worked. In addition, CUPE wants a guarantee that no new employees will be hired until the employees affected by the change are given the necessary training to fill the vacant positions. These training provisions, combined with the advance notice provisions essentially mean that in the extreme situations the employers cannot make use of their equipment until two and one half (2 1/2) years after they have made the decision to purchase.

As an alternative to the Union's training suggestion, the City of Winnipeg should provide some encouragement for employees to obtain the necessary skills at external learning institutions. The clause negotiated with the City of Guelph provides a good example of this type of encouragement:

> In the event that the Corporation should introduce new materials or machines which require new or greater skills which are presently possessed by an affected employee under the present methods of operation, on the job, or after hours training or study courses will be arranged where practicable, where the employee shows that he has the capability, experience and academic background to benefit from the above training or study course so as to be able to perform the new function in a competent manner after a reasonable training period. The Corporation shall reimburse the designated employee, only when he successfully concludes such required training or study course, for the cost of tuition and textbooks, but not for time which may be spent outside of normal working hours. (68)

Both labour and management are bound by what is contained in the collective agreement. Within the public sector, this is the basis from which all labour and management relations now proceed. Items not

identified in the collective agreement are left to the discretion of management. However, unions are starting to demand more say in the introduction of new technologies. Some of their concerns are justified, but some of these provisions may greatly reduce the benefits resulting from the introduction of microcomputers and remove the manager's ability to plan and control their implementation. Many of the Union's proposals for technological change have the potential of being accepted by government negotiators who may be unaware of their implications. These negotiators (within the Personnel Department) are usually bargaining under the direction of City Councillors who wish to achieve a quick settlement. This is of particular concern given the current economic conditions where governments may be willing to grant contract provisions in place of high wage settlements.

The solution to some of the union's concerns is better management plans and policies regarding the introduction of information technology which provides for worker involvement. Workers could be provided with advanced notice of any technology changes to solicit their input. If management were to provide these policies, they would not have to be negotiated in union contracts. Workers could deal directly with their managers on information technology issues instead of relying upon the union as a "go-between." The need for City wide and departmental policies on the introduction of microcomputers is discussed in the next chapter.

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CHAPTER 4

PROLIFERATION PROBLEMS AND THE NEED FOR CONTROL

PROLIFERATION PROBLEMS

The proliferation of microcomputers poses some complex problems for City Departments. These problems generally fall into two categories: technical and managerial. Management issues are by far the most important to the department organizations. Some of the management issues associated with the acquisition of microcomputers are:

1) Hardware and software incompatibility resulting from the lack of a fixed policy for selection and utilization. The inability of some machines to use the software of other machines is an example of one problem that results without standards being established.

2) Duplication of effort can result in the use and development of a wide range of microcomputer programs in various departments or divisions within these departments. Most of these are independent efforts initiated by semi-skilled personnel potentially duplicating the work of others.

3) Experts in different hardware systems are evolving in most departments. However this diffused effort may lower overall productivity as some employees are found spending time on microcomputers like hobbyists rather than on productive City work.

4) Loss of control over the decision making process as a result of uncontrolled microcomputer implementation which also threatens the overall management and security of corporate data.

5) End-user developed software is not documented or maintained. There is a loss of control because individuals are developing undocumented systems for doing their jobs that only they understand.

Additional problems may result when an over-enthusiastic employee develops a fascination with the computer and its applications. Office automation and microcomputer acquisition is often viewed as an image-builder and a means of increasing personal power bases. "This frequently leads to competitive positions and decisions based on inadequate considerations of all the variables in productive office automation performance." (1) Organization tensions can also occur when a department that originally acquired the microcomputer resources becomes strongly protective because a manager or a group within it wants to build up power and influence. This can become even more damaging to an organization if more than one area establishes microcomputer technology and then competes for organizational control and limited resources. Users can become headstrong about their purchases and buy an overabundance of hardware and software. This further adds to the proliferation of microcomputers in departments.

> Personal computing often produce a bandwagon effect. Many employees want one but they may choose unsuitable equipment and applications and they may end up using their machines ineffectively or hardly at all once the initial excitement wanes. (2)

Because the majority of microcomputer development originates outside of the Computer Services Department, there is the possibility of amateurs, who do not know what they are doing, tinkering with computer systems. This could result in a wide range of microcomputer programs in use and under development. Most of these programs are developed in independent areas by semiskilled personnel - some of them are actually working on the same application. Essentially, each division or department is "reinventing the wheel." These large number of inexperienced users can place enormous demands on corporate computer resources. The aging of these microcomputer programs and systems compound the problem. Many mainframe computer departments have made the discovery that

maintenance accounts for over half of the computer budget. (3) Many inexperienced users also ignore security concerns and thus leave their systems, data and equipment open for computer crime or loss due to damage.

> Another area of concern is the casual operating environment of microcomputers...this contrasts starkly with the mainframe environment. Controls over program changes, system documentation, backup and recovery plans, data approval, validation checks, and system testing still need to be implemented in many microcomputer applications. (4)

DATA EXTRACT ISSUES

Microcomputers used as terminals on a mainframe computer can extract data for local processing. This added accessibility of corporate information has the benefit of providing data access to a large number of users who can use the tools on the microcomputer to easily manipulate this information. "The very alluring capabilities of spreadsheet software in the hands of unwary and enthusiastic end users who have not learned the disciplines of computer professionals - built-in checks, balancing against controls and the like - may produce disastrously erroneous results." (5) The possibilities for the spread of false and misleading data have grown. Communications could distribute an error on a microcomputer to a number of machines all connected to the same network. If a microcomputer passes the information to the mainframe computer, the bad piece of information can become part of the corporate data base.

> When corporate data were safely stored within the bastion of the data-processing department, few outsiders dared even enter those air-conditioned, high-tech halls. Now that micros and minis have sprouted outside that central fortress, the data it once contained have also moved beyond its walls. (6)

Because information on the mainframe computer must be protected, the City restricts user access to read-only mode, so data can be altered only by authorized users. Any user who wants to manipulate data or perform analysis, must copy the data base onto his/her own computer.

This method may still produce inconsistent data on microcomputers. However, the official copy is protected as it will always be stored on the mainframe computer. Although these copies of databases ensure protection of the central data, the extra copies deplete computer storage space throughout the City. A solution to this could be the implementation of controls to stop users from copying files. However, a control on copying mainframe files does not stop users from duplicating the data. Users would probably just build their own files from scratch by entering data from a hardcopy output; this would be very inefficient. The creation of unauthorized data files incurs costs to the City in labour as users duplicate data entry, and also in questionable accuracy of the information. These files may also prove costly in the future as program and file (database) maintenance is ignored.

COST FACTORS

The low cost of microcomputers makes them appealing to a number of departments wanting end-user computing capabilities or office automation applications. A $3,000 - $5,000 investment in a stand-alone microcomputer constitutes a small risk, which can probably be cost justified in one year. However, the City's $1 million investment in about 250 microcomputers constitutes a large risk.

> One could expect a large firm to acquire about a thousand micros over the next three years for some portion of its professional population. This is a cool $5 million, or the equivalent of two of the largest IBM mainframes on the market today. I am sure that if Data Processing were to request $5 million in hardware, this would be scrupulously reviewed. Should micros be any different? From a data processing perspective, cost is a minor problem in comparison with the headache of managing hundreds of independent processors in order to ensure that they can perform similar tasks with comparable data. (7)

There are also additional costs to microcomputer acquisition. Software, extra disk storage, printers, communications, and other "add-ons" could increase the cost of a $5,000 microcomputer to as high as $10,000. The hidden costs are even more apparent on the bottom line. Inexperienced users can place large demands on computing resources.

"More information is generated in companies with end-user programs, and that inevitably means more computer related expenses." (8) In addition, the personnel costs are typically not included in budgeting for micro-computers. These costs could include training or even the unproductive time that is wasted for a user to learn a new system.

SPECIFIC DEPARTMENTAL EXAMPLE OF MICROCOMPUTER PROBLEMS

The acquisition of microcomputers in Civic Departments has created a number of organizational and managerial problems. Some Departments have not recognized the need for internal management of computer resources. Computer systems and files are being developed without any departmental direction or authority. Branches within some departments are setting up their own computer resources, which include software and hardware acquisition, and computer system development with little or no concern for Department priorities. This has even extended to the hiring (or requests for hiring) of computer programming personnel throughout the same department. In some cases a lack of expertise exists both in the development of computer systems, and in their proper documentation and maintenance. The following are some specific problems and policy implications which occurred in the Environmental Planning Department associated with the acquisition of microcomputers without any control or management:

1. Systems Development

   A) There are limited resources for systems development and maintenance due to the existing workload of skilled programmers and technicians.

   B) Some new systems are being developed without coordination with other systems or Department priorities. Systems are being set up without the proper manual procedures, such as ensuring that data is entered regularly, verified and backed up. There is no recognition of existing department

expertise and experience - it is easy to create a file on a microcomputer but not to develop a proper system.

2. Systems Maintenance

A) The more systems that are created in-house, the more demand that is placed on existing trained personnel to maintain the system. This involves trouble shooting on software and computer problems, creating new reports, enhancing systems and year end file maintenance.

B) The more time required for system maintenance the less time that is available for developing the existing systems.

3. Project Management

A) There is a need to identify key people who are responsible for computer systems. Individuals have to be identified for system monitoring and data maintenance for specific systems. System designers should not take on extra responsibility each time they develop a new system.

4. Staff Training

A) There is a need to identify individuals for training on specific systems of software packages. There are problems with a diffusion of information where partially skilled individuals are training others.

5. Standards

A) There are no standards for file naming. This has resulted in a variety of files being created by word processing operators all using different naming conventions. In

addition, files are being written to the hard disk that cannot be identified or may be lost in the future if they cannot be identified.

B) There are no standards of system development such as file design, documentation, and maintenance procedures.

6. Procedures and Documentation

A) There is no existing inventory of computer systems which should include a description of the system, the file structure, programs used, and procedures necessary to run the system.

B) There are no standards or approval procedures established for computer system feasibility studies. In addition, major computer projects are being undertaken without a proper feasibility study. This results in poor manual procedures being established, and inadequate staff resources being committed to run the system.

7. Scheduling

A) There is the problem of operators waiting to use microcomputers in key locations. This is compounded by operators using the microcomputers for non-essential work, such as word processing for memos and letters. Because a microcomputer cannot be assigned to everyone who wants to use it, priorities have to be determined for use of microcomputers.

8. Inter-branch Systems Coordination and Planning

A) There is no formal communication and coordination between users and developers of systems. This impacts the future capabilities of systems being designed to share data.

B) Because of the limited resources available, Departmental priorities have to be developed and agreed upon by the users and developers of information systems.

9. Hardware and Software Acquisition

A) Because of limited budget resources, software and hardware acquisition have to be viewed from a Departmental, versus a Branch, perspective. Software upgrades are presently uncoordinated where there may be a savings in ordering all upgrades at once.

10. Hardware Maintenance

A) There is a need to centralize the servicing of machines and the protection of software and hardware. For example, an inexperienced operator may call the service agent for a problem that can be handled in-house. The filing of the service contracts should be centralized so that they are easily accessed, and renewed on time.

B) Proper security should be arranged for purchased software and programs developed in house. If a machine and diskettes are stolen or destroyed, all the time and money invested would be lost.

11. Links to Computer Services

A) Only one Branch should be established as the official contact with Computer Services. This would ensure that

the department's priorities are expressed from only one source, and Branches are not competing amongst themselves for limited Computer Services resources.

Although these issues are specific to one department, the interviews that were conducted indicate that a number of the issues discussed are also common in other City Departments. These problems suggest the need for more departmental management involvement and control over microcomputer acquisition and use.

NEED FOR MANAGEMENT INVOLVEMENT

Technology is often neglected in the management process. It is regarded as a significant feature of the office environment but not as being relevant for managers to control. However, if it is not controlled by management, control can be shifted to the technical experts, or users of the technology, and managers will lose their right to control and manage the technology effectively. Office communication, data retrieval and information processing are the responsibility of management regardless of the tools which are being used. However, computer hardware and software and their use are often decided upon by the technical experts regardless of management objectives. "This curious phenomenon of unchallenged constraints is unthinkable in other disciplines, yet quietly and unyieldingly office technology has slipped from the manager's hands under the cover of jargon and magic." (9)

In many instances the information technology is distributed throughout the organization and as such is handled by a number of individuals with no overall coordination. Many decisions concerning the implementation of office automation are made in isolation of senior management. Office automation offers the opportunity to improve organizational productivity. However, lower level technicians are inadequate substitutes for top management leadership when the issues affect organizational productivity. (10) Senior departmental management should provide guidance and direction to microcomputer users by establishing policies to ensure that microcomputers are used effectively within the

department organization. This senior management commitment and involvement in office automation could potentially reduce the amount of organizational risk.

> When a manager exercises the franchise of planning and organizing office technology, that manager safeguards the additional franchises of directing and controlling the technology and its use. This is what's in it for managers, along with the more obvious benefits and increased management capability fostered by better information (11)

One of the problems of management involvement is the computer illiteracy on the part of managers. "To supervise effectively, managers must stay several steps ahead of people they supervise when it comes to understanding and implementing new technology." (12) Whether management becomes "educated" in information technology or not, they should ensure that they have control over their own department's direction in this area. In addition, City wide control is also required to coordinate computer development throughout the City. The next section discusses this need for City wide control and coordination.

A NEED FOR CONTROL

STANDARDS FOR INFORMATION EXCHANGE

The nature of the microcomputer directs that it be accessible to the individual users. A centralized location for microcomputers may seem to defeat the benefits of the technology, as users and their information requirements do not reside in one place. However, the proliferation of microcomputers throughout the City with different protocols, software packages, and data bases eliminates the ability for Departments to share data. Therefore, integration policies and guidelines are necessary in order that any "corporate" data element is available for combination or manipulation with other data elements residing elsewhere. It is unlikely that the individual microcomputer users will coordinate their activities and develop policies for such things as compatibility, training, and data security. Subsequently, this policy must be developed centrally.

> Computing with a stand alone micro yields personal and local benefits, but organizational productivity relies on linking personal and corporate resources. A company should plan for this long-term integration at the time it installs the stand alone machines. (13)

Control over the acquisition of microcomputers is important in an organization where data is to be shared with other users. The integration of computer technology must be ensured so that machines and systems can communicate with one another. The inability of some microcomputers to use the software and data files of other machines highlights the need for the City to establish a microcomputer policy. Therefore standards need to be developed to establish hardware and software compatibility as well as data format and system compatibility. This standardization would enable the networking of micro, mini and mainframe computers. These "Local Area Networks" (LANs) can avoid duplication of machine effort and data. Additionally, this linkage enables the establishment of new office automation features such as electronic mail.

The issue of compatibility is extremely important if a local area network is to be established. A number of LANs require that all microcomputers that are connected to the network must be compatible. In addition, the use of several different brands of software such as electronic spreadsheets, and word processing packages will also make the transfer of data between microcomputers connected to a LAN difficult. (14) A number of users overlook the importance of day-to-day maintenance and monitoring of the LAN. Establishing a local area network is not as simple as plugging the microcomputers into one another. LAN monitoring and maintenance require greater training and expertise than is required to use a microcomputer in a stand-alone environment. A number of the functions such as data integrity, back-up and restore provisions, and security are similar to the functions required to run a mainframe computer operation.

An additional concern arises when microcomputers communicate with mainframe computers. If microcomputer users are permitted to extract

data from the mainframe, there is a risk that users will create their own private data bases. This may result in management decisions being influenced by obsolete or inconsistent data. There is a need for guidelines and policies to ensure that data is not obsolete. These guidelines might include:

> 1) requiring users to delete (or update with current data) on a regularly scheduled basis all data downloaded from the mainframe and 2) requiring supervisors to review closely the work of subordinates to ensure that current data has been used. Often an effective tool is to require that all reports produced by the microcomputer indicate the date and time the data was retrieved from the mainframe. (15)

The fact that corporate information is stored on the City's mainframe computer does not mean that it is easy to access without extensive modifications to existing computer systems. A number of the systems have security provisions which allow access to either all of the data or none of it; whereas a user may only be allowed to look at part of the database. In addition, other systems are designed for user access only through on-line inquiry screens which do not facilitate data transfers to microcomputers. This may require that the Computer Services Department develop computer programs and access controls for users to extract mainframe data for use on microcomputers.

The greatest problem is, however, the stand-alone system development on the microcomputer. A number of users believe that programs that are stand-alone and not shared do not require documentation or need to follow standards. This activity represents a potential loss of corporate information which has been stored on someone's microcomputer, without the documentation to allow others access to, or even knowledge of this information. The documentation is required when the individual changes jobs or leaves the organization and the replacement is left wondering how to run the system. Documentation and development standards should be taught to all users and enforced, as a matter of City policy.

Some organizations are not prepared to face the complex microcomputer issues. However, without some control policies on microcomputer

acquisition and utilization, the maximum benefits of these "office tools" will not be realized. These benefits may actually be surpassed by additional costs resulting from uncoordinated data management. "Companies can greatly benefit from a policy and strategy on microcomputers - one that seeks to bring the power of these machines to the widest number of people in the organization in a cost effective and controlled manner." (16)

COMPUTER AUTHORITY

The "single authority" responsible for information management and system integration does not necessarily have to be an individual. It could logically be a Department assigned to this task or a coordinating committee with departmental representation reporting to the chief executive officer (i.e. the Board of Commissioners, in the City's case). The committee approach however should appoint an individual who is accountable to avoid the "management by committee syndrome" where nobody is accountable. The Computer Services Department is the logical area in the organization to manage or control the use of microcomputers and corporate information. This area has the experience with systems development and also the technical skills to facilitate integration of computer hardware and software. "If data processing managers do not get involved and facilitate the effective use of microcomputers, the user community would do so alone and thus further undermine the credibility of the data processing organization." (17)

The important issue is that senior management cannot afford to just let things happen, such as the uncoordinated proliferation of microcomputers. Some larger corporations take advantage of existing Computer (or Information Services -IS) Departments to establish control over microcomputers or office automation. Other companies create new "Information Centres" where users can go for help. Whatever the organizational structure, the City needs clear policy and mandates to clarify who is responsible for coordinating microcomputer acquisition. Similar to any corporate decision on capital expenditures, there is a need for clear

strategies on long range planning and investment as opposed to short term ad hoc decisions.

The Computer Services Department has traditionally addressed only the City's need for the large systems which has resulted in frustration of users interested in smaller systems. Microcomputers are filling a tremendous need on the part of small system development for civic departments. Data processing managers must become information managers and not just focus all their attention on large mainframe systems. Some are establishing information centres within the Data Processing organization which support a variety of micros with software support and training. This is what the City of Winnipeg has done by creating the Information Centre. Computer Services cited the following reasons for creating an Information Centre for the City of Winnipeg:

1. Backlog of application in development, some of which can be addressed faster through an Information Centre.

2. Explosion of the micro/mini market making many previously unavailable products and services available.

3. Enhanced user awareness of computing facilities and capabilities.

4. Increasing pressure from User Departments for Word Processing, Personal Computing, and requests for access to, and manipulation of, corporate data.

5. Relatively low cost and short start-up period for End-User Products and mini/micro applications.

6. Increased need to interface with and assist users with computing applications and problems.

7. To assist Civic Departments when dealing with computer vendors to ensure corporate policies and direction are maintained.

8. To place computing power in the hands of the user with minimal assistance from the Computer Services Department thereby freeing the Computer Services Department to address the more traditional large data processing applications.

9. Provide a physical facility including equipment and software to be used by the various civic departments as required.

10. To place computing power in the hands of users to allow them to centralize data and manipulate it for their business purposed.

11. Promotion of computing concepts and capabilities to Civic Departments. (18)

Some cities have established an extensive role for their Data Processing Departments in microcomputer acquisition and follow-up support. Within the City of Milwaukee, for example, the Data Processing Department has the following responsibilities:

> They provide demos, training, programming, systems and services to anyone in the organization requesting assistance. The users in turn are required to conform to operating standards and documentation. Data Processing conducts a periodic evaluation of each installation to verify whether users are conforming to the standards and documentation. (19)

RESPONSIBILITIES OF CENTRAL AUTHORITY

The rapid changes in information technology puts stress on the microcomputer support program in the City. Some departments are starting to reach the limits of their initial software acquisitions (i.e. Lotus and Dbase) and are moving beyond those capabilities. There is also a demand for better hardware, such as larger hard disks, fast graphics quality printers (i.e. laser printers), local area networking, and micro to mainframe communications. In order to react to these constant demands from departments, a microcomputer support program should include the following directions:

1) It must stay totally updated on new hardware and software developments in the marketplace and continually evaluate their applicability for general use in local government;

2) It must rely heavily on individuals within departments to stay current and offer advice on specialized developments in the marketplace (such as CAD, mapping, statistics); and

3) It must continually enhance its understanding of how the systems are being used, who is using them, how the users perceive the current support and what need they have in the future. (20)

The most important consideration in a microcomputer support program is the strategic integration of microcomputers into the City's overall computing direction. The Computer Services Department can ensure this integration by developing mechanisms to process microcomputer requests, monitor their microcomputer use, and recommend further upgrades in the systems when needed. In addition, to reduce the use of duplicate system development, the Computer Services Department could develop an inventory of all systems and applications to permit the sharing of systems across departments. These are by no means the only tasks required to manage microcomputer development in the City. The following additional responsibilities have been suggested for the central microcomputer management group:

1. Standards and guidelines to reduce non-compatibility of systems and hardware - but more important to reduce non-compatibility of data elements and data bases.

2. Coordination of information resource planning to reduce redundancy and provide cost-effective use of information resources.

3. Technical surveillance to stay abreast of technology.

4. Pilot testing of new systems to assure effectiveness.

5. Technical advice and assistance to improve efficiency.

6. Consultation with users to enhance awareness, capabilities and use, and to assess needs.

7. Inventorying information to identify gaps and overlaps.

8. Auditing to ascertain deficiencies and provide compliance. (21)

RESISTANCE TO CENTRAL CONTROLS OF TECHNOLOGY

In a number of departments, the mere mention of a need for policies and controls governing the acquisition and use of microcomputers evokes a negative reaction. Many users feel that formal policies and controls are not required in microcomputer environments. Often the argument used is that there is little difference between using the microcomputer to

perform work versus using a pocket calculator or adding machine. Because central policies and controls covering individual work habits do not exist, a policy regulating the use of microcomputers is not necessary. Polices and controls are viewed as defeating the purpose of user-friendly and individual orientated devices such as microcomputers. (22)

> It is the nature of the species to aspire to freedom and to strain against shackles. Not surprisingly then, the central agencies are universally unloved by the other operating agencies. A special antipathy toward those responsible for the monitoring of informatics will often be detectable. It is frustrating to those who have used imagination to develop a plan for the implementation of some operation by applying the technology to it to find their plans subject to the biases of a central agency staff that stands between them and the political decision-makers. (23)

Within the City of Winnipeg, the introduction of microcomputers is controlled by the Computer Services Department. These controls are in the form of final approval for the purchase of microcomputers (submitting a Feasibility Analysis), and controls over the type of equipment that has to be purchased (standard product line). This is consistent with other cities which have established a control mechanism for the acquisition of microcomputers similar to the City of Winnipeg. The City of Milwaukee, for example, has a system of central control for microcomputer purchase. A structure has been established through the Data Processing Board and the Budget Office which reviews microcomputer applications. "Departments are expected to develop their own skills in using the computer, although some assistance is provided in hardware maintenance and difficult software problems." (24)

However, it is the view of certain individuals that these imposed controls force managers to make decisions according to the dictates of remotely developed regulations and standards, when they should have the ability to determine their own department's requirements. While the imposition of central controls are based on sound principles, such as standardization, they represent a dilemma between imposed controls versus departmental management accountability.

> Managing under control is analogous to having one's hands cuffed behind one's back with the key buried deep in a front pocket, then being told one is free to go. Managers are free to manage technology, provided they do so within the framework dictated by the central agencies. (25)

Departments often question the currency of the Computer Services Department's technical knowledge in the microcomputer field where the pace of development can quickly render current knowledge out of date. One of the problems is the illusion that expertise in data processing can be equated with expertise in office automation. "Selection of office automation equipment and strategies requires determination of whether the user or the data processing technician should be made comfortable with the choice." (26) A difficulty with establishing a central policy-setting group in the microcomputer field is the issue of the credibility of those who are responsible for setting the policy. The rapid development of information technology can cause policies to become out of date within a short period of time. "Within as little time as a year or two the expertise base of the official will begin to lose its relevance because of the pace of development in the technology." (27) Therefore, continuing exposure to the literature and practice in the information technology field is essential to continuing a level of expertise.

THE USE OF "SOFT CONTROLS"

The implementation of microcomputer policies and controls can be initiated in an authoritative way originating from the top down. However, this approach has a potential for great resistance to change. The preferred approach is an "evolutionary strategy" from the bottom up where users participate in the decisions involving the development of policies. More often the users have the expertise with microcomputers and can have beneficial inputs.

In order to avoid resistance, the City should be careful not to initiate too much control over the acquisition of microcomputers. Users react to strict controls by going underground whereupon corporate

management never learns of the existence of many microcomputers. Therefore the use of "soft controls" and coordination policies, rather than all encompassing control is required in the acquisition of microcomputers. Centralized coordination of microcomputer development enables the City to permit a sharing of expertise and ensure that users develop good systems. This is opposed to a system of control where users have to get approval for every system to be developed on the microcomputer. This direction is probably not even enforceable. The microcomputer coordination strategy for the City of Winnipeg should be comprised of four main principles:

1. Coordination rather than control of the introduction of personal computers, with information systems (IS) playing a new role in supporting end users.

2. Focusing on the longer term technical architecture for the company's overall computing resource, with personal computers as one component.

3. Defining codes of good practice that adapt the proven disciplines of the DP profession to a new context and technology.

4. Emphasis on systematic business justification, even of the "soft" and unquantifiable benefits that are often a major incentive for and payoff of using personal computers. (28)

Centralized end-user policies to prevent microcomputer related problems need to be established. Examples of these centralized policies are standards for all microcomputer related purchases, support for only one operating system, selection of a single City wide software platform (spread sheet, word processing and database package, and provision of technical training. However, users should maintain responsibility for meeting all legal requirements, maintaining adequate security, and documentation of the data and systems under their control. The best strategy for controlling microcomputer development is the initiation of "soft controls" which do not try to dictate to users what they can and cannot do. These "soft controls" contain the following components.

Selected hardware: the Computer Services Department provides technical advice for only certain machines;

Centralized purchasing: the City negotiates quantity discounts on the selected hardware and passes these savings on to the user departments;
Limited training: instruction is provided only on the selected standard software;
Consistent software distribution: the Computer Services Department distributes or publishes new releases, this diminishes the possibility of incompatibility and inconsistencies.
Distributed development: Computer Services teaches end-users about good system development practices;
Software bonuses: Communication and electronic mail is provided and supported for only compatible microcomputers. (29)

With the implementation of "soft controls" support of products beyond the standard product is on an "as available" basis only, and not encouraged. Users are warned, in writing that they will be responsible for any problems that they encounter on nonstandard products. A policy of this nature has been adopted by other Cities:

> The philosophy of microcomputer support in Dallas is to focus limited resources on a few products and give them high quality support. If the user needs or desires to acquire software outside the standard packages they are free to do so but they must develop their own expertise to use and support them. Most of the departments have found that the three standard packages can solve their needs. (30)

FEASIBILITY ANALYSIS

Despite central coordination and control of microcomputers, the corporate policy statement on PC's should stress that justification is the user's responsibility. The departments should obtain the funds and the central computer department should have no authority to veto a proposal based on its opinion of the feasibility and benefits of the microcomputer. Only departmental management can make business decisions about the benefits of the information technology to the department. However, from the user's perspective, one of the roadblocks to the acquisition of microcomputers into the office has been the difficulty of measuring benefits.

The current feasibility analysis required by the City of Winnipeg places too much emphasis on a simplistic cost/benefit equation to

improve organizational productivity. Productivity should be measured by analyzing both the quantity and quality of information which will be processed by a new system. Systems should be evaluated based on descriptive benefits instead of numbers which users generate to make their proposal look good. Often these figures are "pulled from the air" and have little bearing on the intended use of the equipment. It is unfortunate that some departments believe that it is necessary to "paint a glowing picture" when seeking approval from the Computer Services Department for a microcomputer system such as enormous savings and vastly improved service.

> Honest communication from the department to the central agency about such risks and opportunities should be encouraged, so that any subsequent evaluation will have due regard for all the circumstances. The abiding sin of central agency officials in the informatics field is skepticism about the plans of departments and as a result they are cautious to an extreme. Undue caution in this field will delay the optimum exploitation of the technology. (31)

There is a risk of the Computer Services Department requiring a too extensive cost benefit analysis prior to introducing any new microcomputer equipment. The risk is in only approving systems which offer tangible dollar, low-risk paybacks. The disadvantage is that opportunities which only offer intangible benefits are rejected as being too uncertain. Introducing new information technologies in this environment would be impossible.

> Consider cost justifying a photocopier in an office where currently all copies are made using carbon paper. To justify the investment in a photocopier would be very difficult. Yet, the primary use of the photocopier is not as a replacement for carbon paper; rather, it is wider dissemination of information through the office, thus eliminating many needless searches for information. (32)

The influence of the Computer Services Department in approving microcomputers should not hold back progress. The Computer Services Department should be careful not to discourage experimental projects. Users should even be encouraged to take risks by trying new systems. The Computer Services Department could then work with the department by monitoring their progress. As the information technology is still

evolving more experience may be needed for the Computer Services Department to set the appropriate controls and standards for the City. (33) Users in departments can help take the burden off the User Consultants by participating in a controlled and monitored project to test out new technology.

Once a microcomputer system is approved, a post-implementation review is rarely, if ever done. This step is important to review the assumptions that went into the cost/benefit analysis. At a minimum, users could be interviewed about a month after implementation to determine if the estimated costs and benefits were realistic. This information could help the Computer Services Department review future feasibility studies for microcomputers.

A more global control related issue which has resulted from the distribution of microcomputers throughout Civic departments is the issue of centralized versus decentralized data processing. This issue will be discussed in the next chapter.

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CHAPTER 5.

CENTRALIZATION, DECENTRALIZATION AND DISTRIBUTED PROCESSING

THE LOCATION OF COMPUTER PROCESSING

The location of computer processing and storage has in the past been determined by the hardware which was available. The large mainframe computers which were first acquired in the 1960's resulted in the centralization of data processing. Mainframe computers could store and access all the City's records on one large machine supported by mass-storage devices. The concepts developed were that all departments would have their data stored on the City's mainframe computer. Then minicomputers were developed, which were often used for special functions dedicated to a specific business activity (such as the Transit information system used by the City). "The advent of minicomputers raised, for the first time, the possibility of each user department gaining complete control over its computing by having its own computer and computing staff." (1) The cost of minicomputer technology was low and did not require a large number of operators. This resulted in the initial concept of decentralized data processing. The main obstacle for departments was the availability of application programs. However these minicomputers were really not a threat to central data processing on the City's mainframe computer as they were still relatively expensive for Departments to justify.

The biggest threat to the mainframe computer has been the acceptance of microcomputers throughout the City. This technology has allowed users to easily store and process their own information without relying upon the Computer Services Department.

> Just as the corporation's total reliance on a mainframe computer is giving way to an increasing extent to a combination of mainframe and personal computers, so too, the single massive, all-inclusive data bases appropriate for the corporate entity will exist side by side with the smaller, individualized, activity and/or subject-specific data bases that increasingly are being built, accessed and manipulated by and for the users themselves. (2)

The microcomputer has resulted in a decrease in the cost of the hardware and the availability of user-friendly software. This development has prompted some to question the necessity of a central computer department. Departments could provide their own computing services using a network of microcomputers or even minicomputers. The development of minicomputers and microcomputers has created opportunities for conducting computer processing within the departments. In fact, given the costs of large mainframe computers, compared to smaller systems, establishing large central data processing facilities may not be justified using purely economic arguments. The economic advantage offered by the central computing function (Computer Services Departments) is based on the technical and managerial expertise and the information technology products as well as the services they can offer the departments. However, this economic advantage held by the Computer Services Department lessens as other departments become skilled in newer information technologies such as microcomputers and are able to develop their own computer systems. This raises a concern about the need for continued development of data processing functions based on the City's mainframe. In the near future, the Computer Services Department may also be impacted by the reallocation of funds away from the mainframe to microcomputers. However, the dilemma between a micro, mini or mainframe computer direction will still exist:

> Every organization with a mainframe must ultimately face questions about the relative economies of running certain applications locally on stand-alone microprocessors rather than the mainframe, and also face questions about the possible impairment to the consistency of data throughout the organization in cases where the choice is made to go even partially the way of the small machines. (3)

CENTRALIZATION VERSUS DECENTRALIZATION

"It has been a long-standing assumption among computing professionals that large, centralized systems offer a maximum efficiency and effectiveness." (4) This assumption is being challenged by the potential for decentralized computing, which has been made available by advances in computer technology (i.e. micro and mini computers). In the

past, large centralized computers were more cost effective due to the high costs of computing power. The introduction of inexpensive minicomputers and microcomputers, has reduced the hardware costs to the point where the cost of the processor has become significantly cheaper than the cost to develop the computer system. The centralized/decentralized issue does not only involve computer hardware. The issue of centralized versus decentralized computing involves the location of three components: the computing facility itself, the analysts and programmers who service users, and the authority for computing in the organization. (5)

The arguments in support of the centralization of computing facilities and staff are claims of better management control and efficiency from consolidating computer personnel and computer hardware. An additional argument in support of centralized computing facilities is based on the claim that computing hardware is so expensive that it should be consolidated to achieve economies of scale. The economies of scale argument used to be true, but with the decreases in the cost of computing hardware resulting from the development of the micro and mini computers, it is becoming more cost effective to decentralize computing facilities. In addition, supporters of decentralization also claim that departmental computer programming staff provides better service to users and greater flexibility in use of the technology. The decentralization of computer personnel can be accomplished by assigning existing Computer Services Department staff members to user departments, or by actually requiring user departments to hire their own analysts and programmers.

> There is some evidence to support the claim that users receive better service if analysis and programmers are decentralized. In particular, users tend to be more satisfied when they have some direct control over the analyst and programmers who work on their applications. (6)

The major issue that will impact the organization of computer systems in the City of Winnipeg in the near future will be whether to maintain a centralized computer operations or allow the decentralization of computing activity to departments. In the past this centralization versus decentralization issue had been settled in favor of

centralization due to the high entry costs of mainframe, and even mini computers. Only large departments, with specialized applications, could justify having their own computer resources. For example, the Police acquired a minicomputer for the emergency dispatch and crime reporting system and the Transit Department acquired a minicomputer for their transit information system (Telebus) and bus driver scheduling. However, the advent of microcomputers has significantly lowered the computer entry costs for departments and therefore, increasing the pressure to decentralize computing in the City.

> This debate will be a serious issue in local governments because it is not fundamentally an issue of costs versus benefits, but rather control over the information technology resources of the organization. Research has shown that nearly all users prefer a decentralized arrangement because it increases their control over the technology, which improves their access to the technology and their influence over how it is applied to their functions. (7)

The more advanced City departments with existing computer literate staff will benefit the most with decentralized computing and can simply build on their existing computer systems. However, departments with little or no existing computer experience are at risk if the services now provided by the Computer Services Department are reduced under decentralization. This may force these departments to acquire their own computer capabilities or do without. An additional disadvantage of decentralization impacts departments, for example Environmental Planning, which relies on data created by other departments, such as the Assessment Department. These departments might find it difficult to obtain the information under decentralization. (8)

There are other concerns with a decentralized computer environment. The decentralization of computer programmers can impact negatively on their productivity. These system development groups dispersed throughout the City could use different standards, productivity tools, procedures and languages, which can cause long term productivity loss in an organization. "While decentralization may be appropriate in some cases, it must be managed carefully to ensure that compatibility of development methods is maintained where necessary and that proper communication

channels are established between groups to lessen the likelihood of duplication of effort." (9) Even with decentralization, there is a need for a central authority to coordinate the system development occurring in the various departments, and ensure that City wide standards are adhered to.

> In the last several years, with the dramatic decrease in the cost of computer power, with the development, proliferation, and diversity of hardware (especially the so-called personal and professional computers), there is a growing recognition of the need for integrated systems and for consistent and compatible data representations and communications protocols. So, the pendulum has begun its swing right back to the concept of centralization. (10)

The adoption of a corporate information management policy and data integration policy also impacts the debate on decentralization versus centralization. "The information management concept fits well with top management's interests; with departments and groups that are primarily data users rather than data providers; and with the interests of the data-processing department, because it offers justifications for doubling computing capacity, thereby offering the possibility of relieving the current computing congestion." (11) A department's views about centralization or decentralization are often tied to their views on integrated data bases. The departments which are the large data providers (such as the Assessment Department) are often concerned about the loss of control over their data in a centralized system. They are also concerned about the additional costs they have to pay in order to collect data for other department's information needs. Their biggest concern is the misuse and release to the public of sensitive data. All these concerns support decentralized computing, which enables Departments to manage their own information.

The large data users, (Planning Department) typically side with the computing department (Computer Services) in support of integrated computer systems that would consolidate all data in the government and give everyone equal access to that data. This supports the centralized computer direction. Therefore, it is evident that the decentralized versus centralized argument covers more issues than simply the location

of computer hardware and technical staff. Other issues are City versus departmental ownership of information and open access to information versus secrecy.

However, the centralize versus decentralize issue does not have to be a "black or white" issue. The decentralized computer equipment, micro and minicomputers do not have to be "stand-alone." The microcomputers could be linked to the mainframe, often through intermediate minicomputers. Using communications data processing and information storage can be combined together. In order to achieve this linkage there has to be a controlling body to manage the technology. "Support for the data processing function, whether based on mainframes, minis or micros must come from somewhere in the organization." (12) Even with a fully decentralized environment, there has to be some form of central coordination. Otherwise, the departments are free to go off on their own in every direction and create little computer empires with little hope of ever tying the different systems together for information exchange.

> To exploit the rapidly moving technology, an effective approach toward IT [information technology] management must provide for the centralized coordination, control, integration and planning of these diverse technologies. On the other hand, sub-unit managers have acquired the desire and, often, the capability to acquire needed IT resources without acting through a centralized IS [information services] function. The dilemma of IT management can be seen, then, as the need to simultaneously provide centralized direction and coordination while recognizing the value of increased discretion regarding IT decision making on the part of managers throughout the organization. (13)

The Computer Services Department cannot dictate how departments handle their information processing. However, Computer Services should guide the department's information technology efforts, by setting policies, guidelines and standards. In addition, the Computer Services Department should continue to operate certain computer systems which are critical to the organization, and that benefit from economies of scale, such as the Financial Reporting System, and Payroll and Personnel systems. The Computer Services Department should also continue to provide and maintain the main communications structure and also set

corporate data architecture standards such that the individual departmental components can communicate with each other.

DISTRIBUTED PROCESSING

DISTRIBUTED PROCESSING DEFINITION

The concept of centralized control combined with some coordinated decentralized processing and staffing has been defined as "distributed" processing. Decentralization involves the placement of information processing resources in user areas on stand-alone independent basis with little or no input from a central authority. Distribution implies the placement of resources in user areas allowing for communication between the areas and to a centralized group who provide guidance and coordination to the dispersed activities. (14) Similar to decentralized, distributed computing involves moving the computer processing out to the departments where most transactions occur. Under distributed data processing, each department has its own computer system (minicomputer or a network of microcomputers), and its own departmental computer programmers and analysts. Departments could also have their own components of the "corporate database" stored locally, if the departmental computers are connected to one another, and the central computer in order to share data and computing power. (15)

The major concept of distributed data processing is the establishment of a network of computers which are capable of operating independently and also communicating with each other or the central computer when required. The other major concept of distributed data processing, as opposed to decentralization, is that the function of planning and control remains with the central computer facility - the Computer Services Department. "Thus policies and standards for city-wide operations, future capacity/growth planning for the computer network and overall performance monitoring/evaluation remains an overall central corporate responsibility." (16)

The information technology is at a stage which makes distributed processing a reality in the City of Winnipeg. Networking and communications capabilities have increased, and the cost of computer processing, memory, storage, have dropped. These trends make distributed processing economically feasible as a corporate information strategy. In addition, these trends have also made it possible for individual departments to acquire their own computing resources, which a number of departments have already done. A number of other trends are evident which have resulted in the increase of departments acquiring their own computer resources and independent computer system development:

> Application backlogs leading to increased numbers of dissatisfied users;
>
> Greater sophistication of the user. Fourth generation languages will assist end-users in their own information processing and application development.
>
> The productivity challenge facing the City is how to keep up and service the growing demand for scarce computing resources. Even as the City's System's Development staff continue to develop their skills, the demand is growing exponentially and has created a large gap between what is needed and what can be provided;
>
> Pre-written software programs that can be "tailored" by end users to solve particular problems are becoming increasingly powerful and easy to use. (17)

STAFF IMPLICATIONS

In addition to the distribution of information technology more computer system analysts and programmers will be located in the civic departments. This trend is evidenced by the number of temporary programmer positions that have been created for departments. The following Departments have created temporary programming positions: Assessment, Civic Properties, Environmental Planning, Finance, Winnipeg Hydro, and Operations. Two departments have permanent programming positions: Environmental Planning, and Employee Benefits. In a number of cases these staff are being hired by the departments to be used in lieu of Computer Services Department's programmers.

In addition, traditional specialist positions in some departments are changing to reflect the new emphasis on computer system development. A number of new job descriptions and titles are being implemented and will continue to be developed to reflect the combined roles of individuals. Examples of these positions in the City are: Research Assistant, Data Coordinator, Systems Coordinator, Research and Budget Officer, Administrative Assistant, and Supervisor of Data Flow. As departments hire computer programmers or if existing Computer Services Department programmers are transferred to departments, there are a number of staff management considerations:

1. Critical Mass: If data processing staff are moved into user areas, there must be a sufficient number to maintain a critical mass. Otherwise they not only feel isolated from data processing, but they are too limited in number and often too low in the user organization to have much impact on the user area. An increase in staff turnover often results. It is not necessary to use only data processing staff to arrive at this critical mass. Balancing user staff who have sufficient data processing background and interest with a DDP staff support group can provide the impetus needed.

2. Data Processing technicians and analysts can get caught up in other administrative functions within the user department reducing their ability to satisfy the information requirements of the department. Without proper actions taken to ensure appropriate career planning, training and cross pollination of staff, data processing staff in the user areas may lose their technical expertise and the data processing focus of their jobs. (18)

In addition to the technical specialists, department managers will also become involved in computer-related activities such as computer policy committees. These departmental managers will have to become knowledgeable about policy issues related to information technology such as hardware procurement, information requirements, development priorities, confidentiality requirements and evaluation of computer-based services. (19) The departmental computer specialists or "information coordinators" (as referred to earlier in the chapter dealing with the impacts of microcomputers) will become the technical advisors to departmental senior managers. These specialists will provide advice on the department's computer developments and also support departmental

interests on city wide computer decisions regarding the allocation of information technology resources.

If the City of Winnipeg refuses to recognize these trends and adopt a corporate information strategy to support a distributed data processing direction, departments will continue to acquire their own computer resources, and staff. The risk is that departments will also develop their own isolated systems and databases, which contain valuable corporate information. This information should be shared, and made accessible to all departments, senior administration or City Council.

> Because a government body and particularly a city, although composed of a number of departments, operates in a single "physical space", has a common client base, and has convergent goals and objectives, it is vital that information and resources be shared to effectively and efficiently meet the needs of its citizens. For this reason distribution rather than decentralization is the appropriate vehicle. Unfortunately, distributed data processing is a much more complex management problem than simple decentralization. Under decentralization it is a simple matter to put staff and computer resources where they are needed. (20)

EXAMPLES FROM TORONTO AND CALGARY

Other cities have recognized the importance of distributed processing in a municipal environment. The City of Toronto is in the early stages of recognizing the trends: "One trend within the data processing industry, including the City of Toronto, is now clear; expanding use of new technology distributed computer systems, by non-data processing staff, as opposed to the historical use of computer facilities by only data processing professionals." (21) The City of Toronto has also recognized the importance of corporate data by developing a policy that states that applications which utilize corporate data will be developed using data base technologies. Non-corporate, or departmental applications will be developed locally within City departments. However these will be developed consistent with corporate standards which have been established for end-user application development.

> Corporate applications are those that effect (update, modify or delete) corporate data bases. The City's central Computer will be the main resource for corporate application development, and data will be down-loaded to intelligent departmental workstations for local execution, as necessary. Common City-wide databases, such as the Central Property Register, will be established whenever possible in order to reduce duplication of effort and provide a centralized resource for all City Departments. (22)

The City of Calgary has also recognized the importance of coordinating to support data sharing in specialized areas. Even though data input and project design is accomplished within the departments in a decentralized manner, committees have been established to maintain communications and continue development with data sharing as an integral part of the process. One such committee is the Land Related Information Systems Task Force which has been established to coordinate computer mapping activities and land information throughout the City. (23) The City of Calgary is already advanced in its implementation of distributed data processing:

> A major thrust in the overall Information Management Strategy for the City of Calgary is the conscious and planned movement toward Distributed Data Processing (DDP). DDP entails transferring a significant portion of the present data processing operations and responsibilities to the major user Responsibility Centres. The viability of this approach has come about for a number of reasons. First, and foremost is the fact that the computer technology is now available to allow effective distribution and utilization of data processing resources. Users are also becoming better educated and more self-confident in the use of computers. Technical development in the area of telecommunications and data base systems has made possible the building of very sophisticated computer networks, and direct links from computer to computer are now possible. Thus many data processing tasks that are now handled by the central system will eventually be farmed out to remote sites thus "putting the user in the driver's seat. (24)

The City of Calgary has identified a number of benefits in distributed data processing over more traditional centralized control or decentralized data processing. These benefits are as follows:

1. Increased control by users: Within the bounds set by corporate needs, users have control over their priorities.

2. Increased motivation and involvement of users: Users feel more part of the system and are more motivated to make it work, resulting in faster systems development and more effective systems.

3. Economy of specialization and simplification: Because users are concentrating on their own projects, they can deal with a problem of smaller scope. This of course must be balanced by the corporate needs to be derived from systems being developed in the user areas.

4. Sharing of Expertise: The integration of people with various backgrounds in the user areas will provide for more knowledgeable people on the business function and on the application being developed.

5. Minimizing the number of products and costs: Through distribution, rather than decentralization, the number of products and types of hardware can be standardized, simplifying training requirements, maintenance, and the ease of mobility of the work force. (25)

IMPACTS OF DISTRIBUTED PROCESSING

The negative aspect of distributed data processing is that it will probably result in an increased investment in data processing throughout the City. The main reason for the increased costs will be the result of an increase in the rate at which technology is introduced into the City. These costs will be reflected in a number of factors: an increase in computer positions in the user departments, increased materials, such as manuals, paper, ribbons etc., and increased storage requirements. Computer utilization will increase as the information technology becomes more accessible to a large number of users. In addition, users will demand a better response from existing mainframe systems. The demand for on-line applications, as opposed to batch, and the demand for systems to run during prime times (9-5) will also increase. Finally, the communications network required to link departmental systems to the City's mainframe computer will also result in an increase in costs. (26)

On the other hand, there should also be a productivity increase resulting from the increased introduction of information technology throughout the City, which would hopefully offset the increases in

costs. Other benefits will also be realized, such as improved decision making, and improved service to the public.

Distributed data processing will have its greatest impact on the users of data processing systems. Users will become more involved in the development of computer systems, either developed entirely in-house or jointly with the Computer Services Department. User specialists (Information Coordinators) will share project management of joint Computer Departmental project teams, and will be responsible for user-oriented system design and analysis and the quality of project deliverables. This increased user involvement in system development is healthy for the organization and can potentially result in better systems, as both users and data processing professions offer a different perspective to system development.

> Users tend to have a more global view of the organization's program orientations and are therefore more concerned with the long-term implications of data processing systems performance. Providers, in contrast, are more concerned with the shorter term monetary aspects of the corporate systems cycle....Users tend to request from providers custom tailored data processing systems that exactly meet all their specific requirements. By comparison, providers tend to promise standardized computer systems that can be easily and cheaply integrated into networks or other configurations throughout the entire organization. Both pictures of course have validity , value and use for the organization. (27)

Distributed data processing requires a corporate-wide commitment to constant technological training and upgrading of existing staff, as well as the recruitment of staff with information processing expertise by City Departments. (28) The emergence of "user specialists" requires that departments develop staff with technological skills and computer knowledge to meet the demands of distributed processing. Some City departments have already recognized this requirement and have acquired personnel with information technology skills. However, some departments do not have any local expertise, and rely solely upon the Computer Services Department for advice and direction. At a minimum, these departments need to develop some level of computer knowledge so they can communicate

with the programmers and analysts to express their requirements for a new computer system.

It is important to note that not all City departments are ready for distributed data processing. Some departments may still rely upon the Computer Services Department for all or most of their data processing needs. In addition, different levels of distribution are appropriate for different departments. Some departments will have almost a self-contained computer "shop" within their departments, while others will rely upon a mixture of internal and Computer Services Department staff for systems development. However, no matter what level of distribution is adopted, the Computer Services Department has to ensure that the overall needs of the City are addressed as a single corporation. In addition, the Computer Services Department has the responsibility to ensure that the information and information technology is used in the most effective way. Distributed data processing in the City of Winnipeg cannot be achieved overnight; it has to be planned and carefully implemented. The following distributed processing implementation steps have been recommended by the City of Calgary:

1. Confirm that the crucial policies and standards are in place for the distributed data processing functions.

2. Determine with departments their current level of distribution and make the appropriate changes to formally move them into the specific level. Establish a time frame for reaching an appropriate level for their department.

3. Select departments on a priority basis to migrate to the next stages. (29)

DEPARTMENTS READINESS FOR DISTRIBUTED PROCESSING

Departments do not acquire their computer expertise overnight. This knowledge is developed over time as the organization matures. Some departments have internal computer competence to the extent that they are capable of developing systems independent of Computer Services. Others rely totally upon the experts in Computer Services to provide their computer systems. The Department's computer competence has a

bearing upon the nature of "distributed data processing" which is assigned to them. One method of measuring the relative stages of computer competence within departments is to compare them to Nolan's stages of data processing growth. Nolan defined a number of stages that organizations go through in the office automation/computerization process.

> In companies we know, there are remarkable similarities in the problems which arise and the management techniques applied to solve them at a given stage, despite variations among industries and companies and despite ways in which EDP installations are used. Moreover associated with each stage is a distinctive informal organizational process. (30)

Nolan also contends that organizations will not normally skip over a step in his evolutionary cycle unless they are influenced significantly by external forces such as major management changes, or competition. However, radical changes of this type occur infrequently. Nolan concludes that the evolution of information systems in most organizations follows a set pattern with a definite learning curve. (31) The progress through the stages can be different depending upon when an organization began to automate. "The information technology is different, and the extent of professional knowledge on how to manage the DP technology is much greater in the latter years." (32) Nolan also stated that not all "divisions" of an organization may be at the same stage. "It is important to understand that a large multinational company may have divisions simultaneously representing stages 1, 2, 3, 4 and perhaps 5 or even 6." (33) Although the City of Winnipeg is not a "large multinational company", it can be argued that because of the independence of City departments, they will be at different stages in data processing development similar to the "divisions" described by Nolan. In other words, different departments within the City of Winnipeg will be at different stages in trying to deal with their own internal computer resources. Some of these stages are evident by the problems a department may have concerning its microcomputer acquisition (as discussed in Chapters 3 & 4).

These stages which organizations go through are not always clearly segregated. They should be viewed as a progression of organization

change, with one stage blending into the next. An organization may be at stage four in regard to mainframe computers, but only at stage one with regard to office automation or microcomputers.

The six stages are initiation, contagion or expansion, formalization or control, integration, data administration, and maturity. The most notable stages in terms of their impact on the departments are proliferation of applications in stage two, which causes the budget to increase exponentially, and the formalization of controls in stage three, which is designed to curb this growth. The following is a brief synopsis of these six stages:

1. Initiation: Occurs when the first computer is implanted in the organization. The organization's computer is normally justified in terms of cost savings. The long term impacts of the computer on personnel or the organization are ignored. Systems begin to enhance technical expertise, and management planning or control is lax.

2. Contagion: The computer area or department "takes off" into new projects that seem to have been selected at random. This is a period of contagious and unplanned growth. There is a steep rise in expenditures for hardware and software. The computing facility has few means of setting priorities or plans. Users display superficial enthusiasm, some users become programmers, and management planning and control remains lax.

3. Control: Top management becomes aware of the runaway computer expenditures. Management initiates drastic measures such as centralized control and elaborate, cumbersome quality control measures designed to put a stop to the growth. Because of rising costs, users are arbitrarily held accountable for applications, documentation requirements are adopted for programs, the responsibility for the "DP" function moves to middle managers, and formalized planning and control measures are instituted.

4. Integration: Where existing applications are retrofitted to user data base technology, users must cost-justify new and existing systems, a centralized DP unit is established, and planning and control measures are increased.

5. Data Administration: Where the major emphasis is to integrate applications into a total organizational resource, data base administration becomes a central DP activity, users are held less accountable for new ones, and planning and control shifts toward an emphasis upon shared data and common systems.

6. Maturity: A Manager of Information Systems is established at a senior management level where strategic planning occurs. Users develop their own "system analyst" capabilities (distributed processing). However, the Information Systems Department is responsible for managing the corporate data base and keeping up to date with new technologies. Application integration mirrors the information flow of the organization, shared data and common systems become a strategic resource. (34)

These stages probably have more applicability to the City as a whole, as well as its historical development of computers and information management policy. On the other hand, there are some remarkable similarities to Nolan's early stages (first three) and some of the issues and problems discussed in the chapters on microcomputers. When microcomputers are first introduced into a department, there is usually little control or involvement by top management. The use of microcomputers quickly becomes contagious as more users are exposed to their capabilities. More microcomputers are acquired and a number of stand-alone systems are developed. As departmental problems related to this microcomputer proliferation develop, senior management become involved, and initially establish a committee to control development or institute strong control measures. Some departments even place a moratorium on microcomputers for a year until things settle down. This development covers the first three of Nolan's stages.

Although integration or data administration may not develop in a fashion similar to the mainframe model, the acquisition of networking facilities to tie microcomputer applications together represents a form of integration and data administration. One of the most important steps is the creation of a data processing/information section within the department reporting to the Director (as some City departments have done). This section will be responsible for all systems development and information processing in the department. This departmental action is similar to Nolan's Stage 6 - Maturity, where a "Manager of Information Systems" is established. This position could be similar to the position of "Information Coordinator" discussed previously. What is important is that this individual reports to the Director of the department. Some City departments have already "matured" by recognizing the importance of this type of position. Examples of existing positions are Manager of Systems and Standards Branch in Assessment, and Supervisor of Human Resource Information Services in Personnel. In addition, some departments are presently undergoing studies to create positions similar to a manager of information systems. It is at this stage that departments have recognized the need to manage their departmental information.

The Chart on the following page entitled "Data Processing Growth Stages and Distributed Processing Migration Stages" shows Nolan's six growth stages overlaid on distributed data processing migration stages (Don Evans, City of Calgary). This chart illustrates that a department is not ready for distributed data processing until it has reached Nolan's Stage 4 (Integration). The matching of the two charts is not intended to be exact. Its purpose is to illustrate how an organization's or department's maturity, can be used as a guide to determine if it is ready for some form of distributed processing. The degree of maturity, as indicated by Nolan's stages, can also be used to determine the extent of self-sufficiency of distributed data processing, as indicated by the different levels.

Departments which are only at the Initiation, or Contagion Stage are not ready to take on the responsibility of running their own

DATA PROCESSING GROWTH STAGES AND DISTRIBUTED PROCESSING MIGRATION STAGES

SIX STAGES OF DATA PROCESSING GROWTH (Richard L. Nolan) *

Growth process						
Applications portfolio	Functional cost reduction applications	Proliferation	Upgrade documentation and restructuring of existing applications	Retrofitting existing applications using data base technology	Organization Integration of applications	Application integration "mirroring" information flows
DP organization	Specialization for technological learning	User-oriented programmers	Middle management	Established computer utility and user account teams	Data administration	Data resource Management
DP planning and control	Lax	More lax	Formalized planning and control	Tailored planning and control systems	Shared data and common systems	Data resource strategic planning
User awareness	"Hands off"	Superficially enthusiastic	Arbitarily held accountable	Accountability learning	Effectively accountable	Acceptance of joint user and data processing accountability
	Stage I INITIATION	Stage II CONTAGION	Stage III CONTROL	Stage IV INTEGRATION	Stage V DATA ADMINISTRATION	Stage VI MATURITY

DISTRIBUTED DATA PROCESSING - MIGRATION STAGES (Don Evans) **

Distributed Processing level	LEVEL 1 Centralized	LEVEL 1 Centralized	LEVEL 1 Centralized	LEVEL 2 Distributed DP	LEVEL 3 Distributed DP	LEVEL 4 Distributed DP
Department Profiles	Small dept's. or limited projects	Small dept's. or limited projects	Small dept's. or limited projects	Significant DP projects and/or end-user computing	Large DP projects and significant end-user computing	Large DP projects and installed base
Department Staffing	Interested user	Many interested users	interested users part-time analyst	Full-time computer programmer	Information Coordinator and end user support staff	Information Manager Systems Analyst Programming staff
Application development and maintenance	Initiated	Initiated	Initiated	Coordinate all development, maint. determine priority	Feasibility studies if possible some output reports	All feasibility studies, some dev/ maint. all output

* Richard L. Nolan, "Managing the crises in data processing", Harvard Business Review, Vol. 57, No. 2, March-April 1979, p. 117.

** Don Evans, "Distributed Data Processing in a Municipality: How to Make it a Win-Win Proposition", Papers from the 1987 Annual Conference of the Urban and Regional Information Systmes Association

internal computer operations with some degree of autonomy from Computer Services. Only after departments have achieved some form of "control" over their computing resources (i.e. microcomputer application development) are they ready for distributed data processing. In other words, they become responsible for their own computer staff and all forms of system development, either microcomputer or mainframe computer. Departments which have not reached this stage would be difficult to deal with in a distributed environment for a number of reasons:

1. There is no single individual or area in the department responsible for information technology, and data processing. Computer Services would have to establish a number of contacts within the department for coordination.

2. The computer area or areas in the department would not necessarily have the support of senior management or the department head. This would make central control and coordination difficult.

3. If the department is in the initiation stage, the level of expertise and experience developed would not be sufficient for the department to run its own computer operation.

Distributed data processing establishes a subset of the overall corporate data resource within departments, who are the main users and producers of the information. This information would have to be managed by the departments, thus requiring the existence of an information manager or coordinator within each department. The duties of the local information manager would include centralized management of the department's information resources, liaison with the Computer Services Department and with other departments, representation of the department's interests at planning and management committees, and the securing of information access rights from other departments. (35) These duties are an extension of the duties of an "microcomputer" Information Coordinator described previously. The increased exposure and involvement of user

management in computer information systems will also increase their familiarity with information technology. This will result in the making of greater demands on their systems. The involvement of user management in delivering some of their own data processing services will result in systems that are better planned and implemented, as departmental management will be responsible for the outcome of system development.

The municipal government environment, because of its need for shared data and a shared infrastructure, offers a different setting for distributed data processing than other organizations. The most important factor is the determination of departmental and corporate data and systems. Departmental systems are systems that serve the needs of a single department, and do not require the sharing of data between other systems. Corporate data based systems are systems that use or create data used by a number of departments, such as land related information systems, financial systems, human resource systems and material management systems. This information is shared by the entire corporate structure, and therefore should not be viewed as the possession of one department, even if it is the originator of this information. When departments generate corporate information, or require corporate data, central coordination and control is required to ensure the accessibility of this information. Distribution of information applies to only departmental systems; systems where a great deal of corporate data is involved requires more coordination and centralized effort.

The following chapter reviews the existing City information technology policies. These policies are reviewed in relation to a number of issues discussed in this chapter, such as the location of computer programming personnel, and issues from previous chapters.

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CHAPTER 6.

EXISTING CITY OF WINNIPEG POLICY

INFORMATION SYSTEMS COORDINATING COMMITTEE

In 1978, the Board of Commissioners appointed an Information Systems Coordinating Committee (ISCC) and established terms of reference defining the objectives of the Committee. The ISCC consisted of the following committee members: Director of Computer Services, General Manager of Personnel, City Treasurer, General Manager of Hydro, and Director of Planning. It was chaired by the Board of Commissioners Research Branch.

> It is intended that the ISCC (Information Systems Coordinating Committee), which is composed of senior representatives reporting to the different Commissioners, will evaluate system proposals sent to them by the Bboard. It is felt that this committee, with its high level of knowledge and expertise, can effectively assist and advise the Board by reviewing requests for system development. (1)

The intent of the Committee was to ensure that future data processing development was coordinated, that systems shared data where appropriate, and that development undertaken was in line with overall strategic direction and goals of the City. The following strategic direction was developed and stated in the 1978 report:

1. The corporate asset, data, will be valued as a corporate resource and will be centrally controlled in the development of Information Processing Systems.

2. The processing of data will be decentralized whenever feasible to the operating units of the City.

3. The linkage between centralized control of data and the processing of data will be a network of computing facilities designed on a corporate-wide basis. This is known as the concept of "distributed processing."

4. The measurement of productivity will be on the "total" system and not on individual sub-system.

5. All opportunities for Information Processing Systems development will be required to pass through a standard set of

procedures and must also meet predefined acceptance criteria before approval to proceed is given.

6. Preference will be given to developing systems which cross administrative boundaries on the basis that these will provide facilities to more than one function. (2)

Of particular interest is the direction of "distributed processing", and the emphasis on system integration (systems that cross administrative boundaries) which were expressed in this policy and direction. However, this was before microcomputers were introduced into the City, and therefore, distributed processing probably referred to the distribution of computer terminals into user departments.

LONG RANGE PLAN

The primary objective of the Information Systems Coordinating Committee was stated as such: "To develop a long-term plan for an Integrated Information Processing System for the City of Winnipeg." The Long Range Plan was viewed as a mechanism by which:

1. Future systems are identified and their development priorities are set.
2. Inter-relationships (Integration) between systems are established.
3. Development is scheduled typically for 3-5 years, based on priorities, integration, and resource constraints.
4. Control is instituted to ensure adherence to the plan, and modifications to it are made as required. (3)

The preamble to the Long Range Plan recognized the problems existing with the traditional approach to the development of data processing applications, such as developing applications as a stand-alone project. "The result often has been redundancy of data, excessive use of data processing resources, and a less than optimum return on the data processing investment." (4)

The need for an "Information Systems Plan" was indicated to determine how one department can benefit from sharing data with another, and how senior management can benefit by gaining an organization-wide view.

The need to manage data such that it could be shared by all Civic Departments was expressed. In addition, the need for "data management" and recognition of data as a corporate resource was also emphasized. "The data management function would include formulating policies and procedures for consistent definition, sourcing, technical implementation, use, updating and security." (5)

A top-down methodology was used to develop the long range plan. The steps were as follows:

1. Obtain ISCC direction and over-all agreement with the study objectives, methodology, and outputs.

2. Initiate contact with senior management in the Civic Departments and conduct first round interviews to ascertain over-all departmental position and direction.

3. Interview senior and middle management personnel in order to:

   a) Determine over-all levels of satisfaction with existing computerized systems;

   b) Determine individual department's over-all goals, objectives and responsibilities. "New" system candidates were identified as a result.

4. Where necessary, further analysis of new system candidates was conducted.

5. Once a total inventory and evaluation of existing systems and new candidates was developed, an integrated approach was taken to formulate the plan. (6)

The "integrated approach" was defined as looking at data and systems across the various functions and civic departments to identify common needs. As a result of this approach, systems would be developed to meet the needs of multiple users.

Despite all the preamble discussing data as a corporate resource and the need for data management, the Long Rang Plan simply became a "wish" list of computer systems which were assigned priorities. The Long Range Plan was not developed around the business functions of the various departments and their data requirements, but from a list of

computer applications that departments wanted implemented for themselves. This system development direction was stated in the plan itself:

> Since a total information architecture cannot be developed and implemented at one time, the City must set priorities for the development of systems and data bases. To set priorities, a list of projects has been developed and evaluated against priority criteria. These prioritized projects form the base of the plan. The plan is not considered unchangeable; it simply represents the analysis of needs and requirements at a given point in time. (7)

The Long Range Plan simply became a vehicle to identify and priorize potential candidates for systems development and to provide estimates of the costs involved and the time frame required to develop identified information systems. (8)

One of the main themes stated in the Long Range Plan was an "integration approach". This was mentioned as a way to formulate the plan, and systems were to be evaluated on their ability to share and integrate information. However, this objective was not realized. The result of the Long Range Plan was a list of disjointed computer systems which were assigned a development priority. The Plan came close to recognizing that some systems could be potentially integrated by categorizing them as "land-based" or "geographic database systems."

> Many of the systems and much of the data the City of Winnipeg generates and maintains today, is land related. That is, the data can be tied to a physical location or piece of land. For example, property tax is directly related to a specific parcel of land; fire hydrant locations and associated watermains are also directly located and related to physically fixed locations.
>
> The common ties and integration come into play when there is a need or an advantage, for departments to share data. By accessing data by its physical geographic location it is possible to access data from the other data bases linked together under this system. For example, if the Streets Department was looking at replacing a road they could also access data from Underground Structures and Waterworks to determine locations of cables, watermains, etc. (9)

However, the Long Range Plan did not indicate how these land-based systems were to be integrated or developed in connection with each

other. In fact, the priority given to these land-based systems did not make sense:

> One of the major problems with the Long Range Plan was its positioning of the "computer aided mapping" relative to the other systems. This component will form the main foundation for the "facilities management" based systems, and therefore should be given a higher priority" (10)

In March, 1985 a final Long Range Report was submitted to ISCC. It included sections titled Guidelines and Procedures for System Development, Technical Organizational Strategy, Project Management, Cost Summary and Development Schedules, and Priority Lists. The Board of Commissioners considered the report and subsequently generated their own list of prioritized systems different from the Long Range Plan. (11) This essentially eliminated any "integration" considerations which may have been planned in the original priority ratings.

PROBLEMS WITH THE LONG RANGE PLAN

As part of the final report submitted to the Board, there was a section entitled "Appendix A- Guidelines and Procedures for System Development", which was subsequently approved by the Board for publication available as a standard to all departments. This section dealt with the Systems Automation Process and outlined the approval points for system development, as well as the process by which the Long Range Plan would be updated. It clearly stated that the responsibilities for the maintenance of the Long Range Plan lies with ISCC and that priorization of new development candidates will be done on a quarterly basis by that committee. (12) However, it now appears that ISCC has faded away, without any official notice or recognition. This is evident by the fact that the committee has not met for well over a year and the Board no longer directs computer related matters to this Committee.

Subsequent to the Long Range Plan, there were a number of activities which had occurred in the Computer Services Department, and the City as a whole, which impacted the validity of the Long Range Plan.

1) Land Based Information Systems Study
2) Establishment of a Data Resource Management function
3) The development of computer systems on microcomputers located in Civic Departments

The Land Based Information System Study covers a large majority of systems that the City will develop and impacts a number of systems that were initially identified in the Long Range Plan. This study is unique in that it is also the first city-wide study to follow a true data-driven integrated approach:

> The Land Based Information System (LBIS) concept is based on the premise that the majority of City information and procedures contain a geographic component and can be represented in a mapped or graphical fashion. This information may be analyzed based on location whether the location is a precise spot, a property, a street, or any other definable area. A Land Based Information System would store all land-related information on a common geographical reference system in a database(s) accessible to all users. Various computer systems that perform automated mapping, geoprocessing, or facilitate management tasks would then access and manipulate this data. (13)

The main difference in the LBIS process from the Long Range Plan is the methodology used to determine system development and data integration. The Long Range Plan established a "wish" list of applications from different departments and priorized them primarily based on individual department benefits and costs. The Land Based Information System approach first determined the individual business functions from the various departments and then analyzed them to determine common business functions and data exchanges. As a result, "foundation" systems which would facilitate the integration of data and the development of common systems, were identified. This analysis changed the system priorities identified in the long range plan.

The establishment of a Data Resources Management branch in Computer Services will also change the priorities identified in the Long Range Plan by changing the way systems are developed. The establishment of this area separate from the Application Development area of Computer

Services will also result in changes to the "Systems Automation Process and the System Development Life Cycle." In a data driven system development approach potential systems will be evaluated on their ability to share data and be integrated with other systems. This process will also impact the systems identified in the Long Range Plan as priorities will be identified based on a data driven, integrated approach as opposed to the application based approach used in the Plan.

Only 5 of the 34 computer systems priorized in the Long Range Plan are complete at this time (June 1988). These systems have all been developed using microcomputers with no involvement from the Computer Services Department. These systems, which were not given a high priority by Computer Services, or the Board, were developed in an isolated fashion within Departments. The Long Range Plan did not address system development on microcomputers. In addition, a number of other micro-based systems have been developed which were never identified in the Long Range Plan. Departments are not willing to wait 10 or more years (approximate life cycle of the plan) to get their systems developed. As microcomputers become more powerful, and users become more experienced, a number of larger systems will be developed on microcomputers.

In summary, it is obvious that the current Long Range Plan has not been very effective and does not follow current data processing methodologies. The following are reasons for abandoning the Long Range Plan:

1) ISCC has ceased to operate, and therefore leaves no one to oversee or review the plan.

2) Project development is not following priorities as set by the Board and in some cases systems are being developed using microcomputers.

3) The development of the Long Range Plan was not consistent with Computer Services Department's current Data Resource

Management direction (i.e. data driven system design and development).

4) The Long Range Plan did not consider or include any micro-computer development - something that has been ongoing inspite of the plan.

5) Systems developed around common business functions, such as the current direction in Land Based Information Systems, are not addressed in the Long Range Plan.

CORPORATE INFORMATION AND DATA INTEGRATION

Currently, the issue of corporate information and data integration has not been resolved within the City of Winnipeg. Unfortunately, few systems have been established which recognize productive interdepartmental automated data exchanges and require that these take place. The lack of progress to date in this area has been largely the result of the refusal of many departments to look beyond their own four walls. The problem has been compounded by persistent departmental attitudes which claim that the individual department, not the City as a whole, is the "owner" of the data which it creates. Moreover, no department or individual has been given the mandate to ensure that new or existing automated systems are integrated across departmental lines. In addition to allowing the sharing and exchange of data, integration would also allow the City to take advantage of economies in overall data base development and computer system development. The lack of a policy or plan for system integration has resulted in the development of recent mainframe computer systems which are not compatible, and also in the loss of potential integration of microcomputer systems already developed. The corporate data residing in these microcomputer systems located in different Civic departments is totally inaccessible, and in some cases unknown.

In the past, computer files in the City were designed for specific applications. Most of these applications were designed for individual

departments, therefore, the files usually reflect one department's perception of reality. This results in many different files containing different values of the same information, if their updating is not controlled in a consistent manner. "This situation can lead to individual departments presenting different views of the "true" situation, and to management becoming understandably skeptical as to the value of their computer system." (14) An example of this redundancy, is the existence of eight separate property based mainframe computer systems in the City all containing information on a property address. In numerous cases the address for the same property does not match.

Effective management and strategic integration of the City's data will not only minimize redundancy but also maximize the useability of information. Proper data management can provide accurate summaries and analysis when requested by middle and senior management. Some queries by middle and senior management can often be answered only by combining data from two or more files. "Problems of consistency arise even within one department, but when more than one department is involved the data may also be defined differently, and it is often impossible to reconcile the different views." (15) This lack of integration between computer systems and files have caused problems for City departments in numerous instances where such analysis has been required.

> This was particularly evident when attempting impact analysis during the recent reassessment. The required data was spread over a number of computer files, and in an inconsistent fashion so as to make correlating Assessment and Taxation data very difficult (16)

Instead of being stored in departmental files (either on the mainframe or microcomputers) which are difficult to access and may contain different values and meanings, the City's data should be available on a corporate wide basis. However, appropriate safeguards for sensitive and confidential information should be provided.

Proper data resource management in the City would increase the value of data by insuring that it is defined in a consistent manner. In addition, data could be made more accessible to end-users through the

Information Centre to access on either the mainframe through user-friendly programs, or down-loaded to a microcomputer. An added benefit from data management is the reduction in computer program maintenance by separating data specifications from application programs, which allows both to be changed independently. (17)

The concept of "Data Administration" is not new to the City of Winnipeg. In a report entitled "Interim Report on Long Term System Development Planning" reference is made to the need for the establishment of a "Data Administration" function as "problems associated with data administration are not currently addressed in this organization." (18) These concerns have also been expressed by external policy evaluators. A recent Auditor's report makes a point of recommending that "the management of the City's data is deserving of immediate attention." (19)

The City of Winnipeg - Computer Services Department does not have any formal "Data Administration" function, policy or position established despite the strong statements indicating the need for one. However, the recent establishment of a Corporate Data Resources section in Computer Services, and subsequent appointment of a manager, is encouraging. The City's database designers report to this manager, who is also responsible for the office automation function in the City called the Information Centre, which mainly deals with microcomputers in Civic departments. The Information Centre's mandate is strictly to provide guidance on hardware and software purchases related to office automation. This section does not concern itself with the information stored on the microcomputer. The microcomputer section, and the database design role are two separate sections. The database designer only deals with data stored on the City's mainframe computer. As corporate data is also stored on microcomputers, this function should be broadened to encompass all City data regardless of where it is stored.

There should not be a dividing line between data processing and office automation regarding the management of corporate information. The

recent combination of the City's Database Designers and Information Centre staff under the Corporate Data Resource Division of Computer Services holds some promise for the future combination of both microcomputer (office automation) and mainframe computer (data processing) based information management. Although presently these two responsibility areas have no formal ties to each other apart from sharing the same manager. In fairness to this section, however, due to time and staff constraints, just managing the mainframe data will be a difficult task.

One of the first requirements of the Corporate Data Resources Section is to acquire a Data Dictionary to record and manage the City's data. An additional priority is to change the application development process from an application driven process to a data driven process. When developing systems, management of the City's information must include consideration of the need for high level decisions based on related data in one or more systems. The responsibility for recognizing and integrating these requirements at an early stage are part of the data administration function. The first step in this process is to modify the Department's "System Development Life Cycle" guidelines to include a data administration role for the Corporate Data Resources section.

OFFICE AUTOMATION AND MICROCOMPUTERS

In 1982, the Board of Commissioners gave the Computer Services Department the mandate to manage the Office Automation process. At this time the microcomputer had barely entered the market and only a handful were in use in the City. In 1982, there were two permanent User Consultant positions to provide microcomputer support and direction. There are now over 200 microcomputers across various civic departments, some connected to the City's mainframe. In addition, this area is also responsible for services to "end-users" accessing the City's mainframe computer using terminals. The number of terminals has also grown dramatically, with over 500 terminal users across the City. "Demand for user-oriented services long ago exceeded the supply" (20) The

Information Centre (within Computer Services) is understaffed to properly assist the users. Today, there is only one permanent User Consultant position. The second position was replaced to create the Manager of Corporate Data Resources. Two temporary User Consultant positions have also been added. At a minimum, there is a need to recognize the necessity of these positions, and formalize their role by giving them permanent status in the staff establishment.

Over the last five years, various initiatives have been implemented by the Computer Services Department in the Office Automation area: Council, and Committee Minutes entry and retrieval, Electronic Mail, user training in microcomputer software and central computer information access; microcomputer feasibility, acquisition, installation and support for over 200 systems; establishment of a Standard Product Line and Standard Offer; and introduction of standardized Word Processing techniques across all Departments. (21) Because of the demands placed on this area for new computers and support of existing ones, a number of required services are not being provided, such as training, demonstrations, and research into new software and hardware.

The only written policy regarding office automation and the role of Computer Services Department is the one published in the "Standard Product Line" document developed by the User Consultants in the Information Centre of Computer Services. In addition, the Board of Commissioners adopted procedures for the acquisition of microcomputers which involve the submission of a Feasibility Analysis to Computer Services for approval. The specific responsibility of the Computer Services Department is to assist the Civic Departments in microcomputer acquisition by:

1) Provide guidelines and an approach to assist in conducting a Feasibility Study;

2) Provide a product line of equipment to address requirements;

3) Assist in selection of equipment and planning of an environment, and;

4) Provide training.

The individual departments are required to:

1) Document and quantify benefits/costs;

2) Acquire the funding for the acquisition of the computer hardware and related software;

3) Insure that adequate provision is made to train staff and that where appropriate, the Personnel Department evaluate proposed changes in function;

4) Realize and achieve the documented benefits, and;

5) Develop, operate and maintain the systems with minimal consultation from the Computer Services Department. (22)

The City of Winnipeg requires that users complete a feasibility study before the purchase of microcomputer equipment. This study, which examines the potential costs and benefits of the microcomputer system, is reviewed by a "User Consultant" in the Computer Services Department. The system's improvement identified in the feasibility study must either cause revenue to increase, or cause total costs to decrease. The following are a list of the procedures adopted by the Board of Commissioners for the approval and acquisition of microcomputers:

a) Feasibility Document completed by user and forwarded to Computer Services Department for technical and operational feasibility sign-off.

b) Feasibility Document and sign-off returned to user.

c) Document reviewed by appropriate Commissioner prior to inclusion in the departmental estimates.

d) Once budget approval is obtained, Computer Services Department is notified by Department.

e) Computer Services Department plans a purchase and implementation schedule for the budget year.

f) Computer Services Department acquires and implements all approved micro-computers according to the implementation schedule. (23)

One of the services to be provided by Computer Services is training. However, due to staff shortages, this function has not been available for over a year. Part of the problem is also that many departments buy microcomputers without giving any thought to training. "This training should be seen as a mandatory component of the automation process, and the need to provide this service out of CSD through professional staff should be recognized." (24) One of the biggest problems is that there are no policies on the use of microcomputers.

> The office automation situation is also cause for concern to both Computer Services and senior management of the City. The reason for this is the rapid proliferation of microcomputers into City Departments, with control and strategy as to their usage being lacking. (25)

In the City of Winnipeg, there is a need for central standards and policy regarding system development on microcomputers. In addition there is also a need for Departments to develop their own policy regarding the use of microcomputers, especially if that department has acquired a considerable number:

> In a recent meeting, the Director of a major civic department with over 20 microcomputers expressed concern with the ad hoc proliferation of micros in the department, the random development of inconsistent and redundant systems, and the development of these systems by individuals whose real responsibilities lay elsewhere. Further, there was no management awareness or perspective of the applications involved, and there was no planning or strategy in place for the coordinated and effective use of microtechnology within the department as a whole. (26)

Presently, departments are on their own when developing applications for microcomputers. In a number of cases departments are either relying on "self taught" internal staff for this development or hiring part-time or temporary computer programmers to provide microcomputer system development and support. One main reason for this is that Computer Services does not provide any microcomputer programming support. Computer programmers were specifically instructed that microcomputer development was not allowed. However, with the increase in the number of "temporary" programmer positions being posted, and the pressures to turn

these into "permanent" positions, the Computer Services Department appears to have changed its mind regarding microcomputer system development.

> Computer Services proposes a policy to provide the necessary resources to departments on the basis of an agreed-to service level, through the End User Application Analyst position, funded and justified by the requesting department. Part of the role played by this individual is also to transfer the systems and knowledge gained from one department or branch to an other. By having an overview of what various departments are doing and how they are doing it, Computer Services would be in a far better position to expedite this transfer of knowledge. (27)

This policy of providing an End User Application Analyst position as a microcomputer programming resource will be sufficient for Departments just venturing into the microcomputer field. However, Departments that have a large number of microcomputers and also conduct significant "end-user" computing on mainframe systems, require their own dedicated resource. Presently departments are obtaining this service by hiring "temporary" computer programmers. To date, this has not been an issue with the Computer Services Department. However, the Computer Services Department objects when a department wishes to hire its own permanent computer programming positions.

LOCATION OF COMPUTER PROGRAMMING PERSONNEL

The location of computer programming personnel has probably become one of the biggest information technology issues facing the City of Winnipeg. This issue, is mainly one of centralized versus decentralized computing, where staff, as well as computer processing (hardware and software) are located in Departments. This trend has already started to occur in the City through the temporary programming positions and positions requiring some computer knowledge located in various departments. What has not happened, however, is that Computer Services (and the Board of Commissioners) have not officially sanctioned this direction; it has more or less gradually evolved on its own in the absence of any policy.

One of the main reasons why departments had to acquire their own computer programmer positions is that Computer Services Department refused to do any microcomputer system development. In addition, because of the application backlog in Computer Services, small or moderate mainframe systems were constantly being pushed to the end of the priority list as big projects were being developed. A number of Departments also use their "temporary" programming resources to develop "management information" and perform system enhancements on their existing mainframe systems. This type of ongoing "tinkering" of some departmental systems was not provided by Computer Services.

The issue that has surfaced recently is the conversion of the "temporary" computer programming positions located in departments to permanent positions. Departments wish to convert these positions, to formalize the tasks being performed in organization, and also to ensure the continued support of the resource. The Computer Services Department feels that these positions should be reporting to a "Project Manager" in their department. On the other hand, departments want to maintain control over their programming resources. They feel that they will lose access and "priority control" over their computing resources, if the position reports to Computer Services.

Part of the issue of locating computer resources revolves around the structure of the City of Winnipeg. The City operates like a "confederation" of independent departments. Because of this, there is a constant hostility towards centralization and a drive for more autonomy. The Computer Services Department represents the central authority. Apart from this general hostility, departments also have specific concerns regarding their desire to maintain or acquire computer programming staff.

Generally, departments are concerned about losing a programming resource and about subsequent service levels if this resource reports to Computer Services. The main concern is that departments can suffer from priority shifts due to Computer Services reassigning resources.

Departments also want the flexibility to set priorities within their own departments related to small system development (typically using micro-computers), and system enhancement without going through the "red-tape" of justifying their needs to an outside department (Computer Services). The problem today is that there is too much weight placed on Computer Service's priority setting abilities. Departments also point to the advantage of having a local resource who understands the operations of the Department. This knowledge base is difficult to achieve quickly with an external computer resource. Finally, some departments have indicated that they need some "immediately accessible" local support for in-house trouble shooting, typically on microcomputers.

Computer Services has changed its policy regarding microcomputer development, and now indicates that it will provide this service when required. This theoretically eliminates the need for Departments to hire their own computer programmers for more sophisticated microcomputer projects. Computer Services has also developed a "Service Level Agreement" with some departments to provide them with dedicated computer programming resources. Departments, however, still require non-programming positions as a liaison with Computer Services and to express department needs. Departments have complained in the past that even though the Service Level Agreement guarantees one "man-year" of computer staff support, there is no guarantee when this resource will be available. This one "man-year" could be provided over a three month time period with four programmers. This problem could be avoided if the programmer is physically located within the department. This has also been agreed to by Computer Services under certain circumstances.

The advantages of centrally hiring computer programming staff are more corporate in nature as opposed to directly beneficial to Computer Services. One of the biggest advantages of centralized computer personnel involves the linkage of corporate data. It would be very difficult to determine and plan for data integration and eventual sharing, if all the development occurs in autonomous departments. Central control over all the programming staff would ensure consistent standards are adhered

to in hiring programmers, as well as provide a consistent method of system development and documentation. In addition, computer programming personnel would be kept up to date as far as training and education was concerned.

A form of distributed processing has occurred in the City with the computer team working on the Police Automated Records Computer System (PARCS). A team from Computer Services Department is physically located in the Police Department developing and maintaining their computer system. The main difference in this system from other systems is that this is a "stand-alone" system developed on a minicomputer. However, the concepts of this project can also be applied to other projects being developed on the City's mainframe computer or Departmental microcomputers.

A policy of distributed data processing does not conflict with the current (June 1988) mandate of the Computer Services Department:

> The Computer Services Department assists all City Departments in attaining their management objective by providing the appropriate computer and communication tools and development methodologies. Tools include large mainframe computer solutions servicing hundreds of terminals throughout the City, mini-computers located in individual departments, micro-computers that assist individual employees and voice and data networks that allow for information to be easily transferred electronically. Methodologies utilized encompass the management of both internal resources and outside contractors through all phases of development, from planning through to implementation. (28)

ENDNOTES

1. The City of Winnipeg, Computer Services Department, "Long Range Data Processing / Systems Development Plan for the City of Winnipeg." (1984), p. a-1.

2. The City of Winnipeg, "Information Processing Systems Users Guide", (May 1978), p. 4.6.7.

3. The City of Winnipeg, Computer Services Department, p. a-1.

4. Ibid., p. a-1.

5. Ibid., p. a-2.

6. Ibid., p. a-5.

7. Ibid., p. a-3.

8. City of Winnipeg, Computer Services Department, "Applications Investigations Systems Directory", Version 1.0 (June 1986), p. 1-13.

9. The City of Winnipeg, Computer Services Department, "Long Range Data Processing / Systems Development Plan for the City of Winnipeg." (1984), p. d-1.

10. The City of Winnipeg, Computer Services Department, "Land Based Information Systems/Land Based Business Functions", (June 1988), p. 38.

11. City of Winnipeg, Computer Services Department, "Long Range Plan - A Perspective, (internal document, December 1987), p. 1.

12. Ibid., p. 3.

13. The City of Winnipeg, Computer Services Department, "Land Based Information Systems/Land Based Business Functions", (June 1988), p. 38.

14. C. Jeffers, Chairman Information Systems Cooridating Committee, "Long Term Information Systems Development Plan", (Board of Commissioners Report, January 3, 1985). p. - appendix (not numbered).

15. Ibid., p. - appendix (not numbered).

16. City of Winnipeg, Computer Services Department, Manager of Corporate Data Resources, "A Corporate Data Resources Division Within Computer Services, (internal docoument, 1987), p. 2.

17. C. Jeffers, Chairman Information Systems Cooridating Committee, p. appendix (not numbered).

18. C. Jeffers, Chairman Information Systems Cooridating Committee, "Interim Report on Long Term Systems Development Planning", (Board of Commissioners Report, February 9, 1984).

19. City of Winnipeg, Computer Services Department, Manager of Corporate Data Resources, p. 2.

20. Ibid., p. 6.

21. Ibid., p. 3.

22. City of Winnipeg, Computer Services Department, Standard Product Line, (unpublished) p. A-2.

23. Ibid., p. A-3.

24. City of Winnipeg, Computer Services Department, Manager of Corporate Data Resources, p. 5.

25. Ibid., p. 3.

26. Ibid., p. 4.

27. Ibid., p. 5.

28. City of Winnipeg, Computer Services Department, "Computer Services Department Mandate, (internal document, June 1988)

CHAPTER 7

CORPORATE INFORMATION SYSTEMS STRATEGY - POLICY RECOMMENDATIONS

STRATEGIC PLANNING

THE NEED FOR STRATEGIC PLANNING

An ideal Corporate Information Systems Strategy for the City of Winnipeg "focuses on the alternative future conditions which the organization may face, and the "position" that the enterprise needs to adopt in order to excel in (or, indeed even to survive) those conditions." (1) A Corporate Information Systems Strategy is the first part of a complete strategic planning process which has four distinct parts:

1. The development and management of a set of strategic technical objectives which address specific problems or opportunities facing the organization, or which position the organization to take advantage of new technologies;

2. An application plan, synchronized with the needs of the business;

3. A system architecture plan to assure the orderly and planned use of information technology;

4. An issues management process to enable the organization to respond promptly and purposefully to unanticipated events. (2)

Organizations develop strategic plans because they recognize the external changes that are taking place in attitudes, economic conditions and the information technology. A planned review of these matters is necessary in order for the enterprise to be able to react in time and survive. In government the equivalent might be the ability to foresee changes in public demand for services while keeping tax increases at a minimum.

The lack of a central strategic plan will not be a hindrance to a department using the new developments in the technology such as office automation, or microcomputer system development. However, if there is no plan, the full advantages of information technology, in terms of its

potential effects on efficiency and effectiveness of the government's operations, will not be realized. At a minimum a central plan or strategy would encourage central computer-to-department or interdepartmental electronic communication.

> Consider first the government as a loose collection of departments and agencies proceeding with separate mandates, which it is in part. Separate distinct informatics systems can serve the separate needs oblivious to one another. Next, consider the government also as a necessary connected collection of departments and agencies, subject to at least some common personnel, financial and administrative policies. Linkages between informatics systems that mirror these connections are required if the machinery of government is to advance. Consider as well some of the many ways in which the units of government are related: a common and limited source of operational funds; several major programs requiring interdepartmental cooperation to function; conflicting legislative mandates; and the sharing of some data bases by two or more departments. All of these interrelationships are capable of being supported by informatics technology. (3)

Information should be treated as a resource and should therefore require assessment of the costs and benefits to the organization. Long range information planning, similar to the long range planning that occurs with capital projects (such as roads and sewers) is required. The awareness that the corporate information is valuable, combined with advances in networking technology have resulted in the recognition of the need for integrated computer systems. This necessitates that the City establish "centralized" control or coordination of the corporate information resource or "data base". The centralized control of the information resource could still permit distributed processing of this data using end-user tools such as microcomputers. However, the technology should be in place to allow the sharing of this information throughout the City.

> The day to day operations of many organizations are becoming increasingly dependent on telecommunications and distributed processing technologies. Organizations that consistently apply technology in these two ways do not gain such capabilities by chance. Rather these capabilities are developed over periods of time in which technology has been tightly integrated into the organization's core business activities and strategic planning. It

is unlikely that either of these events can occur without effective planning processes. (4)

In order for the Computer Services Department to provide direction and coordination for the organization's information technology resources, effective planning should develop a consensus among departments regarding the role of information technology within each department and within the City as a whole. The Computer Department's role is to develop and maintain appropriate communications and data architectures for integrating all of the City's information technology products and services. The role of Computer Services should also be to coordinate the departmental activities where interdepartmental data exchanges are required.

Information technology planning should not just take place at the corporate level but within all the civic departments. A large computer project will take a long time from conception to implementation. This process could take up to a year or more. Computer systems could be priorized and planned for local information planning and could potentially reduce this lead time. In addition, because of the added government "red tape" such as the various stages of approval required and the tendering and budgeting process, the aproval time will be longer than under other circumstances. An additional reason for planning is to allow for the potential impact on employees. Even if the intent of the project is not to reduce staff, a new computer system could be disturbing to the employees who are to use the equipment. In addition, training sessions could be planned to encourage worker involvement in the project and thus reduce the potential disruption. "As anyone with any experience in the implementation of informatics projects will know, the most compelling reason for planning is to reduce the possibility of failure, if not disaster." (5)

One of the biggest risks is using the information technology itself as a means of curing all the organizational problems, without properly considering the organizational changes that need to occur. One example

of this is the use of microcomputers as a means to solve departmental information management problems:

> Microcomputers are not, of course, a panacea to cure all local government ills or solve all problems. They must be installed with planning and forethought, with a basic understanding of their capabilities and limitations, and with a grasp of how they relate to the entire organization. Properly employed, however, microcomputers can be used to improve performance and increase productivity in virtually any size organization. (6)

Therefore the introduction of microcomputers has to be planned and managed in order to avoid any disruptive effects and to achieve the potential benefits. This indicates the need for careful organizational strategic planning. The planning should first place a priority on the changes which may occur in office procedures and secondly on the microcomputer application. Even though these changes in office procedures are taking place as a result of the microcomputer, over night change will not occur in the structure and organization of a civic department. Bureaucratic structures tend to be relatively conservative in order to maintain continuity within any long established government office. Therefore, the organization of a civic department may have to be changed incrementally, and over an extended period.

> The prevailing hopes that somehow important structural changes in bureaucratic organizations will happen through the injection of new technological means in management is largely a myth. (7)

CONSIDERATIONS

There are a number of important considerations when undertaking strategic information systems planning. First, strategic planning is not static, but part of an ongoing planning process. "Given the public sector's shifting priorities, particularly when public opinion is involved, it is necessary to continually reevaluate the direction of plans." (8) Secondly, all corporate information strategic plans must have the support of senior management:

> The director or manager responsible for information systems must be part of the senior management team that develops programs and operational plans for the organization. It is not fair to expect a manager who does not have immediate access and input to business plans to set priorities for the development and implementation of information systems. (9)

Finally, all elements of information technology should be included in the strategic plan. In other words, both microcomputer and mainframe applications should be included in the City's strategic information systems plans.

> Look for opportunities where microcomputers may be able to support selected requirements of the company MIS programs and the company office automation strategy. Evaluate and expand the use of wordprocessors in appropriate areas. Examine the potential costs and benefits of linking microcomputers into a company network. The rewards of potential advanced capabilities are shared files and electronic mail. (10)

One concern with long range strategic planning is obtaining the approval from the civic politicians. Within the City government system, the elected politicians are the ultimate bosses. They are responsible for the resource allocation by setting the mill rate for the City and determining the final budget. This political fact can sometimes be a detriment to long range strategic planning as some governments do not really want long term planning. They are interested in only short term solutions which will keep them in office as long as possible. (11) Therefore, a major consideration of the strategic planning process should be the involvement and education of politicians. This would hopefully reduce the "short term bias."

CONCLUSION AND RECOMMENDATIONS

CONCLUDING REMARKS AND POLICY DIRECTION

The developments in information technology discussed in this study present an increasing range of choices and alternative configurations for applying this technology to City business activities. These developments also increase the requirement for the City to manage information

technology in order to avoid making the wrong choice. The City is confronted with new risks and cost pressures arising from inappropriate technical choices, poorly designed applications, lack of coordination, inadequate end-user training, and systems which do not meet the organization's needs. Costs are also on the increase for system maintenance, processing and communications as the City's dependence on information technology accelerates. In addition, the City is also under external pressures to increase productivity, provide more services, or provide the same level of services while keeping tax increases to a minimum.

These risk and cost pressures indicate the need for the City to develop a corporate information systems strategy to manage its information technology. A corporate information systems strategy is also required to manage the development of computer applications. Data management is no longer exclusively the role of the Computer Services Department, but is being distributed (by default) to Departments who are acquiring inexpensive microcomputers or other forms of information technology. Given these trends in distributed processing, the City must adopt a strategy of supporting end user self-sufficiency, and a strategy of coordinating the end-user development so that corporate information can be shared. This will result in a change in the role of Computer Services Department from its traditional central service role to one of coordinating end-user information processing.

The City needs to develop policies which recognize and encourage distributed development to take advantage of these "islands of productivity." Ignoring this trend, or trying to curtail it, will not stop it, but drive it underground. The City would be going against the trends in the industry of "end-user computing" if they did not recognize the desire of departments to have some control over the development of their own systems. In addition, because microcomputers are becoming more powerful, departments are not limited to just developing small insignificant computer applications which are of little interest to the rest of the City. Departments are capable of developing large information systems containing important "corporate" information.

The City should also recognize the importance of corporate data and the need for information management regardless of where it is located. Corporate information is not only stored on the City's mainframe computer, but also on minicomputers and microcomputers, which are located in almost every City department. Control over this "corporate data" has to occur or it will be lost in the computer systems of isolated departments. The potential of integrating this "corporate data" so that it can be shared by many departments should be recognized. Data integration has the potential to increase productivity and reduce costs, by eliminating the need for duplicate databases. In addition, data integration can also provide the potential to coordinate projects from different departments, such as the land-based example of street, watermain or underground electrical cable repairs.

The City of Winnipeg needs to adopt an information technology strategy which will provide the technology necessary to connect all the departmental stand alone computers (microcomputers) to the City's mainframe computer. This would facilitate the transfer and exchange of information which is now isolated on microcomputers. The City of Toronto has adopted a policy similar to this in their "Corporate Information Systems Strategy":

> With the exception of a few work stations dedicated to end users who do not, nor will, require access to the corporate data base, all computer terminals (including microcomputers) installed at the City are connected to the main computer. In keeping with the corporate goal, future work stations will include interfaces necessary for communication with corporate databases. (12)

An information systems strategy should not only focus on the technology required to integrate information. The following key components should be part of the corporate information systems strategy:

A. A data and application strategy to improve the usefulness of information and to improve the utilization of systems development resources.

B. A computing operations/network strategy to adequately service City needs.

C. An end user computing support strategy to manage the transition to a much higher level of end user computing self-sufficiency.

D. An organizational strategy to provide the structure necessary to deal with the changes technology will bring. (13)

The development of an information systems strategy should not be limited to only a City-wide approach. Departments should also develop their own internal information technology policy, which would complement a city wide policy. This policy could include direction on: 1) which information systems or services to purchase; 2) the department's relationship with the City's Computer Services Department; 3) the level of in-house technical expertise to acquire, 4) the level and type of staff training needed; 5) how hardware and software purchasing decisions are made (who has the final say); and 6) further department systems development and priorities. (14) Each departmental plan and proposed project could then be reviewed and priorized by the Board of Commissioners. Then, for each new project approved the Board should authorize that:

1) the user department be made solely responsible;

2) the funds for staffing and all other expenses for the project be placed in the budget of the user department;

3) that the user department be free to approach Computer Services as one potential resource among many, for all of their staffing, hardware and software requirements. (15)

This strategy would ensure that departments are accountable for their own system development. This strategy was presented to the Board in 1985 by the Chairman of ISCC, but never officially accepted. However, the trends of current system development indicates that it has become the accepted approach. Although departments would become more accountable for system development, the Computer Services should play a role in identifing corporate data and integrating the system with other corporate information. One of the problems of the Board making the final decision on computer system development and priorities is that there is

a potential for little or no input from the Director of Computer Services in the systems developed.

> The managers running the management information system (MIS) function have not traditionally had a seat at the executive management table; they have not been involved in those policy and program formulation decisions that directly affect the direction of their work. We are now seeing signs that this situation is changing in the private sector. However, the public sector still lags far behind. (16)

Instead of giving the Director of Computer Services a seat on the Board of Commissioners, which is highly unlikely given the governmental structure of the City, the Board could be made more accountable for system development and data integration. One way of achieving this is to recognize the importance of the central coordinating and policy setting function of Computer Services and to change their reporting relationship back to the Chief Commissioner. Another suggestion to increase the accountability of the Board under a distributed environment, is to assign the Commissioners an allotment of computer staff to work on system development. The Commissioners could then decide where (i.e. which Departments under their jurisdiction) to allocate this staff for new system development. This concept would be similar to the "resource envelope" system used by the Federal Government for program budgeting. Under this concept, each City Commissioner is allocated a fixed amount of "computer resources" (staff and money) to distribute to departments under their jurisdiction. However, care should be taken to ensure that systems developed can be integrated with other systems and that corporate data is shared among divisions.

In order to develop an internal information systems strategy, the first step is for departmental managers to develop their own "in-house" computer capabilities, including programming expertise and a local information system coordinator. This would allow them to manage their organization better, such that development and implementation of microcomputer based systems could be handled by staff directly under their control and authority. Otherwise they may be at the mercy of external experts, in the form of consultants or Computer Services personnel, or

face internal competition for microcomputer supremacy. Department objectives and priorities can be planned better when they are directly under the department manager's (or director's) control. Therefore this information system coordinator function should also report directly to the Department head. As discussed previously in this study, once departments have recognized the need to control and manage their own information processing, they are ready for distributed data processing. This would involve delegating some of the responsibility for system development and maintenance to the departments, as well as involving the relocation of computer programming staff to departments.

One of the issues concerning the distribution of computer staff to departments is coordination of the programming efforts such that corporate data can be integrated. What is required is a policy that provides central control and coordination, yet also guarantees that departments will also have some control over their own computer requirements and flexibility to set their own priorities. A conscious policy of "distributed" processing could provide the City with the best of both worlds. Distributed processing combines centralized control with coordinated decentralized processing and staffing. Distributed data processing involves the placement of Computer Services resources in user areas allowing for communication between the areas and to a centralized group who provide guidance and coordination to the dispersed activities. (17)

In the absence of any Computer Services programming staff located in departments, the Computer Services Department can also control end-user application programming through "soft controls" which encourage proper programming standards. The following are some suggested measures:

1. Find and promote tools, such as easy-to-use database management systems and application generators, that users can learn quickly.

2. Sponsor newsletter listings, catalogs, and on-line directories of applications developed by end users. Give monthly awards for the best new programs.

3. Make departmental managers aware of their responsibilities for ensuring the security, integrity and documentation of user-developed applications.

4. Promote application prototyping by micro users. Programmers can use such prototypes as signed-off design specifications, and recode the applications to run on larger machines.

5. Find application development tools that are simple enough for end users but that generate codes that can be optimized by system professionals. (18)

The Computer Services Department should not attempt to develop corporate plans and policies in isolation from the rest of the City. As the technology is being dispersed throughout the Civic departments, so should the responsibility for corporate information policy. The City should establish a Corporate Information Technology Strategy Committee as a forum for managing the implementation of corporate information systems plans. This committee should not have the responsibilities similar to the Information Systems Coordinating Committee (ISCC) which was established to review system development plans and settings system priorities. The Board of Commissioners should be responsible for these decisions. However, the committee should have the mandate for:

1. Reviewing and coordinating information technology issues that have a corporate impact, as well as departmental information technology strategies.

2. Advising on corporate priorities for information technology.

3. Providing a forum for senior level information/communication between the Computer Services Department and City Departments. (19)

This senior management systems coordinating committee was identified by Nolan as a sign of a mature organization. "The senior management steering committee is an essential ingredient for effective use of data processing in the advanced stages." (20)

RECOMMENDATION FOR ORGANIZATIONAL CHANGE

The following are some specific recommendations for the City of Winnipeg to adopt in "Corporate Information Systems Strategy". These recommendations are not all encompassing, however, they represent a first step in addressing some of the problems identified in this study:

1. That Computer Services Department ensure that the system development process reflects data driven development, such that corporate data can be identified and integrated into other systems where appropriate.

2. That Computer Services Department create the position of Data Administrator to manage corporate data (using a data dictionary) on all hardware platforms: mainframe, mini and micro computers.

3. That micro-based system development be documented and recognized, and included in any future long range application development plan and data administration activities.

4. That Application Development and Support also encompass microcomputer development and support where appropriate.

5. That the Computer Services Department encourage the distribution of computer programming personnel to Departments for system development and support, where departments have demonstrated a "maturity" to accept this responsibility. The computer programming personnel will remain under the jurisdiction of Computer Services.

6. That Departments direct the support, maintenance, and small system development functions of distributed computer programming personnel, provided that this development does not remove resources from large projects and it follows adopted standards.

7. That Computer Services formulate guidelines for end-user system development and promote tools that facilitate end-user programming.

8. That Departmental Data Processing Sections be encouraged to develop and that these sections be headed by an Information Systems Coordinator (or similar position). The role of this section would be as follows:

   a) Recommend to the Director a departmental system development plan on a year to year basis.

   b) Provide recommendations to the Director on priorities for:

      1) hardware and software acquisition;
      2) resource utilization (including equipment and staff resources).

   c) Provide a communications vehicle regarding projects underway in each area to allow for sharing and expertise.

   d) Establish departmental contact with the Computer Services Department's Information Centre to keep the department informed with overall City policy.

9. That each Departmental Data Processing Section, with the help of the Information Centre, develop the following reports for the guidance of the Departments:

   a) Guidelines for microcomputer system development:

      1) standards for feasibility studies;
      2) standards for file development and backup procedures and;
      3) standards for documentation.

   b) Word processing standards and procedures which would include:

      1) file naming standards and maintenance of a log book;
      2) printing of drafts and final reports; and

3) identification of priority tasks (e.g. avoid tying up machines with short letters and memos).

10. That the Computer Services Department expand the role of the Information Centre to provide the following services:

a) Consulting on system design and implementation;
b) Recommending computer configurations to meet specific needs;
c) Assisting users in the selection of hardware and software products;
d) Explaining policies, procedures and standards;
e) Assisting users in the development of proposals for new applications;
f) Considering suggestions for service improvements;
g) Providing technical assistance to specific hardware problems; and
h) Produce a directory of microcomputer systems in the City.

11. That the Personnel Department assist in creating a position of Information Systems Coordinator or modify existing positions within each department. The duties of this individual will be to:

a) Coordinate all the planned applications in the department;

b) Inform the users within the department of City activities, policies and standards;

c) Report to the Director of the department on system projects, priorities, and acquisitions.

d) Assist users with microcomputer and mainframe "end-user" problems.

e) Act as a liaison between departmental users and the Computer Services Department (such as the Information Centre or Application Development and Support).

12. That the Personnel Department develop a job stream for departmental computer related positions (i.e. Data Coordinator) or assist departments in amending existing job descriptions to accommodate changes in responsibilities as a result of the acquisition of information technology (i.e.microcomputers).

13. That the Personnel Department in conjunction with the Information Centre provide training courses in aspects of microcomputer operation (such as specific software applications) and encourage employees (through full reimbursement) to obtain a higher level of training at outside learning institutions.

14. That the City establish a Corporate Information Technology Strategy Committee to manage the implementation of corporate information system plans. This committee could also resolve any "corporate data" issues, such as the reluctance of a department to share information.

15. That the Computer Services Department modify their microcomputer "feasibility study" to emphasize more qualitative benefits and also identify departmental training requirements.

16. That the Computer Services Department conduct a post-implementation review of the benefits identified in the feasibility study.

17. That the Computer Services Department establish special committees to encourage user involvement in setting corporate microcomputer directions. (Some Committee examples are: Computer Aided Drafting/Design, Desk Top Publishing, and Word Processing.)

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Carroll, William, Director, Waterworks Waste and Disposal

Cohen, Mark, Manager of Corporate Data Resources, Computer Services

Dowdall, Keith, Manager of Branch Operations, Finance Department

Dyck, Dennis, Manager of Systems and Standards, Assessment Department

Herzog, Wilf, Organization Analyst, Pesonnel Department

Jeffers, Cliff, Research and Policy Analyst, Board of Commissioners

Kozmet, Frank, User Consultant, Computer Services Department

Laird, David, Manager of Organizational Studies, Personnel Department

Simmonds, Russel, Director, Social Services Department