THE UNIVERSITY OF MANITOBA

AN INFORMATION SYSTEM FOR URBAN PLANNING

"AN IMPOSSIBLE DREAM"

by

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TO MY MOTHER

MARTHA ZAZELENCHUK

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INTRODUCTION

One of the major tasks facing individuals involved in City Planning today, is bridging the gap between the enormous volumes of information being generated and the effective application of this information to a rapidly changing urban environment.

The purpose of this thesis is to address urban planning and the information problem, and to assess a possible solution, namely integrated information systems.

During the past several years the conception and practice of City Planning has undergone quite a dramatic change. Much of this is due to the modern crisis of our city, which is growth. Accompanying this growth, our way of life, our society and our environment as well as our expectation has become increasingly complex. Also there has been a growing awareness of the intricate interrelationships inherent among the various components of our city and the effect that one has upon the other. The city is being perceived more than ever as a complex system.

City Planning which is a process of decision making related to control and shaping of our cities' environment has thus become increasingly more complex and comprehensive in approach. It has shifted away from a single oriented objective such as Development or General Plan to a more intangible process oriented discipline. It is now more of a continuous process directed toward more flexible

goals and is therefore subject to continuous evaluation, monitoring and revision. It is also broader in magnitude and encompasses more and more disciplines such as economics, sociology, political science and environmental studies. No longer is it restricted to architecture, engineering and urban design.

Concomitantly the planning process and the role of the planner have also changed. The development of more objective planning methods has led to a lesser emphasis on the subjective judgement of planners.

Planners are now doing more things for a greater variety of concerns and are doing this in a more objective and comprehensive manner.

This transformation to more objective comprehensive City Planning has led to new demands for a more analytical and quantitive approach and has forced planners to turn to system analysis and mathematical techniques such as simulation models. No longer is the intuitive judgement and personal expertise of the planner in itself adequate, as emphasis must be placed on the scientific approach as a rational tool.

These fundamental changes in the planning process led to the need for current reliable information as an essential component upon which to base decisions.

An added current phenomenon has been the emphasis on public participation in the planning process. This has led not only to a requirement for an expanded information base but also to a requirement for new methods of disseminating available data and in turn information to a broader spectrum of potential users.

The selected area of study deals with the issue of data and information systems as specifically related to City Planning. The City of Calgary is referenced as a case study to demonstrate the implications of the notion.

The study demonstrates that there is little doubt that information systems are very necessary for City Planning and municipal decision making, and that although much is known about information systems, their components, their design, their problems, information systems are an "impossible dream" in an urban setting due mainly to the complexity with their implementation. This thesis identifies a working definition of City Planning and the need for current information. It then examines the concept of Integrated Information Systems as a theoretical mechanism for meeting this need. In order to establish a clearer understanding of the concept the information system is discussed in terms of its components, characteristics, function, design considerations and benefits. The underlying reasons for past failures in the implementation of information systems are then highlighted and finally the conclusion is formulated that "although information is essential to the City Planning process, in practice,

an integrated information system, at least in the immediate future is an "impossible dream".

The main areas of discussion include:

1. A Definition of City Planning

2. An Identification and Discussion of the Information Problem

3. An Overview of Information Systems as a Solution

4. A Discussion on the Fundamental Components and Design Considerations of an Urban Information System

5. A Case Study

6. Implementation Problems which make Information Systems "An Impossible Dream"

CHAPTER I

PLANNING

A. A NEW LOOK

It is recognized that there are many planning definitions or styles including incrementalism, advocacy, transactive, strategic, to name but a few and that no single definition has been universally accepted. The purpose of this chapter is therefore to establish a practical definition of urban planning as perceived in this thesis. Planning is a difficult term to precisely define because it implies different things to different persons and disciplines. There are, however, certain basic notions that are common to all definitions. A discussion of these underlying notions and a definition within the context of this thesis is therefore necessary. Everyone plans - governmental, industrial and commercial institutions, non-profit religious, educational, cultural and political institutions and private persons. The housewife, the baker, the milkman all plan their daily activities, nevertheless the term is difficult to define. Planning is a term that is common to and part of everyday language, however, it is one that is not totally understood. Ironically, this is not only the situation in everyday life but also a contentious characteristic in the "planning field" itself. S. R. Seeley confirms this by stating that "... the planning field as a relatively new profession fares less well due to the multiplicity of incompatible and contending definitions rather than strategic or clusters of definition".[1] This stems from the fact that the concept and practice

is youthful and evolving and consequently is in a dynamic state of definition.

Nevertheless, attempts have been made to define and describe planning. Melville C. Branch viewed planning in very general terms by defining it as "any activity which contributes to the establishment of objectives for the future and their attainment over time".[2] Simon, Smithberg and Thompson were more specific when they suggested planning to be:

> "... that activity that concerns itself with proposals for the future, with the evolution of alternate proposals and the methods by which these proposals may be achieved. Planning is a rational, adaptive thought applied to the future and to matters over which the planners, or the administrative organization with which they are associated, have some degree of control".[3]

Although no definition of planning has ever been universally accepted, most tend to agree that planning, in essence, is future oriented, continuous and a rational process or method which is applied in an attempt to approach some goal or goals.

The working definition that is selected is similar to that expounded by Herbert Gans who described planning as:

> "A method of public decision-making which emphasizes explicit goal-choice and rational goals-means determination, so that decisions can be based on the goals people are seeking and on the most effective programs to achieve them".[4]

Present and most recent theoretical planning thought seems to question this definition, nevertheless it is applicable in that it best represents the perspective of a practising land use planner and thus the perspective of this thesis.

This definition not only identifies planning as a rational decision making process in a continuum, but also as a process that is oriented toward the people for whom the planning is carried out. This hypothesis should also apply to City Planning as reflected in discussion expressed by Fred Goff,

> "City Planning simply means getting ready for the future in city growth. It is the guidance into proper channels of a community's impulses towards a larger and broader life. On that it has to do with things physical - the laying out of streets and parks and rapid-transit lines. But its real significance is far deeper; a proper city has a powerful influence for good upon the mental and moral development of the people".[5]

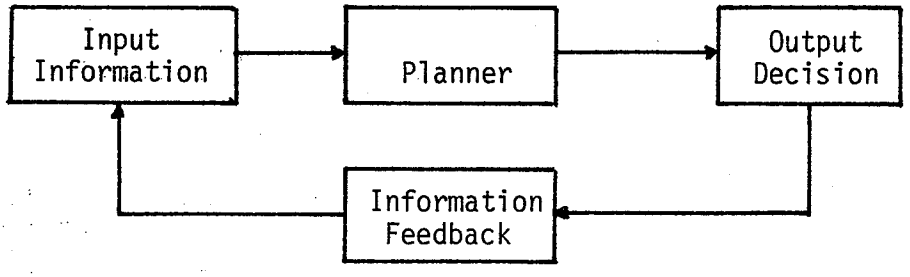
Planning is therefore:

> "A method and process whereby concepts are attained by setting up goals and objectives formulated and implemented through a formal or informal but logical process designed to obtain optimum use of all resources, both human and material, to provide the form of society within present and future political frameworks. Also to resolve problems resulting from the complex inter-relationships of human, social, economic, environmental and institutional phenomena, with a commitment to providing environments responsive to the diverse demands of a pluralistic Canadian Society".[6]

More simply stated, the purpose of City Planning is to draw together available resources, both public and private and to direct them in a coordinated manner toward solutions or problems for the realization of objectives, both immediate and future. The ultimate goal of City Planning as currently understood by the majority of practising planners is to plan for the "total environment of man"[7] which entails a complexity of considerations in the formulation of planning objectives, the plan and policies for implementation, as well as in the decision-making procedures inherent in the planning and development process.

Since City Planning is a decision-making process in which information is combined with experience, judgement and intuition to utilize resources to reach objectives it entails the basic elements of a system or a set of interrelated parts with a purpose. Planning as perceived in this thesis can best be referred to as "Rational Systems Planning" and must therefore be treated as a system.

Figure 1: Planning as a System



In most Canadian municipalities, the planning function is carried out by a specific department established for that specific purpose. In Calgary for example, the Planning Department fulfills this role. Specifically, it is an administrative body whose primary function by delegation of City Council is to advise and assist the Calgary Planning Commission and City Council with regard to the planning of an orderly and economical development within the City. This role involves the Planning Department in a wide range of activities in both the area of policy formation and policy interpretation and implementation. The policy formulation relates to the preparation of policy reports, design briefs, the Calgary Plan, and other specific studies as required by City Council, the Calgary Planning Commission or the Board of Commissioners. The interpretation and implementation of policy involves primarily the processing of various applications such as plans of sub-division, land use reclassifications, development permits, building permits and other miscellaneous permits.

B. THE CHANGING NOTION

During the past several years the conception and practice of City Planning has undergone quite a dramatic change. Much of this is due to the modern crisis of our city which is growth. Accompanying this gorwth, our way of life, our society and our environment as well as our expectation has become increasingly complex. Also there has been a growing awareness of the intricate interrelationships inherent among the various components of our city and the effect that one has

upon the other. The City is being perceived more and more than ever as a complex system.

C. CITIZEN PARTICIPATION - THE NOTION OF PARTICIPATION DEMOCRACY

Political scientists have been recently going through a natural cycle from one of formalized planning to policy making on the basis of opinions and concerns expressed by persons directly affected. This new trend has been based on the premise that centralized planning (decision-making) is no longer adequate as this form is too far removed from the people.

Thus a radical element in the concept of City Planning is an underlying emphasis on the most important component of a city, but one which according to proponents of the concept has previously been overlooked, the people. The White Paper on Unicity presented by the Provincial Government of Manitoba emphasizes this notion:

> "It is the people who make the community not merely the structural forms they have devised over the years to help them accomplish their common ends. Structural forms, governmental set ups, all these things are meaningless in so far as they serve the people who live within them"[9]

The relatively new notion questions the traditional system of planning and democratic government in North America, namely, that of decision making by elected representatives, as these new demands reflect doubts as to whether or not the elected representatives and their appointed administrators are truly representative of public interests.

These doubts are a product of the vastly changing societal awareness brought about by improved communication and higher levels of education. This form of decision making may have been adequate for the provision of caretaker services in earlier days when society was supposedly simpler, since then, the functions of government have expanded and tasks greatly increased; however, the system has remained the same. Sidney Verba notes "the expansion of government interventions in the economic and social life of the nation increase the stakes of participation: the government does more and therefore more is to be gained by having a voice over what it does".[10]

The argument that the average citizen of a large urban centre has limited access or contact with the policy making bodies, namely the government, and even less control over what it does, has been a basic underlying premise for citizen participation in the democratic process.

In essence, what has developed in the minds of the people is the apparent dilemma of participatory government versus representative government as an ideology for a truly democratic process:

> "a professional administration (rule by experts) versus participating democracy (planning with people) is the dilemma of the late twentieth century"[11]

Earl Levin, related effectiveness of government as another important dimension to the issue. He maintained that the crux

of the matter is in achieving a balance between effectiveness and participation, for as he stated:

> "on one hand you have a very effective government with no participation, where as on the other hand you may have participation but no effective government"[12]

There is also a strong school of thought, in both the public and private sector, which advocates that citizen participation in City Planning and decision making should be minimal, and that this function should be in the hands of capable technical experts and market forces. These advocates contend that citizen participation is ineffective in that only vested interest groups are represented and that "unnecessary delays" are encountered in the planning and decision making process. This creates a situation which is intolerable in a rapidly changing technical urban society, in Calgary, for example, delays in land development policies, have at least in part, contributed to the escalating land costs for residential development, as raw land cannot be put "on-stream" at a sufficient rate to meet the demand.

However, whether or not one supports the notion of citizen participation in urban planning and decision making, it is a reality of the 1970's. Therefore, although

> "the complexity and sophistication of functional operations have tended to move policy and decision making to the operational expert, information technology must make it possible for the public and its elected representatives to regain their ability to comprehend and evaluate the options available and to make policy decisions"[13]

Therefore, any dissertation on the urban planning and decision making process must take cognizance of the dual phenomenon of technical expertise versus participatory democracy. As both ideologies have their place in today's cities, a balance between the two must be attained such that a more meaningful decision results through more effective decision making procedures.

D. CONCLUSION

Since planning is an everchanging discipline there are many planning styles and definitions. However, the one used in this thesis can best be referred to as rational systems planning, which implies a rational decision making process. It deals with the many interrelated and complex aspects affecting the urban environment and most importantly is continuous in nature.

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CHAPTER II

THE INFORMATION PROBLEM AND POSSIBLE SOLUTIONS

This chapter reviews the complexity of the planning process and the data related problems encountered. The need for current information is established, and a potential solution is introduced.

A. THE PROBLEM - NEED

In recent years our way of life, our societies and our environment has become increasingly complex and sophisticated. Accompanying this, has been the growing awareness of the intricate interrelationships among the various components which constitute our environment and the effects that one has on the other. Or "that everything on the environment is related to everything else"[14] and "it is increasingly apparent that almost all urban processes are interdependent".[15] Planning decisions are consequently becoming more and more dependent upon comprehensive up-to-date information.

Many attempts in the past to solve urban problems have followed a random, uncoordinated and ad hoc approach often disregarding the complexities of the interrelated aspects. Many of the problems are therefore attributable to the lack of comprehensiveness in the approach. For example, transportation planners have reviewed transportation issues in a city and developed plans and construction programs independent of the efforts of the city planners. As a result of

such a lack of coordination, the urban structure has often been molded without any reference to achieving a well balanced integrated fabric. The problems resulting have clearly demonstrated the need for a "comprehensive planning approach".

The notion of comprehensive planning has varied greatly throughout history. Early classical definitions considered it synonomous with a master plan which implied:

- notion of long range - a guide for long range development;
- priority of capital improvement program;
- program for fiscal implementation;
- regulatory measures such as zoning.

Inherent in early comprehensive plans were the following notions;

- single set of values; which assumes that there is agreement amongst everyone concerned;
- underlying the plan was the notion that it was rational (for example, it does not permit mixes of land uses);
- a public legal document, expressing policy guidelines.

With the advent of vast scale urbanization, notions of citizen participation and advocacy planning, traditional definitions slowly changed. There was an awareness that one set of values cannot really be generated in a pluralistic society and that many plans were much

too rigid and inflexible. Furthermore, at best it is speculative, as it is really difficult to determine what may occur in year 2000.

However, on the other hand, by being rational and orderly, comprehensive planning assists in the equitable allocation of resources in an efficient manner. It provides a tool by means of which various aspects of the city are defined and ensured. For example, if an adjacent area is zoned residential, one can be assured industry will not develop. The most significant aspect of comprehensive planning in more recent years at least, is as the name implies, the totality approach. The urban fabric is viewed as a whole rather than in parts. There is much evidence in Canadian cities of ad hoc development (and apparently ad hoc planning), resulting in discontinuous, unidentifiable and inefficient sprawl.

Comprehensive planning therefore, is not a rigid plan, or a public legal document, it is an "approach" to urban planning. Inherent in its application are the notions of orderly and rational goals and objectives, and the appreciation of the City as a complex network looking at particular areas as part of a whole, not as an entity in itself.

The "comprehensiveness" in approach should in all likelihood lead to a plan, which need not be in the form of an inflexible master plan but rather in the form of policy statements and concepts depicting the goals and objectives of the plan. These may be flexible and can change with the rapidly changing societal values, however, a comprehensive

approach has ensured that all conceivable elements were considered and that the plan reflects these as much as possible.

As the expression of societal values implies, comprehensive planning is not physical planning per se, as it was misconstrued by older schools of thought. Instead it is a planning process which examines all aspects of the urban fabric and their interrelationships within the total urban scene. Goals and objectives are formulated which may be implemented by physical plans, however this is only one means of implementation. The urban area can therefore be viewed "as a system having elements, components and subsystems, which are people, property, government, commercial and industrial enterprise, transportation facilities, and public utilities".[16] Each component performs a function that in some way contributes to the total society demands.

Due to the continuous change that is occurring in our urban areas, planning efforts involve more than just physical planning such as subdivision design and architectural control. Planning is defined in Chapter I as an urban decision making process which involves an evaluation of the cause and effect relationships of the policies and principles that relate to urban problems and underlying the urban fabric in general and directs these policies in such a manner so as to achieve the objectives of the entire urban society. The comprehensive planning approach can thus be linked to a system approach as it examines the city as a total complex system of interrelated economic, social and physical components. The systems approach

> "offers a new way to look at individual large urban problems from all sides, weigh alternate solutions according to their roots and possible consequences, and then select the optimum solution depending upon the relative objectives".[17]

Effective planning may therefore only be achieved through the direction and through understanding of resources related to physical properties, major economic activities, political concepts and social and cultural composition of the regions, all of which reflect the desires and needs or goals of the city's people. The planning process also necessitates the identification, investigation and understanding of the factors which influence these human, economic and physical resources. The importance of knowledge in relation to the planning and development process is emphasized by Waterson who states that with respect to developing regions:

> "planning on the basis of inaccurate data may be worse than no planning at all, since data may not only point to wrong solutions to problems but also create a false sense of complacency and lead to serious rigidities and bottle-necks".[18]

Not only is this knowledge, which forms the basis for decision-making and policy formulation, essential at any one period in time such as when the studies or analysis are being carried out; it must also be on a continual basis. Many extensive studies requiring exorbitant amounts of research are carried out in all areas of Canada on a "one shot" basis. That is, basic research is carried out, with only specific objectives in mind for the particular area and therefore has minimal application on a broader scale. Also, once the information

is compiled and utilized for the particular study, it becomes of little subsequent value as it is seldom, if ever, up-dated. Thus, although it has served an initial purpose in aiding the policy decisions, it does not perform as a mechanism for a basic task of the planning process which is to evaluate the impact of the policies at a later date in order to ascertain whether or not in reality the policies have been oriented in the direction of goal achievement.

Extensive surveys for example, the one undertaken by the Regional Analysis Program for Southern Manitoba[19] provide data for describing and analyzing the situation at a particular period in time. In addition, historical data is often compiled which provides an indication of past trends. In the case of RAP the results were valuable to the Government of Manitoba as a basis for policy formulation related to the Southern Manitoba Regions; however, a major shortcoming of such a data collection program was that, as is often the situation the data very quickly becomes obsolete and nothing more than historical background, as the mechanism for regular up-date and supplementation is not provided for.

Other source data such as that compiled by Statistics Canada is subject to similar conditions as "the decennial census of population and housing provides extensive information about the urban environment but in rapidly changing areas this information quickly becomes obsolete".[20]

Another unfortunate occurrence that has been commonplace in the past, is the ad hoc fashion in which much of the governmental collection and development of information has reached its present stature. Much valuable data is gathered by public agencies in the course of their normal activities, however, each agency is interested only in the data relevant to its own area of responsibility. There is little attempt at interagency communication, to discover if the data needed already exists or to ascertain whether another agency needs data which can be easily collected with minimal effort during the normal operations of an agency.

For example:

> "The assumption that there is a large land use information system is, at least, tenuous. There are "sets" of information from DBS (Dominion Bureau of Statistics), provincial governments, NES (National Employment System), assessors, etc., but they do not compromise a "system" of information with all other sets. The basic problem is how to relate presently loosely linked sets of data".[21]

Furthermore, there is often a duplication in the type of data that is being collected by various agencies, as was observed by Professor B. M. Rotoff in a study related to land use data banking in Manitoba.

> "In this study it became apparent that on one hand, a great deal of data, useful for planning purposes is being collected by the Assessment Branch and much of the data collected by other agencies may be of value for planning studies. On the other hand,

> much redundant data is being collected and much unnecessary duplication takes place. Much effort could be saved if this information was kept by one single agency and be made available to whoever needs it via computer".[22]

One of the more current issues in urban planning relates to the decision making process in our democractic system. A new trend has been based on the premise that centralized decision making is no longer adequate as this form is too far removed from the people. Thus, the citizen participation notion has evolved. Citizen participation is defined simply as a concept whereby people who are affected by planning or decisions should have a more direct say in what is planned or decided. This implies a closer relationship of the citizen with the decision-maker in all aspects of the process: in defining the problem; in stating objectives and in formulating solutions or alternatives to the problem. In essence, the prime objective of citizen participation is to incorporate the people more directly into the decision-making process by decentralizing political responsibility.

Accepting the notion of citizen participation, an essential component for effective implementation is well informed participants. The citizen must have relevant information which is both accurate and up to date readily available. The lack of an effective information system has resulted in poorly informed residents, as the mechanisms are not available to gather, analyze and disseminate the required data and information.

In light of the expressed concerns, it becomes apparent that to accomplish effective urban planning, there is a need for accurate, up-to-date and integrated information. The problems related to the collection, recording, storage and retrieval of information have been experienced by all planning agencies in both the private and public sectors. In order to overcome some of the shortcomings that have occurred in the past it is apparent that the information problem must be addressed using the same systems approach that is required to perform comprehensive planning.

B. IN SEARCH OF A SOLUTION

In order to alleviate and rectify many of the problems outlined, a comprehensive view and understanding of information technology is essential. However, such a view is apparently non-existent and there are no links for coordinating data collection, nor for that matter, storage or retrieval. This lack is not only on an urban scale, but on a national one as well.

This inability to rapidly and efficiently collect vast quantities of current and accurate facts about our complex urban fabric presents a major obstacle to understanding and analyzing the changing environment.

Many analytical tools and forecasting models have been developed over the years which may be applied to urban planning. These include

linear programming, regression analysis, principal component analysis, input-output models to name but a few. However, all of these require reliable updated information. The absence of such facts also hinders public and private urban planners and decision-makers in their endeavours to provide rational and comprehensive alternatives to problems of regional scale. Accurate facts are also required to substantiate and support various policy statements before the public will accept them as being realistic and oriented towards achieving the desired goals.

Thus, what is required is a "tool to aid rapid and efficient collection analysis and updating of vast quantities of data".[23]

In addition, an integral part of sound decision making and meaningful policy implementation is an effective means of evaluation and feedback. "Together, electronic data processing technology and new data systems form a vital feedback link between environment and man, giving man essential knowledge of what is so that he may better fashion 'what it is to be'".[24]

This can only be realized with the aid of comprehensive up-to-date information for purposes of assessing the programs and altering them as may be necessary.

A comprehensive information system, utilizing modern technology such as sophisticated electronic data programming, designed within a "systems" framework can provide such a tool:

> "The 'data bank' movement promises more improvement than merely better immediate decisions about the environment and regional development. It will also enhance professional capability by providing data for research, for better understanding of ecological relationships and for the generation of new planning tools"[25]

Many attempts to solve the information problems have in the past followed a random, uncoordinated and piecemeal approach similar to the approach taken with urban planning and have thus fallen short in many respects. Since the need for information in urban planning has arisen because of a dynamic urban environment and in turn a more comprehensive approach to urban planning, the solution must therefore follow a comprehensive, completely integrated systems philosophy, and must involve a similar approach to both the planning process and the information component.

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CHAPTER III

INFORMATION SYSTEM: A SOLUTION

A. INTRODUCTION

This chapter examines the underlying philosophy of information systems and introduces the nature of an integrated information system.

In general, the field of information storage and retrieval is concerned with methods of creating and managing collections of data to facilitate the recovery of pertinent facts as they are needed. Ideally it is desirable to have both access to amounts of potentially useful data and the ability to retrieve rapidly and accurately the particular data that pertain to each specific need as it arises.

All urban planning, whether comprehensive or partial requires some basic resource data and statistics. The specific kinds of data and information required, and the detail in which these must be accumulated depend to a great deal on the type of planning that is to take place.

While the planner should adapt his planning techniques at first to the state of the existing data bank, "the statistical apparatus should over a longer period of time be adopted to more advanced planning techniques".[26]

One way of arriving at the data needs, is to include in each study or analytical endeavour undertaken, a program or potential listing for expanding and improving the data needed to formulate and implement the next plan or series of studies. Also in order to build up a basic data file for future planning requirements in an organized fashion, foresight is required on the part of the planners, users or decision-makers about the kinds of concerns and areas they will be dealing with. For example, with reference to land use classification systems, Hodge states:

> "The planning process itself has to be studied to ascertain the requirements imposed by this process on a system of land use classification which would be useful to planners in different planning jurisdictions".[27]

B. SYSTEMS PHILOSOPHY

In a very general sense a system is defined as:

> "the phenomenon or idea of an interacting of independent elementary components which form a unified whole with a common goal and purpose".[28]

The meaning of system can be more fully appreciated by a review of its prime characteristics. These include the following:

1. a system consists of various different parts or components;
2. the parts are related and have definite interrelationships;

3. any change in one component is likely to have an influence on another component and/or the entire system;
4. all of the components work toward a common purpose or function which is the prime objective of the entire system;
5. a system is usually complex;
6. each system is usually an integral part of a larger system, thus the principle of sub-systems.

In urban planning for example, which in the context of this thesis is at the administrative level, a rational decision making process for arriving at a set of planning related goals and objectives, a systems approach can provide an ideal method to follow. It can offer a new way to look at individual scale problems from all sides, examine and weight alternate solutions according to their possible consequences, and then select optimum solution, depending upon the predetermined relevant objectives.

C. DATA SYSTEMS

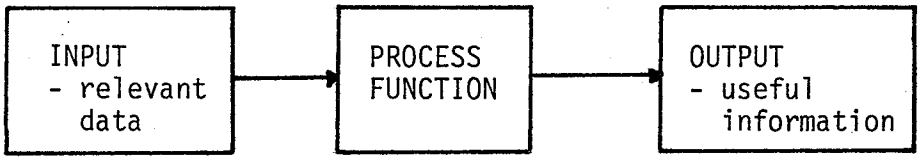
Data may be defined as a set of basic facts about an object, a person or transaction and can include such things as date, name, place, size or amount.

There is no universally accepted definition of the term data base. However, one of the more common ones includes:

" - an organized, integrated collection of data,
- a natural representation of the data with no imposed restrictions or modification to suit a computer,
- capable of use by all relevant application without duplication"[29]

A data system specifically involves data and is concerned with firstly, the capture of data or facts; secondly, the input of data into some sort of processing system, and thirdly, the output of processed information that is in a form useful to the intended user.

Figure 2: Data System Concept



Information as indicated in Figure 2 is processed data. It is produced by comparing, summarizing, grouping, classifying or otherwise processing data into a meaningful form. It necessarily implies the relationship of data with other data. The objective of every data processing system is information. In general, the field of information storage and retrieval is concerned with the methods of creating and managing a collection of records to facilitate the recovery of pertinent facts when required. An information system, however, is not merely a data base.

The contemporary state of information systems is such that at this time, an encompassing definition does not exist. Nevertheless, it can be fundamentally described as:

> "the regulated systematic allocation of data or information and systematic processing (arranging, interpreting, transforming) of these inputs".[30]

Rosove[31] expands upon this by stating that an information system is "the formal or rationally planned means whereby (users) receive and transmit information".

The purpose of an information system is,

> "to determine and provide as efficiently and effectively and economically as possible what management (planners) needs to know"[32]

Efficiency relates to the ability of an information system to capture and manipulate information on a cost effective basis and also at the same time to maximize the use of data. Effectiveness refers to the ability of an information system to provide timely information to each "user" of the organization for whom the system was designed. One of the principal objectives of a system is therefore to bring "relevant data in useable form to the right users at the right time".[33]

An information system, thus, is the total complex in which data are generated, processed, and refined to produce the information needed by the users of the system. Reynolds[34] points out that "the information system is analogous to the central nervous system that coordinates and controls the various components and forms a whole".

Since a systems approach is a method of looking at a certain thing in a particular way in order to achieve a pre-established goal

or an end, in an information system as with a data processing system this desired goal is output information.

Furthermore, since a system usually consists of sub-systems and parallel systems, an urban information system can be considered on one hand as a sub-system of a larger national system and on the other hand as a parallel system within an overriding system of urban organization and management. Also, an urban information system consists of numerous sub-systems.

D. INTEGRATED SYSTEMS

The term integrated emphasizes the relevance of each input into a system to every other input and to the system as a whole, or in the case of information, the relevance of each piece of data to every other piece. It implies that each piece of data should be considered in light of every possible application it might serve. The main reasons for this are to minimize and hopefully eliminate any redundancy in data collection, storage and processing and to increase the overall efficiency of the system.

> "The lack of an integrated approach in the collection and processing of data greatly limited the use of information for regional planning".[35]

The integrated concept is exemplified in Figure 3. In this diagram the core represents the essential link or "funnel" required in an integrated system.

PROPERTY FILE SUB-SYSTEM

CITY OF CALGARY PHASE 1

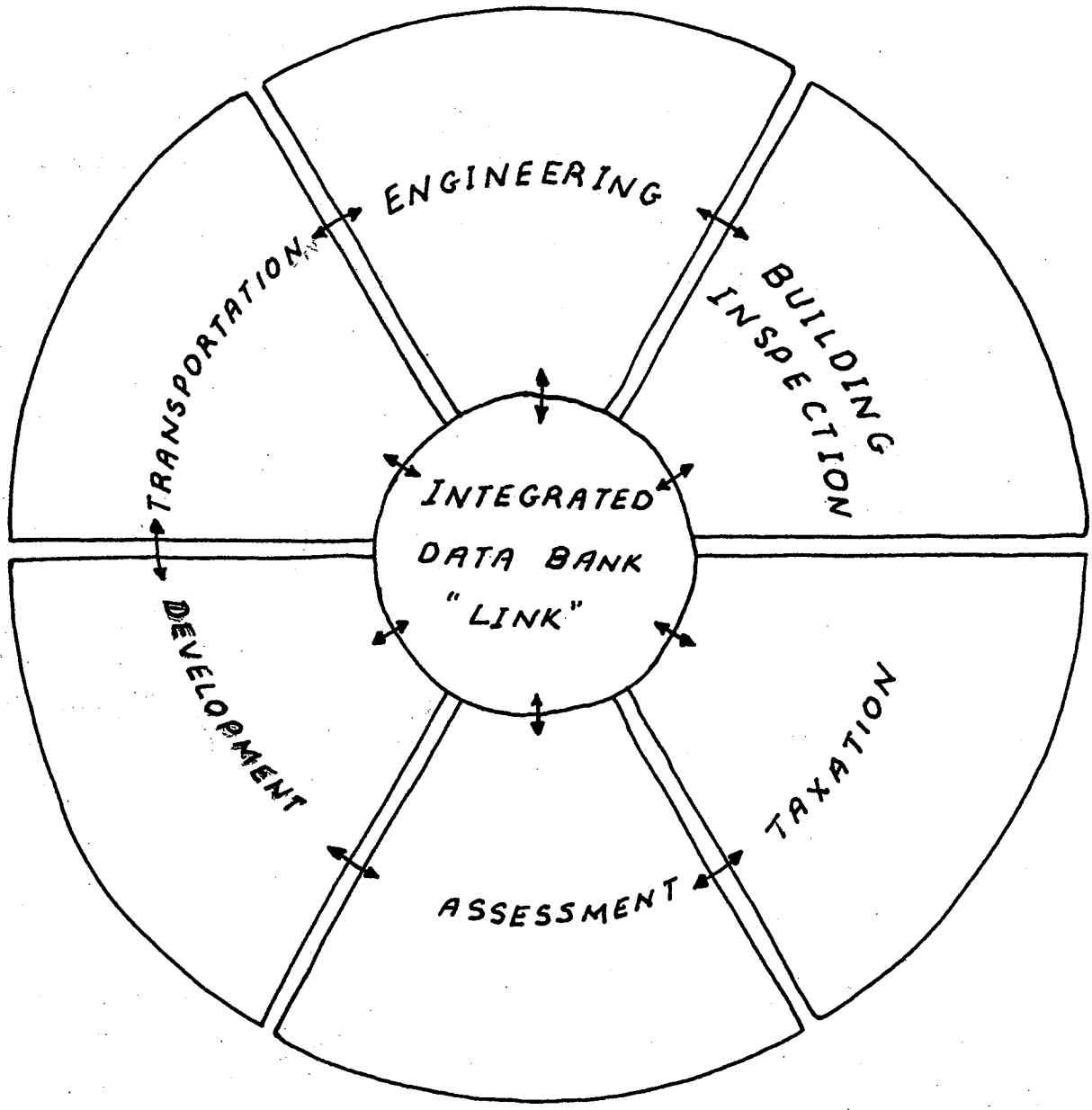


FIG. 3

Integrated Information System

An integrated information system is a system which permits the collection, storage, maintenance, retrieval, and reporting of information from many sources and provides the integrated use of the data to perform analysis and planning functions on a large scale. One of the prime objectives of such a system is to provide up-to-date information as a basis for decision-making and planning. This implies that in addition to its integrative nature one of the most basic prerequisites of an effective system is a built-in capability for continual updating of data, for without this capability any data input soon becomes obsolete and the entire concept of a system jeopardized. A secondary objective of an integrated information system is administration and management controls by not only aiding daily operations but by supplying management and progress reports which can be utilized to evaluate the operation of the particular entity.

E. PLANNING INFORMATION SYSTEM

A planning information system is only a segment of a much broader Information System and is not necessarily the first sub-system to be developed. An information system can be derived from any of the other potential sub-systems such as assessment, taxation or utilities with the planning sub-system linked in at a subsequent time. A planning sub-system is specifically designed to meet the needs of the Planning Department and its functions and other related disciplines. As such

it must be designed and implemented incrementally but at the same time incorporating the objectives and principles of the overall city wide information system.

FOOTNOTES - CHAPTER III

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33. Reynolds, H. D., An Information System for the Management of Lake Ontario, Cornell University, Ithaca, New York, May, 1973, p. 48.

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CHAPTER IV

FUNDAMENTALS OF AN INTEGRATED URBAN INFORMATION SYSTEM TOWARDS A BETTER UNDERSTANDING

The urban information system has been recognized as the answer to the urban information and management problem. Thus in order to better appreciate and understand urban information systems, the fundamental components, ranging from steps in developing a system to testing the system are presented in this chapter.

A. STEPS IN THE DEVELOPMENT OF A SYSTEM

The steps in developing a system essentially involves a systematic approach similar to the planning process followed by rational systems planners. For example, the procedure adopted by the "Project Team" established to carry out a systems study in the City of Calgary Planning Department is outlined below;

1. Decision to develop an information system and a clear definition of the objectives of the system and of the uses;
2. Define the specific areas of concern, and determine how the current method is functioning;
3. Explore alternative ways of carrying out the tasks;
4. Adopt the most appropriate alternative;
5. Implement the new plan;
6. Evaluate and review the new plan continually.

The approach was based upon generally accepted systems theory contained in virtually all related documentation.

B. THE REQUIREMENTS OF AN INFORMATION SYSTEM

The design of any information system which is oriented primarily to planning must be considered as a sub-system of a broader urban or regional system that is developing or will eventually be developed. Specific requirements and objectives of urban information systems vary from one jurisdiction to another, however, there are certain common aspects that prevail;

1. There must be enough information so that the use of computers is feasible;
2. A well designed system will be flexible and lend itself to expansion;
3. The system should be capable of serving a number of users and must be user oriented. "Success must be related to the satisfaction and the creativeness of the intended user of a system, not merely the current users".[36]
4. The system must be tailored to the real users' needs;
5. The system must be designed to work on a continuing basis, providing current and historical data. In order for this to occur the following must be established:
   - understanding of supply and demand for data, "input-output requirements";

- public and private cooperation to assure optimal provision of data into the system and optimal utilization by all potential users;
- adequate communication to assure continuing information flow;

6. The system should not exceed the manpower, equipment and financial resources of the sponsoring agency;
7. The development of any system should take cognizance of other information systems either local or regional;
8. The requirement for central direction or coordination will be increased as the scope of the system and the number of participants increases. In the City of Calgary for example an independent department, Management Systems Development, was formed to carry out the function;
9. The system should be related to the regular operating procedures of the system participants;
10. The system needs full support of participating agencies;
11. The system must have adequate safe guards to protect the confidentiality of the data and to ensure proper authorization for the use of the data;
12. The systems must return some benefits to the data supplier;
13. The system design and implementation must have top management involved;
14. The system development must be plain and simple in order that all participants can understand it;

15. Proper personnel must be hired and motivated, "Look for people who are not inhibited by knowing that something cannot be done or believing that it has to be done in a certain way because that is the way that it was done before";[37]
16. Progress in the system development must occur very quickly in order to maintain the required level of commitment.

In addition to providing up-to-date information an information system should provide a management evaluation and central mechanism for optimizing operations and procedures.

C. FUNDAMENTAL DESIGN CONSIDERATIONS

1. Establishment of Effective Input Procedures

The information system must be designed to work on a continuing basis providing not only historical but current data as well. Suppliers of data or input into the system must therefore be established in order to provide data on a regular recurring basis and thereby avoid the costly repetition of original research such as field surveys. Since this relates to those agencies who actually generate or first record the data it presents considerable difficulty as there are such a wide range of concerns not only in government (all three levels) but in the private sector as well. For example, certain inputs must be provided by Statistics Canada, the Municipal

Assessment Branches, Provincial Land Titles, Education Boards, Planning Branches, Engineering Departments to name but a few. An information system must always strive to obtain data from sources which best satisfy the criteria of availability, accessibility, currency, reliability and efficiency.

Thus, one of the first considerations in the design of a system is to determine the agencies that will be supplying data, and to obtain their cooperation on a continuing basis. In many situations the sources of data will also be the users of the information system. The user-supplier relationship must therefore be encouraged to provide the incentives for free exchange of information, and

> "Agencies should not be expected to devote their limited resources to providing information to the office unless they expect to gain by their cooperation by receiving needed information in return",[38]

or by evidencing an increase in efficiency of their operation's function.

An effective means of achieving this objective is to design the system in such a manner that it assists the concerned suppliers in their normal operations such as the automation of permit issuing procedures. In fact this aspect is considered as a pre-requisite to the implementation of a successful information system.

An input format must also be established for assembling all of the data. This format is the key to the entire system and must be flexible in order that data may be added or deleted without great difficulty as the need arises. It should also be capable of accommodating information stored in any existing files systems.

2. Media or Process Requirement

The application of computers and electronic data processing (EDP) techniques is a pre-requisite in the creation of an integrated information system due not only to the volume of data but also due to the complexity in the processing and updating procedures. The fundamental function of computer equipment and programs is to receive and interpret the input data to perform the operations the system requires.

The equipment requirement can be broken down into two basic categories; the hardware and the software. The hardware includes printers, card punchers and the computer itself. The software or programs consist of reports and documentation on the system and the instructions which effectuate the operations of the hardware.

In most areas the hardware is available or at least it is readily accessible. However, this is not the case when it comes to the software. The software must be specifically designed and consequently it is this area in which the major costs are incurred.

There are three basic considerations which must be incorporated in the design of the software. These are:

1) The software must be able to handle user requirements;
2) The capability of the software must not exceed the capability of the hardware;
3) The software must be capable of handling the intended input.

The designers of the software must therefore be thoroughly familiar with the entire system, as the efficiency of the system revolves around the software.

3. Geographic Identification and Data Aggregation

The location of an entity is an important consideration, because planning is so often concerned with spatial patterns.

Geographic location identifiers such as census tract, parcel roll number, legal description, street or parcel address and municipality are usually associated with planning and other agency data and functions. However, user requests, especially for purposes of analysis, frequently necessitate an aggregation of data into an areal unit in which the relationship between the identifiers is quite complex. A similar situation occurs on the supplier side as well. In addition, a total composite picture can only be obtained if information on individual elements can be linked through a unique identification

and the data must be organized in such a way that there is flexibility for various correlations.

Therefore, in order to efficiently collect, organize and disseminate data, considering the multiplicity of suppliers and users, there is a need for a common identification that is acceptable to all. Furthermore, "flexibility can only be maintained if data is stored on the basis or the same entities from which it is collected. This is known as the "atomic principle"."[39]

In essence what is required is a "coordinate system whereby information is referenced to a unit area, such as the individual parcel lot, with built-in assembly of such units to any desired area of reference".[40]

One such technique is referred to as the "Geographically Referenced Data Storage and Retrieval System (GRDSR), more commonly called Geocoding".[41] This technique is based on a system of x-y coordinates representing the intersection of a pre-determined grid. As such a coordinate system is simply a numbering system for identifying location. Specific locations can thus be completely and uniquely described by coordinate numbers representing the intersection of numbered grid lines. These x-y coordinates can thus serve as common denominators to correlate all of the geographic identifiers used by the various agencies. Such a system provides the mechanism for relating data to a geographic location and virtually makes any combination of data that a user might request, as the "computer can sort machine-readable

data into various geographic arrangements".[42] Thus, all the user has to do is define the area of interest and the system automatically retrieves the corresponding coordinates along with the associated data. The flexibility inherent in such a system is imperative for summary purposes and for re-assembly in different types of analysis. In addition, such a system provides the integrating element for all the data that is incorporated into the system or the input side. Geocoding thus "becomes a form of linkage between different applications or components of the system"[43] and "only if the information on individuals can be linked through a unique identifier can a composite picture be built".[44] One major disadvantage of a geocoding system is that "although a unique identifier is applied to each specific point of the City these identifiers carry little meaning by themselves".[45] Other more common methods of linking data to a specific area or parcel is to use the assessment roll number as the key identifier, combined with the municipal address.

4. Confidentiality Requirements

The development of data access controls must become an integral part of the system design, as the system becomes more comprehensive and includes data concerning individual persons. This is of utmost importance and it is essential to ensure that unauthorized persons cannot gain direct access to the data.

Furthermore, since the data relating to individuals must be kept in confidence, it is imperative that control mechanisms are

incorporated to ensure that the release of this sort of data is on an aggregate basis only and without identifiers. "Even there, however, care must be exercised to assure that any sample group is not so small or unique that conclusions can be drawn about specific individuals by careful study".[46]

Siegel[47] emphasizes that an additional requirement relates to the integrity of the system. Careful vigilence must be exercised over the entire system and the data entry procedure carefully defined to ensure that improper data is not entered into the system which would replace good data previously stored. Furthermore, not only must standards be developed for data entry, but validation criteria for data items must also be established.

The factors of confidentiality, security and integrity are so important, that in reality, acceptance or rejection of the entire system by our political leaders and the public may depend on the degree to which this is ensured. A Data Control Board, whose function is to oversee what part of information is released and in what form, must therefore be established before the system becomes operative.

5. System Documentation and Charts

Since the success and optimum utilization of an information system depends upon good management, an important feature of a good system is comprehensive documentation and charting of the entire

system as well as of its sub-systems. Flow charts are simply a method for displaying information in pictorial form and provide a technique for indicating relationships, flows of information and any other useful facts. Charting can be used for stages of systems development and to provide a composite of the entire system. For example each sub-system can be independently charted and then either linked with charts of other sub-systems or of the entire system to provide a complete picture of the development.

This type of presentation greatly assists all interested participants (users and suppliers) in attaining an overall understanding of the system and its operation as well as an appreciation of the various interrelationships of the sub-system. Such an overview by management inevitably results in a better acceptance of the system, and better management of the system, both of which are essential features to a successful systems operation. Documentation on the other hand is a narrative description of a particular organization, policy or procedure and is in many instances nothing more than a well-written procedures manual. Systems documentation for example can include such things as description of access facilities, the format in which the data is stored and the degree of accuracy. The documentation, which can be in the form of organizational policy or procedural manuals is thus a valuable tool of communication and better management. One very specific area that good documentation assists in the operation and maintenance of a successful system, is to ensure continuity in situations where high staff turnover prevails. The unavailability

of the person who designed the procedure or system is a problem suffered all too often especially by government agencies.

6. Testing the System

A procedure for evaluating and checking the system is imperative not only to ensure that the design of the system meets the objectives but also to ensure its operation. Not only must the system be tested and programs debugged during the initial design and implementation, it must also be analyzed and evaluated on a continual basis. Built-in checks on the reliability and efficiency of data should be an intregal part of the systems daily operation.

7. Integration with Non-Planning Departments

Integration with other City departments such as Assessment and Business Tax is attractive because this affords the Planning Department the opportunity to utilize data collected by other departments in their daily operations. Since the other departments in turn must benefit from the system a common need must be identified.

This does not mean that an entire integrated system has to be designed and implemented at the outset. A system by definition, consists of an assembly of sub-systems, and therefore facilitates incremental development as long as the sub-system is compatible with other sub-systems. In the interim each of the sub-systems may even

serve as independent systems, such that the implementation of a sub-system is at no time in jeopardy pending the design of a larger system. All too often in the past the development of small sub-systems has been unnecessarily delayed.

On the other hand it is imperative to realize that in the design of any information system the relationships between the sub-systems are not well defined during the early planning and design stages and thus one single area or sub-system should not be penetrated too deeply before the broader relationships of all components are examined. It is also necessary to clearly document and chart the sub-systems and the interrelationship of the sub-systems, and to explain the total information system. If properly conducted this step can greatly assist in all aspects of systems development.

In order to maximize the benefits to all concerned, planning and non-planning functions, an independent "team" must be structured to undertake the design and implementation of the system. In addition this "team" can coordinate the development of all sub-systems and thereby provide not only the "unbiased" coordination but the continuity essential to the task.

And finally as stated by Hoak, "a coordinated data system among separate and independent agencies must be based upon a spirit of cooperation and a recognition of common interest among the system participants".[48]

D. CONCLUSION

This chapter has identified some of the fundamental factors of an integrated information system such as the steps involved in systems development, the requirements of an information system, and certain pertinent design considerations. These were presented in order not only to offer the reader a better understanding of information systems but to provide some basic guidelines for systems feasibility and development pursuits. Any serious attempt at developing an effective system must, due to its very complex nature, take cognizance of the requirements of the system, and of design considerations such as input-output procedures, geographic identification and systems testing. Without due attention to these components at the outset, a proposed system is doomed from its initial concept.

FOOTNOTES - CHAPTER IV

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45. A Comparative Evaluation of Urban Computerized Data Systems, The City of Peterborough Planning Department, December, 1974.

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CHAPTER V

DETERMINING DATA USERS AND THEIR NEEDS

One of the key issues in good information systems development is to clearly determine the data users and to identify their data needs, as it is for the data user that the system was originally designed.

A. DATA USERS

As with the suppliers of data, there must be an assurance of optimal utilization of the system by potential users. Consideration must be given not only to the planning departments' needs per se, but to other government and private concerns in the city. However, since it is virtually impossible to determine all of the potential users and their information requirements, and prohibitively expensive to create a system that will respond to all possible questions and user demands imposed upon it, the system must initially be designed on a modest basis, but with a built-in flexibility that will permit it to adapt. This initial system "can be designed for the future by extrapolating from past trends and interests; indeed, this is the only rational approach to design".[49]

Reynolds[50] suggests that as a starting point an attempt should be made to categorize the potential users according to the primary use for which the information is needed. His broad categories include research, regulation and operations, planning and policy making.

Ulrich[51] has suggested that in situations where there is more than one user for basically the same system , two approaches exist:

"1. unique systems are developed for each user; and/or

2. all the users and information systems together serve as a task force to design the system."

He concludes by indicating that the best approach in most cases is to begin with single user specific systems.

It is thus evident that a system must therefore be created in anticipation of user needs and requirements which are not fully known, consequently it must be designed in such a fashion so that it can quickly respond to any information requirement changes. Lipetz points out that over a period of time it is not only the system that must be adaptable, but the users as well;

> "A system that is fully responsive to its users will react not only by conducting immediate searches but also by adapting its collection and organization activities over the long run to accomodate indicated interests and probable needs. Conversely, the users will also adapt in time to an existing system."[52]

This means that the users will have to familiarize themselves with the system, not necessarily with the detailed mechanics, but at least with its conceptual aspects and capabilities. Output procedures, formats and generalized retrieval programs that are suited to the needs of the anticipated users must be established. The retrieval programs must be capable of extracting and providing data in any specified form and/or

combination. Since this element specifies the kind of information and its format, it is really responsible for the design of the entire system.

B. DATA NEEDS

The success of an information system depends a great deal upon the ability of the system designers to determine information needs and to design a unique system to meet these needs. Although this is a very critical aspect of the information system, it is one of the most difficult problems facing a designer of a system. The matter is complicated by the fact that information for decision making is often complex and not easily defined, and that different levels of "management/planning" require different kinds of information. Furthermore, "information needs relate not only to information required to solve known problems but is also required to find problems".[53] The latter aspect is especially difficult to ascertain because most users tend to pinpoint their information needs on the basis of what they are currently reviewing or analyzing, rather than on that of their long-term requirements.

Decisions related to data selection should not be made on the basis of quantity data items, but rather upon a determination of what data is actually required for the activities which the system is to support. Although information cannot be generated if supporting data are absent, the scope of the base cannot be so broad that implementation of the system becomes financially impractical. Norton Isler points out that:

> "All too often, planning resources spent on land use, demographic and economic data are never reflected in policy decisions; thereby they are wasted. It is too easy to attribute this perversity on the part of policy makers; more often than not the planner is at fault for not selecting such information in relation to its eventful application".[54]

Similarly this concern can relate to an information system which is designed for a specific purpose. On one hand, a screening process is required to ensure that data is not handled for data's sake, however, on the other hand, it is not only essential to determine what information is currently important to the users, but at the same time provide for a comprehensive outlook.

It is thus apparent that in information systems development much consideration must be given to formulating a meaningful approach to the difficult task of determining user needs. Urlich[55] has indicated a survey approach whereby broad terms of reference are provided by the user/client and the systems designers then provide the broad design based upon a survey of the user requirements. The City of Calgary Management Systems Development Department employs a technique whereby the entire "user process" is reviewed and the user requirements are defined as an integral step. In the case of a City Planning related system for example, the planning process is carefully studied and understood in order to ascertain the requirements imposed on the system. This has an added advantage, in that wherever possible, the current process can be modified for system adaptation. A vital component of this method is a

"design team approach" where all interested parties are represented; namely the user department, systems analysts and data processors.

This course of action is somewhat similar to Horton's "communication model approach" whereby there is;

> "less emphasis on the technical structure of the information system and correspondingly more emphasis on the behavioral attributes of the information users".[56]

In this way certain relevant clues about the users needs and requirements can be obtained. Horton, however, qualifies this by pointing out that "there are not formulas or higher order keys for determining information needs and uses" and thus "the final identification of needs and users will be found to be heavily dependent on feedback based on actual usage of the system".[57] That is, as the system becomes operational, the originally perceived needs and uses will be modified.

C. CONCLUSION

Two very salient aspects are evident in any approach to determining data users and their needs. Firstly, that a systems approach, its basic concept and applied methodology can be an extremely useful tool and secondly that a "team approach" is virtually a prerequisite. Furthermore, although data selection is so vital to information systems development, there is a danger that too much emphasis may initially be

placed upon data collection and its organization, and by the time its application is considered the appropriate data for the system is not available. Extreme caution must thus be employed when determining data requirements of the system.

FOOTNOTES - CHAPTER V

49. Lipetz, B., Op Cit., p. 178.

50. Reynolds, H.D., Op Cit., p. 63.

51. Ulrich, M.A., Article contained in Information Technology and Urban Governance, Ministry of State, Urban Affairs Canada, Edited by Barry S. Weller, Ottawa, June 1976, p. 114.

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54. Isler, M.L., Selecting Data For Community Renewal Programming, AIP J. XXXIII March, 1967, p. 66.

55. Urlich, Op City., p. 113.

56. Horton, E.W., How To Harness Information Resources: A Systems Approach, Association for Systems Managements, Cleveland, 1974, p. 32.

57. Ibid., p. 33.

CHAPTER VI

POTENTIAL USE AND BENEFITS OF AN INTEGRATED INFORMATION SYSTEM

A. INTRODUCTION

An integrated information system can perform two essential functions. Firstly, it can provide an automated method for performing many of the daily operations more effectively and efficiently which should result in an increased level of service to the public and a more effective control and management of operation. For example, checks can be built in which prevent the issuance of permits prematurely. Secondly, it will provide continually updated information for decision making. It is this latter function which requires a more in-depth discussion at this time.

B. POTENTIAL USE

The use of the information is theoretically unlimited. However, it is greatly dependent upon the type of system that is created in terms of capacity, sophistication and acceptability. A relatively small isolated sub-system will only generate very specific and limited information.

Consequently, the potential use of the information is more limited than it would be from a broader, more complex integrated system.

Although there is an unlimited number of areas where current readily accessible information may be used, there are several basic areas related to planning. Four of these areas are outlined below:

1. Planning and Analysis: Information both qualitative and quantitative such as employment, population, incomes and education levels can serve as the basis for examining area growth characteristics. An example of this is the Winnipeg Regional Study[58] in which such characteristics are vital to the project. Up-to-date information on land use, land capability and economic activity would greatly facilitate land use analysis and economic base studies.

   The area in which the information would perhaps be most useful is in comprehensive development planning. Since the concept of process and continuity is inherent in this type of planning a continuous flow of up-to-date information would be an invaluable asset, if not in fact, a pre-requisite for purposes of policy and plan implementation and policy or plan evaluation within a time dimension.

2. Municipal, government and administrative entities: The availability of currently up-dated and easily retrievalbe information would relate directly to management and administrative functions, as well as to longer range decision-making endeavors. For example, the record-keeping capability and automation of procedures of aspects such as building permits, certification of title, and subdivision approvals would prove

to be not only advantageous as a device for having this information on file, but would also greatly assist in the processing and handling of daily inquiries by various entities and in the production of monthly and yearly statistical and other reports.

3. Special Studies: In addition to planning and analysis, information that is well documented would serve as a valuable input into particular studies such as the determination of housing needs or transportation facilities which, in many instances, require the use of forecasting models and other more sophisticated techniques.
4. Policy and Project Evaluation: Readily available up-dated information can facilitate evaluations of proposals and assist in assessing their impact. This type of feedback is an essential component of an effective planning process.

The listing outline above is by no means exhaustive. However, it does provide an indication of the wide application of information which is current in nature and is readily retrievable on a pre-conscribed format. There is little doubt that such a feature would be a tremendous asset to urban planning.

C. POTENTIAL BENEFITS OF AN INTEGRATED INFORMATION SYSTEM

In undertaking such a discussion, it must be realized that much of it is speculative, as "no city yet has a true integrated information system".[59] Nevertheless, there are certain benefits which can be

anticipated and must therefore be considered.

1. An integrated information system can "by its very nature provide the feedback required to follow the community or region as various programs are implemented, modified, abandoned or expanded".[60]
2. An information system can provide an automated mechanism for the collection, storage and retrieval of good data on a current basis and can ensure a commonalty of data.
3. An integrated information system can eliminate the duplication of data collection and storage by various agencies, and in turn make data readily accessible to all concerns.
4. Information systems can contribute to the interdisciplinary staffing of municipal government agencies. For example, Planning Department staff would be complemented with economists, statisticians and systems analysts to aid in turning data into information.
5. By automating and streamlining many of the normal tasks performed by various agencies, an information system can increase the operational efficiency and thereby in the long run reduce costs.
6. Information system technology can enable the same set of data that is used in daily operations such as assessment and building permit processing to be used in other functions.
7. An integrated information system can improve services to the citizen. For example, the use of CRT's (Cathrode Ray Tubes)

in the Assessment and Taxation Departments can provide easy "on line" access to records and greatly expedite the handling of customer enquiries and billings.

8. Information systems can simplify the analysis stage of information. City Planners can thus spend less time manipulating data into information and can devote more attention to policy-oriented matters.
9. Information systems can augment decentralization of services and decision making by disseminating data from a centralized system to "decentralized branches".
10. An integrated information system can encourage the creation and evolution of many alternate plans.
11. An information system can facilitate and speed up some decision making and routine activity, thereby allowing management to spend more time on leadership activities.

Some specific Planning Department activities which can benefit include:

1. an increased level of service to the public. Public inquiries can be quickly and accurately answered by means of on-line CRT's which are directly linked to computers. An example of this is the Property File currently on-line in the City of Calgary.
2. the provision of statistical reports and summaries on "stored data". A system provides the inherent capability of producing not only more meaningful and accurate statistical reports

but more diversified ones as well. Furthermore, these reports can be updated periodically or as required with relative ease.

3. an augmenting of the data base with current and historical data.
4. communication with property owners and tenants by means of computer-printed address labels.
5. the potential for graphic display by means of a computer.
6. an increase in the coordination and control of operations which results in increased efficiency and productivity and
7. the provision of management reports which will enable managers to control their operations.

D. COST BENEFIT ANALYSIS

A cost benefit analysis of an information system can be undertaken at any or all levels in the analytic framework and systems development commencing with an initial systems feasibility study. It is particularly imperative that this sort of analysis be carried out at the initial stages of development in order to minimize expenditure of money and resources should a system prove to be unfeasible. The Stages of Systems Development established by the Management Systems Development Department outlined in Figure 4 provides such a mechanism at the termination of stages 1 and 2. At the end of these stages in the systems development it is determined whether or not the exercise should

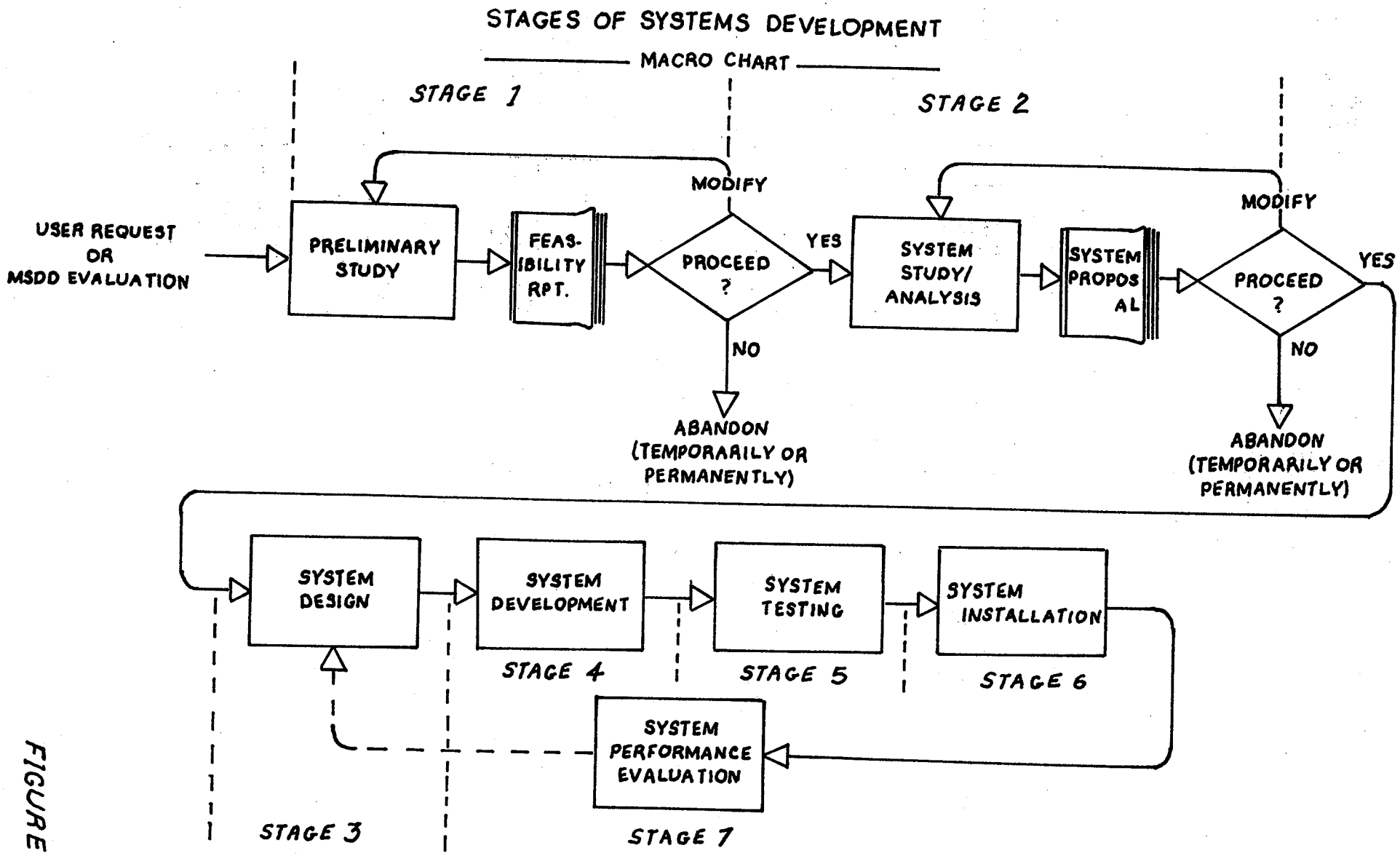


FIGURE 4

Source: The Management Systems Development Department
The City of Calgary

proceed or be abandoned. In addition, such checks should be carried out through subsequent stages.

A cost benefit analysis of an information system is a precarious undertaking as the results or benefits are difficult to precisely determine and especially difficult to quantify in monetary terms. Zani,[61] for example, in a cost benefit analysis of selected operational information systems, found that the system did not automatically generate savings for a company and that the information flow in and out of itself had marginal added value. It is only when a system is meaningfully integrated into the management process that it yielded a benefit.

Horton[62] has postulated the problems of assessing the benefits that a system offers and suggests that certain guidelines must be established or followed in an evolution of a system and its benefits. Firstly, some system of measurement must be developed. This is especially difficult to formulate for "in-house services". Secondly, the benefits must be quantified where feasible, however, many of the costs and benefits are more qualitative and intagible. Thirdly, some form of weighting the system must be considered for measuring the benefits against the costs. This weighting system can then be employed to evaluate any trade offs or compromises.

In so far as the provision of information to the user, four key criteria can be assessed to measure the benefits of the system. These include:

1. timeliness of information and response time. This relates to whether or not it is available when requested;
2. reliability of data;
3. accuracy and precision of data, and
4. completeness and thoroughness of data.

Regardless of what system is adopted for measuring the effectiveness and benefits of an information system, it is imperative that costs (expenditures) can be justified if the system is to have any hope of being accepted by the user or senior management responsible for its financing and allocation of the necessary resources. The potential benefits outlined, whether quantifiable or not, must be evident.

E. CONCLUSION

The benefits of an integrated information system are only speculative as there is no completely integrated information system in operation today. Theoretically, however, the most potential benefits identified include improving the decision-making process by providing an automated mechanism for data handling and automating and streamlining the operations function, thereby leading to more effective planning and service to the public. Regardless of the potential benefits, the success or failure of information systems is very dependent upon evident results to all concerns.

FOOTNOTES - CHAPTER VI

58. The Nature of Demand for Exurban Living, Winnipeg Region Study, University of Manitoba, February, 1974.

59. Nation's Cities; Op Cit., p. 24.

60. Mitchell, W.H.., The Anatomy of a Municipal Information and Decision System, article in American Society of Planning Officials, Chicago, 1967, p. 40.

61. Zani, William M., "Real Time Information Systems: A Comparative Economic Analysis, Management Science, p. B-354, February, 1970.

62. Horton, Op Cit., p. 86.

CHAPTER VII

INFORMATION SYSTEMS DEVELOPMENT
A CASE STUDY: THE CITY OF CALGARY APPROACH TO THE DEVELOPMENT OF A "DEVELOPMENT AND BUILDING PERMIT CONTROL SYSTEM"

A. INTRODUCTION

The City of Calgary, in 1974, attempted to develop a Development and Building Permit Control System, which was intended to serve as an integral part of a City-wide information system. The purpose of this chapter is to briefly outline the role of City Planning in Calgary and the feasibility stage of the proposed City of Calgary Development and Building Permit Control System. The feasibility stage identified the problems encountered in the current operations and demonstrated a need for an automated system. The most significant aspect, however, is that, although the feasibility study clearly indicated a need for a control system that would not only assist in the daily operations but that would also augment the Planning Department's data base, five years later the system is still not implemented.

A new department, Management Systems Development Department, was given the responsibility of carrying out the systems analysis and operations research. In order to facilitate better communication, a project team was established consisting of members from the Planning Department, Management Systems and Data Processing.

PLANNING ADMINISTRATION CHART
CITY OF CALGARY

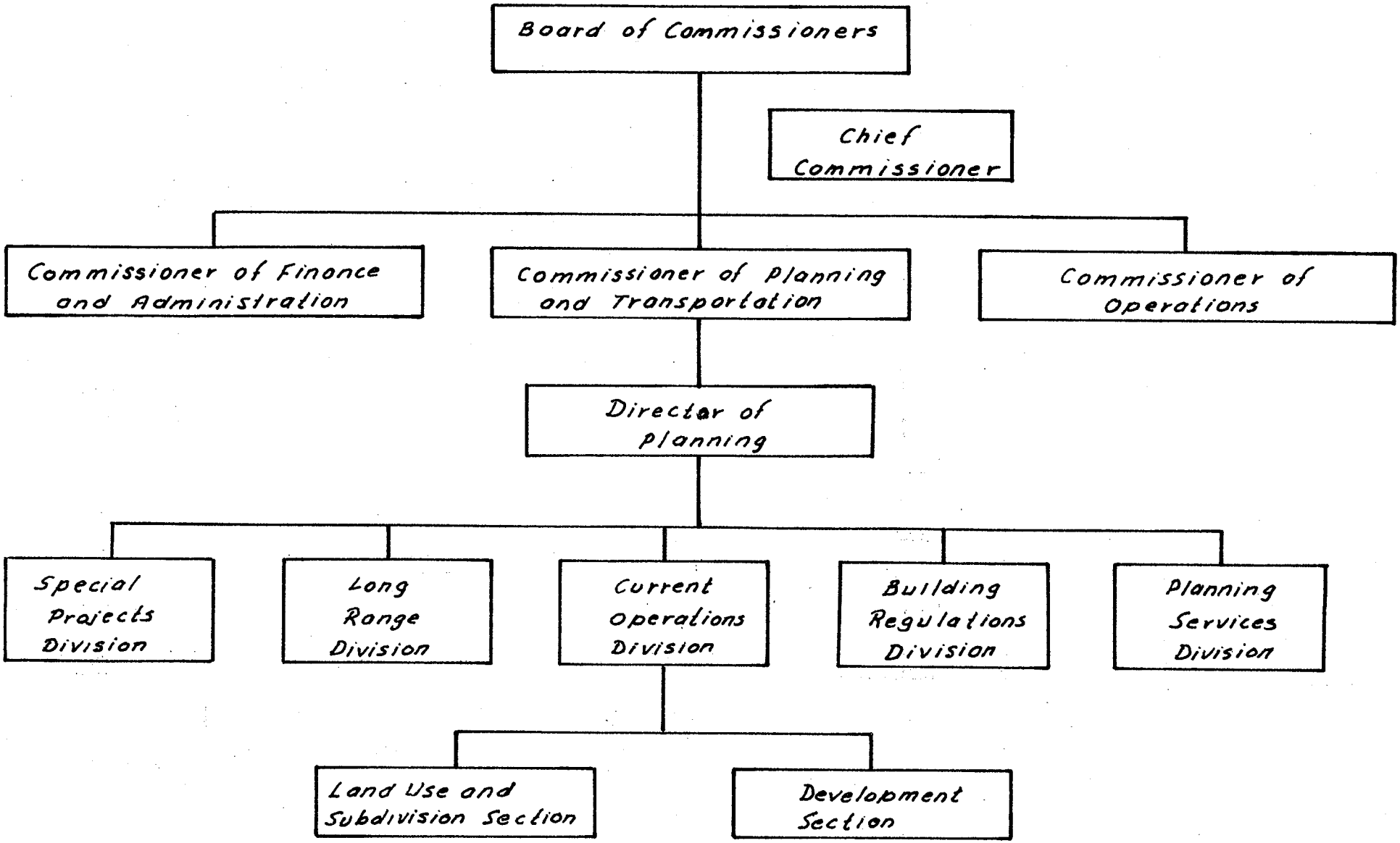


FIGURE 5

Source: The City of Calgary Planning Department

B. CITY PLANNING - THE CALGARY SITUATION

In order to place the role of City Planning in its proper perspective as related to the context of this study and to establish a working framework, a brief overview of the planning and municipal government structure in the City of Calgary is presented.

All of the municipal or suburban communities within the metropolitan boundaries of Calgary have direct representation on City Council and in turn the City is governed and administrated by one corporate body, City Council. As such, the municipal government structure can be referred to as "Unicity" in which one central body is responsible for governing the entire metropolitan area.

City Council, the governing body and ultimate decision maker, consists of 14 aldermen and a mayor, all of which are elected ward representatives. This body is supported and advised by an appointed technical or administrative staff consisting of senior administrators, the Board of Commissioners, and various departments, each responsible for specific functions. In addition, there is an appointed advisory board, the Calgary Planning Commission, composed of both Civic employees, usually Department Heads, and representatives from the private sector.

The primary role of the City of Calgary administration (Figure 5), of which the Planning Department is an integral part, is to service the public (residents) of Calgary by:

1. providing the essential services such as transportation, water, sewer, electricity, fire and police protection, ambulances and emergency rescue aid, and;
2. controlling and maintaining these services.

In fulfilling this responsibility, there are two major functions. Firstly, there is the operational control function which refers to the carrying out of specific tasks in functional areas effectively and efficiently. This includes tasks such as taxation and assessment, finance and payroll, utility billing, social services and street maintenance, to name but a few. Secondly, there is the management planning function which refers to the establishment and attainment of the objectives of the organization through the allocation of human and financial resources.

However, since the entire spectrum of urban government and decision making in general is outside the scope of this study, only the specific role of the City Planning function is examined in greater detail.

Specifically, the Planning Department's role in the City of Calgary is as a support entity to the City Corporation. It is an administrative body whose primary function is to advise and assist the Calgary Planning Commission and City Council with regard to the planning of orderly and economical development within the City. This involves the Planning Department in a wide range of activities in both the area of policy

formation and policy interpretation and implementation. The policy formulation role relates to the preparation of land use policies, design briefs, the Calgary Plan and other specific studies as required by City Council, the Calgary Planning Commission or the Board of Commissioners. The interpretation and implementation of policy involves primarily the processing of various applications such as plans of subdivision, land use reclassification, development permits and building permits.

It is thus within the framework of the general definition of the planning process and the specific function of planning in the City of Calgary, that the implementation of a Development and Building Permit Control System was investigated.

C. CITY CONTEXT

1. City Growth

The City of Calgary is a fast-growing western Canadian city which as of June 1, 1978, consisted of 492,100 persons.

It is evident from Table 1 and Figure 6 that Calgary has experienced a high rate of population growth during the past 10 years. Population forecasts indicate that although the annual rate of increase may decline slightly, in absolute terms the City is expected to continue to grow substantially over the next 10 years. (Table 2 and Figure 7.)

Table 1 Population Growth
- The City of Calgary 1968-1978

Year	Population (as of June 1)	Percentage Increase
1968	360,760	4.2
1969	375,860	4.2
1970	390,690	3.9
1971	403,319	3.2
1972	417,780	3.6
1973	428,370	2.5
1974	439,770	2.7
1975	455,287	3.5
1976	469,917	3.2
1977	490,580	4.4
1978	502,700	2.5

Source: The City of Calgary Planning Department
Fact Sheet, June 1979

Table 2 Projected Population of Calgary
1978 to 1988

Year	Population	Annual Increase
1978	502,700	3.5
1979	520,400	3.5
1980	538,600	3.5
1981	557,200	3.4
1982	576,000	3.4
1983	595,200	3.3
1984	614,700	3.3
1985	634,200	3.2
1986	653,900	3.1
1987	673,600	3.0
1988	693,400	2.9

Source: The City of Calgary Planning Department
Fact Sheet, June 1979

FIGURE 6 POPULATION GROWTH

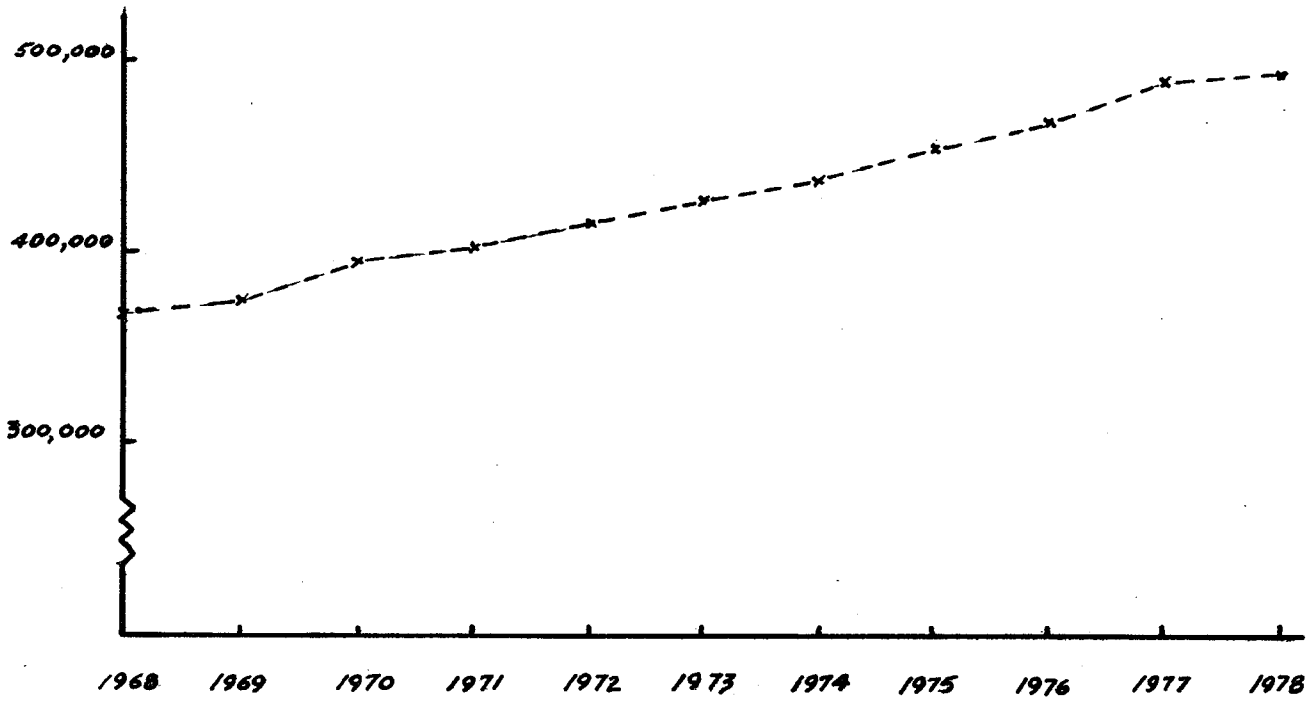
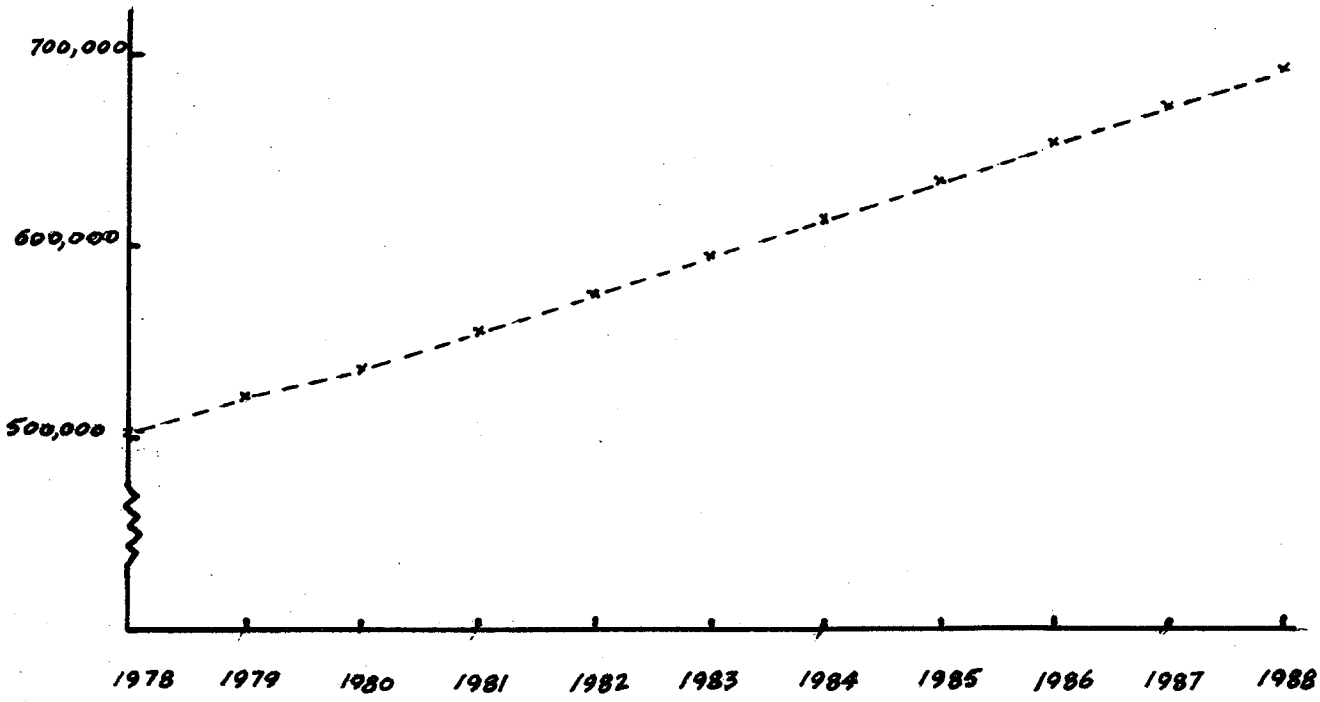


FIGURE 7 PROJECTED POPULATION FOR CALGARY



This population growth has resulted in pressure on the City for the provision of houses, utilities, education facilities and all of the other services demanded by a growing populace. Urban planning and policy formulation relating to direction of growth, transportation networks, land use and population density has been required more than ever, in an attempt to accommodate this growth in an orderly and economic manner. Much of this burden is placed on the planning department.

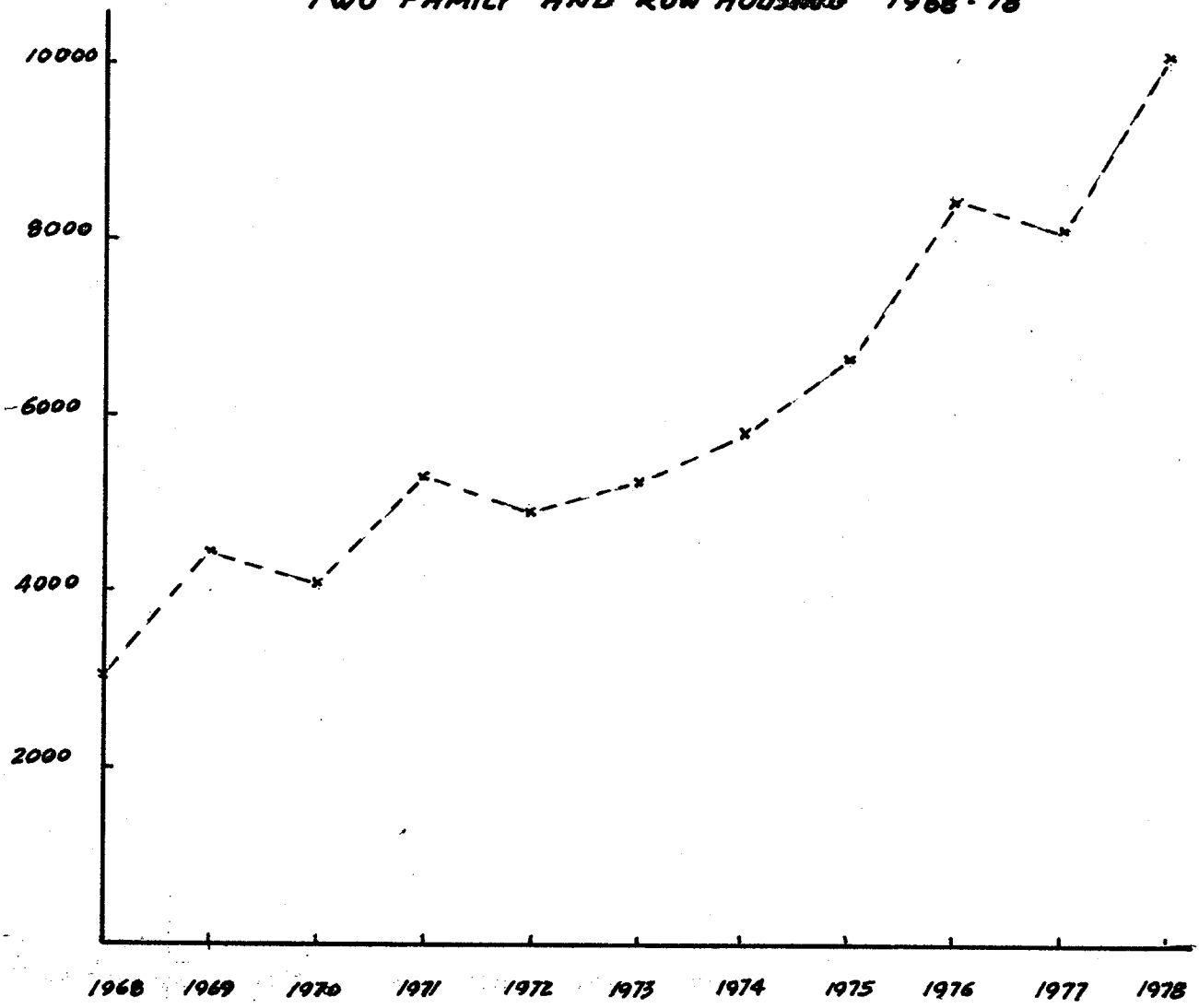
Steady population growth accompanied by a thriving construction and development industry has increased subsequently the work load of the Planning Department in recent years. Not only have the number of reports and studies been on an increase, but the processing function has increased as well, as indicated by the number of single detached, two family and rowhouse dwelling starts between 1968 and 1978 (Table 3 and Figure 8).

Table 3 Dwelling Starts, Single Detached, Two Family and Row Housing 1968 to 1978

Year	Total
1968	3,035
1969	4,473
1970	4,116
1971	5,307
1972	4,978
1973	5,258
1974	5,831
1975	6,647
1976	8,446
1977	8,143
1978	10,084

Source: City of Calgary Planning Department March, 1979

FIGURE 8 DWELLING STARTS, SINGLE DETACHED, TWO FAMILY AND ROW HOUSING 1968-78



2. Past Experience

In 1972, the City of Calgary Planning Department carried out a land use inventory of the Downtown in an endeavour to augment and update the City's existing data files. The primary objective of that study was "to collect, store, update and retrieve land use data required for long range planning programs, efficiently and economically using electronic data processing techniques".[63]

The study was coordinated by the Long Range Planning Division and carried out by a group of summer students. An actual field survey was undertaken during which certain pertinent data such as land use, building areas and occupancy was obtained. In addition, existing records were searched and cross referenced to ensure that the most reliable data was gathered and to determine the most reliable source, if any, from the existing files. This aspect of the study took approximately four months and cost approximately $20,000.

Once all of the data was gathered, manipulated and checked it was edited and entered on a Computer file. Some of the coding, such as land use, was done in the field. However, it was all checked in the office. In this case the General Land Use Code (see Appendix A) and the Standard Industrial Classification were used. Since the data was all entered on a roll number basis, the file was sorted and added to the existing property file. All definitions of terms, procedures, data sources and problems were carefully and elaborately documented in a manual which could serve

as future reference. In addition, a critical review of the entire undertaking was conducted. It is these findings that are particularly noteworthy.

Firstly, although study concepts and purposes were determined in advance, the actual survey was premature as the detailed programming of procedures, information source and staff organization was not completed at the time of commencement. This resulted in a lack of testing and a considerable lack of efficiency. Therefore, it is imperative, that procedures be carefully formulated and all methods and systems thoroughly tested well in advance.

Secondly, it was concluded that the Inventory did provide the City of Calgary with comprehensive data to supplement the existing file for the Downtown. However, it provided information for one period only and on this basis was a successful undertaking. However,

> "as a part of a city-wide information system the merits of the entire project are highly questionable until the City implements a feasible method of updating the files created. Without such a system of updating, the data will be of little value and soon obsolete, the project will have been futile!"[64]

This concern, along with the increase in processing workload and demand for current information has prompted the City of Calgary Planning Department to investigate the development of a planning information and control system with specific concentration in the first phase upon a building and developing permit related system. The author of this thesis

was employed by the City of Calgary as part of the 1972 Downtown Land Use Inventory Team, and in 1973-74 as the Planning Department representative on a "team" formed to pursue the development of just such a system. The remaining section briefly outlines the method used and some of the major preliminary observations made by the Team.

3. Systems Thinking

The Management Systems Development Department has formulated a seven stage systems development process. These stages were outlined in Figure 5. The case study represents the initial phase of Stage 1 or the Preliminary Study. Portions of subsequent stages have been carried out on an incremental basis. However, the overall system development is at the Preliminary Study Stage. For example, on line CRT's have been installed in the Planning Department. These, in the long term will access the entire Planning Department File and will provide the terminals for data entry. At present these serve only as a means to readily access a historical data file and, as such, are literally nothing more than a display screen. The information currently available by means of the CRT is from the Property File.

D. THE DEVELOPMENT BUILDING PERMIT SYSTEM

1. Introduction

The current Operations and Building Inspection Divisions of the City of Calgary Planning Department have as their prime responsibility

the issuance of permits. The type of permits include:

- Development Permit
- Building Permit
- Plumbing Permit
- Gas Permit
- Heating Permit
- Occupancy Permit
- Permit to Drill Well
- Home Occupation Permit
- Homeowners Plumbing Permit
- Moving Permit
- Sign Permit
- Use of Street Permit

It is becoming apparent that as the City grows, increased demands are being placed on the permit system. Furthermore, proper management of the City is requiring a higher degree of control and integration among the numerous permits.

Studies of the current permit system indicated some serious shortcomings with respect to the control function and also in the generation of uniform data. These studies have consisted of an analysis of all procedures and forms currently used in the processing of individual permit applications.

The purpose of this preliminary study was:

- to outline the policies and procedures currently in use and document those areas which are of concern.
- to provide some general concepts or approaches which could be used in improving the procedures.

- to provide recommendations as to whether the project should continue, terminate or be postponed.

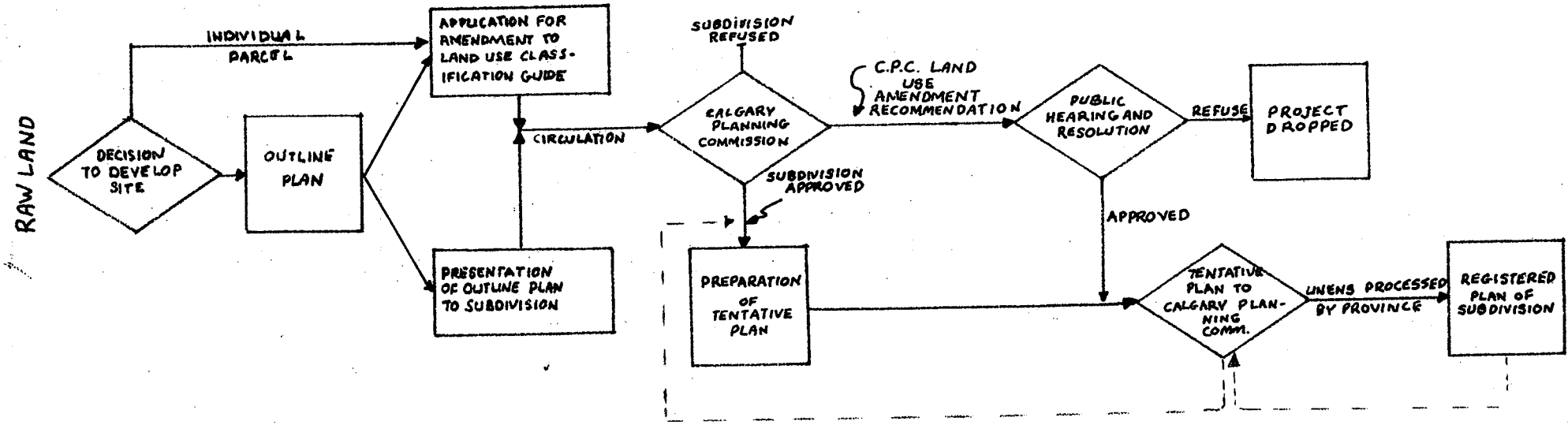
2. Objectives of the Proposed System

The broad objectives generated from the preliminary study are briefly outlined below:

- to provide an increased level of service to the public.
- to increase coordination and control of all permits.
- to provide management reports which will enable managers to control their operational functions.
- to augment the City's data base with current and historical data.
- to provide the ability to produce more meaningful and diversified statistical reports.
- to provide a means of updating other sub-systems in the Property Information System.

It was concurred that the above objectives can be realized with the development of a computer based system.

Figure 9 briefly outlines the major approval processes carried out by the Current Operations and Building Inspection Divisions. Insofar as the Planning Department is concerned, these virtually relate to the entire process entailed in the development of land from its raw state

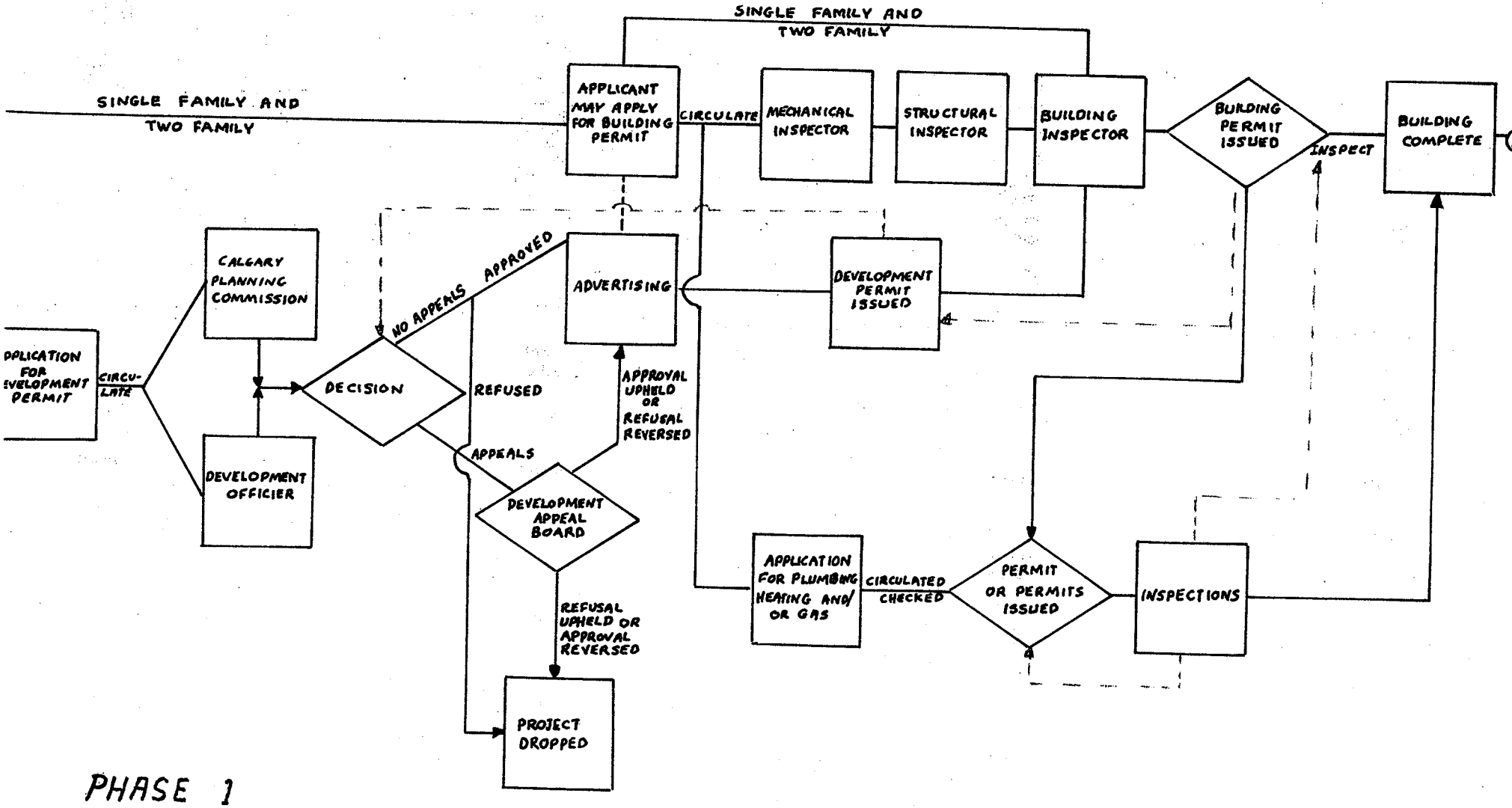


BRIEF SUMMARY OF LAND DEVELOPMENT

AND LAND USE CLASSIFICATION LEADING UP TO

AND INCLUDING THE DEVELOPMENT – BUILDING PROCESS

FIGURE 8


SINGLE FAMILY AND TWO FAMILY
SINGLE FAMILY AND TWO FAMILY
APPLICANT MAY APPLY FOR BUILDING PERMIT
CIRCULATE
MECHANICAL INSPECTOR
STRUCTURAL INSPECTOR
BUILDING INSPECTOR
BUILDING PERMIT ISSUED
INSPECT
BUILDING COMPLETE
CALGARY PLANNING COMMISSION
DEVELOPMENT OFFICIER
CIRCU-LATE
DECISION
NO APPEALS
APPROVED
REFUSED
APPEALS
ADVERTISING
DEVELOPMENT PERMIT ISSUED
APPROVAL UPHELD OR REFUSAL REVERSED
DEVELOPMENT APPEAL BOARD
REFUSAL UPHELD OR APPROVAL REVERSED
PROJECT DROPPED
APPLICATION FOR PLUMBING HEATING AND/ OR GAS
CIRCULATED CHECKED
PERMIT OR PERMITS ISSUED
INSPECTIONS
PHASE 1
A
APPLICATION FOR OCCUPANCY
CIRCULATION
FINAL INSPECTION
OCCUPANCY PERMIT ISSUED
PROCESS COMPLETE

to its final form. The procedures dealt with within this report are indicated by a dashed line.

3. Areas of Concern with Existing System

The existing permit system functioned adequately upon initial implementation, however, due to the imposition of increased demands and volume, some major deficiencies have developed. These are outlined below:

a) Multiplicity of filing systems makes valuable data not readily accessible. For example, there are two filing systems related to permit processing, each having a unique key.

b) Building permits have been issued prior to the approval of a Development Permit. Also, Development Permits have been issued without due consideration being given to the conditions stipulated by the amendment to the Land Use Classification Guide and in some instances prior to the amendment being approved by City Council. Therefore, developments have occurred without adhering to all requirements.

c) The Building Inspectors inspect all types of construction to ensure that the builder adheres to all the Building Permit regulations. At present, the enforcement of Development Permit regulations is not necessarily done by the Building Inspector. This situation must be rectified.

d) Building Permit Fees are based on value stated by the applicant. The Development Permit includes only advertising costs and unless

it reaches the Building Permit stage, processing costs are not taken into account.

e) There is a lack of literature (i.e., brochures) defining submission requirements for each permit type (i.e., definition of square footage, site coverage, etc.). Incomplete applications for permits have caused processing delays.

f) Due to the multiplicity of forms the applicant is required to initiate repetitious data (i.e., name, address, type of building, use of land, etc.).

g) The information that is provided by permits is frequently inaccurate due to inflexible coding systems and a lack of common definitions.

h) The present system is deficient in the production of statistical reports (i.e., reports produced are manually assimilated and typed; information needed by other departments is not provided in the form required and additional information constantly required by the Planning Department such as land use, parking statistics, etc. is not provided).

i) The dual use of an Application for Development Permit form for either the construction of a building or a change of use - creates confusion.

j) Building Permits have been issued on the basis of tentative plans rather than registered plans. Although this is legally undesirable, it does assist in expediting the Building Permit process. Historically, this has not created any serious problems, and therefore may continue so long as the procedure is carefully "flagged".

k) The dual use of an Application for Occupancy Permit form - completion of new building and approval of change of use - creates confusion.

4. Proposed Objectives

The proposed objectives of the new permit system cover two major areas: daily operations and data base development.

a) Daily Operations

Daily operations pertain to the actual day-to-day processing of permits. The more specific considerations include:

i) Level of Service to the Public

The level of service to the public may improve by the one-time only collection of repetitious information required on the existing permits. The possibility of combining one or more permits (i.e., Building and Development) and making them more self-explanatory with accompanying literature on requirements and instructions for completing an application where necessary, offers improvement in this area. Public relations will improve with the decrease in processing time of each permit (not at the expense of quality) due to more complete applications and the elimination of redundant steps. These benefits can be achieved through automation and stream lining of the permit system.

ii) Effective Control

Through more effective controls, such problems as the issuance of Building Permits prior to or without due consideration to Development Permits and errors or omissions on applications will be eliminated. Any reports produced from a system with tight controls will be of a more meaningful and precise nature. Comprehensive, definitive and consistent information must be obtained on all forms. These forms will be used as source documents to up-date the building, property and other sub-systems. Controls will provide a closer integration with other departments, sections and divisions.

iii) Cash Control

An automated cash control function will eliminate the present manual and coding and transcription of accounting and statistical data. The statistical reports produced by the cashier will be automated.

iv) Management Reports

With the production of management type reports, the managers within the Planning Department will have a useful tool to assist them in making their administrative decisions. Summary reports can be produced on a regular basis to aid management in evaluating their operation as well as provide data in a format essential to the implementation of quality control techniques.

b) Data Base Development

The other major benefit relates to the data base. The data base approach will centralize all the information and organize it in such a manner that it is efficiently stored and conveniently accessible and maintainable. This will allow permit data to be used in a more sophisticated manner for many purposes by Planning and other departments. It will allow a more convenient means of accessing the data and for the production of special reports and management summaries. In summary the data base will facilitate the following:

i) the consolidation and integration of existing data contained on permits, plans and other relevant documents dispersed throughout the Planning Department;

ii) automatic production of more meaningful statistical reports;

iii) the generation of new reports for other departments and/or divisions such as Engineering, Assessment, Fire and License. Specific examples include:

- Urban Development Division (Engineering Department)
  - list of all new construction by Developer and by Plan of Subdivision.
- Business Tax Assessment Division (Assessment Department Report) - a listing of all changes of use and all new commercial occupancies.
- Long Range Division (Planning Department) - building and land data such as building square footage, site coverage, number of storeys and number of parking stalls;

- Subdivision Section (Planning Department) - Lot Inventory System - provision of data indicating which lots have had Building Permits issued.

iv) the provision of a means of updating the Building sub-system and other sub-systems of the Property Data Base, i.e., 1872 Downtown Land Use Inventory is obsolete without a means of update.

The Property Data Base is a part of an entire City-wide information system. Figure 10 is a schematic representation of the Property Data Base and its relationship to the overall City Information System.

The integration of all relevant data relating to permits on a centralized machine-readable media will facilitate the production of reports that were impossible or at least much too time-consuming to produce manually. Currently produced reports could be expanded and made more meaningful as well as more accurate. A further attribute of an automated system is the production of reports for other City Departments. For example, Urban Development would be able to receive permit data in a predetermined format and sequence. This would enhance the development of the Urban Development Division Information and Billing System. The ability to provide other departments with data generated by the Planning Department in a format useable by them is another large benefit which would be derived from this system. Under a data base concept not only will the data generated by the Planning Department be made available to

PROPERTY DATA BASE - INTERRELATIONSHIPS

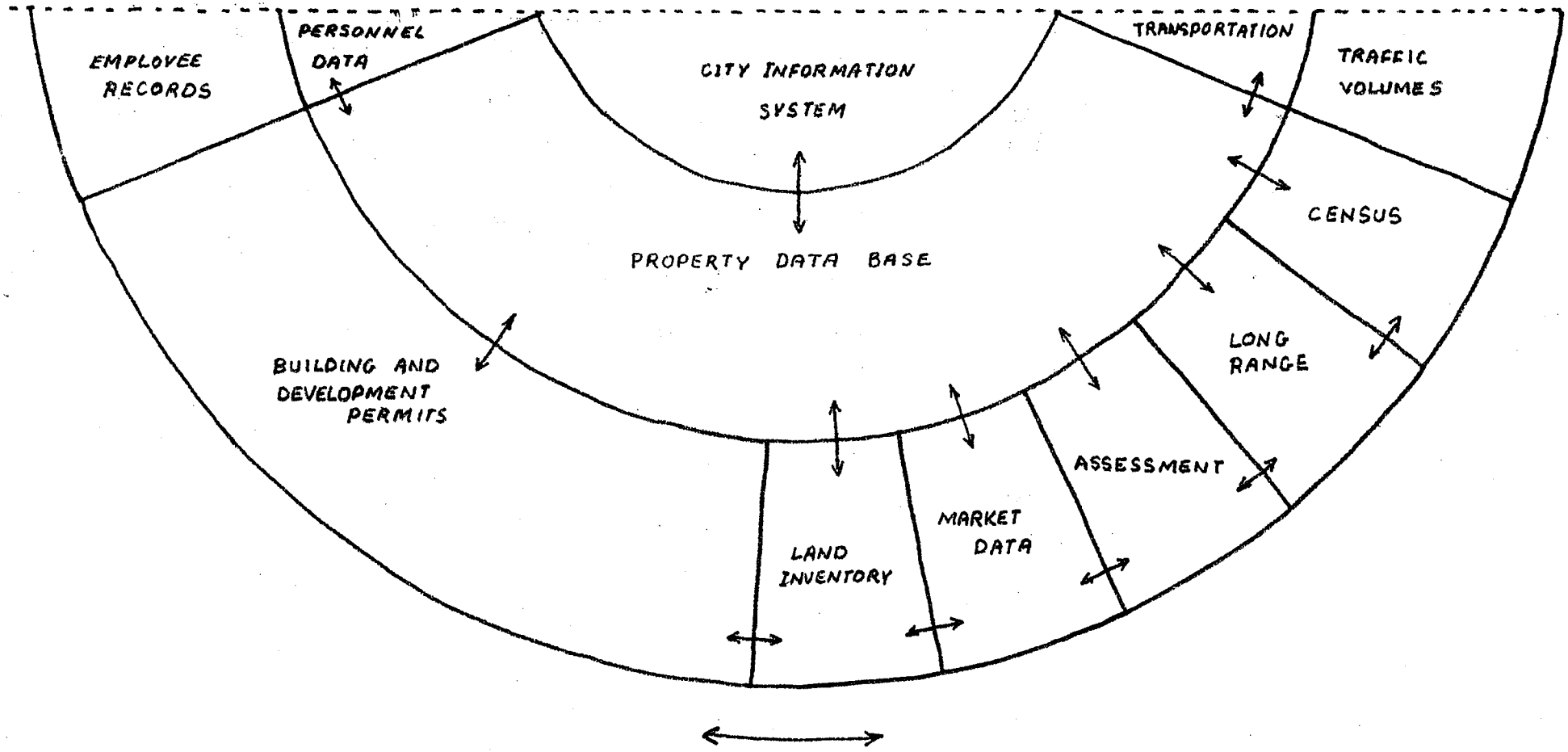


FIGURE #0

Source: Planning Department Development And Building Permit Control System Preliminary Study

other civic departments but also the Planning Department in turn can receive data generated and updated by other departments (i.e., Assessment and Land Departments).

5. Recommendations and Conclusions of the Preliminary Study

The recommendations of the Preliminary Study were:

a) that this study be approved and authorization be given to proceed with Stage II;
b) that a project team (working level team) be established and consist primarily of two people: a user representative (Planning Department) and a systems analyst (Management Systems Development Department);
c) that a firm commitment be made with respect to the personnel mentioned above in order to ensure continuity essential to the success of the project;
d) that other human resources be readily available to work with the project team as required;
e) that the project team report regularly to the Coordinators of Current Operations and Building Regulations Divisions.

Stage II recommended by this study entails an investigation into:

a) alternative solutions to the problem defined;
b) alternatives compared to the existing method;
c) an alternative chosen.

The development of the system master plan in the "System Proposal Report" (Stage II) will require a combined effort from the Planning Department, Management Systems Development Department and Data Processing Services Department. The preparation of the detail design of the alternative chosen by the Planning Department will follow the acceptance of the Stage II proposal.

With the implementation of Phase 1 of this project, the new permit system will accomplish the major objectives outlined in this study.

The Case Study outlined only the beginning of what was anticipated to be the initial steps in the design and implementation of an integrated information and control system related to urban planning within the City of Calgary.

E. CONCLUSION

Although at the time the system was not developed nor implemented, the Feasibility Report was successful in that it convinced the managers within the City of Calgary Planning Department that an Integrated Information and Control System is not only a desirable feature but an essential one in order to ensure better planning in an ever changing and complex urban environment.

Furthermore, although the "Development and Building Permit Control System" was only an incremental sub-system intended for a specific user

and clearly defined user requirements, five years later this sub-system has not been effectively implemented. The practicality of a larger, more complex integrated system is therefore highly questionable.

CHAPTER VII - FOOTNOTES

63. The Downtown Land Use Inventory UES Technical Report 72-1, The City of Calgary Planning Department, November, 1972, p. 14.

64. Ibid., p. 47.

CHAPTER VIII

INFORMATION SYSTEMS IMPLEMENTATION "AN IMPOSSIBLE DREAM"

This chapter outlines the problems encountered in implementing not only the Development and Building Permit Control System in the City of Calgary but integrated urban information systems in general. Although it is recognized that information systems are very necessary for City Planning and municipal decision making and although much knowledge has been developed relating to information systems, implementation of such systems are an "Impossible Dream" at least at present in our urban setting. There are many problems confronting practical application of an information system, right from the time of conception until such a time as a system may be operative.

The following section outlines the more outstanding issues, some of which have lead to past failures and others of which have been experienced in current attempts to develop and implement an urban information system. Although much of the discussion is based upon literature related to situations all across North America, the most significant aspects relate to specific circumstances encountered in the City of Calgary.

A. LACK OF APPRECIATION OF NEED FOR A SYSTEM

One of the major constraints in the development of a complex information system is the lack of understanding and appreciation by the people

responsible for the allocation of resources, particularly financial, for such a venture. The impact and potential benefits are, at least in the initial stages, difficult to be realized by the decision-makers and in view of the costs likely to be incurred and the concerted effort required, attempts at any serious consideration are greatly impeded. Management, in more cases than not, expects instant results and thus because of this lack of understanding, fails to appreciate the practical capabilities of the system.

B. FEAR OF LOSS OF AUTONOMY

Many agencies and individuals refute the concept of information systems fearing that they will lose the autonomy of their own particular entity or "empire" as their operations will inevitably be more exposed. Weller[65] has pointed out that he "who holds the key to entering, manipulating and retrieving information affecting the organization will have substantial power and status". A loss of power is thus perceived by the "user department" as the information is often controlled by an outside department. This aspect particularly hinders efforts in obtaining cooperation amongst the suppliers of data and in the automation of present operations. The situation is also especially prevalent in the Urban Planning function as there is an insecurity amongst planners because of the lack of a clear definition of the "planning profession".

In this respect, a private corporation such as General Motors is more likely to succeed in the implementation of a system than is a

municipal administration because the profit orientated corporation can identify its objectives more clearly. In government, there is no profit motivation thus the prime motivation often becomes "empire building" and an information system is viewed as a threat.

C. FEAR OF COMPUTERS

Many of the "traditional" planners (employees) who, because of seniority and experience, are the senior managers, are unfamiliar with computer technology and its capabilities. There is thus an inherent fear that computer imperfection or error can result in the destruction of data or a delay in the institution's ability to perform its accepted standard of service. This concern is well founded since "it is not possible to devise a system which simply cannot be disrupted or destroyed".[66] Furthermore, a computerized system is subject to errors which are often difficult to detect and difficult to correct.

D. RESISTANCE TO CHANGE

Reluctance to accept changes in traditional methods of operation is common among managers at all levels of corporate organization, "thus it occurs when MIS (Management Information Systems) is designed and implemented".[67] This resistance to change results in lackadaisical attitudes and minimum support by the management responsible for endorsing the system.

E. LACK OF RESEARCH EXCEPT BY EDP EQUIPMENT MANUFACTURERS

Although this aspect has no direct bearing upon the implementation in a particular city, it does have an impact on the information systems concepts and technology. Due to the priority of investment there has been little research undertaken in the past, which partially explains why there is not a completely integrated planning information system operative in North America. Technology is thus far too advanced for the systems specialists employed to catch up with the new technology and insufficient effort is expended in systems development.

F. COMPLEXITY OF TOTALLY INTEGRATED INFORMATION SYSTEMS

A totally integrated information system on a city-wide scale is so complex that it is impossible in the initial stages of design to consider the entire system, except within a very conceptual and schematic framework. Attempts at doing so very soon lead to frustration on the part of all entities concerned. Also, because of the complexity, the development cycle for an information system are too long all too frequently resulting in a loss of interest by the user of the proposed system. Although attempts have been made to reduce the development cycle and to phase development such that the user can assess progress and ascertain benefits incrementally it was discovered in the City of Calgary that such action requires more expertise as more programs and system development is required.

G. INSTALLATION CONCERNS

Since the planning process and city operations cannot be halted while a system is being implemented, managers are reluctant to accept the system in anticipation of delays.

H. STAFF COMMITMENTS

In the past it has been difficult to find and retain qualified personnel who are not only familiar with data processing and systems development, but with the planning functions as well. Weller[68] has pointed out that Wichita Falls used outside consultants. However, these consultants were higher paid than the City personnel which resulted in an inferiority complex amonst the staff and in turn a high rate of turnover and lack of continuity.

The lack of understanding and lack of discipline has often resulted in a communication gap between planners (users) and data processing personnel. Thus "attitudes often become belligerent because they tend to defend their different specializations. Each group regards the other as threatening; such behavior impedes communication and destroys any hope for cooperation."[69]

A further related problem is the division of responsibilities regarding the maintenance and operations of the system. The City of Calgary attempted to overcome this concern by forming a special independent department, namely Management Systems Development Department, to

serve as the link between various disciplines related to the system. One major advantage of this approach is that this independent department can provide an unbiased input and thereby better serve the interests of all concerns and can function as the essential link for all the sub-systems in operation. A major disadvantage, however, is that the Management Systems Development Department reports directly to only one of the City Commissioners, yet the Department's work overlaps the jurisdiction of all of the Commissioners. Obtaining the necessary commitment and authority has thus been a major problem.

I. MANAGEMENT COMMITMENT

The senior management must be fully aware of the systems program and must be committed to the development of the system. If this is not the situation, the entire undertaking is an exercise in futility, as the system has little chance of success. The Planning Chief or his delegated aid should have some experience with and a good knowledge of "Systems and Systems Theory" in order to fully appreciate the task at hand. Furthermore, this individual must have the necessary control of the system and its implementation. Thus what is required is someone in the user department who is not only totally committed to the principle but also one who has sufficient administrative and political "clout" to not only sell the concept but to implement and maintain it as well.

This is very difficult to achieve as all too often, senior planning personnel are "traditional planners" with little or no systems background

and are therefore skeptical about the entire concept. The responsibility is thus usually delegated to junior personnel who do not have the necessary "clout". Even if top management is directly involved, the system implementation cannot be forced if subordinates are not commited as sabotage and an inevitable breakdown in systems maintenance will result.

There is also the impediment of line versus staff functions, particularly in the operations aspect of the system. For example, a line function such as the Building Regulations Division may have a difficult time understanding certain aspects on a building permit which are related to staff functions such as quality control and really have no apparent bearing on the issuance of a permit. This often results in the line function not carrying out the tasks necessary to sustain the system.

J. ORGANIZATION AND ADMINISTRATION

The problem of organizing and administering a systems development project is particularly of concern when considering such a project on an urban scale, because of the proliferation of potential related agencies, both on the user's and the supplier's side.

K. LACK OF UNDERSTANDING

All too often new technology fails simply because the persons closely related do not understand or appreciate the intent and opera-

tions of the proposed innovations. Innovation also implies change, which people are often not prepared to easily accept.

L. SIZE OF MUNICIPALITIES

The costs of implementing an information system may be prohibitive for many of the smaller municipalities who have only limited financial resources. Since the major portion of the cost is attributed to the hardware and software and since on a regional basis more than one municipality is involved in the cost, time sharing principles may be applied. By distributing costs in this fashion, affordability becomes less of a factor for the smaller municipalities. Furthermore, if the system is properly designed, it can fulfill, on an automated basis, standard operational requirements such as issuing permits and licenses, maintaining records, etc. for the municipalities involved. In the long run, this characteristic will result in a decrease in operation costs as pointed out by Werner:

> "Automated information systems can reduce the cost of municipal operations anywhere from 10 per cent to 33 per cent of current costs, depending upon the effective adaptation of the system to municipal processes. This reduction comes primarily from the streamlining of procedures (paper work generally) and by permitting the same staff to handle vastly increased work loads".[70]

However, it is during the initial stages that costs are prohibitive and the long term benefits not sufficiently evident. "The tangled web of services and support services, the involvement of all levels of

government and administration and cost sharing make the goals uncertain and the accountability hazy in the extreme".[71]

M. DEPARTMENTALIZATION

Municipal corporate structure and departmentalization results in a four-fold impediment to systems development. Firstly, there is a reluctance to permit outside departments to undertake a systems study as the study is viewed as an intrusion which probes into the operation of the particular department. There is an inherent fear that certain inefficiencies may be discovered or that the particular department is performing tasks that are functions of other departments.

Secondly, each department has local goals which may often be in conflict with other departments. For example, the Assessment Department and the Planning Department in the City of Calgary cannot agree upon a common definition for building square footage. The Assessment Department is concerned with the "assessible area" whereas the Planning Department is concerned with building bulk and floor area ratios. Although a compromise may be possible, conversion and acceptance is difficult to achieve.

Thirdly, the exchange of data and cooperation essential to the operation of a successful system is difficult to achieve unless direct benefits are evident to each department. This is very difficult if not impossible at the early stages of development.

Fourthly, departmentalization creates barriers to intergroup communication, thus often the needs of one entity are not reflected or expressed to systems designers. A further related complication is a further structure break-down or a "divisionalization" within each of the departments. For example, there are six divisions within the City of Calgary Planning Department, each with "local" objectives, giving rise to similar problems as amongst departments. One of the major drawbacks in the implementation of the Development-Building Permit Control System in Calgary has been just such a conflict.

N. LACK OF SECURITY

A large portion of the data that is retained in municipal files is of a confidential nature. Under a manual method of operation, confidentiality is not a great issue because each department usually maintains its own filing and recording system, thus the total complement of information relating to a specific area or site is scattered and is therefore not readily accessible by any one individual. With an automated system the risk of a breakdown in security is much greater because all of the relevant information is stored in one central place - the computer files. Thus access to the computer would virtually mean access to all information. This problem relates not only to retrieval of data but to entry as well, as incorrect entry or entry of invalid data would quickly jeopardize the creditability of the system.

Although the use of passwords and codes for both entry and retrieval of data has been fairly successful in the past, the rapid development of computer technology without adequate security measures, has resulted in computer thieves. Some computer technologists now make a living breaking computer codes. In addition the proliferation of terminals especially the portable types, has made access to computers easier than ever in the past.

0. USER DATA REQUIREMENTS

Assuming that the users of the information system are identified, by designing a specific system for a specific user, their real data needs are difficult to determine, and are seldom properly researched. All too often "data was included in the system because they were available, because they were presently used, because people said they need them or all of these. The key criteria, organizational decision and operations requirements and their information needs, simply were not included."[72] Coleman and Riley[73] have pointed out that information systems have failed to meet the needs when:

"a) crash data are defined and identified and then installed, rather than developing an orderly, well thought out effort;
b) hypothetical (instead of actual) information needs are used for design basis, and
c) information does not distinguish between critical and non-critical organization of factors or does not relate to objectives".

Many systems typically arise because of a particular need, usually associated with an administrative crisis. This not only results in a

narrow focus but the administrative needs often take precedence over research and planning needs. The planning function is thus forced to rely on data obtained for administrative records and is limited in scope.

A further drawback with municipal information systems is that there are no provisions made for potential users in the private sector as "the only needs government data systems are designed to meet are government needs."[74]

Obtaining and disseminating information from and to public and private sectors is difficult because of the diversity of interested participants and the different kinds of information. "One of the real problems of information exchanges today is the different formats in which information is gathered and used by different users".[75] The problem is further festered by the apparent conflict between the public sector and the private sector. Since the City Administration views the private sector, developers for example, as someone on the opposite side, and someone who the Administration must protect the public from, the City Administration is naturally reluctant to readily release information to the private sector.

In many instances the system designers build the user requirements around a specific piece of hardware, rather than designing the software and hardware to meet the user requirements.

Another problem is that information systems or at least the designers of the system have not been able to react promptly to new conditions arising as a result of changes by the user department. The systems are therefore simply not flexible enough to meet the user demands.

P. CONCLUSION

This thesis has shown that although there is a definite need for an integrated information system in municipal government and specifically in urban planning, such a concept has little chance of becoming a reality, at least in the near future.

It has been indicated that although there are various planning styles, urban planning is a rational decision making process, adaptable to a systems approach. Furthermore, the ever increasing complexity of our urban fabric has in fact, created not only the need for a systems approach to planning, but also the need for the application of integrated systems technology both in terms of the information function and the operations function of urban planning. This integrated system by its very nature is not exclusive to City Planning but is a necessity to all facets of urban decision making and operations. However, due to the complex nature of a total system, each potential sub-system, i.e., planning, must be dealt with incrementally and with a clear understanding of the fundamental components. At the same time an overview of the total system must be maintained, the potential users and their needs clearly defined.

The potential application and benefits of an effective urban information system are virtually unlimited, however, two major areas stand out. Firstly, there is the information function. it would provide better more current information for comprehensive decision making and evaluation on a continuous basis. More specifically, it would ensure current accurate data for all users, improve services to the public, simplify the data analysis stage of the planning process, provide a means for better dissemination of data, facilitate the creation and testing of alternate plans and expedite without a loss in effectiveness, the routine activities performed by urban planners.

Secondly, there is the operations function, which includes management and control. It would increase efficiency and productivity by eliminating routine tasks and provide a more effective management control device.

Although the need for an integrated system is quite evident and the benefits clearly defined, a successful system has not been implemented, either in part or in total. A case study of the City of Calgary's attempt at developing a Building and Development Permit related mini subsystem and a review of endeavors in other applications has identified the major difficulties in the implementation of systems technology.

One of the salient shortcomings is the reluctance on the part of the users; a lack of appreciation for the need of a system, a fear of losing autonomy, a fear of computers, a resistance to change; a lack of

management commitment and a general lack of understanding of systems technology have emerged as inhibiting barriers. Other contributing factors include the complexity of integrated systems, the lack of research in the application of systems technology, departmentalization lack of built in security and a failure to clearly identify user requirements.

The major drawbacks have overshadowed any potential benefits and have stiffled any attempts at successful implementation to date. Too many changes must therefore occur in the attitudes and education and in the structure and composition of our administrative fabric before the concepts of integrated informations systems has any hope of becoming a reality.

FOOTNOTES - CHAPTER VIII

65. Weller, Op.Cit., p. 16.

66. Weller, Op.Cit., p. 19.

67. Coleman and Riley, Op.Cit., p.20.

68. Wellar, Op.Cit., p. 15.

69. Coleman and Riley, Op.Cit., p. 21.

70. Werner, M.E., Cost-Benefit Ratio of EDP: A Political Challenge, article in American Society of Planners Officials, Chicago, 1967, p. 17.

71. Wellar, Op.Cit., p. 29.

72. Reynolds, Op.Cit., p. 41.

73. Coleman and Riley, Op.Cit., p. 10.

74. Wellar, Op.Cit., p. 135.

75. Reynolds, Op.Cit., p. 71.

CHAPTER IX

CONCLUSION: OUTLOOK ON THE FUTURE

A. GENERAL

This thesis has outlined that in order to carry out effective urban planning in an increasingly more complex environment, there is a need for accurate, more up-to-date and integrated information. It has also established that in order to overcome the major shortcomings confronting the development and implementation of information technology, the issue of information systems must be addressed in a systematic manner similar to that required to perform meaningful comprehensive planning. However, due to a number of factors, a high degree of skepticism has been expressed relating to the implementation of a successful integrated information system in planning.

In conclusion, however, it is the contention of this thesis that although the creation of a totally integrated urban planning information system is an impossible dream at this time, the need for such a concept is crucial enough that to drop the matter would greatly impede good effective planning in the future.

Accepting the premise that information systems are essential to urban planning and that totally integrated information systems are "an impossible dream" in today's urban scene, the most important question is raised: "What can we do?" The only future appears to be the acceptance, development and implementation of small independent sub-systems at the

risk of insurmountable integration and coordination problems at some future date. This mini sub-system philosophy must be adopted to encourage the growth of systems technology and application, and to orient potential users to the entire concept of systems technology at a scale that is more easily comprehended. Whatever happens the field of information technology must be actively pursued and promoted as more informed decisions are generally a better decision.

There is no simple answer or approach to this very difficult and complex issue and any endeavor to present a single answer would be an exercise in futile optimism. The following section however, outlines and briefly discusses some of the positive aspects and courses of action that must be actively considered in systems technology and urban planning. It does not formulate a clear cut methodology but does address some of the very key issues and establishes guidelines and recommendations essential to keeping the notion of information systems in urban planning alive and perhaps in the long term making effective integrated information systems in urban planning "a possible dream!"

B. SOME GUIDELINES AND RECOMMENDATIONS

1. Design Factors

One of the fundamental considerations of any attempts at developing and implementing an integrated information system is the approach or methodology employed. Although there is no way of insuring the success

of system development, Li[76] suggests that the following basic principles serve to reduce the chance of failure:

"1. Identify the key objectives;

2. Set up a high level steering committee and recognize thereby the high cost and potential of computers;

3. Involve the operating managers in the computer development and ensure that they benefit from and contribute to it;

4. List all potential applications looking particularly for applications in areas of high company expenditure;

5. Draw up long range plans for the successful implementation of different applications;

6. Be prepared to revise plan."

In order to alleviate some of the misconceptions and lack of understanding relating to information technology, several different courses of action may be considered.

a) Incremental Development

A totally integrated information system on a city-wide scale is so complex that it is impossible in the initial stages of design to consider the entire system, except within a very conceptual and schematic framework. Attempts at doing so would very soon lead to frustration on the part of all concerned. It is therefore not only desirable but essential that the system be designed and implemented incrementally. That is, to concentrate efforts on some less complex

isolated sub-system. However, at all times keeping in mind that the sub-system may be an integral part of a larger total system which, in all likelihood, will be designed at a subsequent date.

Furthermore, since the planning process and City planning operations cannot be halted, installation must be over a period of time. In the interim it is therefore necessary to support the planning function with a non-integrated system until such a time as the overall system is available.

b) Education

In order to gain "universal acceptance" and to maximize the input and objectives of both the systems design function and the planning function and to bridge the communication gap between them, personnel trained in both aspects are required. However, since such individuals are not readily available Hemmens[77] has suggested that:

> "It is easier to train someone familiar with the (Planning) application in data processing than it is to train someone familiar with data processing in the application."

This may be achieved by on-job training where Planning personnel are encouraged to participate in seminars and courses offered in systems technology and to work closely with systems analysts and programmers on various projects as an orientation exercise. In

addition, universities, colleges and technical schools offering planning courses must be encouraged to expand their curriculum to include systems and information technology as specifically relating to the planning discipline.

Concurrent with the actual development and implementation stages of an information system, an education program must be developed and conducted within the user department, whereby all persons directly or indirectly involved in the system are well informed. The fundamental principles of systems philosophy must be well articulated, the objectives of the system clearly defined and procedures and operations manuals prepared which succinctly document the system. These must not only be distributed to, but carefully reviewed with all personnel, that is, all potential users of data and the system suppliers and system operators. A clear understanding and a common objective should certainly lead to greater cooperation and commitment and hopefully successful development and implementation of a better more efficient system.

c) Moral Suasion

Concurrent with an effective education program, an approach best referred to as "moral suasion" should be pursued. That is, the benefits and potential of an integrated information system to urban planning should be explicitly exposed not only in the areas of information collection, storage and retrieval but also in the

streamlining of or improvement to current operations function of normal activities. In other words, simply "sell" the concept to all concerns by clearly and concisely focusing objectives of the proposed system to firstly, augment the flow of information such that the opportunity will be provided for more informed decision making, and secondly that streamlining of daily operations will result in more efficient allocation of human resources.

An effective public relations and promotion program must be formulated and implemented. This may involve the hiring of specially trained personnel to perform the task.

d) Systems Research

Initiative must be taken by urban planners, administrators and decision makers to encourage further research and development of computer and information technology at the local level, which is specifically oriented towards the planning function and its needs.

2. Development Responsibility

A related concern is the decision of responsibility regarding not only design, development and implementation of an effective information system but also the maintenance and operation of the system. One apparently effective means although not yet proven, is that adopted by the City of Calgary. As outlined in Chapter VIII, the City of Calgary has

attempted to overcome this concern by establishing a special independent department to serve as the "link" or coordinating body among the disciplines related to the system. One major advantage of this approach is that this independent department can provide, in theory at least, an unbiased and objective input and thereby better serve the interests of all concerns and having an overall perspective can function as the essential tie for all the sub-systems under development and in operation.

3. Team Approach

The problem of organizing and administrating a project of such complexity is particularly of concern when considering the development of an information system on an urban scale, because of the proliferation of potential agencies, both on the user and supplier side. One approach to the situation is to appoint a project team during the initial stages of the design and development. The composition of this team should be such that on one hand it represents all major interests and on the other hand it is relatively objective and unbiased. Attaining the degree of objectivity and impartiality required is no easy task, however, once again the insertion of a team member from an independent administrative department such as the Management Systems Development Department in the City of Calgary can greatly assist in achieving this end and can mediate in situations of major disagreement or in instances where common objectives amongst the participants is not evident. The effectiveness of this approach may be increased by employing training programs such as

"The Management Grid" outlined by Blake and Mouton[78]. This program for instance, not only "provides a framework of alternatives for unravelling and solving complex problems", but also offers methods for achieving maximum efficiency through the Team Approach.

4. The Human Element

Acceptability of information technology by administrative and management staff members looms as one of the major impediments to effective implementation of an information system. Loss of autonomy, resistance to change, fear of computers, job security, loss of professional identity and lack of motivation may all be underlying factors for the skepticism and reluctance to accept the new emergence of technology and its application to urban planning. In addition to "moral suasion" several considerations to overcoming this human resistance are suggested. These are outlined below.

a) Planning Profession and the Role of the Planning

The lack of a widely accepted definition of the urban planning profession and its specific functions and of the role of the planners in urban operations and policy formulation has resulted in a lack of confidence and an insecurity amongst planners in urban government. This has contributed to impeding the development of information systems in the planning field due to the reluctance amongst planners to acknowledge the benefits of computer technology

fearing that these innovations will further jeopardize their somewhat "shakey" profession. To alleviate some of these concerns a concerted effort must be made by universities, the Canadian Institute of Planners, and all affected persons to more precisely define the planning profession, and its relationship to urban decision making and the role of the planner. The professional engineer for example, seldom if ever doubts his purpose. Once an identity is established, and in turn confidence in a profession, resistance to external forces will be greatly reduced, and attitudes towards information systems more positive.

b) Implementing Technological Change

One of the major problems confronting implementation of information technology can be referred to as the "People Problem", that is simply - a resistance to change and new technology for whatever the reason. This factor has been reflected in all of the previous discussion, however, it must be emphasized once again. Several methods have been suggested such as moral suasion, and staff education, but the overriding approach is "The Human Element", that is to analyze the factors in work situations which underlie the resistance and then to decide on the best method for meeting the problem. Analysts and system designers must be aware of pre-change attitudes which exist in user and supplier departments so that implementation strategies can be designed accordingly. Li[79] has pointed out that in this regard,

> "The Sociologist would reply that a knowledge of the factors influencing peoples attitudes to their work and an ability to analyze particular departments in these forms when implementing EDP systems can make all the difference between success and failure".

The human study is very significant because people do respond differently depending upon their work environment. For example, if the situation in the potential user department is satisfactory such that the people like their work and the job is meeting their needs, there is no internal force for change. This may be in contrast to a situation where employees have a number of grievances and are generally dissatisfied. It is only after the systems analysts have carefully assessed the "Human Element" that an effective strategy can be formulated and the other implementation techniques discussed be selected.

The task is enormous, however, if effective urban planning is to prevail in the future, one of the greatest challenges facing urban planners and administrators is the information crisis and making totally integrated information systems a "possible reality".

FOOTNOTES - CHAPTER IX

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77. Hemmens, Op.Cit., p. 320.

78. Blake and Mouton, The Managerial Grid, Gulf Publishing Company, Houston, Texas, 1964, p. 1.

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