INFORMATION IDENTIFICATION SYSTEMS IN CITY PLANNING: AN EVALUATION OF EXISTING SYSTEMS

by

KENNETH GEORGE DENIKE

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Division of Community and Regional Planning

The University of British Columbia,
Vancouver 8, Canada

Date April, 1966.

ABSTRACT

Systems of identification have long been used in city planning to relate land use information to the physical structure or pattern. The street address is the form of identification that is commonly used in land use surveys; but with the advent of the computer, the systems of identification in use within the city have become outmoded because they cannot be readily mechanized. The military grid was discovered to be highly compatible with the computer and hence it has generally been adopted as the system of identification for use with automated means of locating land use information and retrieving this information for research purposes. A result of this combination is the computer-produced map.

And yet, all spatially located activities can be easily referenced by street addresses. Surveys are conducted from the street and the information is identified by the street address. To make use of the military grid it is necessary to convert street addresses to locations on a military grid. In practice a long description of the street must be maintained. Before adopting the military grid and the inherent conversion from the street addresses, it is necessary to determine what purposes are fulfilled by using

both street addresses and the military grid. Furthermore, referencing information by street addresses alone may fulfill the information requirements of urban planners.

This study deals with the two fundamental systems of information identification: the street address type and the military grid type. Both are evaluated for use in retrieving information for city planning and a framework is structured for this purpose. The relevant criteria are established by reference to the principles upon which information handling is based. The framework and the relevant criteria are tested with existing empirical evidence and it is found that it is feasible and useful for comparing the two identification systems.

The two systems of identification are then evaluated and it is found that the street address type should be selected for installation in systems for retrieving information at the interdepartmental level and directly from land use surveys. There are other reasons for developing systems of identification including the analysis of information once it has been collected and communicating the results of the analysis.

Therefore, following the general evaluation, further criteria relating to the discrete nature of land use designs are developed and applied to an identification system currently being implemented in the City of Vancouver, B.C.

This is a case study of a street address type of information identification system and fulfills the requirements for handling information in urban planning. It is used to assure that the criteria relating to the discrete nature of land use can be recommended for use in future evaluation of identification systems.

Based upon the case study a recommendation is made that further research is necessary to explore the implications of using the street address type of information identification system for the collection of information and possibly the military grid type of information identification for printing that information. Further research is necessary into the uses, design and evaluation of identification systems in urban planning.

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CHAPTER I

INFORMATION SYSTEMS FOR CITY PLANNING

Planners have relied extensively upon intuition to understand cities; but with new information handling techniques a more precise understanding is possible. Before these techniques are adopted, Creighton argues, reasoning among planners has to be based largely upon individual experiences with people and consequently, many years of experience are required to comprehend the forces which cause growth and decay in cities; and, that the "probable effects of a given action and of the probable effects of alternate decisions" are not known now because planners are unable to handle the available information.[1] He finds that these new techniques provide opportunities "for the first time...to overcome these difficulties."

Although the probable effects of a given decision are not known now, various authors have indicated the importance of the decision-makers on urban growth patterns. Schaller emphasizes the critical nature of governmental expenditures in the growth processes.[2] Accepting the critical nature of certain decisions, Chapin and Weiss describe urban growth patterns in terms of decisions by individuals and public and private groups.[3] Furthermore, certain governmental expenditures for capital works provide the potential for creating

"secondary" decision-making.[4]

For "any process as complex as planning, and particularly any process with great requirements for information" to become effective, it "must be organized around some formally structured concepts".[5] A theory for city planning is proposed by Optner stressing the importance of goal definition and the means of implementing goals.[6] He utilizes formally structured concepts which are compatible with new information handling techniques to eventually solve urban problems relating to land use controls and the allocation of public funds for capital works.

The advantages and uses of new information handling techniques in solving city planning problems are discussed by Creighton.[7] He emphasizes that the machines are only tools and that the planner must decide what facts to be put into them. Wheaton has indicated that some facts are more important than others to decision-makers and that "the simple act of providing facts regarding market trends...would make a real difference in our urban development rates.[8] Webber acknowledges the importance of supplying better information that might be used as a basis of more rational decisions, and indicates the need for forecasts.[9] He describes "intelligence centers" which would supply the information.

The planner is responsible for providing information on what is occurring and analyzing past experience within the city and making proposals as to what should be occurring

within selected substantive areas such as land use development. On any particular project being considered by the municipal executive, the planner is responsible for making explicit the relevant information. The planner's impact on the city is related to this continuing information function and the interdependent application of techniques for handling information in order to implement plans. These plans are not static proposals but are controls which can be adjusted to changes in the functioning of the city. The difficulty for planning is that change makes plans obsolete unless relevant information can be collected and analyzed quickly enough to permit certain adjustments in these plans to compensate for changes. Also, the planner indirectly implements these adjustments through the municipal executive and hence the planner needs the continuous supply of information in order to inform the executive.

I. THE ROLE OF THE CITY PLANNER IN DECISION-MAKING

Advisor to the Executive

The present role of the planner can essentially be improved.[10] In order to advise the executive the planner must have an efficient means of collecting information as well as analyzing and reporting it. Fundamentally, this is communicating selected information as a better basis for legislation and places certain requirements on the information.

The information must be to the level of detail required by the legislator. If information is required on construction activity over a period of time and there has been a continuous collection of this information, then the desired level of detail should be made available. If this is not the case and the information is too detailed, it must be generalized before being presented to the executive. Furthermore, the information must be presented at the time it is requested in order to be useful in the legislation or policy formulation being considered. This may mean, that the legislators are not able to make the very best decision requiring complete knowledge and complete information but that enough information is given to make a reasonable decision. If the decision is not made, the opportunity may pass out of the legislators' hands.

Informing the executive and making the executive sympathetic to the scope and nature of planning purposes requires more than strictly communicating information to them. Accurate forecasts are also required and this entails creating a model of what the city may be like, or is expected to be like, in the near future. Relative to the city, this model will likely be a spatial one although the actual forecast may be economic, such as an allocation of funds, or it may be a complex model, such as a functional change in land use.

A system which will supply a continuing source of information is needed if the planner is to fulfill his role effectively as an advisor to decision-makers. If the planner is unable to supply the required information at the right time and the the requested level of detail, the planner's advisory role is severely limited. The executive, making a council decision on a capital works project which is intended to last for twenty years, may look to reasonable long range objectives, but the decision will likely be based on short range projections and possibly the decision may be made via a plebiscite, in which case only short range considerations may be taken into account. Consequently, both the formulation of long range objectives and the forecasting of short range projections may be required to evaluate alternatives in order to reach any one decision.[11] Therefore long range projections may be made and then modified at intervals for a long range plan and accurate short range projections may be required for the first interval. In the example being considered, the role of advisor to the executive becomes an integral part of the decision-making process. But this is dependent on the planner being able to provide accurate information.

Collecting the Information

The planner collects information from secondary sources and in some cases from direct surveys. Secondary

sources relate to civic departments which generate information acquired from their own direct surveys.[12] This information is primarily collected for use within the civic department acquiring the information and hence the information is often suitable only for the original purpose of collection. The role of the planner as advisor to decision-makers is generally enacted coterminous with preparing plans which require comprehensive physical, economic and social information. To collect the majority of the necessary information from direct surveys would result in duplicating secondary sources which may collect the information for different purposes but may acquire essentially the information that the planner requires. There is a further inefficiency in duplicating the secondary source; although the information, or data upon which the information is based, may not be exactly in the form that the planner requires. The civic department probably collects information on a continuous basis, whereas the planner generally conducts direct surveys only when a distinct shortage of information pertaining to a particular problem exists. The planner will be interested in collecting and analyzing data on a periodic basis to establish and evaluate trends in urban growth characteristics but he may not be able to conduct the required surveys because of administrative difficulties such as those involved in acquiring confidential information. However, the planner will be interested in the trends in urban growth characteristics

and generally not in the confidential information per se. The planner is interested in the pattern of social welfare cases and not in the individual family. However, if the planner is to establish the pattern, he must conduct a survey of a confidential nature or alternatively collect the information from a secondary source such as a civic welfare agency. Utilizing information from a secondary source is the most efficient of the alternatives for the planner.[13] In this way, the planner can also maintain a check on certain indices without having to continually conduct surveys.

II. INFORMATION RETRIEVAL SYSTEMS FOR CITY PLANNING

Information Retrieval Systems in General[14]

The retrieval of large quantities of information from secondary sources is necessitating the development of information retrieval systems in large cities. These systems have generally been designed with specific objectives in mind and consequently the proposed systems differ greatly from city to city. In some cities the information retrieval systems are being developed with the objectives of existing departments in mind;[15] while in others, the objectives are those of centralizing administration.[16]

The particular objectives of the department which actually develops the information retrieval system tends to

further influence the design. Each application has certain complexities and the civic department within which or for which the system is initially developed tends to concentrate on these complexities. Hence the information retrieval system tends to be oriented towards solving the problems found within the department for which the system is initially developed and consequently this must be considered when looking at these systems from the orientation of the planner.

Hearle describes the trend in information retrieval systems towards more comprehensive systems incorporating the needs of more and more departments.[17] This is in keeping with centralized administration of city departments, but although this seems to offer the most efficient operation for cities, the methods of achieving such a system have not yet been developed. The problem is that of achieving compatibility in purpose between departments. There are certain necessary functions carried out by municipal departments which tend to be incompatible such as the real estate function and the urban renewal functions. The incompatibility of objectives between departments is reflected in the requirements made on information retrieval systems. Proposals have been made for central information retrieval systems which would incorporate all the collected information but no method is included by which this can be done given the differing objectives involved in information collection. Until workable methods have been developed, such proposals should

command little attention from urban planners. Given the existing evidence, it would seem that there will likely be a possibility for developing a central information retrieval system, but it would relate basically to information generated from secondary sources and not to all the information collected for the city.

Before centralized information retrieval systems are developed it is necessary that planners fully document their information requirements so that these can be accommodated in any central system which is developed. This discussion on information retrieval systems is meant to point out that these systems reflect the orientation within the department for which the system was initially developed. Essentially, a system is initially developed to handle complexities within one department. Furthermore, the choice as to what objectives to fulfill has partially been determined by familiarity with techniques transferred from disciplines other than planning. A critical analysis of information retrieval systems from the perspective of planning must be carried out so that planners will be able to influence the development of these systems. The alternative is acceptance of information retrieval systems designed for different objectives than those of planning or transferred techniques which will not fulfill planning requirements.

The city planner is the adviser and analyst on the physical environment of the city and especially on the methods

of making plans. Rodwin describes him as concerned with the direct and indirect spatial implications of public and private decisions.[18] Information required by the planner, therefore, tends to be location-oriented such as facts related to land use.

Assumptions

This focussing of attention on information relating to the physical environment has implications for any system, or part of a system, designed to handle information for city planning. Information which is not identified in a manner which relates to location must subsequently be identified by the location to which it refers; information relating to a building site must be identified by the location of that site in the city. Otherwise, it is extremely difficult to effectively utilize this information in spatially locating urban activities. Hence, the assumption that only location-oriented information will be considered in this study.

Currently, systems being designed to retrieve large quantities of information are likely to be used with automation. The latest and most proficient techniques now available relate to mechanized systems.[19] It would seem then that systems developed to handle information for city planning are also likely to be mechanized systems because of the quantities of information which must be handled. The requirement that a system designed for retrieving information or an integral

part of that system be compatible with automation is used as a further basic assumption of this study. Systems or integral parts of retrieval systems which cannot be mechanized are likely to be used only for severely limited purposes in the future.

These assumptions limit the scope of this study to the analysis of methods of identifying information related to physical location such as a building site for which the retrieval of this information can be mechanized.

III. IDENTIFICATION SYSTEMS USED FOR LOCATION-ORIENTED INFORMATION

The Current Controversy in Identification Systems

Identification systems are not a new invention but have existed for centuries in the form of postal addresses. In this form the address is the method of identifying the destination of the letter. While the retrieval is manual this method works extremely well. The postman knows the location of the address and hence his performance in delivering letters is generally faultless. This is essentially the task which mechanized retrieval systems must do although in an abstract way. They do not actually deliver information to the physical site but they are required to deliver information relating to that site. However, the identification of that information may be essentially the same as the postal address.

Some form of address is actually used to identify the site in all location-oriented identification systems.

Recent innovations in the mechanization of information handling have partially outmoded the historic systems of identification such as postal addresses. These systems generally lack the logical consistency necessary for machine compatibility although they can be made machine operative with extensive redesigning. When this is done they can be considered "street-oriented" identification systems. In even broader terms even the manual postal type of identification system could be considered a street-oriented system. Street-oriented identification systems are but one form of identification systems.

An alternative type of identification system is the "grid co-ordinate" identification system which essentially is a military grid. The grid is superimposed on the city and a building site for example would be identified by the intersection of the nearest horizontal and vertical line.[20] The lines are generally based on 1000 foot intervals.

The emphasis which is now placed on the aspect of mechanization within systems accounts for the major criticism of historical identification systems such as the postal address type. In unmodified form the historical type is not generally compatible with automation. However, to analyze functional relationships between the component parts of the city suggests a mechanized retrieval of information.[21]

Accepting the view of the city as a complex physical product resulting from operations of intrinsic functions necessitates the automatic retrieval of information. The classical identification systems are not readily converted directly to machine operation although directories giving the postal address and identifications compatible with machine retrieval have been prepared.

Approaching the retrieval of information from the point of view of the requirements necessitated by automation yields some interesting observations. An understanding of the machines available for this purpose would facilitate this approach but suffice it to say that some form of co-ordinate system would be the most practical for mechanization.[22] Accordingly, most identification systems designed for the mechanized retrieval of information have been designed with this in mind.

The translation of this observation into a system for the mechanized retrieval of information was most obvious in the case of the grid co-ordinate system. Information location in this system is in direct relation to the position of the site in the city, the information can be directly positioned on a map for visual interpretation.

Street-oriented systems essentially use the streets as co-ordinate lines as the basis of identification. Since the street is the co-ordinate line, a curve in the street should be a curve in the co-ordinate line. It is not and

therefore the information location in the system is not relative to the position of the site in the city.[23] Information relating to curved streets would be positioned as if the street were straight. This results in a distorted view of the city when information is printed directly on a map. Hence any evaluation of street-oriented identification systems in terms of direct machine positioning of information on maps are likely to be negative at present.

Both these basic identification systems have been used and can be used to identify information relating to city planning. Taking account of the vested interests of those involved in developing these systems it is with some hesitation that an evaluation of these systems is attempted. In comparing workable techniques it is generally the case that the researcher is accepting a point of view and if this point of view differs from those of the persons developing the techniques, controversy is likely. There is a further reason for this hesitation and it relates to the problems involved in comparing one segment of a total system with an alternative segment of the system. Real progress can be made only with a framework for evaluating the whole system of which the segment is an integral part. It will not be possible to establish such a framework, although the theoretical considerations will be documented in order to limit the evaluation to comparable parts.

What documentation is available on both identification systems tends to be biased precisely because there is no overall framework within which to objectively analyze the achievements within any one segment. Different people working on selected segments of information handling are interested basically in how the system works relative to their segment of interest.

Narrowing the area of evaluation to a single segment from the overall framework which would be necessary to use in evaluating information retrieval systems in general does not make the choice any less difficult. The grid co-ordinate system can be expanded from grid systems already in use on many maps and therefore can be used as a common denominator of those grid systems. It is also highly compatible with automated equipment for efficiently handling a large quantity of information including directly mapping and graphing the information.[24] This can be an extremely effective means of communicating information because a picture tends to be much more quickly comprehensible than tabled facts. The information can be tabled relative to the physical location of its source. This system can also be highly educational in that the communication between planners and laymen is greatly improved.

And yet it seems difficult not to look to a street-oriented system because it has been used to such a large extent in the past. The very precision with which mail is

delivered is a case in point, as well as the street being one of the most permanent physical forms in the city. The streets in a built up area are very likely to remain, despite the fact that the character of their use may change. The streets generally outlast the buildings they serve and represent a very large investment of social capital. The planner's orientation to the spatial aspects of the city therefore focus to a great extent on the street. He has very much more control over the use of the streets than over surrounding land because the streets are publicly owned whereas the surrounding land is generally not publicly owned. These factors tend to be characteristic of most cities.

Noting these theoretical differences between both systems results in an observation that each system has been established for essentially different reasons. The grid co-ordinate system is highly compatible with automation and the street-oriented system utilizes an existing facility which has historically been proven operational for retrieving information and is of interest as an entity per se. This system, although historically used under varying conditions, suggests a further utility for urban planning and for independent reasons is incompatible with direct visual communication.

Is this then a dilemma which condemns planners to deny the automation aspects of the co-ordinate system or the utility of using an existing facility as in the "street-

oriented" system? Street engineers, oriented to street maintenance were not concerned with the visual aspects of communication and hence opted for street-oriented systems. It would be extremely difficult to defend their system without further analysis from the perspective of planning. As the grid co-ordinate system has been used and is currently being tested for planning use, the same cannot be said of this system. However, proponents of this system may have accepted the ease of automation aspect of the grid co-ordinates at the expense of a number of operational aspects which may prove to be theoretical faults which cannot be easily overcome. Neither system should be readily accepted and yet a negative attitude is not really any more satisfactory. Proponents of systems have been put in the position of having to defend their system and have been very worried lest they provide evidence for opponents of information retrieval systems in general. The rejection of these systems because they have apparent difficulties is much worse, from the point of view of scientific progress, than the formulation of hypothesis. If there is no conformity between the resulting systems, and what is required in a system for urban planning, then the system has one strike against it.[25] Attempting to scientifically justify a system provides a check on otherwise zealous patriots of one system or the other, while at the same time adding an objective fund of knowledge which will likely enable researchers to go beyond the current method.

Study Hypothesis

Attempting to justify a system is the logical way to make progress in providing the required information for urban planning, an attempt to validate the use of the street-oriented system shall be made. It is accepted that this system cannot now be automated to directly print information on maps corresponding to the source location. The hypothesis is that:

A 2street-oriented" information retrieval system provides the optimum solution to a number of problems in the retrieval of factual information pertaining to urban planning. But even if it should be proven that a street-oriented system has a number of inherent problems, the historical use of this system should make investigators look elsewhere for the explanation. The value of this approach derives precisely from the historical use of street-oriented postal addresses. If the use of these systems has changed so drastically that the historical reasons are no longer valid, then it will be necessary to look to the actual functioning of information retrieval systems in general to see what appeal competing systems hold. Possibly the very emphasis on automation for these systems has sufficiently changed the operations of information handling so that historic uses no longer hold. But this does not prove that the street-oriented systems cannot operate effectively, only that further knowledge may be required as to the actual purposes of information handling.

The emphasis in this study is placed on evaluating the methods of identifying location-oriented information and developing the criteria by which to evaluate these methods. The testing procedure is to evaluate the theoretical conformity of these methods and the criteria. After this evaluation of theoretical considerations, a simulation of a physical environment study is documented. This study will be conducted manually but duplicates those of conducting a study with a street-oriented identification system. It is hoped that this simulated study will point the way to a more exact set of criteria for the identification of information relevant to city planning. Subsequently, certain recommendations are made relating to the geographical expansion of this system to regions.

Summary

The objective of the study reported on here is to develop a crude set of criteria in order to evaluate existing methods of identifying location-oriented information used in information retrieval systems for city planning. In addition, a case study is used to test the operation of one of these systems for a simulated physical environment study.

Identification of location-oriented information must be compatible with automation and the continuous collection of information and may be accomplished by two general methods: street-oriented identification systems such as postal addresses;

or alternatively, grid co-ordinate identification systems such as the military grid.

Attention is concentrated on street-oriented identification systems in this study. It is hypothesized that: A "street-oriented" information retrieval system provides the optimum solution to a number of problems in the retrieval of factual information pertaining to urban planning. It is assumed that if an identification system cannot fulfill the criteria to be established, the overall information system cannot be expected to be effective for handling information pertaining to urban planning in a continuous manner.

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CHAPTER II

FRAMEWORK FOR EVALUATION OF IDENTIFICATION SYSTEMS FOR CITY PLANNING

Identification systems are currently being developed and will be extremely costly to change when operational.[1] However, there is not yet any explicit documentation of the requirements that these systems must fulfill to be useful in city planning. The implications of this are, that should development of identification systems continue and city planners not document requirements, the systems will soon be operational. It will then be highly unlikely that major adjustments can be incorporated to facilitate information handling for city planning.

If the requirements of city planners are to be taken into account, it is necessary to develop and document criteria in order to reach provisional conclusions about ambiguous performance. The basic concern is to provide recommendations to serve as a basis for decision-making by executive authority. Hence the theoretical aspects are stressed in an attempt to provide basic and exhaustive criteria. The theory, and not the machinery, is of interest in postulating long range evaluation criteria. The underlying theory of information retrieval systems is examined towards this purpose for the assessment of competing

identification systems.

A framework for evaluation is used to objectively analyze comparable identification systems from the point of view of city planning. To assure that objectivity is served, it is necessary to compile the criteria from evidence independent of a direct analysis of one type of system or other. Comparing identification systems based on criteria adopted from an analysis of one of these systems cannot but result in biased conclusions. Only if the system used for compiling the criteria were an ideal system would there be any hope of obtaining an objective comparison. In the two basic systems being compared, this is certainly not the case.

An ideal system against which to compare actual systems is essentially what a detailed framework for evaluation would be. However, in the alternative systems to be compared, neither has the requirements of an ideal system. The basic problems in the two general systems are that few analogies seem to exist between the two systems for identifying location-oriented information beyond the basic essentials. Therefore it is necessary to compile the criteria from first principles of information handling.

Considerations of first principles will directly result in a minimal set of criteria for the theoretical evaluation of comparable identification systems. However, it should be noted that only a minimal level of operation

can be assured with these criteria. More detailed criteria would first require examination of further empirical evidence to recommend criteria for further testing.

To develop criteria from first principles of information handling requires an analysis of the information process in general. The information process incorporates a number of simple steps. A review of the literature indicates the functions of the steps and underlying implications; but not a procedure for comparing alternative techniques of fulfilling any one function.

I. FUNCTIONS OF INFORMATION PROCESS

The Information Process

The information process refers to the functions of acquiring, storing, retrieving, interpreting and presenting desired information; and in the broadest conception would also cover the generation of information. For the purposes of explaining the information process, generation of information is segregated from the other functions. The information process acquires information which is generated from other information processes and in turn generates its own information.[2] The generation of information from other information processes is beyond the effective influence of any one information process. There is little that can be done within one information process to affect the generation of information from other information processes.[3] If this were not

the case, desired information would be generated when required and there would be only the need of one information process. The initial information process in a sense would be educated to produce the desired information directly.

This discussion of the information process implies the very critical concept that information which is selected for acquisition can be communicated. Actually, the decision as to what information to collect is partially influenced by the form of generated information: "To collect information one must first translate one's observations into a transferable, transmissible, comprehensible form."[4] This does not refer to the initial generation of information; an idea which is unintelligible cannot be generated in any form whether audible, visible or tactile, although such an idea can be initially collected. Given that the information content can be communicated, this does not mean that the information can be transmitted. Survey maps must be transmitted in a visible form for reasons of legality, whereas the information content could actually be transmitted in an audible form. The survey map conveys more information than its actual content because the form is part of the information. It is therefore important to utilize the form within an information process best adapted to conveying the information. Several forms such as audible and visible may actually be used to convey information within any given information process. Information which is represented in a visible form

such as the written language may be substituted for information in an audible form given that the information being transmitted can be recorded in written language. The form being utilized within an information process to convey information affects the acquisition of information. The communication of information at times imposes critical restrictions on what information can be acquired and transmitted.

For the reasons already given, the initial generation of desired information cannot be greatly affected by an information process. This is true for when the information is generated as well as for what information is generated. Hence, for information to be accessible when desired there are storage and retrieval functions. These functions are dependent on an underlying implication that relates to the characterization of information.

Identification of Information

The retrieval of information, in fact, implies that there is something which is recognizable in the information and which determines whether information is desired or not.[5] Information, once collected, must have this characteristic which relates to the content. By identifying the information in terms of its content it is possible to then retrieve it. However, this implies that the information is reduced to some set of semantic symbols so that the content, itself,

does not have to be retrieved in order to determine if it is required. The set of semantic symbols may refer to a description or some other attribute of the information. Therefore, it logically follows that if information must be recognizable by content and the content is reduced to a unique set of terms of unique semantic symbols to be retrieved. Information retrieval is possible when information can be assigned a set of unique semantic symbols. Identification in terms of a set of unique semantic symbols is therefore fundamental to information retrieval systems.

This identification of information is in terms of content which is reduced to semantic symbols. The actual content reduction is known as indexing although, generally, identification in terms of semantic symbols is often referred to by this term. There is a further identification of information which can be carried out. This is known as coding or referring to the set of semantic symbols in terms of a set of symbols such as zeroes and ones which permits techniques of logic and induction. Translating the set of identifiers into unique codes serves only as a particular means for performing the recognition or indexing the information.

Interpreting the information is the final function within the information process or, in more formal terms, "the information retrieval system." However, to interpret information requires that the desired information be retrieved

and this assumes that the method of information reduction is taken into account. Demand must match the way that information is put into the information retrieval system in order to retrieve the desired information. This matching procedure is critical because information stored in a manner which can subsequently be retrieved has to be demanded in a recognizable form. The effectiveness of the matching procedure partially determines the degree to which information in the retrieval system can in fact be retrieved.

The essential problem in retrieval is providing an identification system which is applicable to the potential user of the system. The information content must be representable by a limited set of symbols which serve as identifiers. "Adequate and useful evaluation of an I.R. (informational retrieval) system must provide means to appraise the effectiveness of this aspect of the system; the measure thus devised should be highly weighted in any overall figure of merit."[6]

The symbols or codes in terms of location-oriented identification systems are the addresses of the site. The information pertaining to the site can be imagined to be reduced to the address in the identification system. The information is retrieved by going to this address. Actually, the information is only identified by this address and the reduction took place when the information was collected. For example, the information may relate to the number of

persons at a site. Only selected aspects of characteristics relating to the persons will have been collected; essentially this task of selecting what characteristics to record is a form of information reduction. However, we are concerned primarily with the aspect of addressing information and not the form of reducing information related to recording only selected characteristics in this study.

II. THE PROBLEMS OF EVALUATING IDENTIFICATION SYSTEMS

Basic Framework

It should be pointed out that information identification will be investigated in terms of its contribution to the city planner. Different users have different requirements of information and it is necessary to ensure that formal identification of the information for all users is possible although precedence must be given to city planning. A unique addressing system is necessary for machine processing for all users.

Assessment of information retrieval systems depends largely on the availability of knowledge of basic factors. These basic factors relate to the purpose and mechanics of information retrieval systems. Specifically they are; the objectives, dynamics and systematic methodology of performance.

It is felt that these three factors should be utilized in evaluation procedures for information retrieval systems. This results in evolving a framework permissive of incorporating descriptions of information retrieval systems. Although the framework could be differentiated by the three basic factors and be, in reality, three fused frameworks, a single framework should be more effective for systematically evaluating criteria. The basic concern being to evaluate criteria relating to theory, comparison of information systems must necessarily be more than the evaluation of additive factors except in the concept of the whole. The parts do not operate independent of the system and only by relating the part to the whole is comparison possible.[7]

Emphasis being placed on the theoretical aspects results in the framework being an abstract representation of operation. The cost and time involved in actually operating an information retrieval system are not considered. Each information retrieval system has its own complexities and long range efficiencies may be the result of current inefficiencies. Criteria relating to theoretical aspects are long range and will not be as quickly outmoded by expanding the information retrieval system. Furthermore, by emphasizing the underlying theory it should be possible to evaluate, within the context of the framework, individual parts of information retrieval systems.

Parts which fulfil comparable functions within the context of the framework are evaluated later in terms of their

respective information systems. By comparing abstract representations of their operation in a consistent manner, a meaningful evaluation of theoretical considerations can be carried out. It is not the abstract representation of operations which are applied per se, but the criteria. This necessitates carrying out the application consistently and measuring the effectiveness of the part within the framework. The framework does not change and therefore it should be possible to evaluate parts fulfilling comparable functions.

This framework for systematic evaluation permits analysis of the relative parts of competing systems and conclusions as to the comparative applicability of information retrieval systems for specific purposes. A framework enclosing time and cost criteria would also be beneficial but this is secondary to the basic objective of providing recommendations relating to long range evaluation. Therefore the following evolution of a framework does not enclose these criteria.

Work Done on Evaluating Information Retrieval Systems

There has been a great deal of work done on selected facets of information retrieval systems but a review of the literature indicates that few attempts outside of library systems have been made to provide the means for examining alternative systems in respect to their purpose.[8] In planning, a number of information retrieval systems have been proposed

and developed but the lack of a framework for evaluation limits the future development. Without a means for examining alternative systems the benefits of innovation of substituting comparable parts are left to conjecture.

The development of selected facets of information retrieval systems has been brought about to extend techniques to handle greater quantities of information than traditionally possible. The methods of indexing for retrieval of desired information could then handle only small quantities of common information. The vast increase in information relating to planning has been brought about by the increase in information in related fields and the need for more information for decision making.

There have been a number of attempts to develop information retrieval systems for library use. Techniques are currently being tested to represent books more fully than traditionally possible in the location system. Documents are machine stored and handled and in a sense the information retrieval system provides a means of high speed browsing. There have been a number of other developments based on librarians' indexing methods and automated methods. There have been a number actually developed and although the current value of these information retrieval systems may be limited, the potential is not. Any long range evaluation of these systems is dependent on ascertaining:

1. the basic operating characteristics,

2. the volume of information that can be accommodated,

3. the degree of relevance and reliability of the retrieved information,

4. the effort required to maintain and utilize a system,

5. the economics of the system.[9]

There is a further information problem: "A related problem is the lack of standardization of data elements in common use and the codes used to represent those elements. While this lack is a problem of long standing, predating the computer by many years, the advent of electronic data processing has raised the problem to a position of high priority.

Information is not available in a form which can be used by all those who require it. Traditionally, information was collected respective to the specific use of the organization collecting it. This has resulted in the following adverse effects.

1. Similar information is collected and stored by different groups without consideration being given to the information which has already been collected. The information is similar, but because it is used for different purposes it is in a different form. Duplication in collecting the storing information results.

2. Information which is readily available is identified in a manner which cannot be used except for the original

purpose for which it was collected. The information cannot be used without prior conversion and the conversion may be more difficult than the task of collecting the information.

3. Information collected and used in a non-automated form must generally be automated to be used for other than the initial purpose. It is particularly slow and difficult to transfer this information and keep it up-to-date.

Ignorance on the user's part in regard to the specific knowledge within the information system or the methods used to reduce knowledge to its coded identification is a difficulty which is independent of machine or manual operation. The problem is information reduction and coding, not machinery. Machines can speed up the operation under some conditions but they may be inflexible and inefficient at times.

Information processing in certain instances is more efficient if manually carried out. The potential usefulness of machine processing is lost when only a small amount of information is to be processed or when complex analysis cannot be reduced to a set of rigorous operations. In these cases a common indexing or identification system would facilitate other users of that information but machine processing may be ineffective although it may be beneficial for other users to put the information into a machine useable form. Once the information is in a form which can be used by the machine the information can be used again and

again. Thereafter the information can be used as basic information or as secondary information.

A simple manual system of retrieving information will often provide desired information in seconds whereas a proposed machine system will require hours.[10] In the simple manual case, the user may be able to go to the information or direct a search in the right location. The user is aware of the existence of certain information in the manual system although his request may be made in ignorance of the information in an automated system. The user may not be familiar with the automated methods of reduction of knowledge to coded identification. This difficulty is less likely to arise with manual systems than with automated systems.

Special purpose information retrieval systems are often very effective. Results can be obtained with little machine assistance and the operations either are simple or can be made simple. These systems are generally limited to search functions and the machine assistance contributes very little more than possible by strictly manual means. The information is generally related to one subject and the information reduction is unique. Classification of information in one subject and completeness of information reduction is the reason for effective search.

In some municipal departments, only a special purpose information retrieval system may be warranted. This poses

a serious problem to planners who require the information, but, as was mentioned in the first part of this chapter, cannot greatly affect the generation of the information from that department. For the city planners to conduct a survey would be to duplicate the facilities of that department for information collection. To meet the needs of a department, other than the planning department, a special purpose retrieval system may be all that is required, but to meet the needs of the planning department, a general purpose retrieval system is required.

Solving this problem is a difficult task. The work that has been done towards this end has generally resulted in posing a common identification system. It is also postulated that this system could be used by most departments and still be retrieved for analysis requiring information collected by several departments. Hence the purpose of a general information retrieval system are achieved as well as those of special purpose information retrieval systems for some departments.

In order to guard against a fallacious view of the resulting general purpose information retrieval system its organization should be explored. The special purpose information retrieval systems used by specific departments form the information collection stage of a generalized retrieval system. To do this requires a common identification system so that the information can be used between departments.

The information retrieval system which city planners need to keep a check on trends occurring within the city is the general purpose information retrieval system. The planning department may also conduct its own surveys in which case the planning department would use its own special purpose information retrieval system. It is quite likely that only the identification system would be common to all departments.

Establishment of a common identification system for most departments within the city solves the problem of requiring universal applicability of a retrieval system. The information retrieval system is not really universally applicable; the identification system is. Once this factor is recognized, the work done on evaluating information retrieval systems can be put into perspective.[11] A number of the problems relating to location-oriented information have arisen because city planners have not assimilated this factor.

Data processing experts seem not to have differentiated the organization of general information retrieval systems adequately to define the parts. Therefore, any knowledge of where the parts fit has been only from operational knowledge. But it should be pointed out that by differentiating between the departmental level and the inter-departmental level of information retrieval systems a number of criteria can immediately be ascertained. Had the data processing experts

broken a general purpose system into levels of retrieval systems and the component parts of each; then the criteria for evaluating these component parts would have been relatively easily ascertained.

III. FRAMEWORK FOR THE EVALUATION OF IDENTIFICATION SYSTEMS FOR CITY PLANNING

A Minimal Set of Criteria

The realization that it is the identification system which is universally applicable and not special purpose information retrieval systems, aids in clarifying what criteria are essential for the retrieval of information from departments. First, the criteria relate to the special purpose retrieval system used within departments. Second, these criteria relate to the identification system which must be common to all departments collecting location-oriented information. Finally, the criteria must distinguish between the two levels of information retrieval systems.

An identification system must fulfill essential requirements relating to the special purpose information retrieval systems. This is the level at which information is collected and without information, the value of an information retrieval system is academic at best. These requirements depend on the objectives of collecting the information. Engineering departments in cities generally collect information in conjunction with maintenance and

construction tasks. Such things as street maintenance generally requires that a location be very accurately identified. Assessors' departments conduct field surveys continually and therefore identification from the street is essential for efficient operation. Planning departments collect information in relation to the physical environment and require that information be identified so that it can be analyzed in flexible spatial units.

An identification system must be common to all departments collecting location-oriented information. This requirement is essential if there is to be a general purpose information retrieval system. Without one, city planners will have to conduct their own surveys and this has been shown to be an unacceptable alternative. It should be pointed out, however, that there is no inherent reason why the identification system which is common to all departments has to be the same one that is used within the departments. Two levels of information retrieval systems could be used with two distinctly different identification systems. This would necessitate translating information required at the inter-department level but in specific instances this may be warranted. However, the minimal criteria for evaluation would remain the same.

The essential requirement from the point of view of city planning is that information pertaining to the physical environment be permissive of being grouped relative to

different areal units.

A limitation which is very relevant for planning decisions is the difficulty caused by different sources using variations in area units upon which to base their information. Often the information is in non-comparable units because the different units are juxtaposed over one another. This results in a kaleidoscope of base areas which must be manually broken down to the lowest common denominator and built up again to areas suitable for analyses. Manual grouping of areas is time consuming because the areas must be continually checked for errors and compatibility. Information collected at the block level such as total population per block, cannot be used at a lower level such as the population for any particular household. Grouping blocks into a larger geographical area for analysis purposes is also costly unless the information is automated. Accurate and rapid analysis of change in urban areas therefore requires that machine processing of information be utilized.

The basic difficulty to be overcome in implementing a coordinated approach to information retrieval relates to surveys being custom-designed for particular purposes. Surveys tend to be conducted at the level of detail and on the geographic basis required for the degree of analysis required of the information being collected for a specific problem or purpose. It would, however, in no way impinge upon the accuracy of any survey if a basic geographical unit

and consistent methodology were adopted for the collection and tabulation of data.

For any department to use the collected data for internal use it is necessary that the lowest common statistical area unit be adopted. The ideal unit on which to collect data related to planning is the individual parcel. Using the individual parcel is the most expensive because of the level of detail but the individual parcel is the lowest common unit and therefore can be used either individually or grouped to make up larger units for analyses. In this way the statistical unit serves multiple purposes.

A number of problems arise in recording data other than on an individual parcel basis. The first problem relates to the permanency of the basic geographical unit. If the boundaries change the unit cannot be used as a stable building unit. This presents the problem of utilizing large areas units which may be only of historical significance because of changing conditions and shifting social patterns. These units may require adjusting to account for changes. If the boundaries of the units are adjusted, continuity is lost between the data collected prior to the adjustment and after the adjustment. If the boundaries of the units are not changed the units lose their effectiveness for analyzing social-economic patterns. The second problem relates to the size of the area unit. The largest basic unit for tabulating data cannot be too large to be a common denominator which can

be used for different purposes. The size of the unit is about inversely proportional to the cost of collecting data for that size of a unit. However, the cost of collecting the data several times with suitable boundaries for specific analyses may increase the cost to an extent that it would have been more efficient to have collected the data on the basis of a smaller size initially. The final problem arises in relating a locational index to the statistical area unit. This is essentially a cross-reference which requires that a unique position be allocated for the statistical area unit. Without having a unique position to which to allocate information this would be difficult.

The requirements which are referred to above are really minimal for operational purposes. An identification system which could not fulfill these requirements could not be effectively utilized in city planning.

Framework for Evaluation

The framework for the evaluation of identification systems for location-oriented information incorporates only the essential criteria for assuring operational effectiveness. These are generalized to enable an objective evaluation of comparable identification systems for use at the planning department level as well as the inter-department level. The framework can be segmented in the following manner:

1. The identification system must be compatible with automation. (a) Therefore the location code or address must uniquely define the location and hence the position of the information relative to that location. (b) It must be possible to directly group information into flexible area units.

2. The identification system must be able to act as a common system for inter-department use.

3. The identification system must be compatible with continuous field surveys.

At this time it should be mentioned that the requirements relating to the information being represented by the location code or address have the greatest importance to any identification system whether it is to be automated or not. The way that the identification of the information is generally thought of is as a position in space. The machine however, works on the basis of linear logic and hence cannot really position information. The information must actually be allocated a point on a line. This makes the aspect of uniquely allocating a point more critical for mechanized systems than for manual systems. It is considered advisable to mention this because manual systems are analyzed to test the framework for evaluation.

Summary

If city planners are to have their information requirements taken into account when inter-department information retrieval systems are being developed then they must document their information requirements. As this has not been done it is necessary to analyze the information process of collecting and assimilating information. It was deemed advisable to concentrate on the theoretical aspects of information retrieval systems in order to establish a framework for evaluation. It was found that only segments of these systems are being worked on at present. In order to put the identification problem into perspective it is necessary to examine the organizational relationship between inter-departmental and departmental information retrieval systems. It was found that there is a common identification system holding the information retrieval system together. The departmental information retrieval systems supply the information and therefore the requirements necessary for their operation were adopted for the framework. In all likelihood the identification system used at the departmental level would also be used at the inter-departmental level. The most essential criterion is that information be uniquely identified.

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CHAPTER III

THE EVALUATION OF IDENTIFICATION-SYSTEMS FOR USE WITH LOCATION-ORIENTED INFORMATION

It has been suggested that the framework for the evaluation of identification systems and its related criteria can be used to make an approximate estimate of the way in which an identification system will fulfill operational requirements. An identification system which can not fulfill these requirements could not be used for the continuous identification of information from surveys. To test the framework, historical identification systems are evaluated; since they are not directly compatible with automation, they should not be able to fulfill the minimum requirements.

There is a further aspect to the evaluation of identification systems which relates to the problem of communicating the information once it has been collected. This is dealt with separately because, although a system can not be used in the collection of information from surveys it may have utility in the communication of that information. In educating the municipal executive this becomes an important aspect of the planners' role. Information, once collected, must be analyzed and communicated and this may have serious ramifications for identification systems.

Before changing the basic assumptions of this study, alternative identification systems are tested. If information cannot be effectively collected, it cannot be communicated and therefore this aspect is dealt with first.

I. TESTING THE FRAMEWORK FOR EVALUATION

Purpose of Testing the Framework for Evaluation

A framework for the evaluation of identification systems tends to become obsolete quickly if practical criteria and not theoretical criteria are incorporated. On the other hand, the framework may be useless if the criteria are so general that evaluation is reduced to mere value judgement without any empirical basis. For both of these reasons, it is necessary to test the framework for evaluation in order to clarify the scope of the framework needed and the nature of the relevant criteria.

The framework essentially incorporates three basic criteria and therefore the evaluation of identification systems is probably best demonstrated by testing three identification systems each of which lacks one of the basic requirements. In this way it should be possible to see what effect the other two criteria have in the evaluation. The basic requirements are that an identification system be compatible with automation, field surveys and different sized physical units of comparison. Existing identification systems are evaluated relative to these criteria in order to

permit evaluation of the framework. One of the assumptions of this study is that identification systems are compatible with automation and by evaluating systems which are not compatible with automation it is possible to assess criteria relating to automation. This is an indirect means of testing the framework but it is the only way that empirical evidence can be used which is relevant; yet separate from the identification system to be evaluated. If the hypothesis is based upon essentially the same empirical evidence as the framework for evaluation, it is necessary to first test the framework before testing the hypothesis. This, in itself, is not a small task, but by organizing the outside empirical evidence it is possible to simplify the task. In this case, historical identification systems are intentionally included so that every criterion is tested.

The purpose of testing the framework for evaluation is essentially that the framework is based upon the same empirical evidence as is the hypothesis and therefore it must be tested with independent empirical evidence. Subsequently, it should be possible to test the hypothesis within this framework. In this study the hypothesis refers to one of two alternative methods of identifying information and hence the alternative method should also be tested with this framework. If they both fulfill the necessary requirements then the hypothesis is likely to be too general to explain anything. If the alternative method referred to in

the hypothesis is the only one which fulfills the necessary requirements then it is to be favored. This does not imply that the hypothesis is substantiated; only that it is not disproved. Even this, however, depends on testing the framework for evaluation of location-oriented identification systems for use in city planning.

The Evaluation of Historical Systems for Assigning Addresses

Historical identification systems for assigning addresses are identification systems such as those used in postal addressing, and were established before there was a need for compatibility with automation. They are essentially manual systems, and as such, generally lack characteristics required by automation. The theoretical basis of these requirements is related to the unique identification of a site about which information is recorded. In historical systems, the identification of information is generally coupled with human knowledge of the proximity of the area and there is no unique identification of information.

The street is the co-ordinate in this system and the address is the code which is assigned to the site. The site can also be referred to as the basic statistical unit. The numbering of these sites or basic statistical units generally begins at some axis and progresses sequentially away from the axis. There is generally a further definition of the city by street intersections. Two sites on the same street

but separated by an intersection will likely be identified by addresses which are numerically different by about one hundred. At times sites on opposite sides of the same street are differentiated by the last digit of the address. In this case, the address of a site on one side of the street will end in an even number while the address of the site on the opposite side of the street will end in an odd number. By knowing the names of the streets and the numbering technique it is possible to locate a specific site.

If the street name is not known, however, the address cannot be located. An individual looking for an address would be required to look at an index map of the city. For example, the axis may be in an east-west direction and a north-south direction and without knowing the street or whether the address was east, west, north or south, several addresses would have to be checked. The point to be made here, is that the identification system is based on a familiarity of the location of addresses and streets.

The basic requirement of systems being compatible with automation is not fulfilled in this identification system. The reason that it is not, relates to the ambiguity in the address. Without knowing the streets there is no inherent method of locating the desired street and even then there may be two addresses which have the same numerical address separated only by an east, west or north, south prefix. Automation cannot handle this because the addresses

are not systematically allocated to the sites and therefore there is not a unique identification of every site in the city. This is known as the problem of location control and for automation it is necessary that an identification system use sequential numbering. Without this, there is not adequate location control.

When an identification system for postal addresses utilizes sequential numbering of streets (originating from the intersection of two axes) adequate location control may exist for automation. Cities which conform entirely to the "military grid" method of designing streets are a case in point. If the streets have been numbered systematically and not named randomly, as most streets within cities have, a knowledge of the technique of numbering streets and sites is adequate to locate any address. Hence location control and unique identification exist and the identification system should be compatible with automation.

The criteria incorporated in the framework for evaluation relating to compatibility with automation has therefore been verified. The aspect of unique identification is basic to compatibility with automation in identification systems. By analyzing the postal address method of identifying sites it is possible to clarify this with existing evidence. The theoretical basis of the requirements relating to automation may be verified with empirical evidence and can therefore be accepted.

Rather than numbering the streets and sites it is possible to number areas surrounded by streets. These areas which are generally called "blocks" can then be sequentially numbered starting from one point of origin in the city with the blocks numbered progressively in the city until every block is numbered. When the city conforms to the military grid, sequential numbering is extremely simple.

There is a serious problem in sequential numbering relating to utilizing anything but individual blocks for analysis. There is almost no location control in that adjoining blocks may have very different numbers. A block which has been assigned a number will be one number less than an adjoining block and one number more than an adjoining block on one axis. However, the adjoining blocks on the opposite axis are not systematically numbered. The numbering system is systematic only from the origin and therefore only area units of single block size can normally be used for analytical purposes.

The requirement that an identification system be compatible with different sized units is not fulfilled in this system. Although the blocks are uniquely identified they cannot be readily grouped or differentiated by sectors of the city. Sequential numbering is not readily adaptible for analysis of other than block sized area units.

Criteria relating to this requirement can therefore be clarified. If different areal units can be readily formed

for analysis then the identification system can be said to meet these criteria. That sequential numbering of blocks does not meet these criteria shows that it fulfills a limiting function on the number of identification systems for comparisons

The sequential numbering system meets the criteria relating to compatibility with automation because each block is uniquely identified.

By not including criteria relating to areal units for analysis, sequential numbering would be considered an acceptable identification system. Hence, the criteria are essential for a framework for evaluation.

The city has been divided into a number of area units such as census tracts for specific purposes. These area units are generally divided further into such units as enumeration areas. However, these units are used for analysis and not for continuous collection of information. It is necessary to collect the information for a smaller area than the enumeration area. This is usually done at the site level. For the intended purpose the area unit generally works well but relies on maps for identification. It can only be used because it is possible to collect the information for a smaller area such as the site and group sites to form the enumeration areas. This necessitates manipulation of the information prior to recording it for area units which then must be identified by a map. Information that cannot be

collected and directly recorded in relation to the identification system necessitates prior manipulation of information and hence incompatibility with direct machine processing. If the same area unit of analysis was suitable for all purposes this would not be such a problem; but they are not, and it is a problem.

Unit areas such as enumeration areas are not generally acceptable as identification systems. They work well for specific purposes of analysis but not for the continuous collection of information for a variety of purposes. If criteria relating to continuous collection and compatibility with automation were not included, this system would be acceptable as a general purpose identification system. That enumeration areas are not acceptable shows the value of including these criteria. They limit the number of systems for consideration and therefore leave the systems for serious consideration which likely warrant such attention.

The framework for evaluation of identification systems for location-oriented information has been tested. It incorporates approximate criteria arrived at from analyses of the principles of the information process which if fulfilled would assure that an identification system has at least minimal operational potential. A further observation can be made relating to an historical postal addressing system: those systems having unique identification of sites and sequential systematic numbering of streets fulfill the

essential requirements for compatibility with automation. As they have historically been used for continuous collection and analysis of information in the field these criteria are fulfilled as well as the use of different sized units for analysis. Fulfilling the criteria incorporated in the framework for evaluation indicates that this form of identification system should be researched further for use in information retrieval systems.

II. EVALUATION OF BASIC ALTERNATIVE IDENTIFICATION SYSTEMS

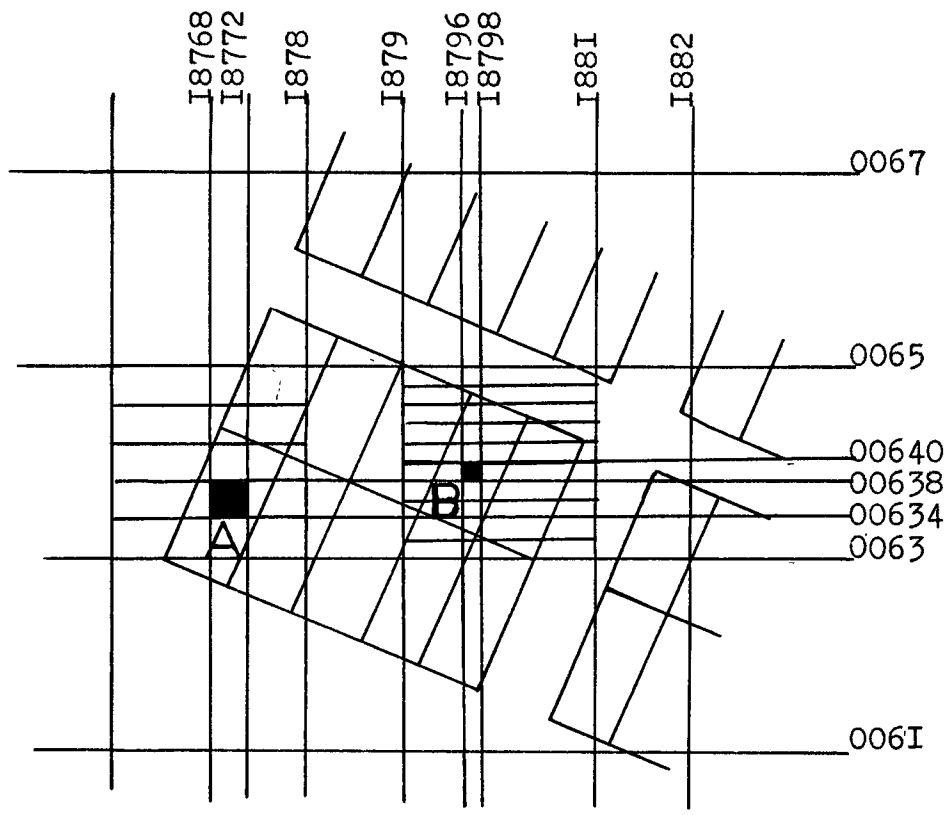
The Grid Co-ordinate Identification System

A grid co-ordinate system is superimposed on a map and the location of a physical sites may then be identified by the nearest intersection of co-ordinates. The measurement unit of the base grid is optional but is generally some multiple of ten feet. In Los Angeles the proposed base grid unit was one thousand feet. Alternatively, the scale which facilitates direct machine printing can be used. The base grid in this case is generally six to eight vertical and horizontal lines per inch. In either case, the base grid is superimposed on a map of the city.

The base grid is superimposed on the city and addresses of sites or analysis areas may then be identified by locating intersections of the horizontal line and vertical line

intersection nearest the center of the site or analysis area being identified. The horizontal and vertical lines are numbered sequentially and hence the site or analysis area is assigned the co-ordinate numbers for the intersecting horizontal line and vertical line. The identification of several sites and a larger analysis area is shown in Figure 1. (Page 59)

The grid co-ordinate identification system must now be tested against the framework for evaluation. As has already been mentioned this system has been shown to be highly compatible with automation. This, however, must be verified; and basic criteria relating to automation do not require compatibility with machinery only. Information must be uniquely identified such as assigning each piece of information a number and as the superimposed grid co-ordinates are scaled from maps this becomes problematic. Information relating to areas falling between co-ordinates must be identified by interpolating the location of the area from the nearest co-ordinates. By allocating the identification in this manner it is possible to give the same area several identifications. This results in ambiguity of identification. Therefore this identification system is not really compatible with automation. Theoretically, it provides absolute control of location identification but by attempting to superimpose an abstract grid on the physical city, the practical value is sacrificed. There is a further



Note: 400' Grid = 0065 I878

40' Grid = 00638 I8768 (Site A)

20' Grid = 00640 I8796 (Site B)

FIGURE I

GRID CO-ORDINATE MAP

problem related to abstractions from the physical city. The grid is superimposed on a map which may not be a perfect representation of the city to begin with. Using a different map would result in a different identification. What has been mistaken for compatibility with automation is actually ease of machine reproduction. This is entirely different.

There is a distinct difference between an identification system being compatible with the direct reproduction of information and the unique identification of that information. This is not generally realized because information is directly reproduced by being positioned at a point in space and an address is thought of as a point in space. Seemingly then, in a formal sense, an address is a point in space for storing information and information is reproduced at a point in space. As the co-ordinate system can be very effectively utilized to reproduce information and in a formal sense both storing the information and reproducing it are thought of in the same way, the co-ordinate system should be effective for storing the information as well. This is not true. "Specifications of addresses in such a space are not metrical, and conventional co-ordinate systems are not directly applicable to the formal storage problem."[1]

Identification can be achieved by allocating a number or address to a site but the effectiveness of the grid co-ordinate relative to directly representing information is achieved at the expense of being able to efficiently allocate

addresses for continuous surveys. Surveys are generally conducted from the street and the probability of errors is extremely high unless sites are numbered sequentially from the street. Information on the street itself is often required and yet the grid co-ordinate identification system cannot identify a street by one number unless that street happens to be coterminous with a grid line. This is seldom the case and hence the street is identified by a succession of points which cannot be retrieved at the same time. A complex street pattern can be represented only by a virtually unintelligible group of numbers. Because points are positioned for representation the grid co-ordinate operates effectively for this purpose but not for continuous surveys. Complex and curbed street patterns are in fact unmanageable within the grid co-ordinate system for the above reasons.

The Street-oriented Identification System

The street-oriented identification system adopts the streets within the city as the co-ordinates, and systematically assigns them sequential numbers. These streets are the basic grid which fits the configuration of the streets whether they are curved or straight. Such a basic identification system has been developed for the City of Vancouver.[2] East-west streets have been assigned numbers above five hundred while north-south streets have numbers below five hundred with a reserve of numbers provided for potential future streets.

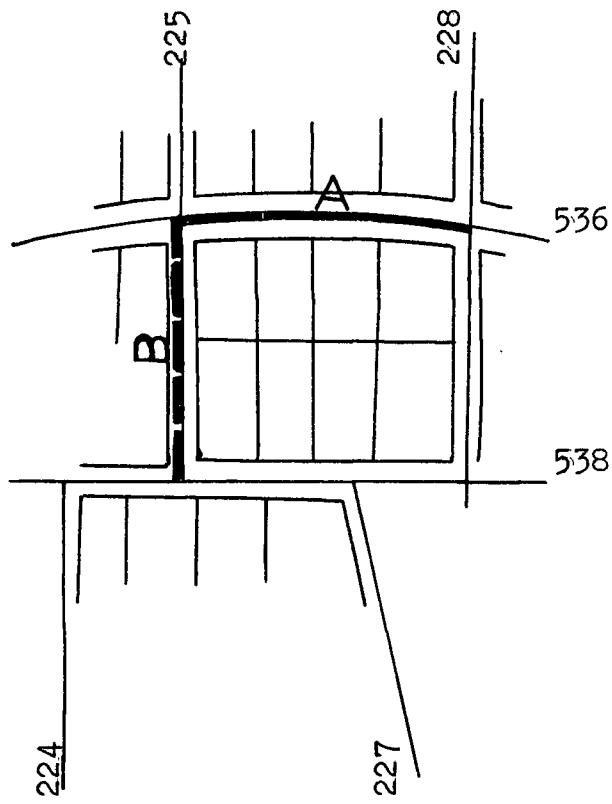
This is essentially the same identification system as the system for postal addresses for a street system which rigidly conforms to the military grid. The only difference is that the co-ordinate lines curve to fit the configuration of the streets. This is shown in Figure 2, page 63.

The street-oriented identification system is utilized with a more systematic numbering technique than that normally employed for postal addresses. By allocating addresses systematically unique identification is assured and hence the relating to unique identification criteria are fulfilled.

The streets are the co-ordinates and are numbered sequentially with absolute control of location. Hence any sized area ranging from an individual site to the whole city can be utilized for analysis.

The numbering technique assures that both the streets and the sites are numbered sequentially and hence the identification system is compatible with continuous surveys.

The street-oriented identification system fulfills the necessary requirements for at least minimum operational potential. This is a major accomplishment because the essential part of information retrieval is the unique identification of the information. However, there are other relevant factors to be considered such as communicating the information once it is collected and identified.



Note: Street Section A = 536 225

Street Section B = 225 536

FIGURE 2

STREET-ORIENTED MAP

III. CHANGING THE ASSUMPTION UPON WHICH THE STUDY IS BASED

The Purpose for Developing a System

An important aspect of the municipal planners' role relates to advising the executive (to make rational and informal policy decisions) and this can be aided by having a mechanical means of assembling information and displaying it visually. This aspect can be dealt with by changing the basic assumption that an identification system must be compatible with automation for the basic purpose of collecting information.

If the primary reason for developing an identification system is changed from the collection of information to the analysis and display of that information there are serious ramifications to the design of the identification system. The grid co-ordinate identification has been documented as being most effective for utilizing visual aids to facilitate communication between specialists and laymen.[3] The information is positioned by machine and a map printed by a machine from information fed into the machine is a spectecular example of what can be done by automated systems. However, this has been used primarily as a cartographic and display method rather than for research purposes.

These visual aids can subsequently be interpreted by use of an overlay of some recognizable features such as street

patterns, Reproduction of the visual aid and transparent overlay can be made on a single print to facilitate display. The map is actually printed as a grid of type characters which completely covers the map and the information is printed for any analysis zone.

When the analysis zones are relatively fixed and large quantities of information are required for display purposes, this method works extremely well. Trends can also be displayed by positioning information in sequence for areas being analyzed. Automated mapping is effective when processing large quantities of information for large analysis areas that are relatively fixed such as for census tracts. The display can also be of a spatial pattern such as mapping the distribution of welfare cases and urban blight. In this way, areas requiring further analysis can be quickly located.

There is a limitation to the scale that can be used for display which is set by the spacing of the standard symbols or characters used as well as the available kinds of symbols. That curves are represented as a series of vertical and horizontal lines because of the spacing of the characters is not a serious limitation when the scale is four inches to the mile or greater. Fixed zones negate use of flexible analysis zones for visual display but the grid nature of the identification system does not in itself limit the display to rectangular plans. Irregular plans

can be displayed given an appropriate grid size.

It is currently possible to display transportation networks once they are identified. The print provides a quick visual check of the accuracy of the identification system. From five to ten patterns and time contours can be plotted as well as a map of assigned volumes. Display of the density of transportation systems is an effective use of these machines. The time for plotting traffic assignments and displaying traffic volumes is greatly reduced by use of mapping machines.

The Display Capacity of the Street-oriented System

The street-oriented identification system has not yet been developed for direct visual display of information. However, distances are recorded for all streets and the system has been used effectively for organizing the routing procedures of trucks.

As the identification system has been used for routings which require absolute location control and the recording of distances it seems probable that visual display could be developed. It is not presently developed and until it is, there is a problem of installing a street-oriented identification system for both information collection purposes and display purposes. This must be seriously checked before a single general purpose identification system is developed within any city.

The solution to the problem of which identification system to adopt for specific purposes can be partially clarified by an understanding of the purposes of developing a system. However, it seems likely that there will be several purposes for developing any one system and possibly the only solution may be to develop an identification system for collecting information and an identification system for displaying the information. In this case the identification system for displaying information may be for use only within the planning department and not for all the departments within a city.

Summary

The basic element of information retrieval is the unique identification of information. The street-oriented identification system fulfills this requirement at least well enough to assure a minimum operational potential. The framework for evaluation was tested to ensure that it is objective. The framework is based on the assumption that identification systems are developed for the purpose of identifying information collected from continuous surveys. This assumption is changed. When the purpose of developing an identification system is the communication of information once it has been collected; the grid co-ordinate identification system has the required characteristics, which have not yet been developed for the street-oriented identification

system. The information must first be collected, however, and therefore the street-oriented identification system fulfills the necessary requirements.

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[2]City Engineering Department, An Information Retrieval System for Urban Areas, Vancouver, British Columbia, 1965.

[3]University of Washington, Using Computer Graphics in Community Renewal. Urban Renewal Service (Urban Renewal Administration, Housing and Home Finance Agency, Washington D.C.), 1963.

CHAPTER IV

A STREET-ORIENTED INFORMATION RETRIEVAL SYSTEM: A CASE STUDY OF THE CITY OF VANCOUVER B.C.

The framework for the evaluation of identification systems for location-oriented information enables an objective comparison to be made in order to assure that a minimum level of operation can be performed. To establish more refined criteria it is necessary to examine further empirical evidence. As there is no available body of such evidence it is necessary to examine a study where a basically workable system has been used. Only in this way can recommendations as to more rigorous testing procedures and the development of refined criteria be made for evaluation of alternative identification systems for use in city planning.

Once this is done, the criteria will not necessarily have applicability for other than the identification system studied. Recommendations based on a single study are applicable to the system being examined in this study. They are appropriate for other identification systems only if all relevant factors are equal. It is unlikely that this will occur without: analyzing the relevant factors such as the organization within which the system is utilized; and establishing identical conditions. For the case study described here, observations are made which are applicable

only to the case study. Although conclusions regarding identification systems other than the one being studied cannot be made from these observations, inferences about criteria for evaluating identification systems having widespread applicability can be drawn.

Appropriate and useful recommendations must evolve from a conscious expression of the purpose of the methods to be evaluated and the means of fulfilling that purpose. Recommendations made without regard to practicability are likely to attract little attention; especially in regard to information identification systems which are being developed. The basic purpose for identification systems in city planning is the problem of having other departments collect information which planners need. Except for making available the information which is normally collected by other departments, it is very difficult for city planners to induce these departments to collect information for them. The basic reason for this is that city planners have not made explicit their purposes for collecting information and how this information must be identified. Generally, recommendations are made by city planners regarding identification systems without the practical means of implementing them. Ideal identification systems for city planning have been proposed but no practical means of implementing them or even how they can be used without prior identification of the types and characteristics of information required.

I. THE PURPOSE AND METHOD OF CONDUCTING THE CASE STUDY

The Purpose

The purpose of the case study is to test the street-oriented information identification system with land use patterns which are by nature discrete rather than continuous. Residential land use is composed of subdivisions which are discrete physical entities rather than sites which are continuous segments of the city. Identification systems are generally developed with the site, or the street bounded area known as the block, as the level of analysis rather than discrete land use patterns.

With a prior knowledge of which sites are included within a subdivision, it is possible to identify the subdivision. The subdivision is not identified; the physical lots or sites are. Land use units tend to be discrete and yet it is necessary to identify the individual lots. This solution to the problem of providing desired information for analysis of subdivision does not correspond with the associated need for analyzing subdivisions to determine the optimal combination of sites.

Industrial land use tends to be composed of industrial parks and identifying the individual factory site of the total area does not facilitate understanding of which factories provide the optimal combination. An identifica-

tion system is used in the analysis of factory locations and therefore should be able to satisfy the demand for information on discrete land use patterns.

Sites within subdivisions and industrial parks are generally connected by streets which tend to be one of the most permanent structures made by man. Street relocation or widening tends to be extremely costly and once a street system is established, it is not generally relocated. Hence it seems that a street-oriented system is acceptable as a means of identifying the abutting sites for purposes of analyzing optimal combinations of land use.

In order to examine combinations of sites within subdivisions for physical environment studies it is necessary that the location of a site within a subdivision be identified as well as the type of subdivision. Currently, this can be done; but only by prior knowledge of which sites compose any specific subdivision. Identifying subdivisions prior to being able to utilize an identification system represents a time consuming task for city planners. Therefore a study is carried out to determine what characteristics are essential for identifying subdivisions and for the subsequent examination of alternative means of doing this.

Generally, clusters within subdivisions which are by nature discrete, tend to consist of only a few lots. The residential cluster or group of houses facing each other seems to be a more basic element than the neighbourhood.

Hence the level of analysis being carried out in this case study relates to the cluster as the basic element of residential land use.

The street-oriented identification system is analyzed relative to the residential cluster. This necessitates examining the identification system for area units greater than the individual site but smaller than the city block. The lots in the block can be street-oriented in which case the boundaries would be lanes. (Street-bounded blocks are described earlier in this study.)

Analysis at a more detailed level than the block level has generally been regarded to require identification only of the individual site and not the residential cluster. Research has concentrated on identification of the site. The site is of course the lowest common denominator and therefore must be uniquely identified. But this in itself, is not adequate for examining subdivisions which are discrete by nature and consist of more than an individual site.

What is required of the identification system is a further degree of location control than that necessitated by unique identification alone. This is necessary if clusters are to be identified without prior knowledge of which sites comprise a subdivision. With this it is possible to sample different types of subdivisions without having to first compile a listing of all subdivisions of any one type and their constituent sites.

The Method of Conducting the Case Study

Aside from the purpose of conducting a case study, it is necessary to document the conceptual level of which a method of investigation is to be carried out. As the ultimate purpose is to have recommendations relating to identification systems implemented the ideal conceptual level should relate as closely as possible to the operational level. In terms of the attention likely to be given to the ultimate recommendations by municipal executives it is necessary that there be a means of implementing these recommendations in operational information identification systems. The conceptual level must therefore be very close to the operational level to the operational level or must fairly accurately simulate it.

The usefulness of these recommendations to other than planning departments will depend to a large degree on whether these can be implemented for surveys. If it is necessary to: first, identify the site and therefore the information relating to that site; and then have to utilize some further technique to implement the recommendations, they are unlikely to be implemented in any department but the planning department. As most of the information for city planners is collected outside of the planning department, the futility of these recommendations can be seen relative to collecting the information. The planning department would have to conduct a survey of the whole city to implement

these recommendations.

To forestall this, practical means of implementing recommendations at the level of information collection are needed. Should it be shown that these cannot be fulfilled at the survey level of operation, then it may be necessary for city planners to conduct their own surveys. Merely to accept that this is necessary without a comprehensive analysis of information collection at the operational level is to ignore any influence that city planners are likely to have on the development of identification systems. It may be necessary to have a separate identification system for use only by the planning department. In the interests of efficiency, this should be implemented only as a last resort and even then a method of converting to the identification system used at the inter-departmental level is essential.

An assumption of this study is that the recommendations are to be oriented towards the operational level of identifying information. Hence the identification must be unique as well as incorporating the recommendations. The identification system must first be compatible with at least minimal operative potential before more refined criteria are applied to it.

A workable identification system is used as the basis upon which to test alternative means of identifying the site. The alternative means account for a varying degree of control for factors other than unique identification.

A co-ordinate identification system which can be classified as a street-oriented identification system is currently being implemented in the City of Vancouver, British Columbia is used as the basic system. It has been documented that the advantages of this identification system are manifold.[1] It can be used at the level of: individual buildings; sites; a city block, either street-oriented and bounded by lanes or bounded by streets; the street or segment of the street or lane including the intersection; and finally, any area within the city. The system meets the necessary requirements for machine use and continuous field surveys. Further, the system will provide an efficient means of identifying land value information for the mechanical calculation of assessed land values. Relative to clusters and detailed identification of such discrete areas the system distinguishes between: major streets and minor streets; north-south and east-west streets; and, corner and other sites.

For the purpose of identifying subdivisions, these factors do not provide a comprehensive enough identification to be used without prior knowledge of which sites comprise a subdivision. The subdivision may be a cluster of four or five sites in the center of a street-oriented block. There is no explicit identification of this cluster which distinguishes it from the rest of the block excluding the corner sites. Only clusters of four sites surrounding

intersections can be readily distinguished from the remainder of the residential areas in the city. As these represent only a small proportion of the total number of clusters in the city, a further identification of clusters is required. The sites surrounding intersections may not be parts of the same cluster but may be oriented towards sites in the block. Utilizing intersection sites for purposes of examining clusters would then lead to spurious results.

The examination of the identification of subdivisions begins with the cluster which is then identified. In this way the physical environment is given the focus of attention rather than the means of identifying it. Planners are primarily concerned with the physical environment not with the techniques for analyzing this subject. To limit the perspective only to the means and not be basically interested in the fundamental reason for utilizing the means is likely to result in a practical operational technique which severely limits the perspective. To assure that this does not occur it is necessary that the method of conducting the study reflects the importance of the purpose and only then, the means of achieving the objective.

Means are utilized to achieve some desired result but they tend to affect the purpose. The means limit the perspective of the designer unless the purpose is the prime concern. Concentration primarily on the means and not the purpose leads to strictly pragmatic progress towards diffuse

objectives. A study cannot reflect the primary purpose if the approach begins solely at the means. The means must be kept in perspective if they are not to seriously alter the purpose.

Reflecting these considerations, the case study is conducted by assessing what constitutes a cluster or more specifically the identification of such a cluster. Alternative solutions to the problem of identifying such clusters are posed and tested under simulated conditions of use. The conditions are those under which surveys are to be conducted. This approach places the proper perspective on the purpose of identifying clusters and the means of identification.

II. THE IDENTIFICATION OF RESIDENTIAL CLUSTERS

Alternative Methods of Identifying Clusters and Their Evaluation

The identification of subdivisions presupposes that aspects of subdivisions can be identified. Being concerned here with how subdivisions relate to location-oriented identification systems, only the latter are considered. In this way it is possible to focus on the problem without a long discussion on subdivisions.

The identification of certain aspects of subdivisions is assumed to be more important than other aspects. These aspects relate to the location of sites within the block and

are assumed to be: the corner sites of any intersection; the position of a site relative to those surrounding it; the arrangement of sites in order along the street. The street configuration is also important for subdivision analysis. Relative to the street-bounded block the lanes become important and a problem arises as to the identification of blocks which are divided in half by a single lane; are divided in quarters by "H" shaped lanes; have no lanes or only partial lanes; are divided in half by lanes but a number of sites have no lane access. The identification of these basic types of blocks would greatly facilitate physical environmental studies.

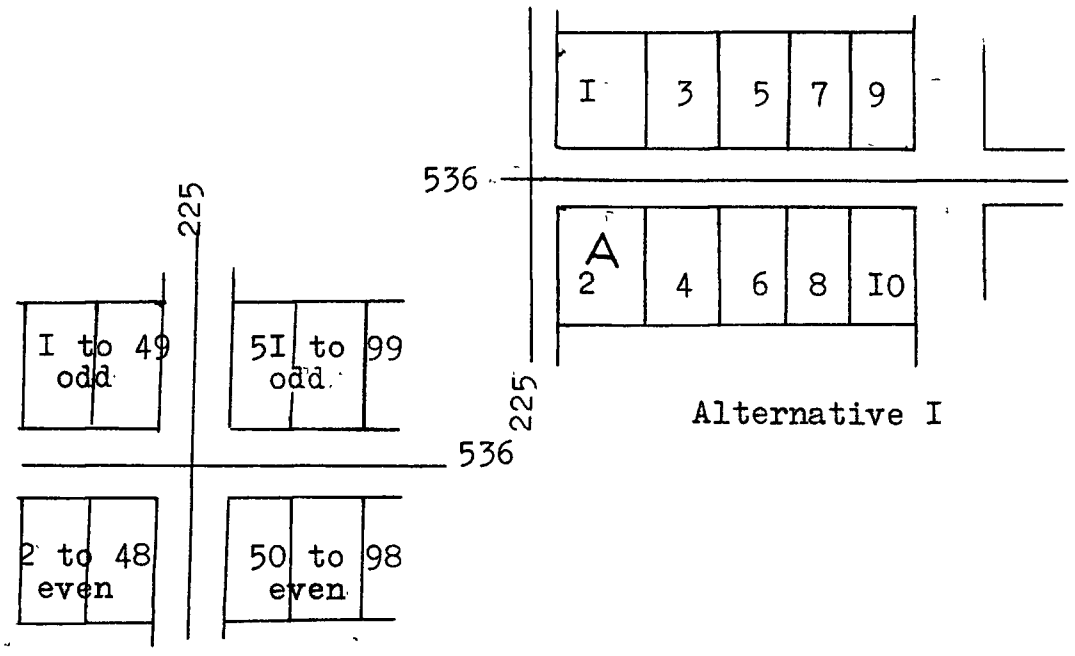
There are alternative methods of identifying sites in the city while retaining the basic street-oriented system. As development of sites is generally more compatible on opposite sides of streets than across lanes, it seems important to retain this system. This can be readily accomplished, but which alternative provides the optimum solution in light of the foregoing assumptions?

The alternative consist of: sequentially numbering the sites from one corner with one side of the street given even numbers and the opposite side, odd numbers; sequentially numbering the sites from the middle of one block to the middle of the next block on the same street; and numbering the sites within a street bounded block starting from one corner site and continuing until that site is again reached.

The latter alternative can be adapted to give a further alternative but this is described later in this study. These alternatives are shown in Figure 3, page 82 and are numbered in the order given above.

These alternatives provide for location controls not required for unique identification of sites. The controls are: corner sites are readily distinguished from other than corner sites; the side of the street which the site is on is distinguished by whether the last number is odd or even; the position of a site from one corner is given if numbers are not saved for future sites or subdivision of existing sites.

Taking into account that development generally occurs more similarly across a street than across a lane, and clusters are oriented towards a street it seems that a street-oriented site identification is preferable. A further reason is that surveys, conducted from the street, are more compatible with street-oriented identifications. Information for both sides of the street can be collected at the same time and as the sites across streets are generally more closely associated than the sites across lanes this is clearly an advantage. Utilizing a street bounded block tends to negate the functional relationships of land use which is similar across the street and less so across the lane.



Note:

Site A = 536 225 02

Site B = 536 225 07

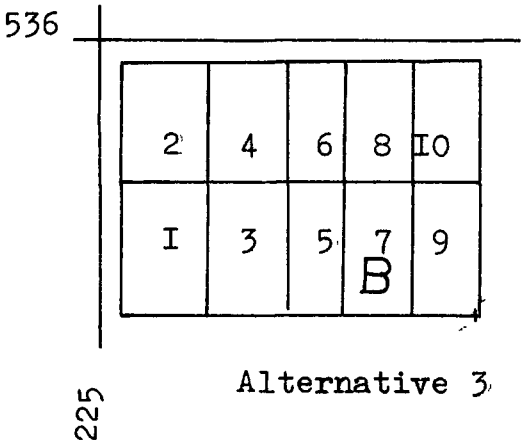


FIGURE 3

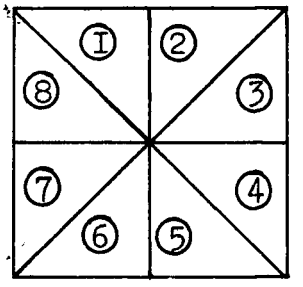
ALTERNATIVE METHODS OF NUMBERING SITES

Before accepting street-oriented site identification, however, a further alternative is pointed out relative to the street-bounded block which can be adapted to street-oriented site identification. This alternative provides more location control than the other alternatives, but likely at the expense of being able to readily conduct surveys to collect the information. This alternative is shown in Figure 4, page 84.

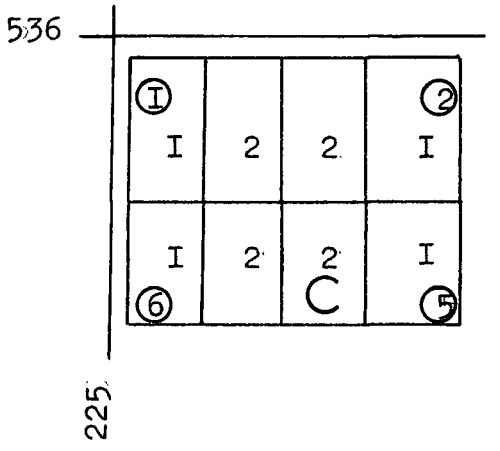
Alternatives can be mechanically converted to other alternatives. The alternative with the greatest location control, however, would lose a degree of that location control upon conversion to any other alternative. For example, a site in the middle of the block may be identified so that it can be clearly denoted as such by one alternative but upon conversion, to any other alternative, the position of the site in the block may be lost. It is important to mention this in regard to the alternative shown in Figure 4.

This alternative identifies the location of any one site relative to those either on both sides and across the street or on both sides and across the lane; the intersections at both ends of the street which the site is on; and the arrangement of sites along the street from either corner.

There are problems involved in utilizing this form of site identification and they relate to administration. Only twenty or twenty-five sites between intersections



Numbering Mechanism



Note:Site C = 536 225 52

FIGURE 4

A METHOD OF NUMBERING SITES

facing one street can be identified by utilizing two digits for this purpose. The other alternatives can identify 99 sites with two digits and there are blocks with more than twenty-five sites facing one street from one direction in Vancouver.

The major criticism of this alternative is not that more than two digits may be required but that a person cannot directly record the site identification at the same time that he is collecting information for that site. It is necessary to have the site identified uniquely before information is collected. Any errors in identifying sites cannot be corrected during the survey because sites are not sequentially numbered, but must be picked up later. There are also problems in ascertaining if the site identified for survey purposes is the one for which information is being collected.

A person on foot, conducting a survey needs to be able to start at one intersection and successively record information for every site on that street. While collecting the information he must be oriented from one intersection and hence the sites must be successively identified from one intersection to the next. In the form of site identification being considered, the sites are identified successively from two intersections to the center of the block. The orientation is from two intersections and a person on foot would have to start at one intersection and walk first to

the middle of the block and then go to the other intersection and walk back to the same site. For continuous surveys of the whole city this is considered to be too tedious and time consuming. Also, it would be virtually impossible to administer which route a person should use while collecting information. As site identifications are to be checked by the person on foot it is imperative that a readily ascertainable site identification method be used. If the person on foot cannot verify the method of identification and check for any record errors such as sites which have been subdivided but not recorded as such; the identification system is likely to have only limited use for surveys.

From the point of view of administering the collection of information, a street-oriented system is essential. Alternative one for identifying sites is clearly the best from the administrative standpoint. However, it fails to clearly provide a number of identification factors which are basic to the analysis of physical environment. A method of identifying sites which fulfills the necessary requirements for city planning cannot be used in the actual collection of the information. Information that is identified by a generalized method such as the one which can be readily solved for the specialized method and only the specialized identification method can be mechanically converted to the generalized method. On the other hand, only the generalized method can be readily used for the collection of information

and once identified, the information cannot be converted to the specialized method of identifying information.

Observations and Implications

Conversions can be made only from specialized to more generalized forms of identification systems. Following this logic further leads to the observation that it should be possible to convert from mechanized identification systems to non-mechanized identification systems. Information collected from street surveys may be identified by the postal address so long as both the postal address and the mechanized identification system address are included in one survey card for checking. In this way, rapid mechanical conversion is possible to either system. Once, the whole city is covered by both systems, only one need be used for the actual collection of information. However both are required for the first complete survey. Otherwise the identification could be only by the form used in collection or a mechanical conversion to a more generalized form.

Once a mechanical conversion has been established, either method of identifying information can be used for the collection of information. If postal addresses are used than they can be converted to a mechanized form of identification system later.

For analysis, the identification system which is compatible with automation is generally required. New sub-

divisions can be introduced in this type of identification system and be readily obvious as an error if they are not because a person on foot can check the identification. Keeping dual identification systems up-to-date requires that the person actually collecting the information be able to readily ascertain errors and correct them. Therefore both systems must be compatible with field checking.

However, neither of these systems fulfills all the requirements necessary for physical environment studies. As it is not possible to readily field check with the method of identification which fulfills these requirements it relegates the system to ad hoc studies. As an identification system is more than an aid to efficient project planning, consistent methodology must be utilized in the collection of information on a periodic basis. Shortcomings and inconsistencies result from collecting information on an ad hoc basis and trends cannot be readily observed.

This implies that information for physical environment studies cannot be identified except for ad hoc studies and ad hoc studies have inherent shortcomings. At this point in the progress of the research it is not possible to reach any firm conclusions. The identification of physical environmental information is required but there does not seem any way that it can be incorporated into the basic identification system. Possibly an auxiliary code identification might be a solution. In any event, it will be necessary

to continue to utilize a more detailed form of identification than that currently provided by mechanized systems.

III. SUMMARY

The case study has been carried out in Vancouver. It was felt that this case study should be included because the framework for evaluation includes only the essential requirements for identification systems for urban planning. Although this type of evaluation permits the elimination of the inefficient or totally unworkable ones it does not point to the serious aspects of identification that will be required of these systems. That the street-oriented one fulfills these essential requirements in no way makes it a complete system. In fact it requires a great deal more work especially relating to directly printing maps and although the ability to directly print maps for the grid co-ordinate system was at the expense of efficient retrieval of information, this factor cannot be overlooked. Primarily the aspect overlooked relates to planners being interested in groupings and functions and hence requiring much more location control than that available in any system.

Alternative to this is an essentially centralized operation and a breaking up of departments into more functional units so that each has its identification system for its particular function. This has been proposed as a second stage development but the real alternative is to put the

system in as one unit and not as segmented parts. The reason for using one unit is administrative and if adopted would rule out the possibility of inefficient systems remaining throughout the second stage.

Another alternative is to have each department develop its own identification system which would be similar only for interdepartment information exchange. This would mean, for instance, the planning department could incorporate nearly all its own modifications within its own identification system while retaining some degree of information exchange with other departments, although the information exchange would be much less than from the method being adopted.

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CHAPTER V

OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

A street-oriented identification system for use in information retrieval systems is analyzed in this study through a framework for evaluation structured to enable comparison of alternative identification systems. The criteria incorporated within the framework represent an attempt to develop a general, empirical method for evaluating the performance of identification systems for use in the collection of information from surveys and in the mechanical retrieval of information from municipal government departments conducting surveys.

Subsequent to this evaluation, subjective criteria relating to the identification of selected physical environmental factors are postulated and utilized in an examination of a street-oriented retrieval system developed for the City of Vancouver, B.C. For this study the criteria are assumed to be essential for analyzing land use patterns which are by nature discrete.

When the necessary elements are developed, street-oriented identification systems should fulfill the requirements for general application in city planning. Before identification systems can be regarded as operational tools

for the study of subdivisions, further research is recommended. However, the street-oriented identification system is sufficiently developed to be considered a valuable mechanism in the collection of factual information for city planning.

These observations are drawn from the study but require a systematic analysis in order to enable the formulation of explicit conclusions and recommendations for city planners. Without an analysis there is no adequate method of interpreting the research and hence the conclusions are not explicit enough to enable sufficient documentation. It is imperative to substantiate the hypothesis in order to provide direction for further criticism and research. In this way, innovation of new technique can be justified and verified for use in city planning or by being proven unacceptable may enable progress towards constructive innovation.

I. OBSERVATIONS

In the evaluation of information identification systems for planning use it is possible to make observations that are wider in scope than those made relating to specific criteria. These observations are general in nature and implications can be drawn from them. Implications both as to: the impact that identification systems will likely have on city planning; and the potential application of these systems and information retrieval systems which incorporate

them in city planning, further research is required.

General Observations

Identification systems are not simply a more efficient means for the handling of information. They require a change in the concepts of those using them even though they may be originally adopted for the efficient handling of information. To effectively accommodate component identification systems an awareness of the total system is necessary. This often leaves questions of design to be answered outside of city planning for reasons of technical specialization. It seems evident that unless the questions are explicitly asked and the answers evaluated by city planners; questions of system design are likely to be answered by the available means rather than what is required by city planners. It is also possible to make observations relative to the usefulness of research conducted by means which are alien to the purpose of the research.

Awareness of the total system for handling information is likely to have different meanings for planning departments having different scales of operation. A large city has, generally a complex planning department which has different sections with different scales of operation. Some sections may be fulfilling strictly administrative functions which require only limited information. The cost of collecting comprehensive information related to a specific

problem is generally not warranted for the depth of analysis which is required to present a solution. Hence, an attempt may be made to utilize information collected by another department in order to promote efficiency. In this case only a limited degree of awareness of the total system is necessary for operational efficiency. On the other hand, the planner may be conducting a study which requires almost total awareness of the capabilities of the system. This would necessitate a high degree of knowledge of specialization in the technical aspects of the identification system.

Whether the scale of information handling is large or small the planning department is likely to depend upon outside specialized assistance to develop identification systems for use in information retrieval systems. The technical aid may come from consultants or other municipal departments. In either case the purpose for implementing the identification system is communicated to those responsible for designing the identification system.

The design generally begins with several alternative identification systems in mind rather than with identification and definition of the purposes for implementing the system. The alternatives are investigated and possibly minor variations are developed to somewhat modify one of the alternatives for the purpose of implementing a system. Essentially, however, the modifications do not greatly change the basic alternatives available. The design begins

with several alternatives in mind and ends with a decision to utilize the basic or modified system.

This is not meant to imply that outside specialists are at fault. A general observation is that partial accommodation of these purposes is all that can presently be expected within the design of identification systems. City planners have conveyed the purposes for implementing identification systems to the specialists in a general manner. They have not explicitly documented their information requirements. The specialists, already oriented towards basic alternatives, attempt to accommodate the purposes of all departments with one of them. Neither design researchers nor city planners formulate probable information requirements; which may vary over time but still require stating, and hence the design specifications which are developed tend to vary little from those of the basic alternatives.

The approach to designing identification systems that is commonly used is considered to be generally acceptable. The problem lies in the fact that the design specifications are not developed to accommodate the necessary requirements. As the basic alternatives have been initially developed for other purposes, the design specifications reflect these other purposes too greatly. By developing their requirements more fully city planners could expect the design specifications to more fully reflect these needs.

In a general manner it is possible to divide all design specifications into those relating to performance and those relating to cost. Only performance specifications are analyzed in this study from the perspective of city planning and therefore it is not possible to make observations about design specifications that relate to cost.

Design specifications, relating to performance, have not been developed for identification systems for city planning. Only in special cases, which generally involve single purpose identification systems, have any design specifications been developed. Without such specifications, it is extremely difficult for city planners to be assured of an adequate level of performance.

As design specifications have not been adequately developed for information systems, the requirements of information handling are used to postulate design specifications. By postulating these design specifications from the process of handling information, a specific level of performance can be guaranteed to the city planner. The identification system can then be implemented with an assurance of at least a minimum level of performance.

This study documents the above method of developing design specifications for identification systems. However a general observation can be made about the level of performance which can be guaranteed with these design specifications. These are developed from first principles and

therefore can be related only to theoretical performance. As design criteria in this study are established from theoretical performance; the selection of a single identification system which meets these criteria is made on a theoretical basis. Hence the identification system is selected because it assures a theoretical level of performance.

Just as the criteria are based solely on theory, the criteria are likely to relate only to a minimum level of performance in operation. First principles of information handling are analysed to establish the design specifications and hence operational difficulties are not considered.

This has not been observed to be a serious problem in the selection of a single identification system for installation. However, it appears to become a serious problem when a number of alternatives are being evaluated. The criteria are used to evaluate competing systems as well as for the selection of a single identification system; but as the number of systems increases the likelihood of a clear evaluation can be seen to decrease.

This observation is taken from the testing procedure used on the criteria. Three identification systems are used and there is no problem in the evaluation while systems lack different necessary characteristics to be operational. However, it can be noted that when all three identification systems fulfill a single requirement, it is extremely

difficult to ascertain which system is the best relative to that criterion. With more than two identification systems it seems likely that at least two will have the necessary characteristics to meet any one criterion. The problem then arises as to which system incorporates the most satisfactory combination of criteria.

Evaluating the two basic identification systems does not lead to such ambiguities. Both systems lack certain characteristics and the problem can be readily solved by reference to the framework for evaluating identification systems. The organization of the criteria establishes the relative importance of the criteria. An identification system which fulfills the essential requirements and hence the basic criteria is clearly superior to one that does not.

Once developed, the framework for evaluation permits an objective evaluation of two identification systems for the above reason. A comparison of the grid co-ordinate and street-oriented identification systems is a logical use of this framework given that the framework is adequately tested. A testing procedure is carried out in this study.

It can be observed that the street-oriented identification system meets the criteria while the grid co-ordinate identification system does not. It should be pointed out that the compatibility of identification systems with mechanical display of information is not an essential criterion. If identification systems are viewed from the point of view of

directly displaying information once it is collected then it is necessary to include this criterion while omitting others from the framework. By adding this criterion to the framework without removing others, it appears that the outcome of any evaluation is likely to change. However the purpose for developing the framework must change also.

For a thorough evaluation of identification systems for all purposes it appears that more than the above criterion can be added. Subjective criteria are not in the framework but this only serves to illustrate that the framework is developed to assure only that an identification system which satisfies the incorporated criteria has potential applicability in city planning for the collection of information.

Subjective criteria are postulated and applied to the street-oriented system but it can be observed that this system does not adequately fulfill the necessary requirements. The implications of these criteria are not fully tested by altering the assumptions upon which they are based. However it is observed that they tend to be extremely compatible with a street-oriented identification system although this system does not explicitly meet the criteria.

The general observation made is that the street-oriented identification system fulfills the requirements postulated within this study with a limitation regarding: the direct display of information; and, subjective criteria

for evaluating the capabilities of identification systems to permit the direct retrieval of subdivisions.

Potential Application of the Street-oriented Identification System

Identification systems have potential application in fundamental areas that are important to city planning. A street-oriented identification system could be implemented in its present form in creating an information retrieval system for metropolitan regions.

Many municipalities generally direct effort towards collecting information in metropolitan areas. Limiting the development of an identification system for the collection of this information to one municipality is of dubious value to city planners. Economic, social and physical conditions tend to be similar throughout the region and hence accurate economic and population projections require the collection of information from many municipalities. The time necessary to collect the information and the accuracy of that information, is largely determined by the municipality which is slowest in collecting the information and the municipality which maintains the least accurate records. Hence, improving information handling techniques in only one municipality is not likely to greatly improve the effectiveness of regional information collection. Of course the qualification is made that the continuous collection of information pertaining to

the region as a whole is required.

Planners are generally in the position of having to advise municipal executives on the basis of partial understanding on partial information. When the problem is regional in scope the information is also likely to be largely inconsistent. Conducting a special survey of the region may provide more and better information to improve the potential for rational decision making but the information must be made available and manipulated in time for a reasonable course of action to be recommended to the municipal executive or executives. The decision cannot wait for the information and as a result, decisions have traditionally been made from operational knowledge of the situation. Operational decisions are based on empirical experience and rule of thumb. Increasing the quantity and quality of the information by conducting a single regional survey improves the potential for achieving better decisions but only a further understanding of the situation can substantially improve the decision process.

Only the continuous collection of information on a regional basis can assure further understanding of situations and the availability of information in time to improve the potential for better decision making. To facilitate collecting the information a street-oriented identification system could be utilized. This identification system could be used for the region as well as an individual municipality.

It could be readily expanded for regional analysis such as transportation studies.

Transportation studies represent only one type of regional study but can be used to provide an example of a potential application of street-oriented identification system for the continuous collection of information on a regional basis. For clarification, it is assumed that a regional collection agency is responsible for providing the information.

Regional problems of developing transportation networks are generally characterized by partial understanding of the effect that decisions have on the overall land development. A variety of regulatory controls are available for achieving planning objectives. One device is the regulation of building density and land use so that the transportation system is always adequate for the traffic generated. If the transportation system is improved the building density can be raised assuming there are no other variables such as diverse social goals involved, thereby generating more traffic. This device is used only to illustrate the use of controls as there would likely be diverse social, economical and physical objectives involved in any regulation of building density.

This control depends on all other traffic generation factors being equal and if they are not equal, other devices would likely be necessary. However, given that all other

factors are equal, it is necessary to determine what the relationship between building density and traffic generation is at any time to determine whether it is possible to increase the building density or improve the transportation system. To determine what is happening a feedback of information is required. A feedback is a method for providing a regulating link between, for example, a furnace and the room temperature. In this case the feedback is provided by a thermostat and electrical wires.

Partial understanding of a complex situation necessitates feedback controls. A complete understanding of traffic generation would be permissive of predicting land use patterns and the consequences of imposing new traffic arteries on this land use. The understanding would permit a forecast or prediction of transportation demands far enough ahead to plan adequately. This does not seem remotely possible without continually checking on what is happening. Transportation trends are observed and projections made and decisions are based on current trends. Controls are then put into effect in an attempt to improve the transportation network. The decision may be timed to coincide with what is actually happening or it may not. Normally there are a number of controls at work but for purposes of illustrating the example it is assumed that only one control is relevant. If the control is poorly timed, the consequences may be critical and it will be necessary to quickly change the

control decision. A feedback loop is necessary so that the results of the decision can be measured. Without a feedback loop, decisions are likely to be made at inopportune times and the decisions not changed in time to prevent serious problems. Currently, the accepted technique for handling transportation problems is the addition of unplanned arteries on an ad hoc rather than systematized basis.

Identification systems are required to facilitate the collecting of information so that even decisions based upon partial understanding and partial information can be effective. Decision must be made while the transportation system is in operation. The decision cannot generally be held up until a study is conducted if it is going to require an extensive period to collect the information.

II. CONCLUSIONS

A framework for evaluation is used in the selection of a street-oriented identification system for installation in systems for retrieving information pertaining to city planning. Subjective criteria are indicated and used in the further evaluation of a specific street-oriented identification system being developed in Vancouver, B.C.

Evaluation of Study Method

The framework for evaluation developed in this study incorporates the criterion of automation for the evaluation

of identification systems for city planning. This appears to be the basic criterion for objective evaluation of identification systems which are to be utilized in information retrieval systems. Many possible criteria are cited within this study such as: unique identification of sites; universal applicability of the system for use in all municipal departments; and flexible areas of analysis.

These for the most part can be assumed under automation. If there is not unique identification for example the information retrieval system will break down when mechanically sorting information. Accepting this criterion as basic is essentially proving that the assumption relating to automation in this study is necessary in any evaluation of identification systems. A further advantage of proving this assumption is that this criterion can be used in a more refined way than the other criteria. In relying on automation, a measure can be used and more than the presence or absence of an essential requirement established. It is possible to evaluate the degree to which an identification system can be automated.

When relying on the other criteria for evaluating an identification system, it is possible to measure only the presence or absence of design specifications. An identification system incorporating a required design specification, cannot be evaluated any further with that criterion. Hence, it is generally necessary to utilize as

many criteria as possible to evaluate the potential of an identification system.

The criteria in this study are established by analyzing the basic principles of information handling. In this way, sufficient criteria are included to assure that an identification system which satisfies the criteria has at least a minimum degree of practical use in information retrieval systems. Relative to potential application within retrieval systems, a measure of the degree to which an identification system is compatible with automation is essential. Further, this criterion established more than the presence or absence of an attribute and tends to assume the other criteria. In light of these advantages it is necessary that compatibility with automation be included in any framework for evaluating identification systems for use in city planning.

There is no inherent manner of weighting the criteria adequately within a framework to assure that more important criteria carry more weight. Having established the basic criteria from first principles it is now necessary to postulate a framework to incorporate these criteria and test it with empirical evidence. The empirical evidence used in this study is a set of existing identification systems. This set: is mutually exclusive of the set of identification systems to be examined; and, is composed of identification systems each of which lack at least one

essential design feature for use with information retrieval systems. The test clearly indicates that the framework for evaluation can be used to test two identification systems.

Therefore, the study method for evaluating two identification systems for use in information retrieval systems is objective and logically consistent. Identification systems lacking any of the essential requirements have only limited use in the retrieval of information at the interdepartment level or at the department level for city planning.

The study does not end once it is established that basic requirements are necessary for an identification system to be used in the retrieval of information at the interdepartment level and directly from surveys. These are considered the fundamental reasons for developing information retrieval systems and hence identification systems in cities; but there are further uses of these systems which demand consideration from city planners.

Information, once collected, requires analysis. Subsequently, the results of the analysis are generally communicated. Both of these functions are considered as a basis for formulating recommendations about identification systems.

Consequently, the functions of analysing the information and communicating the results are considered as a basis

for formulating recommendations about identification systems. Recommendations pertaining to the direct display of information take account of the consideration established early in the study that the grid co-ordinate identification system is definitely superior for this function. No empirical evidence is generated later in the study to make this consideration controversial.

No such considerations are established pertaining to the analysis of information and it is therefore suggested that a case study is the best way to generate empirical evidence to facilitate theoretical investigation. On this premise, a case study is conducted of a street-oriented information retrieval system currently being implemented in the City of Vancouver, B.C. However, it is pointed out that recommendations made on the basis of this case study have relevance only to street-oriented identification systems.

Recommendations are evolved from a conscious expression of the purpose of the methods to be evaluated. Alternative means of identifying the individual site are evaluated in the case study for the purpose of identifying land use designs which by nature cover more than the individual site. A further consideration relating to the practicality of utilizing the alternative means of identification is made. This consideration is necessary if the recommendations are intended to attract any attention from

those responsible for designing identification system.

Making recommendations beyond those cited above are not justified with the available empirical evidence. However, it is possible to draw inferences from the case study.

The behaviour of identification systems under different testing procedures is largely unknown, and hence conducting a case study utilizing a testing procedure is likely to to be very rewarding. The results of a case study under these conditions are likely to generate further possible criteria for evaluation.

Although recommendations pertaining to both general systems of identification cannot be justified, it is possible to draw general inferences about criteria for evaluating both of them on the basis of studying only one identification system.

Therefore, the study method assures that recommendations and inferences based on the case study are adequately qualified. The case study can be used to make recommendations relating to the means of identifying land use designs, for use specifically and to draw inferences pertaining to criteria for the evaluation of identification systems in general.

Conclusions

Identification systems are being installed as component parts of information retrieval systems to handle

factual information which is required by city planners. It is suggested that unless city planners are technically able to select identification systems which are conscious expressions of their requirements; component parts are likely to be installed, contrary to the planners' interests.

This study indicates a framework for evaluation, structured to enable comparison of alternative identification systems to be installed in order to facilitate the collection and handling of information. After structuring and testing the framework, the design criteria incorporated within it are used in the selection of a general system of identification. A case study is conducted utilizing this general system of identification upon which recommendations are made and inferences drawn regarding further design criteria.

To orient this study, an hypothesis is established and tested in the manner described above. As scientific progress is made by formulating specific hypothesis and attempting to substantiate them; it is hypothesized that: A "street-oriented" identification system provides the optimum solution to a number of problems in the retrieval of factual information pertaining to city planning. The hypothesis is generally substantiated in this study with qualifications relating specifically to the purpose for selecting and installing identification systems.

Street-oriented identification systems are essential for collecting information both at the interdepartment level and directly from surveys. They are not yet compatible with automation for the purpose of directly mapping information. However, information must be collected before it can be displayed and therefore the display of information is considered secondary to its collection.

The framework for evaluation of identification systems for use in city planning is used in this study to select the street-oriented identification system for installation in retrieval systems for the purposes of collecting information at the interdepartment level and directly from surveys. The framework is also tested in this study for the evaluation of alternative identification systems. The grid co-ordinate identification system is found to lack required design elements for purposes of information collection. Tests indicate that the framework is adequate for the evaluation of alternative identification systems given that not more than two are being compared.

As the design criteria and the framework incorporating the criteria are tested procedures of evaluation; it is concluded that the street-oriented identification system is superior to the grid co-ordinate identification system for purposes of collecting information at the interdepartment level and at the department level. There are indications that the grid co-ordinate identification system has presently

superior characteristics for compatibility with automation for purposes of directly printing information, once the information has been collected. For city planners the essential purpose of installing identification systems relates to collecting the information while a secondary purpose relates to the representation of that information. The framework is structured on this consideration, to enable comparison of alternative identification systems, and therefore substantiates the hypothesis.

There are further considerations to be regarded such as those reflected in the case study as well as specific limitations on the study results. Only factual information such as that information relating to land use which can be transmitted in retrieval systems is considered. A further limitation is that only theoretical performance standards are established and not cost standards. These limitations affect the scale of the identification system which is practical for any given city. However, they are unlikely to seriously affect which identification system is practical for given purposes.

The case study conducted on a street-oriented identification system being developed in the City of Vancouver, B.C. provides a basis for the general conclusion that a street-oriented identification system is required for the analysis of land use designs which are discrete by nature. As the streets are the most permanent physical elements in

the city and the costs of rebuilding an entire street system is prohibitive, it can be said that using the streets as co-ordinates provide the most permanent form of location control imaginable. Planners invariably analyse the streets or abutting sites and using the streets as co-ordinates facilitates these analyses.

As the street-oriented identification system does not presently contain all the design elements required to identify alternative land use designs without prior analysis, recommendations are made for further research on this system. Inferences can be drawn that any identification system for use in city planning requires further research on identifying land use designs. It is possible to uniquely identify the site and therefore the inference can be drawn that it is also possible to identify land use designs.

Inferences are also drawn relating to the design criteria. Those incorporated within the framework for evaluating identification systems for use in city planning are sufficient to assure practical installation in information retrieval systems. They are not sufficient, however, to enable an adequate evaluation of the compatibility of an identification system with analysis. Subjective design criteria relating to land use designs are assumed in the case study, and alternative methods of identifying land use design attempted. It is concluded that the most practical method of identifying the individual sites which make the

physical city, for purposes of continually collecting information, does not provide sufficient identification of alternative land use designs.

The conclusions do not preclude the development of an ideal identification system for use in city planning. They do, however, indicate that a street oriented identification system is essential for collecting information, and that planners are still faced with the problem of developing a single identification system for the purposes of collecting, analyzing and displaying information. The two fundamental systems of identification, the street-oriented system and grid co-ordinate system combined, fulfill the necessary requirements. But even if there is evidence to support the claims of both identification systems, it is imperative to first install a street-oriented identification system for general use within cities. Hence, there would be an assurance that sufficient information is available to city planners in a suitable form.

III. RECOMMENDATIONS FOR FURTHER RESEARCH

Recommendations for further research are indicated from the results of this study, to evaluate the selection of a street-oriented identification system for installation in information retrieval systems from the point of view of the city planner. In general, research is required into: the potential use of identification systems in city planning;

the design of these systems; and, the selection of these identification systems for installation.

Identification Systems

Further research should be conducted into the potential use of identification systems in city planning and the design characteristics which these systems are likely to possess. The street-oriented systems of identifying information possess design characteristics which make them essential for collecting information from surveys while the grid co-ordinate systems of identifying information possess design characteristics which make them extremely compatible with the machine display of information. Hence, the potential uses of these systems are largely limited by design characteristics. However, the design characteristics should be the conscious expression of the purpose for that identification system.

The design characteristics of an identification system are generally determined by the available alternatives rather than with identification and definition of the purposes for implementing the system. With further research it should be possible to identify the information handling requirements of the city planner and then to adequately document these requirements. The potential uses of identification systems could then be ascertained with some degree of accuracy. By making explicit the potential uses of identification systems,

further research on the design characteristics of these systems is likely to result in identification systems being installed to fulfill the desired purposes rather than on the basis of currently available alternatives.

This argument implies that further research be conducted on the actual design characteristics of identification systems. It is both feasible and desirable to conduct further research on the design specifications of existing identification systems and the design characteristics of general systems of identification. The results of this research are likely to be the separation of component parts of identification systems. The component parts could likely be combined in different ways to fulfill different requirements.

The street-oriented type of systems of identification are extremely effective for conducting surveys and for analysis of small physical areas. There are indications that the grid co-ordinate type of systems of identification are effective for direct positioning of information to simulate maps and the identification of large physical areas which do not require the degree of location control necessary for small physical areas. It may be possible to separate the component parts of these systems of identification and combine them in a manner which would fulfill any desired purpose. A recommendation is made that further research be conducted on this aspect immediately if the interests of city

planners are to be expressed in the identification systems being developed for regional and national surveys.

Criteria for Evaluation

To evaluate identification systems that are being developed and have been developed, a recommendation is made that further research be conducted to provide adequate design criteria. Only by thoroughly evaluating proposed information identification systems will it be possible to assure that sufficient design specification be included to provide city planners with a working tool.

A framework, incorporating design criteria, is structured in this study for the evaluation of identification system in city planning. However, it assures only that identification systems meet minimum performance standards relative to the collection of information. A recommendation is made that cost standards be considered and that further design criteria be incorporated within the framework.

Incorporating the subjective design criteria assumed in the case study requires further research both to substantiate the criteria and test their relevance in city planning. The subjective criteria cannot be excluded because it may be difficult to substantiate. They seem essential for a thorough evaluation of identification systems for use in city planning and require testing if only to be shown inadequate and hence point the way by the research and

criticism to better criteria.

In general, recommendations are made that further research is conducted: to provide more explicit criteria; to rigorously assess the implications of requiring that planners have the technical competency to select identification systems without well defined purposes for installing these systems; and, to assess the available alternative identification systems. This study provides only the basic framework for evaluating identification systems and therefore a specific recommendation is made that it be enlarged.

Summary

The objective of this thesis is to evaluate a specific method of identifying location-oriented information for use in city planning. The method evaluated is a street-oriented identification system such as that commonly used for street addresses. In addition, a crude set of criteria for evaluating methods of identifying location-oriented information are developed.

In order to be operationally useful, an identification system must generally be compatible with the retrieval of location-oriented information from municipal departments and with the collection of this information from surveys. The most fundamental requirement for an identification system is that it be operational within the departments actually collecting the information. Assessors can provide

a large part of the information required by city planners, but the identification system must be capable of being used for the continuous collection, storing and retrieving of that information. If it is not, there is every indication that the retrieval of information at the interdepartment level is likely to break down.

The emphasis in this study is placed on evaluating the methods of identifying location-oriented information and developing the design criteria by which to evaluate these methods. A framework is structured with the relevant criteria to evaluate the two general systems of identification which are proposed for use in retrieving information at the interdepartment level. It is observed that a street-oriented method of identifying location-oriented information fulfills these relevant criteria.

A general description of continuous, regional transportation study is presented in an attempt to show a potential application of the street-oriented identification systems. This is done in order to provide the general reasons for collecting the information and hence illustrate the basic purpose for identification systems: to enable the retrieval of information at the interdepartment or intermunicipal level. Attention is focussed on the method of using controls to regulate transportation systems but it should be noted that this is to point out that information handling is a continuous process.

Two systems of identification: the street-oriented system and the grid co-ordinate system are described and evaluated in an approximate manner. Since there are a number of complexities and problems involved in a single application of an identification system, the fundamental theories are emphasized in the evaluation. The framework and relevant criteria for this evaluation assure an objective comparison.

The specific hypothesis in this study is that: a "street-oriented" identification system provides the optimum solution to a number of problems in the retrieval of factual information pertaining to city planning. This is tested in the study and is substantiated with qualifications regarding the problems. For the problems of retrieving information at the interdepartment level and from surveys, the street-oriented system does provide the solution. However, for the problem of directly producing maps, this identification system does not provide the solution.

Recommendations are made regarding further research into, the purposes, design and evaluation of identification systems for use in city planning. It is hoped that these recommendations provide the basis for further research and criticism; and thereby may enable progress towards an ideal identification system for city planning.

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