

A CONCEPTUAL INFORMATION SYSTEM
FOR
ENVIRONMENTAL ANALYSIS

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Thesis submitted to the Graduate Faculty of the
Virginia Polytechnic Institute
in partial fulfillment for the degree of
MASTER OF ARCHITECTURE
in
ENVIRONMENTAL SYSTEMS

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August, 1969
Blacksburg, Virginia

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CHAPTER I

INTRODUCTION

Nature of the Problem

The tremendous expansion in urban development has been matched by the increased complexity of data that has been commenting upon it. Mathematically, the addition of a new component to the environment increases its complexity factorially and not linearly. For example, the ramifications of an introduction of one variable to an existing ten is not ten percent but eleven-fold. Consider over one hundred variables, and the resulting interfaces number in the thousands.¹

To prevent inundation man has been required to seek greater analytical skills and rapid processing techniques. Analytical skills have developed in the form of conceptual approaches and frameworks attempting to explain urban structure and function in a logical sequence of events. These approaches and frameworks have sought to advance the new field of environmental studies beyond an ad hoc status by supplying guidelines for planning activities. However,

¹W. L. Rogers, "Aerospace Systems Technology and the Creation of Environment," in Environment for Man, ed. by William R. Ewald, Jr. (Bloomington, Indiana: Indiana University Press, 1967), pp. 260-268.

their current status remains theoretical, and they have yet to make the transition to a workable system. This progression to operational use requires compatibility with information-type systems, so that problems may be systematically and rigorously tested from initiation to execution. Rapid processing techniques have developed in the form of computer-based information-type systems, with public and private agencies gathering and storing immense quantities of data pertinent to the environment. These systems have been centered around land use and have gravitated towards the land parcel and its characteristics as the basis of most of the systems. Much of this accumulated data is inadequately used, because such an information-type system, while providing a means of storage and retrieval, does not sequentially relate its component areas. Each component exists as a separate entity that must be assimilated and organized within the user's mind.

These occurrences of available data, complexity of techniques and theoretical structure in each field have led to greater specialization of environmental disciplines, resulting in greater segregation among them. There now exists in these areas a general lack of awareness of the relevant influence of important points that each offers. This problem of increasing requirements for specialization was precisely characterized by Bertalanffy, who points out

that, "the physicist, the biologist, the psychologist and the social scientist are, so to speak, encapsulated in a private universe, and it is difficult to get word from one cocoon to another."² When communication does occur between one discipline and another, new disciplines like cybernetics and information theory emerge, but in the process of so doing they likewise erect their own barriers and extend the fragmentation. Currently, the majority of solutions or processes are specifically oriented to the discipline practiced by the proponent. This has produced a wealth of solutions politically, economically and architecturally oriented, but with their potential as a viable contribution limited by their narrow sense of vision.

Man's comprehension of this ever-enlarging environmental spectrum might seem impossible initially, but as this change is occurring, an extension of man's ability is likewise taking place. The advent of electronic media as an extension of man's senses provides the requisite means to cope with this problem.³ Computer science alone offers a tremendous potential. The computer is capable of assimilating vast quantities of diverse information and

²Ludwig Von Bertalanffy, "General System Theory," Yearbook (February, 1956), p. 1.

³Marshall McLuhan, Understanding Media: The Extensions of Man (New York: The New American Library, Inc., 1964), pp. 19-35.

storing them for future use. The data can also be edited quickly for significant patterns and returned to the inquirer. Eliminated is the tedious, long man-hour task that normally would be required.⁴ The computer functions as a natural extension of man's analytical ability, since it explores relationships quickly and systematically in depth according to a prescribed set of rules.

Hopefully we are embarking on a new course that will bring with it a consciousness of the total environment and the relative value of each discipline. Marshall McLuhan has optimistically prophesied that this is the trend to come:

The day of the individualist, of privacy, of fragmented or "applied" knowledge, of "points of view" and specialist goals is being replaced by the over-all awareness of a mosaic world in which space and time are overcome by television, jets and computers -- a simultaneous, "all-at-once" world in which everything resonates with everything else as in a total electrical field, a world in which energy is generated and perceived not by the traditional connections that create linear, causative thought processes, but by the intervals, or gaps, which Linus Pauling grasps as the language of cells....⁵

⁴C. H. Davidson and Eldo C. Koenig, Computers: Introduction to Computers and Applied Computing Concepts (New York: John Wiley and Sons, Inc., 1967), pp. 83-202.

⁵Marshall McLuhan, "Playboy Interview: Marshall McLuhan," Playboy Magazine, March, 1969, p. 70.

Scope of the Thesis

To aid and abet the foregoing, there exists a need among environmental disciplines for a strong yet highly permissive framework, from which participants would be able to communicate about the objects of their concern. The framework would serve as a means of exchanging ideas and proposals. It would be computerized and capable of continuous interaction among participants. The advantages of such a system are many-fold. It would allow simulation of environmental problems, thus providing a means of evaluation before actual implementation. It would serve as a continuing index of information. Over a period of time, as information is accumulated, the environmental patterns would be discernible. The framework would also serve as a means of formulating interdisciplinary hypotheses.⁶

This thesis suggests the rudiments of a possible conceptual information system. Much of what is utilized in this effort is drawn from work completed and in progress. The system proposed is a synthesis and integration of divergent areas in hopes of providing a better mode of comprehending the environmental process.

The purpose of the thesis is to develop a system for handling data pertinent to environmental analysis within

⁶Donald L. Foley, "An Approach to Metropolitan Spatial Structure," in Explorations into Urban Structure (Philadelphia: University of Pennsylvania Press, 1967), pp. 21-75.

a conceptual framework. The thesis will focus on the initial conceptual information system analysis, which will delineate the basic structure of the system. What is presented is not an all-inclusive system but a basic framework that can receive additional increments of knowledge as they become available through time. Initially, the system implemented would provide a frame of reference for the user.

A test problem will be injected to determine the overall feasibility of the system. The problem will concern itself with site analysis and the process of human interaction within a given area. The passage of this problem through the various components of the system will indicate the functional adequacy of these areas and their impingement upon each other.

As the system evolves, it can be extended, integrated and synthesized with other approaches to achieve its ultimate objective: a comprehensive analysis framework that evaluates environmental phenomena.

CHAPTER II

TOWARDS A SYSTEM OF ENVIRONMENTAL ANALYSIS

As stated before, many of the tools of environmental analysis exist, but they have not been integrated into a continuing thought/problem-solving sequence. To resolve the gap between a conceptual framework and an information-type system requires that a common denominator be provided, so that both areas may be integrated and function as one system.

This thesis suggests that such a common denominator could easily be based on a state plane coordinate system extended to a three-dimensional coordinate system, in which established points in the environment would become storehouses for data. Such a system of locational control would provide a common reference for all disciplines, providing the cohesiveness and continuity needed.

This approach to a conceptual information system is different from what currently is being evolved, in that the information-type areas will be considered an extension of the conceptual framework chosen. Rather than establish an information-type system that lists data unsequentially around a physical or similar unit, the system will be extended from a methodological conceptual framework, a framework

that will provide a more comprehensive thought process from initiation of a problem to its final execution.

Each area of the conceptual framework will be a part of each parcel record of the information system. This will prevent confusion of concepts, so that ideas will remain sharply defined within their own common data series. First we will consider locational control, and then an adequate conceptual framework established within an information-type system.

Locational Control

Every action and product of man occurs at a distinct point in space and time. As man passes through the environment, occurrences and products at specific locations establish continuous evolving patterns of development. Since it is these patterns that we attempt to ascertain through analysis, locational control is of paramount importance; it establishes the relationships we seek.

The location method establishes a system of locational coordinates superimposed on the surface of the earth as a means of geographically identifying collected data. A basic feature of this approach is the opportunity to reference all types of data about each fixed point, making it possible to relate to other points while functioning through one control

network. A given area may be analyzed by aggregating the points pertinent to the problem.⁷

The location method has also been used for hundreds of years, principally by explorers, navigators, and cartographers who have compiled large volumes of data useful for their purposes by latitude-longitude co-ordinates. More recently, surveyors and engineers have used co-ordinate systems; for identifying the location of monuments, properties, highways, etc.; also, co-ordinates have been used as a basis for control in large-scale mapping. Map location co-ordinates, a most simple device, are employed by map makers to facilitate indexing and locating places on a map sheet (for example, the A8, B6, D7 type of co-ordinates).

In urban planning information systems, use of co-ordinates originated with the very recent metropolitan transportation studies. In 1947, co-ordinates were used in Sacramento, California, by the California Department of Highways to prepare trip travel desire line charts and trip intensity contour charts. The co-ordinate system or location method, is now firmly established as the main method of geographic identification of most data specially collected in the modern metropolitan transportation studies, such as in Kansas since 1955 and Pennsylvania since 1964.⁸

Locational control concerns itself with two basic types of location: (1) a physical location of a segment of the

⁷Marion Clawson and Charles L. Stewart, Land Use Information -- A Critical Survey of U. S. Statistics Including Possibilities for Greater Uniformity (Baltimore: The Johns Hopkins Press, 1965), pp. 31-33.

⁸Robert E. Barraclough, Geographic Aspects of Information Retrieval (paper presented to Urban Planning Information Systems Conference, University of Pittsburgh, Pittsburgh, Pennsylvania, 1964), pp. 3-7.

earth's surface, which is basically immutable and permanent, and (2) improvement locations, which are man's imprints on the surface of the earth and are more easily modified. Physical locations on the earth's surface are relatively unchangeable, in that their location characteristics are fixed in relation to the equatorial poles and can only be modified by erosion or physical displacement by man or nature. Improvement locations, as roads and physical structures, vary in time and place. A situation exists in which the positions of improvement locations affect their interrelationships, as for example the economic drawing power of a shopping center located near an apartment complex.⁹

Important characteristics of the location method are noted by R. E. Barraclough as:

...(a) close-to uniform spacing and size of units, (b) almost automatic statements of density, (c) full territorial coverage of geographic universe, (d) addition or deletion of referenced parts or sub-areas, without altering the reference values of the system, (e) built-in indicator of the position or location of point or sub-area in the geographic universe, (f) mechanical measures of distance, direction, area, proximity, and centrality.¹⁰

⁹Clawson and Stewart, Land Use Information, p. 31.

¹⁰Barraclough, Geographic Aspects of Information Retrieval, pp. 3-7.

Location is also relative and is considered in light of the study at hand. The user may be concerned with an area as small as a cluster of single-family houses or as large as a metropolitan or regional area. The grain of the problem in the proposed framework necessitates a hierarchy of locational scale to effectively utilize the system and provide continuity throughout. Parcel definition and locator sequence will delineate the requisite scale.

Parcel Definition

A parcel is usually defined as a portion of land with established boundaries and one ownership.¹¹ Assigning data to a concentric point in a parcel is woefully inadequate, however, and is useful only for problems of a general nature seeking averages and indicators over a large area. The detailed problems of human interaction within a given area demand a more detailed locational control of parcels. Within our conceptual information system, therefore, the following definition will apply: a parcel is any area or volume that can be identified as having a man-oriented activity use. Parcel, in this context, is not simply a segment of land but a quantity of space which could possibly exist at a height or depth removed from ground level. Under the current

¹¹Metropolitan Data Center Project (Tulsa, Oklahoma: Metropolitan Data Center Project, 1966), p. 19.

definition, separately owned lots such as those in a residential neighborhood are considered parcels; but different activity areas within one ownership or parcel, as individual residential units, parking and recreational areas within an apartment complex, are also considered parcels. Urban areas of high density and multiple-floored structures could, under this new definition of parcel, convey the multiple functions occurring within them. The term "activity use" is not only limited to the present, but is considered in its future tense as well. An area may serve as a potential mineral or lumber deposit for man; hence, it would also be categorized as having an "activity use."

The limitations of parcel identification, terminating with an ownership tract, are those of scale. The locator sequence, however, clarifies this discrepancy.

Locator Sequence

The locator sequence originates with a tie-in to dependable origins in a grid system. The Coast and Geodetic Survey has established a nation-wide network of marked points. These points are kept constant, even though some are destroyed over time, by a triangulation system in which

lost points are easily reestablished through reference to remaining points in the overall network.¹²

However, the use of a pure coordinate locator system is questionable. Such discrepancies as identifying a sub-parcel or micro-parcel as part of a parcel would prove difficult to cope with using a pure coordinate series. This problem and others are overcome, though, when a coordinate series is coupled with a supporting set of identifiers which enhance its use.

For instance, from the Survey network a number of states have developed a plane coordinate system of X and Y coordinates on a single grid. The Missouri Grid System is typical and designates six grid blocks within a 5,000-foot map area. The grid blocks are, in turn, each subdivided into four minor squares whose sides are each 1,250 feet. The map areas are aggregated to cover larger areas; they are part of a zone of about 100 to 200 miles wide and high. Accuracy is within one-half foot per mile. Parcels are then located in reference to this grid network through a locator sequence which would appear as follows:

¹²U. S. Department of Commerce, Plane-Coordinate Systems (Washington, D. C.: Government Printing Office, 1948), pp. 1-3.

Map Number	Grid Block	Quadrant	Parcel Number
21-S	1	2	30

The point-coordinate value of each parcel becomes the most refined level that the system extends to.¹³

There is some question at present as to which coordinate system offers the best support for environmental analysis. The decision to utilize a state plane coordinate system was predicated on the following facts. A longitude and latitude grid, while useful for large-scale geographic studies, is not particularly suitable to smaller scale studies which involve the boundaries of parcels and roads. Since the majority of environmental studies will be conducted at a smaller scale, the state plane coordinate system is utilized. However, an equivalent system in conjunction with a latitude and longitude grid would facilitate studies at a larger scale.¹⁴

As previously noted, parcel identification may take place at many minor levels of an environmental system. The

¹³Elliott Chamberlain, The Role of Locational Control in an Information System -- A Pilot Study for the East-West Gateway Coordinating Council, report to the East-West Gateway Coordinating Council, St. Louis County, Missouri, November 20, 1967 (Clayton, Missouri: Office of the Executive Director, 1967), pp. 45-56.

¹⁴U. S. Department of Housing and Urban Development, Urban and Regional Information Systems: Support for Planning in Metropolitan Areas (Washington, D. C.: Government Printing Office, 1968), p. 211.

scale or detail of the data and problem are likely to be determinative of which level is chosen.

A refined system of identification within the parcel is necessary to provide the requisite means for analysis. What follows is a method of enumerating all portions of a parcel that reflect a man-activity use. The progression in refinement of parcels is identification of sub-parcels and, if need be, sub-units of sub-parcels themselves. The order of such an identification system would be:

<u>Parcel</u>	<u>Sub-parcels</u>	<u>Micro-parcels</u>
Office complex	Parking	Corridors
	Walkway	Storage
	Office unit	Individual offices

The occurrence of various activity uses at different vertical levels requires that these levels be accurately identified. The Z coordinate value is introduced at the parcel level and will reflect the height or depth in feet above or below a fixed standard level. This provides parcel location and identification at one level relatable to parcel location and identification at other levels as a means of comparing data and use.

With each refinement the identification sequence is extended and would appear as:

<u>Parcel Number</u>	<u>Sub-parcel Number</u>	<u>Micro-parcel Number</u>
P30 (Coordinates centroid X_1, Y_1, Z_1)	S1 (Coordinates centroid X_2, Y_2, Z_2)	M1 (Coordinates centroid X_3, Y_3, Z_3)
	S2 (Coordinates centroid X_4, Y_4, Z_4)	M2 (Coordinates centroid X_5, Y_5, Z_5)

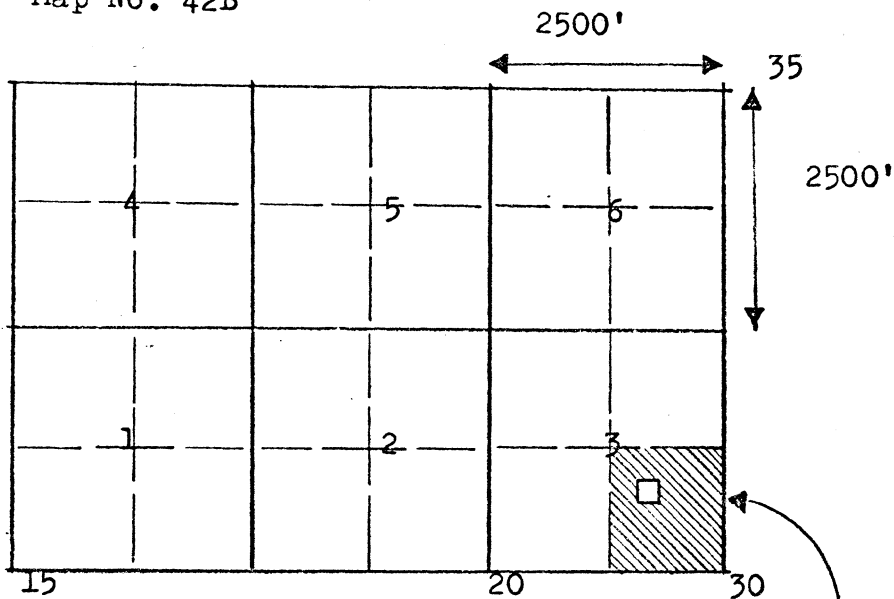
Figures 1, 2 and 3 are graphic descriptions of the locator sequence.

Locational control by itself is of little use to the environmentalist, but in conjunction with coordinative planning, it provides a total conceptual information system. It uniquely identifies each parcel within the environment and thus establishes the basis for relating data elements to one parcel or a series of parcels. These data elements may be logically coordinated within the parcel by grouping them in sequential, conceptual framework levels.

Coordinative Planning

Coordinative planning is basic to all of our actions within society; even a simple physical movement involves coordination between mind and body. Various types of integrative linkages occur among an individual's needs, activities and physical environment to provide a workable framework for carrying on the daily activities of life. They may be intuitively or purposefully executed by

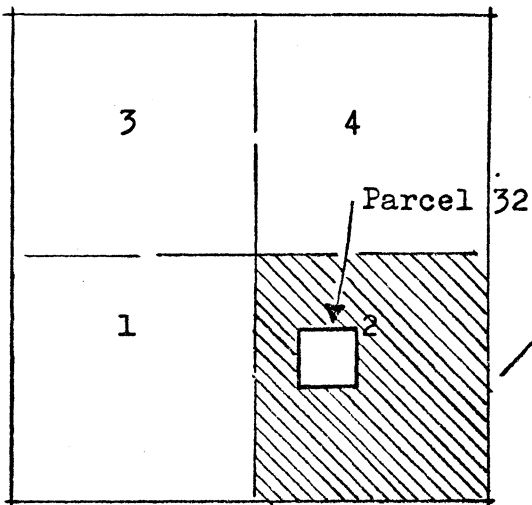
Map No. 42B



15 20 30
 Typical map face showing 2500' x 2500' coordinate grids.

Coordinate sequence:

X_1	Y_1	Z_1
2129	3050	650



Locator sequence:

<u>Map No.</u>	<u>Grid Block</u>	<u>Quad.</u>	<u>Parcel</u>
42B	3	2	32

Figure 1. Base map orientation -- locator no. convention.¹⁵

¹⁵Ibid., p. 52.

Grid Block 3

Quadrant 2

Parcel No. 32

Intersection
Coordinate point

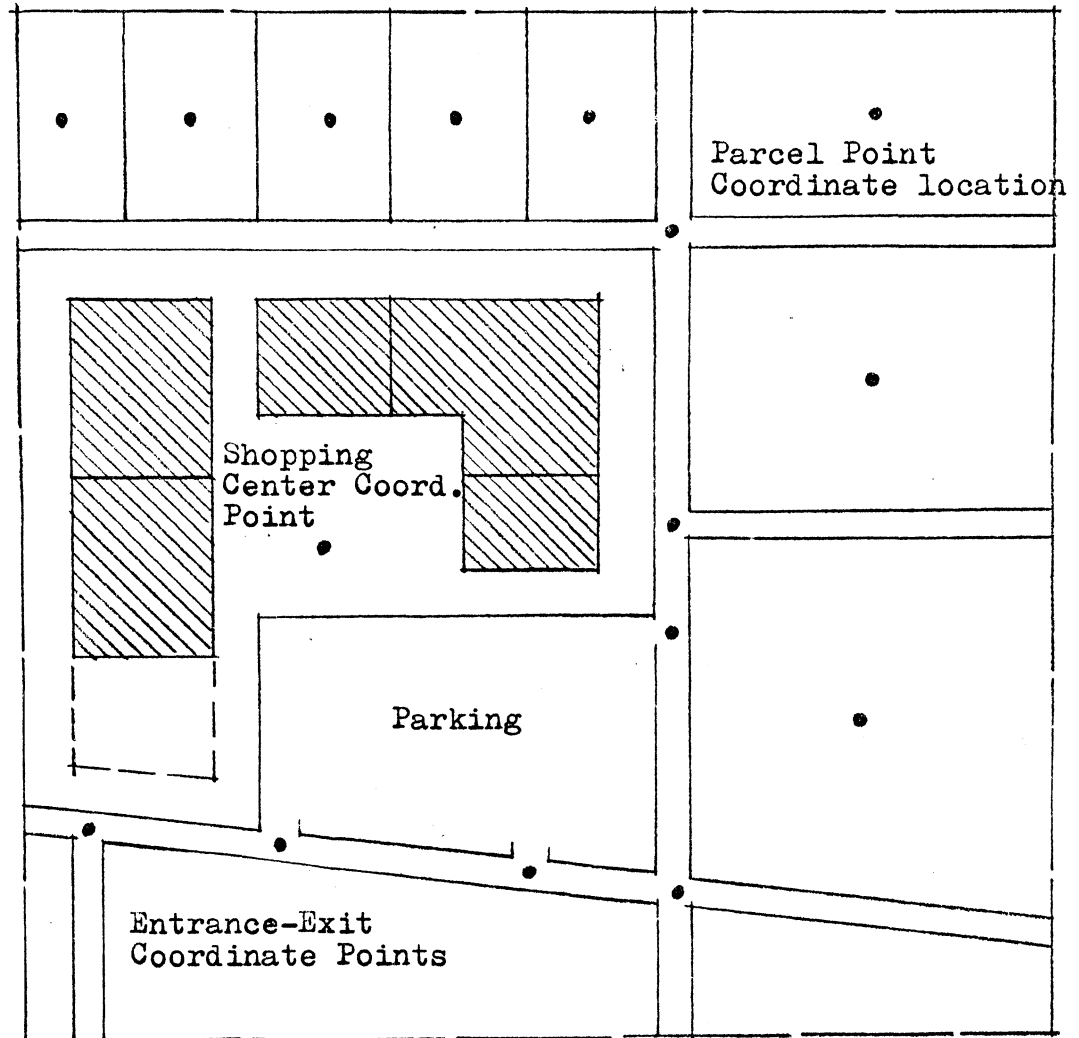


Figure 2. Locator Sequence Quadrant 2
Parcel and Street Coordinate Points.¹⁶

¹⁶Ibid., p. 53.

Parcel 32, containing
Sub-parcels:

- S1 Nursery
- S2 Dress shop
- S3 Drug store
- S4 Bakery
- S5 Insurance office
- S6 Barber shop
- S7 Court
- S8 Parking

Sub-parcel 5, containing
Micro-parcels:

- M1 Reception
- M2 Offices
- M3 Offices

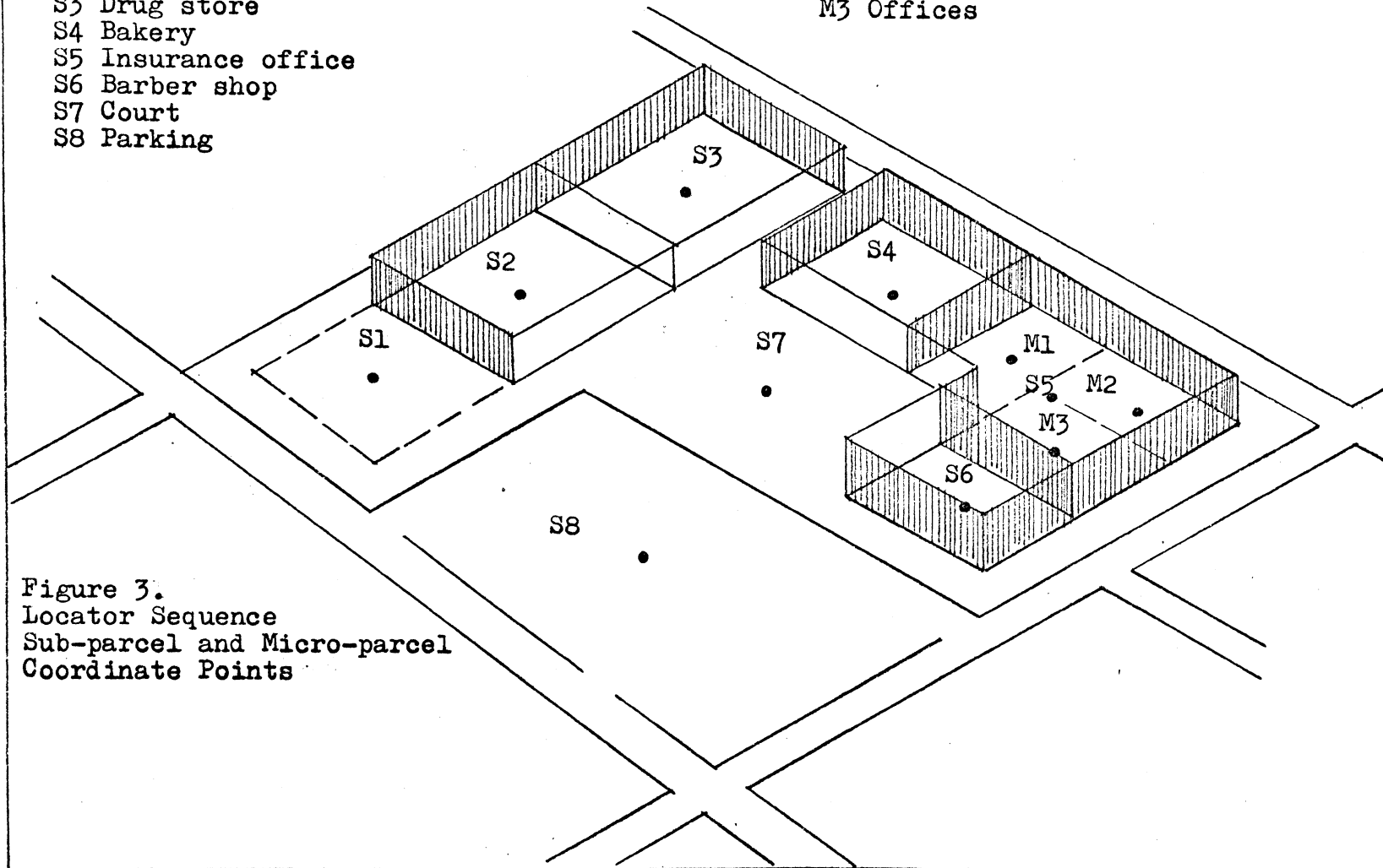


Figure 3.
Locator Sequence
Sub-parcel and Micro-parcel
Coordinate Points

automatic, semi-automatic or deliberate mechanisms, but they must occur for society to continue. Thus, coordinative planning makes operative the diverse, complex elements of our technical society. Every minor component of the environment, whether communication, transportation or physical structure, is affected by these many interrelationships. The contribution of coordinative planning to our proposed system depends on an adequate delineation of this network of causative interaction.¹⁷ An increased understanding of deterministic, probabilistic causality and correlation of parts will enable us to determine its relation to the environment as a whole.¹⁸

An environmental system includes a wide variety of areas from a normative, cultural aspect to man-developed material improvements. It is concerned with elements readily quantified, such as physical objects, and also with man's values and needs, less easily measured. A means of comparative evaluation is required to determine the relative effectiveness of parts and their contributing effort to the whole.¹⁹ Within the last decade, theoretical research has focused on

¹⁷Melville C. Branch, Planning: Aspects and Applications (New York: John Wiley and Sons, Inc., 1967), pp. 299-300.

¹⁸Russell L. Ackoff, Scientific Method: Optimizing Applied Research Decisions (New York: John Wiley and Sons, Inc., 1962), p. 16.

¹⁹Branch, Planning: Aspects and Applications, p. 300.

coordinative planning in the environment and has attempted to delineate its basic component areas and their interrelationships. Theory, in many instances, has evolved towards concepts slanted in the direction of a particular discipline, in which the environment is explained as a process centering on communication, transportation or economics.²⁰ These divergencies of individual approaches and procedures have been valuable in one sense, for they have expanded awareness of common, pertinent areas. As divergent as these approaches have been, their parts bear remarkable similarity. They all normally consider portions of three major areas: normative, cultural aspects; functional, organizational aspects; and physical aspects.

A Conceptual Framework

Donald Foley has recognized a need for a more permissive, inclusive system of major components that is not slanted towards a particular discipline and has proposed a common conceptual framework. Essentially, he has proposed the rudiments of a possible framework that considers the three major components of the environment previously mentioned in

²⁰F. Stuart Chapin, Jr., Urban Land Use Planning (Urbana, Illinois: University of Illinois Press, 1965), pp. 69-99.

both a spatial and an aspatial sense.²¹ The framework reflects his effort to relate conceptually the spatial arrangement that concerns architecture, landscape architecture and planning, and the essentially aspatial approaches of psychology and social sciences. When an architect or planner approaches the development of a site, he is primarily concerned with the physical layout of elements. But a social scientist might consider the same area in terms of value structures and the organization of institutions, which do not necessarily reflect a spatial arrangement.

Foley's conceptual framework that seeks to relate these two areas, between the "aspatial" and the "spatial", is shown as Figure 4. The following distinction is made between "aspatial" (Column A) and "spatial" (Column B):

...spatial refers to a direct concern for spatial pattern, i.e., for the pattern in which culture, activities, people, and physical objects are distributed in space. Conversely "aspatial" refers to a lack of such concern for spatial pattern.²²

The major components of the environment are then designated in three levels and are shown as 1, 2, and 3 in Figure 4. The first level, normative or cultural aspects, concerns

²¹Foley, "An Approach to Metropolitan Spatial Structure," in Explorations into Urban Structure, p. 23.

²²Ibid., p. 23.

	Aspatial Aspects	Spatial Aspects
Normative or Cultural Aspects	<p>1A Social values; culture patterns; norms; institutional setting; technology</p>	<p>1B Spatial distribution of culture patterns and norms; values and norms directly concerned with the qualities and determination of the spatial patterns of activities, population, and the physical environment.</p>
Functional-Organizational Aspects	<p>2A Division and allocation of functions; functional interdependence; activity systems and subsystems including persons and establishments in their functional-role sense</p>	<p>2B Spatial distribution of functions and activities; linkages (functional relationships spatially conceived); spatial pattern of establishments, by functional type</p>
Physical Aspects	<p>3A Physical objects; the geophysical environment, man-developed material improvements, people as physical bodies; qualities of these objects.</p>	<p>3B Spatial distribution of physical objects; the resulting spatial pattern formed by this distribution of land forms, buildings, roads, people, etc.; distribution in space of varying qualities of physical objects</p>

Figure 4. A conceptual view of metropolitan structure.²³

²³Ibid., p. 24.

itself with expected modes of action and social relationships within society. This level copes with the multiplicity of rules which govern the actions of individuals, to include their needs and goals. Such norms or rules pervade all areas of an individual's life and determine to a large extent individual and group behavior patterns. Finally, the normative facet of society entails the formulation and specification of goals and the utilization of approved means for seeking these objectives.

Functional or organizational aspects are defined as, "...the structure by which diverse functions are allocated and integrated within a community or among communities."²⁴ The second level is concerned with the entirety of various functions to include continuing activities and the interaction of people. This area of study includes activity systems and sub-systems and their interrelated components -- activities and communications. The activities component is concerned with interaction occurring within adapted spaces, and the communications component involves the movements of goods, people and messages between adapted spaces.²⁵ The delineation of these respective component systems is

²⁴Ibid., p. 25.

²⁵Chapin, Urban Land Use Planning, pp. 222-223.

necessary to provide the means for comprehending and anticipating the locus of activity patterns.

The third level of the conceptual framework is perhaps the easiest to define. Physical aspects include the geographical base of the environment, such as climatic conditions, topography, and geological data. It also includes the physical objects that man creates and uses, as buildings, streets and parks.²⁶ To describe physical objects fully, it is necessary to know their respective qualities, such as uses, attitudes towards them, and values (Level 1) assigned to them. The physical environment becomes the end result of society's manifestation of the previous two levels.

Main Relationships

There are a multitude of relationships or paths that are possible through the conceptual framework. By considering Figure 4 in cylindrical form, so that the physical level is next to the normative level, any variety of relationships may be established. Each user could discern a different prominent relationship, depending upon his own point of view, in which any one of the three levels could be pivotal.

²⁶Foley, "An Approach to Metropolitan Spatial Structure," in Explorations into Urban Structure, p. 27.

The S-shaped set of relations from 1A to 2A to 2B and then to 3B, or in reverse order, is a path that most significantly depicts the manner in which norms and goals are translated through the functional, organizational level into the physical environment. This relationship is shown in Figure 5. Then Level 2, containing 2A and 2B, assumes extreme importance, for it stands as the pivotal linkage which translates goals and values into the actual physical environment.

The initial relationship connects 1A to 2A and deals with the interface of norms and values and the functional organization of the environment in essentially an aspatial sense. Sociological findings have indicated that the functional, organizational level of the environment evolves more rapidly than the normative level. This lag is a result of continuing efforts within institutions to reorganize so as to cope with evolving functional demands.²⁷ For example, a technological innovation such as the automobile resulted from functional demands for more efficient transportation, but the general values associated with it took a decade or more to develop. Initially there was much resentment against the automobile as a means of transportation, primarily

²⁷Ibid., pp. 28-29.

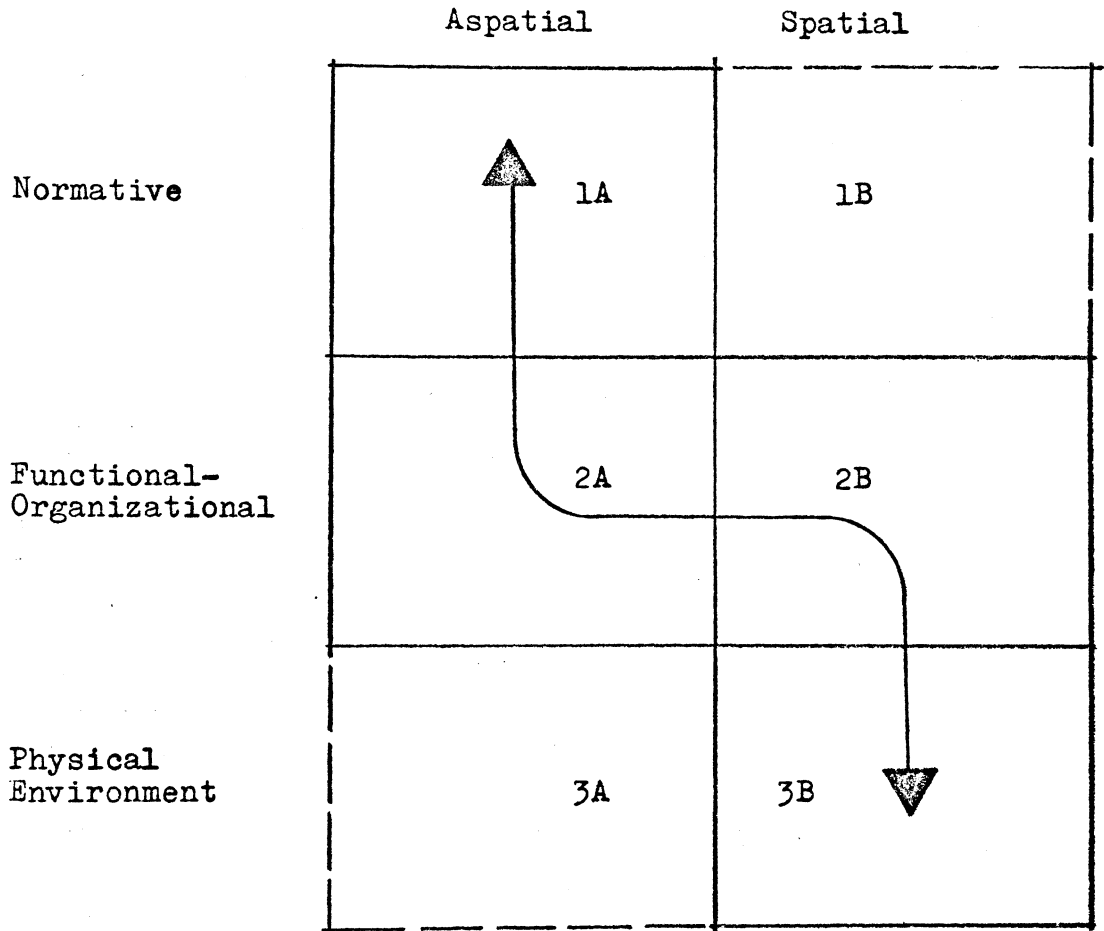


Figure 5.

The main relationship, with functional organization (2A and 2B) as pivotal.²⁸

²⁸Ibid., p. 30.

coming from people who placed high value on the horse and buggy. However, these changes in the functional, organizational level eventually fed back into the normative levels and became reflected in the values of society.

The second relationship connects 2A, the functional, organizational cell in an aspatial sense, and 2B, the functional, organizational cell spatially conceived. The problem Level 2 contends with is to determine how the functioning of institutions aspatially viewed develops into patterns of spatial arrangements. For example, how do the technologies of transportation and communication modify the spatial pattern, and, conversely, how does the pattern affect the processual, functional, organizational changes in 2A?²⁹ Our primary concern in this level will be activity systems and sub-systems and how the patterns of their structuring affect the functional organization of the activity and, in turn, affect values and norms.

The last relationship is between 2B, the functional, organizational cell spatially viewed, and 3B, the physical environment spatially viewed. This category is concerned with the accommodation of activities within physical facilities.³⁰

²⁹Ibid., p. 29.

³⁰Ibid., p. 32.

Suitability of existing streets to the transportation demands of today would be one of the typical problems with which this area is concerned. Once a physical facility is established, it has a tendency to be rather rigid. Activities, however, alter themselves over time in intensity, distribution and type. The compatibility of 2B to 3B is of tremendous concern, since it is the index of how well the environment functions.

It has been necessary, in the description of the cells of the environment, to refer to the intricate relationships which exist among several cells that constitute the whole. These relationships consider one single facet of environmental analysis. This focus may remain at the level of each component of the environment in general or may be directed towards a specific sub-system of a component. Thus, we may consider a functional system such as transportation or communication separately; but only by utilizing the entire process may we eventually enlarge our understanding of the environment in general.

Information System Organization

An information storage and retrieval system is primarily concerned with the organization of information to ease its retrieval. In the past information in index files has been organized so as to provide an optimum means of finding a

particular document. No thought has been given to relating the component areas of the file in a continuous, thought/problem-solving sequence.³¹ To cope with this problem within our proposed system, data elements are grouped in a logical, analytical organization corresponding to the conceptual framework advanced by Donald Foley.

Simply, data elements for any one parcel are all filed in the three levels of the conceptual framework: (1) normative or cultural aspects, (2) functional, organizational aspects, and (3) physical aspects, natural and man made. Within these three levels, the elements are further divided into aspatial and spatial groups. Since the locator sequence identifiers of parcels, sub-parcels and micro-parcels become the control for information variables assigned to them, the file organization is termed the Locator Control Format. This arrangement makes possible a continuing collection and recording of diverse data about each point.

Since Foley's conceptual framework initiates the beginnings of a subject heading language by using three subject classes, the division of subject classes within each cell can be conveniently continued. Although a subject heading language

³¹William H. Mitchel, "Urban Planners and Information," Datamation, October, 1966, pp. 82-83.

lacks a strong structure, it provides numerous advantages for a system beginning from scratch and with little available information initially. One of these advantages is that a subject heading language does not necessitate the creation of a structure that is all-inclusive at the very beginning. Increments may occur as knowledge and experience permit.³²

For our purposes, each level of the file record becomes an assemblage of variable-length locational data elements that are accumulated through time. Changes in content would occur as data was obtained and filed for future reference within each of the three levels provided. This approach provides wide latitude and the ability to adjust to unforeseen events.

As the storage of data increases, the subject heading language adjusts to the situation. New terms to cover new subject areas are added, while existing descriptors are kept intact. A subject heading may be split, allowing a new term to cover subject matter previously covered generally under the old term. Subdivisions may occur at any level, and a hierarchical structure may be introduced if desired.

The use of commonly spoken language terms and phrases constitutes another advantage, because the vocabulary of a

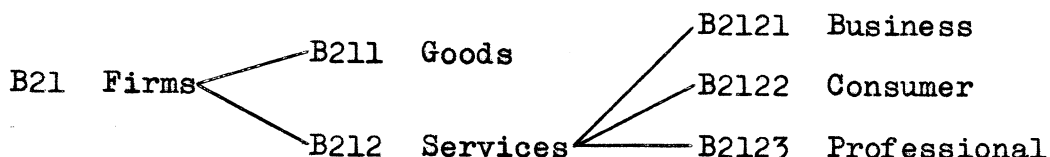
³²Charles T. Meadow, The Analysis of Information Systems -- A Programmer's Introduction to Information Retrieval (New York: John Wiley and Sons, Inc., 1967), pp. 25-26.

subject heading language is a natural language and is comprehensible to all disciplines at sight. This relieves the user from having to learn a specific set of descriptors with their own unique relationships. Every word or combination of words is naturally spoken and is not invented as a special form of communication.³³ If, for example, social activities were a subject heading, the words "social" and "activities" would not be considered separate legal descriptors that were built from an index language, but would be words normally spoken in the English language.

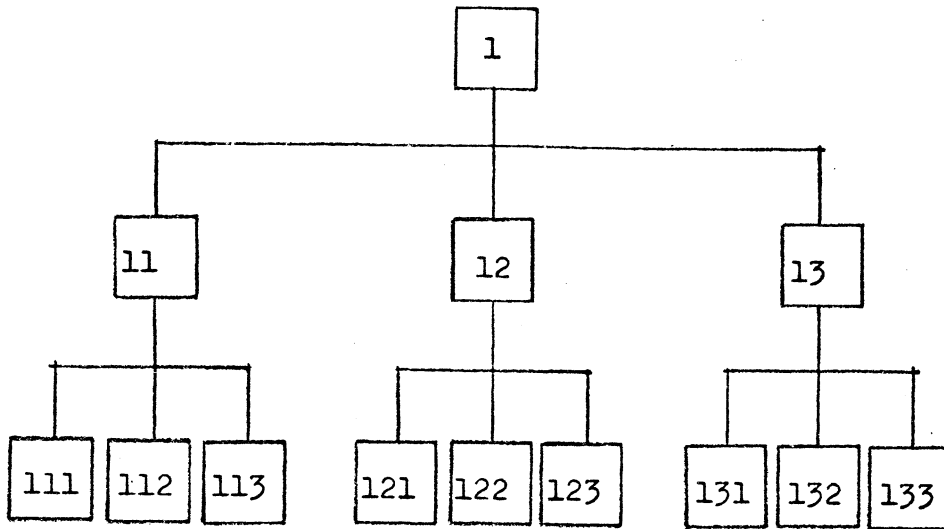
However, subject headings vary in length and complexity and do not lend themselves to a computer card format. Because of the general lack of structure and the need for compatibility with an electronic data processing system, we will combine a hierarchical alpha-numeric code and the subject heading language evolved for each level. The information system file will contain a code for each data element subject heading rather than the subject heading itself, but the subject heading and code will be quickly available to the user in a cross-reference directory card file. Thus, the alpha-numeric code simply serves as an address system and has no bearing on the structure of the subject language.

³³Ibid., p. 25.

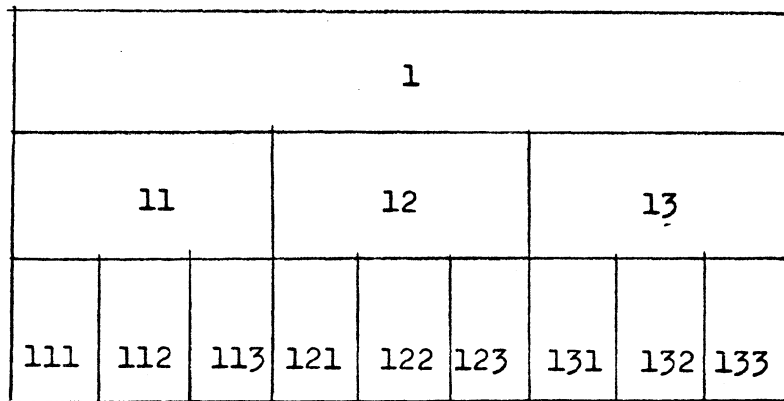
The code is analagous to a "tree" or "pidgeon hole" structure as indicated by (a) and (b) of Figure 6. The first alphabetic character in the code represents the cell within each major level, as shown in Figure 7. The numeric portion of the code represents further grouping of data elements within the cell according to logical subject headings. In combination with a typical subject heading group, the directory would appear as:



This type of classification can be carried to great detail; however, its primary purpose is to provide a general directory for the user. There is no intent to develop a typology of subject headings within each level, but only to suggest possible procedures and contents. A typology of subjects which are relevant to each level must be formulated according to the criteria of all disciplines. Possibly a multi-disciplined team could develop the subject heading typology and the depth to which it should be extended within the three major levels -- normative, functional-organizational, and physical.



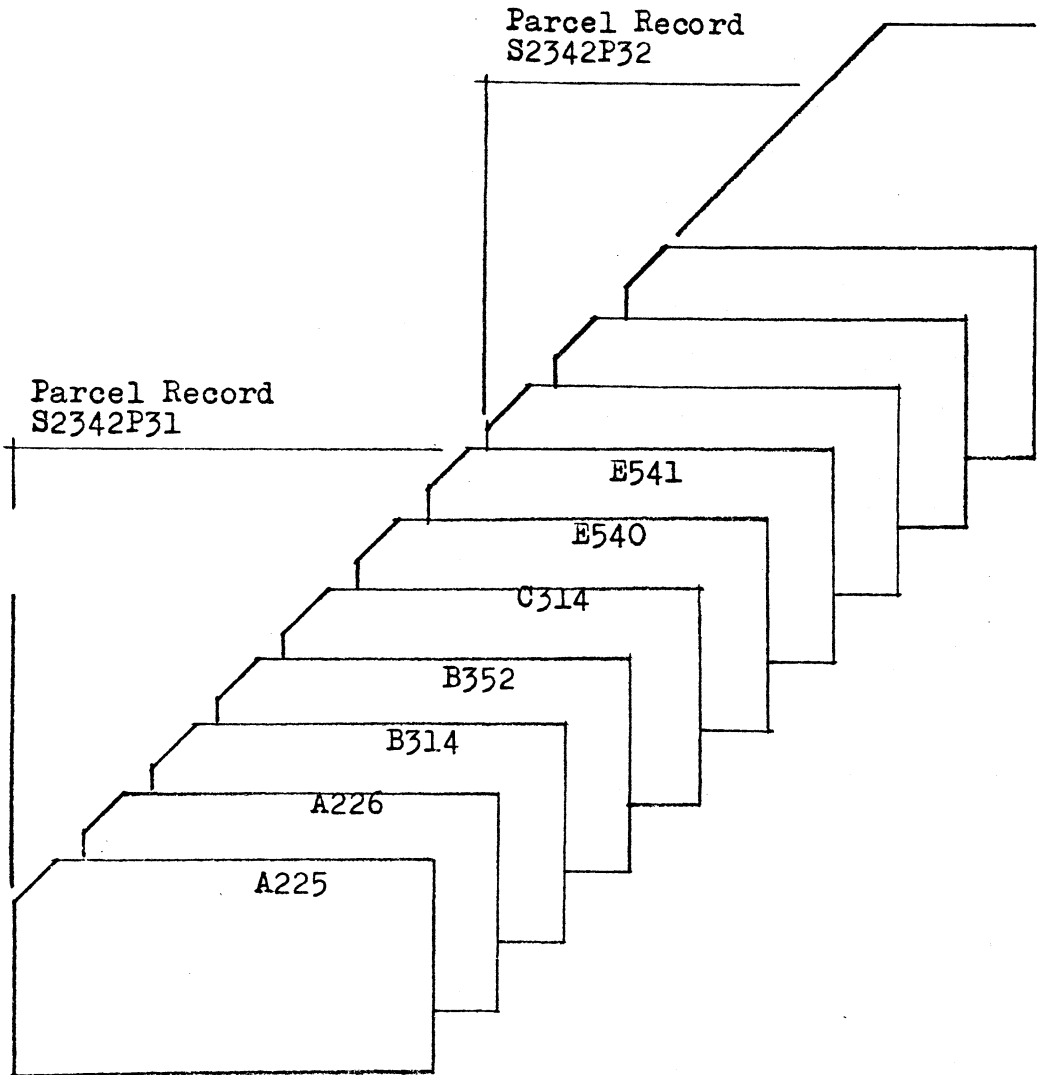
(a)



(b)

Figure 6. Hierarchical structure: (a) "Tree"
 (b) "Pigeon hole"³⁴

³⁴Ibid., p. 22.



Codes:

- | | |
|-------------------------|------------------------|
| A Normative (aspatial) | D Normative (spatial) |
| B Functional (aspatial) | E Functional (spatial) |
| C Physical (aspatial) | F Physical (spatial) |

Figure 7. File relationships.

Normative

The normative level of the location record format poses many difficult problems. For example, goal formation is guided by the aims of the individual participants and by the environmental restrictions under which they operate. Goal formation is as varied as man himself, with each environmental condition delimiting its own goals and the activities required to accommodate them. Besides the difficulties involved in identifying values and purpose, their quantification becomes an extremely complex problem. It is a problem of assigning specific values in terms of a common denominator, as possibly money (cost benefit ratio), or other similar procedures for relating goal structure to other environmental areas.³⁵ To attempt a universal approach to goals and cultural values with the intent of quantifying all possibilities, establishing a hierarchy or classifying all situations initially is not the intent of this effort. What is suggested for this level of the format is that each problem be approached individually and that the goals, needs and cultural attributes be determined and stored as required. As the system expands, the problems may be aggregated into larger areas and related to each other. Once

³⁵Chadwick J. Habersroh, "Control as an Organizational Process," in Modern Systems Research for the Behavioral Scientist, ed. by Walter Buckley (Chicago: Aldine Publishing Co., 1968), pp. 445-446.

this step is taken, congruity or incongruity with other levels of the system could be ascertained in various manners.

One such manner to determine the degree of congruity is indicated in Figure 8. The figure considers the minimal requirements for goal-guided activities in the environment. The movement of Point X along Line F in attempting to reach Point Y represents the activity of the system in solving a given problem. Within our system the active agent E represents the searching through the data file, attempting to minimize the distance XY. The search is governed by C, which functions as the control system. Within the location record format, C consists of a listing of those data elements pertinent to the problem at hand. Mismatch or tolerance levels are represented by R.³⁶ For example, if our goal in designing an apartment complex were to achieve between 60 and 80 percent passive contacts among the inhabitants, Y would equal the range 60 to 80. When X fell within this range, our goal would have been reached. Then C, in this case, would be a set of criteria by which the data elements are analyzed for minimum values

³⁶Donald M. Markay, "Towards an Information-Flow Model of Human Behavior," in Modern Systems Research for the Behavioral Scientist, ed. by Walter Buckley (Chicago: Aldine Publishing Co., 1968), pp. 339-362.

of XY, probably in the form of a computer program which would be E.

The order of the basic record format for typical normative data elements would appear as:

<u>Location Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
43A42P36		Apt complex	A41	60-80	%	101268
41B32P40		Neighbor- hood	A22	4000	\$	111868

In this instance, a search through the cross-reference subject heading directory would reveal that A41 represented the social value of passive contacts, and A22 was the goal of a minimum standard of living.

A series of subject headings of data elements would define the normative area and could be expanded as required. The subject index would include some of these divisions:

- A Normative
 - A1 Goals
 - A12 Individual
 - A13 Community
 - A14 National
 - A2 Cultural Patterns
 - A3 Norms
 - A31 Customs
 - A32 Fashion
 - A33 Etiquette
 - A34 Law

A4 Values

A41 Social

A5 Beliefs

The line between these subject headings is not always easy to designate. A continuum exists from one to another of slight graduations. For this reason, the normative file should be kept as simple as possible, to adequately cope with each environmental problem.

Functional-Organizational

Our primary concern within this level is activity systems of the environment. Activity systems are defined as, "...behavior patterns of individuals, families, institutions and firms which occur in spatial patterns that have meaning in planning."³⁸ That aspect of human and institutional interaction with which we will be concerned will have a place at a particular point at a given time. This differs from the aspect of non-place which Melvin Webber defines as the "urban realm," which has no specific boundaries and may be world-wide.

Another distinction noted by F. Stuart Chapin is that between the "activities component," or within interaction occurring within an adapted space, and the "communications

³⁸Chapin, Urban Land Use Planning, p. 224.

component," or between interaction which involves the movements of goods, people, and messages between adapted spaces. Additional considerations are the dynamic recurring aspects of interaction, in which the nature of the interaction is constantly modified by the previous interaction. Chapin also notes privacy as a final distinction and points out that our concern should be, "interaction which involves the public interest and has a relationship to the physical layout of the community."³⁹

Studies of a finer detail, as Leon Festinger's work in determining how passive contacts among the residents of a site are a function of physical and functional distance, must be carefully handled so as not to infringe upon the privacy of those concerned.

In keeping with these distinctions, a general typology of activity systems has been advanced by Chapin, which could be utilized for the system and extended within each given area of concern. The major classes, in combination with the alpha-numeric addresses, are set down as follows:

B21 Firms

B211 Goods

B2111 Extractions

B2112 Processing

³⁹Ibid., pp. 223-224.

- B2113 Communication
- B2114 Distribution
- B212 Services
 - B2121 Business
 - B2122 Consumer
 - B2123 Professional
- B22 Institutions
 - B221 Human development
 - B222 Community development
 - B223 Group welfare
- B23 Households and individuals
 - B231 Income-producing
 - B232 Child-raising and family activities
 - B233 Education
 - B234 Spiritual development
 - B235 Social activities
 - B236 Recreation
 - B237 Club activities
 - B238 Shopping⁴⁰

In attempting to define spatial patterns of activity, this level would file such information as "to-from" interactions about each point as they occur in time. The quantity of the to-from interactions would also be noted to judge the impact upon given areas. The order of the basic record format for a typical to-from interaction data element would be:

⁴⁰Ibid., pp. 232-243.

<u>Location Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
23B42P96	T43C31P29	Southwest Neighborhood	E238	132	No.	061467
43C31P29	F23B42P96	Towers Shopping Center	E238	132	No.	061467

The data element description represented by Code E238 would be found in the cross-reference directory as being Southwest residents shopping at Towers Shopping Center.

This continuous recording about each point assists us in understanding why and how activity systems change. However, such investigations must be collaborated with the other cells of the framework to determine how the patterns are regulated by the system which generates the activity.

Physical

The third level considers parcels, sub-parcels or micro-parcels as physical objects with certain qualities. These qualities include the geophysical environment and such physical characteristics as size, volume, color, etc.

People are considered as physical objects when they establish a parcel that has a man-oriented activity use. An open space within a park used for group meetings becomes a sub-parcel at times of the meetings. Physical qualities are the number of people, space displaced and other such information.

This level is also concerned with questions of functional adequacy, of which the health and comfort of man are important parts. Factors that are well known but neglected in practice could be stored for the use of design-oriented professions such as architects. Minimum standards for noise levels, climate and comfort are a few of the areas that could be included.

The file might contain some of the following divisions within the physical level:

- C Physical space characteristics
 - C1 Coordinate location
 - C2 Geophysical
 - C21 Soil associations
 - C22 Rainfall
 - C23 Ground water capabilities
 - C24 Rock types
 - C3 Size
 - C31 Average parcel width
 - C32 Average parcel depth
 - C33 Parcel area
 - C34 Parcel volume
 - C4 Space use information
 - C41 Number of employees
 - C42 Number of residents
 - C43 Number of children

The order of the basic record format for typical physical data elements would be:

<u>Location Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
43A42P36S24		Apt unit	C33	1,250	SF	061368
43A42P36S20		Parking lot	C33	20,000	SF	061368

The proposed conceptual information system is designed and organized for the primary purpose of enabling the user to view the environment more comprehensively by including the elements of an inclusive analytical sequence. In order that this primary aim may be realized, the system provides the following:

1. Compatibility with an electronic data processing system.
2. Assigning data elements to locational control points.
3. Establishment for each parcel record of a locational control format of three levels: normative or cultural aspects; functional, organizational aspects; and physical aspects, all viewed spatially and aspatially.
4. Providing a system that may be extended when needed and which allows the addition and deletion of data elements when desired.
5. Initiation of a framework for reference and use by many disciplines.

CHAPTER III

COMPUTERIZING THE SYSTEM

Because of the tremendous quantity of data involved, the proposed conceptual information system's transition into reality depends on the utilization of electronic data processing means. A computer is capable of scanning upwards of one thousand cards a minute, whereas the same task would take a human being hours. It is also capable of making an analysis of a problem and printing the results in far less time than it would take an individual to begin work on the problem.

To initiate computerization of the conceptual information system requires that the record on each parcel, sub-parcel or micro-parcel be kept in a logical format. The information system could be maintained in a punched card file in order by parcel locator sequence. It is suggested that there be one card for each data element pertaining to the parcel and that these cards within the parcel be kept in chronological order within data element code sequence. Such a file would be easy to maintain manually. Data elements could easily be added or deleted from the file for any one parcel or all parcels, as desired.

The file would also lend itself easily to numerous multi-disciplined applications, since the diversity of

information contained would make it of interest to many individuals. For example, a developer might be seeking the best possible location for a shopping center. The computer could search the file and report any parcels which met the conditions the developer desired. Additionally, the introduction of models would allow the projection of trends within an area.

To test the various components of the system and to indicate how the file might be drawn upon, sample problems are included. The first problem deals with the hypothesis that passive contacts within an area are a function of physical and functional distance. The subsequent problems illustrate how the first problem is evaluated at higher levels.

The potential of this type of systems approach is vast. The simple card system could eventually become a disk or magnetic tape permanent file, with the inclusion of on-line, key-in units such as console typewriters, light pencil consoles and plotters. This would introduce the ability for the user to concurrently interact with the system.

Basic Record Format

The basic record format relates the various concepts of locator sequence, coordinate control, parcel description and data elements in a manner that is compatible with a data processing system. A prime aspect of our basic record format is well-defined divisions. These divisions in their sequential order are:

1. Locator sequence (parcel identification).
2. To-from sequence.
3. Parcel description.
4. Data element code.
5. Quantity of data element.
6. Unit of measure (data element).
7. Date.

The locator sequence, since it consists of a unique series of alpha-numeric descriptors for each parcel, is used to specifically identify each parcel for the computer file search routine. Each locator sequence number is fourteen characters in length and occupies the first fourteen positions in the data card, as indicated by Figure 9.

The to-from sequence allows the relating of data from one parcel to another parcel. An alpha-numeric prefix would indicate the type of relationship established. For instance, T indicates transference of a quantity from a

Locator Sequence	To-From Sequence	Parcel Description	Data Element Code	Quantity	U/M	Date
43N42P31	T21S31P24	Supermarket	E232	50	No.	061269

Figure 9.
Basic Record Format

parcel identified by the locator sequence to a parcel indicated in the T sequence. The transference could be in terms of goods, people, and other quantities. The sequence occupies positions 15 through 29 in the data card.

The parcel description is that of a specific man-oriented activity use for which data is applicable: examples -- apartment complex, apartment unit, parking area, shopping center, bakery. Positions 30 through 50 are allocated in the data card for parcel description.

The data element code is an alpha-numeric combination which is used to represent the subject heading (data element description) and through which the subject heading may be obtained in the cross-reference directory. The first character is alphabetic and indicates the cell within the major level which the data element pertains to. The seven numeric positions following the alphabetic character specifically define the data element.

Quantity and unit of measure are the qualities of the data element with which we are most concerned; they tell us how much and of what the data element consists.

Time relationships have received little attention in the development of the majority of information systems. The significance of time in data collection and use is one of assisting in ascertaining significant patterns. Data elements may alter themselves over time, making it necessary

to note these changes when they occur, so that projection techniques may be utilized. The relevancy and validity of data are also conditional upon time. Time is used to denote when the data element took place or when the observation was taken, whichever takes precedence. This division requires six positions, allocating two places each for the numeric month, day, and year.

Coordinate Data Element

Since a computer card contains only 80 positions with which to work, the coordinate grid points (X,Y,Z), which alone would occupy more than eighteen positions, will be entered on a card for each parcel as a data element.

The locator sequence, by extending to micro-parcels, necessitates great exactness in location. This is accomplished by indicating the exact position within the proper quadrant at which the point occurs. Parcel points can be located to tenths, hundredths or to thousandths, according to the accuracy desired. For example, using the Missouri Grid square, which measures 1,250 feet on a side, a reading to tenths (one decimal place) gives location to a 125-foot accuracy; a reading to hundredths (two decimals) gives an accuracy of 12.5 feet; and finally, a reading of thousandths (three decimal places) would locate a point within 1.25 feet. Grid squares of 1,000 feet on a side would be easier to

work with, and a reading of thousandths would give an accuracy within 1 foot.

The System at Work

Since our information system is a card file, we can easily keep it current by manually or mechanically inserting new cards for new parcels and/or new data elements or, on the other hand, deleting old cards for obsolete parcels and/or data elements within parcels. By the same token, any errors in the file are easily corrected by removing the card in error, correcting it and replacing it in the file. A mechanical sorter would be useful when the volume of additions to the file becomes large. By keeping the entire file in locator sequence and the data elements within each parcel in data element code sequence, we facilitate mechanical means in maintaining the file.

The retrieval of information occurs in two manners: (1) by parcel (locator sequence control), and (2) by data element (data element code control). For instance, an architect designing a building on a given parcel would desire all available information pertaining to that parcel. Therefore, the file would be searched for a given locator sequence for the desired parcel, without respect to data element code, and all information stored within that parcel locator sequence would be retrieved. A land developer or

investor, on the other hand, interested in obtaining a site with particular attributes, would probably like to see a report of all parcels possessing such attributes; hence, we would search the file for these specific data element codes without respect to locator sequence.

Possible Applications

The uses of a conceptual information system are as varied as are the many facets of the environment. A sociologist would find in it the opportunity of discerning cultural patterns within specific areas. A political scientist could ascertain political cohesiveness within parcel groups. For architects and landscape architects, it offers the opportunity of obtaining a comprehensive reading on a given area and relating it to adjacent areas.

To urban planners, the conceptual framework offers increased rationality in the decision process. It not only concerns itself with what is and why, but also with what ought to be. What ought to be springs from what was and what was not. The failure to make this analysis retards the progression to improvements in the environment. For instance, planners contemplating a renewal effort of an established neighborhood have on hand data elements pertaining to what is and why. Goals, cultural values, activity systems and physical features all add up to a comprehensive

coverage of the area in question. The coverage is only limited by the efforts of the planners. The "what ought to be," or the eventual renewed neighborhood, should be predicated on the basis of facts that the system offers. Such a fact could be a behavior pattern within a community, such as locations where children play or where adults congregate for casual conversation. Factors like these could be noted as data elements and incorporated in the final design effort.

For the behaviorist, then, the possible implications of the system are numerous. Consider a typical study in which an attempt is being made to determine how people react within a given area, as a neighborhood. The various distinct areas of the neighborhood may be assigned sub or micro-parcel coordinate points. These points become a storehouse of data elements for reactions within each given area. Also, the "to-from" interactions between areas and the qualities of these interactions are all possible data elements. The residents' interactions with the neighborhood store, playground, church, and their important physical features are all needed facts that must be stored.

The system may also be linked to methods currently being utilized in the field, such as time-lapse photography, in which specific data elements are accrued over time. For instance, in a time-lapse photography study within an open-planned school, in which the architect is attempting to

determine how a distinct physical space modifies the reactions of its users, the physiological features become physical data elements; the movement of people from one area to another constitutes an activity system of "to-from" interactions; and finally, the children's and teachers' reactions or feelings may be noted in the normative level. As this data is accumulated, hypotheses may be drawn and conclusions reached by relating the various cells in the conceptual information system.

Sample Problems

Consider a situation in which an architect desires to foster social contacts among people. The architect realizes that the arrangement of units with their accompanying walks and roads determines to a large extent which inhabitants of the site will meet.⁴¹ Studies by Leon Festinger and Leo Kuper have reaffirmed this basic hypothesis, and it is the architect's responsibility to implement the results of studies done to date.

The problem may be approached in one of two ways. The first would analyze existing housing projects to determine which arrangements offered the optimum solution.

⁴¹Robert Gutman, "Site Planning and Social Behavior," The Journal of Social Issues, XXII, No. 4 (1966), pp. 103-115.

Using the second way, the architect could establish models to determine which arrangements offered the best solution. The conceptual information system would support either approach.

Let us consider the second way, in which the architect has already designed a site plan (Figure 10) and wants to know the number of passive contacts generated and the percentage of friendships that will ensue among units. In terms of the conceptual information system, we are examining the influence of the disposition of physical buildings (Cell 3B in Figure 4) on the total number of possible choices (passive contacts) in the 2B category (Figure 4), and finally the relation between the number of passive contacts and the percentage of established relationships (2A in Figure 4).

We have several previous parcels that have been examined in this context, and we will draw upon them in our evaluation. The physical arrangements and social relationships of one of the parcels are indicated by Figure 11.

The architect's first step would be to have the site digitized. After this is accomplished, the total number of possible choices (passive contacts) is determined and established as data elements. For large complexes, a computer program using the locator sequence would ascertain the number of contacts; for smaller sites, a visual

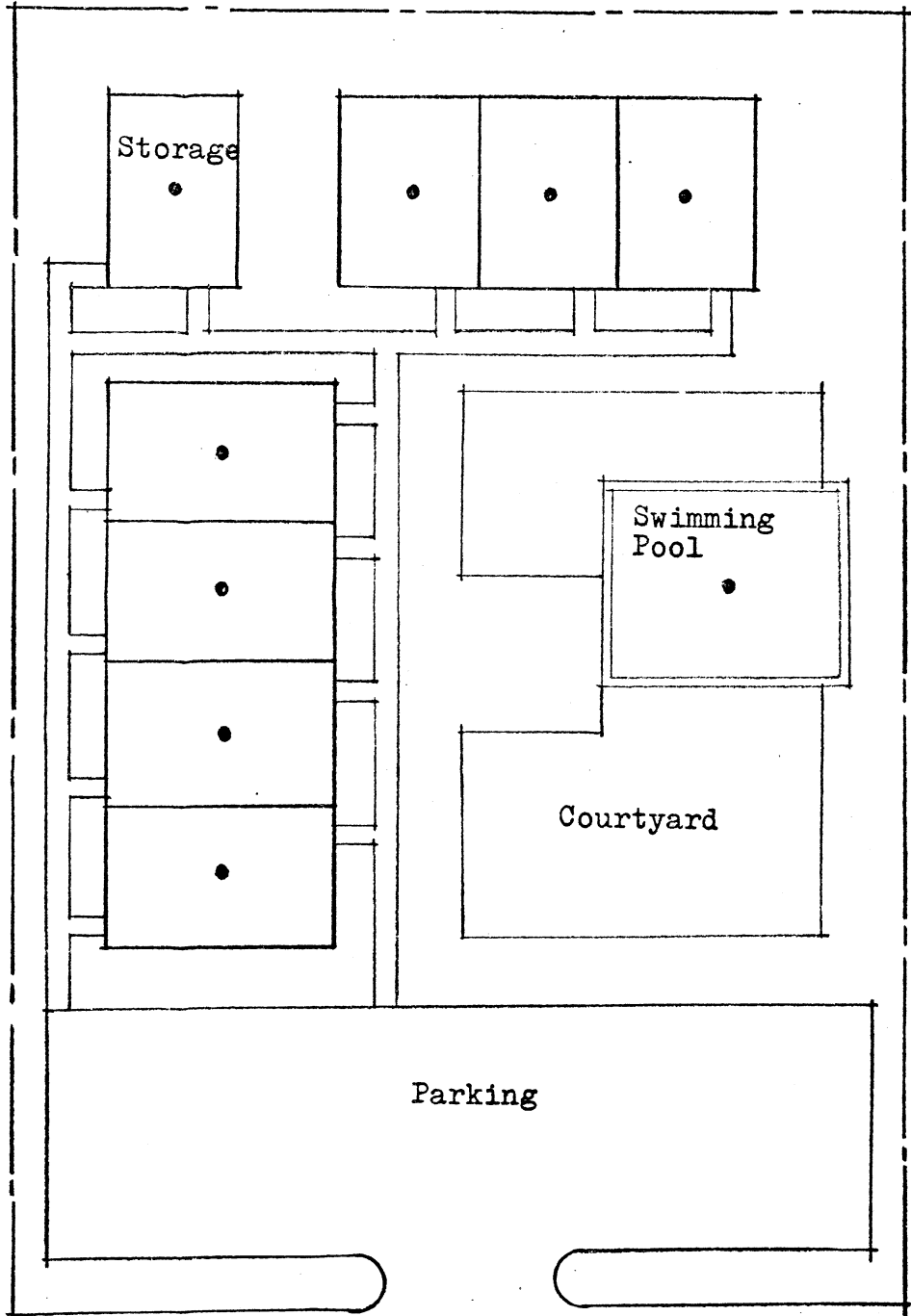


Figure 10. Preliminary Site Plan.

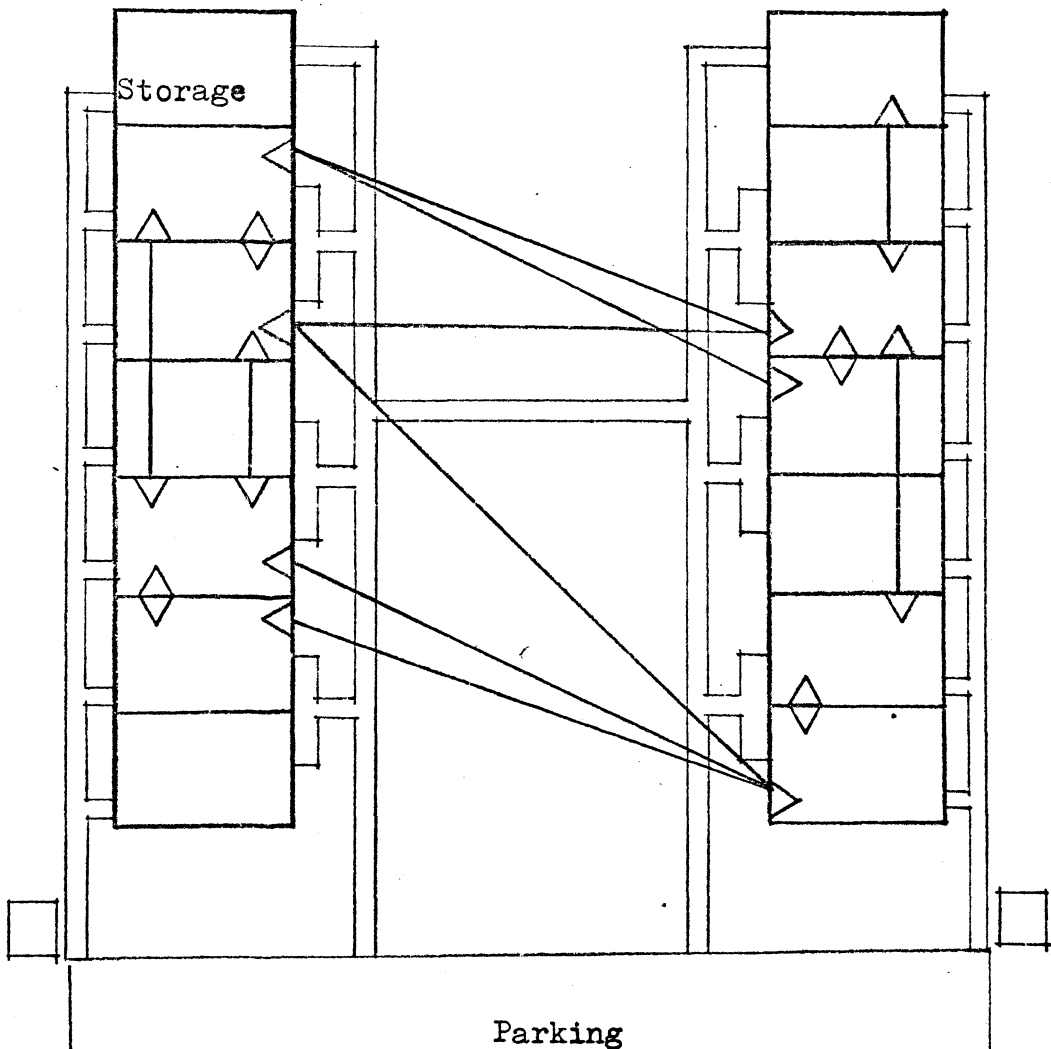


Figure 11. Established social relationships, Apperson Townhouse Apartments.⁴²

⁴²Richard R. Tangum, "Sociometric Patterns in Site Planning," Virginia Polytechnic Institute, 1968, p. 3 (mimeographed).

determination would be sufficient. The passive contact data elements for the architect's site would appear as:

<u>Locator Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
B2132P42		Apt complex	E2351	12	No.	081269
B2132P42		Apt complex	E2352	10	No.	081269
B2132P42		Apt complex	E2353	8	No.	081269
B2132P42		Apt complex	E2354	6	No.	081269
B2132P42		Apt complex	E2355	4	No.	081269
B2132P42		Apt complex	E2356	2	No.	081269

The cross-reference directory file gives us the subject headings for the codes we are dealing with:

E2351	Passive contacts for 1 unit of physical distance.
E2352	Passive contacts for 2 units of physical distance.
E2353	Passive contacts for 3 units of physical distance.
E2354	Passive contacts for 4 units of physical distance.
E2355	Passive contacts for 5 units of physical distance.
E2356	Passive contacts for 6 units of physical distance.

A comparison to an existing apartment complex, such as Westgate or Apperson Town House Apartments, would furnish us with a valid indicator of the number of friendships that

would develop. From the 2A category (coded as B235) for the parcel, we would obtain the pertinent data elements that have been stored for Westgate or Apperson Town House Apartments, indicating the percentages of friendships for given units of physical distance. Using the Westgate parcel record with its percentage of friendships for given units, the following relationship is established:

$$\text{No. of friendships} = \text{No. of passive contacts} \times \begin{matrix} \% \text{ friendships} \\ \text{previously} \\ \text{determined} \end{matrix}^{43}$$

A computer program, as shown by the flow chart in Figure 12, would provide us with the following numbers of friendships for units of physical distance:

<u>Units of Physical Distance</u>	<u>Total Number of Expected Friendships</u>
1	4.94
2	2.25
3	1.29
4	.60
5	.30
6	.10

What has transpired is a simple way of showing some of the practical uses of the system. By analyzing a

⁴³Leon Festinger, Stanley Schachter and Kurt Back, Social Pressures in Informal Groups (New York: Harper & Brothers, 1950), pp. 36-59.

particular site in comparison to previously analyzed parcels that are stored in the system, trends (numbers of friendships) may be predicted, so that the architect may be aware of the implications of his design decisions.

Let us consider also how the system supports analysis at higher levels. The site plan previously discussed would be submitted to a municipal agency for approval. Before approval would be given, an evaluation would be conducted utilizing the conceptual information system.

A municipality contains a number of departments which would directly or indirectly be concerned with the effect of the housing project. Their concern with the project touches the total spectrum of housing, economics, social and other conditions within their incorporated areas and adjacent areas.

The city planning department would probably act as a clearing bureau and coordinator for requests. Upon receipt of the request, the department would contact other departments for their respective evaluation as the development affects their area of concern. Each department would conduct its evaluation through the system and report back to the city planning department. Their procedure would be as follows:

Department of Transportation

This department is primarily involved with the second and third levels of the system. Its concern centers around the transportation network as an activity system and its transition into the 3F cell. Thus, this department would study the impact of the proposed development on the thoroughfare system and the added demand for buses or subways that might develop.

First, the file would be scanned to locate the streets abutting the parcel. Then, a printout of data elements relative to conditions of the streets (3C) would be processed. Such a printout might contain some of the following conditions and supporting material, as microfilm maps:

<u>Locator Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
42B13S42	T42B13S43	Minor street	C8934	50	Ft.	061269
42B13S42	T42B13S43	Minor street	C8926	3	Rate	061269
42B13S42	T42B13S43	Minor street	C9345	10	Ft.	061269
42B13S42	T42B13S43	Minor street	C9346	8	Ft.	061269
42B13S42	T42B13S43	Minor street	F9432	1	In/ 200 ft.	061269

The cross-reference directory file gives us the subject headings for the codes we would be dealing with:

C8934 Right of way.
C8926 Condition of street (rating on scale).
C9345 Two moving lanes.
C9346 One parking lane.
F9432 Microfilm map.

Concurrently, the street pattern in the immediate vicinity of the parcel would be laid out by the plotter (3F), and pertinent microfilm maps would be retrieved and projected (F9432).

The development's impact on the minor street in front of the development would be analyzed and considered negligible and well within the defined limits. The addition of the development would be noted when completed, and periodic reviews would reflect its impact, along with others, on the existing transportation network.

Department of Housing

The department of housing is concerned with the total demand of housing over the entire city. Periodically, through the use of the system, it reviews all parcels in the city, ascertaining data pertinent to housing conditions, such as vacancy rates, structural conditions, and the addition and deletion of housing units. Areas that have sufficient housing and those areas that are in need of additional housing are noted. Potential sites are tagged

for future development, and developers are advised of these conditions. As a proposed development is received, it is analyzed through the system within this context.

For its use the housing department has aggregated parcels into larger parcels covering neighborhoods and districts that have more or less defined boundaries. This allows them to scan a neighborhood for data element codes of a specific nature. For example, 32A31A62 is an aggregated parcel (62) which defines a neighborhood and falls into map areas 31A and 32A. To it have been assigned data elements that were ascertained through reviewing all parcels within its boundaries. The neighborhood that the development will be situated in reveals some of the following conditions:

<u>Locator Sequence</u>	<u>To-From Sequence</u>	<u>Parcel Description</u>	<u>Data Element Code</u>	<u>Quantity</u>	<u>U/M</u>	<u>Date</u>
32A31A62		Westover Neighborhood	F3291	1	%	101068
32A31A62		Westover Neighborhood	F6345	3	Rate	101068

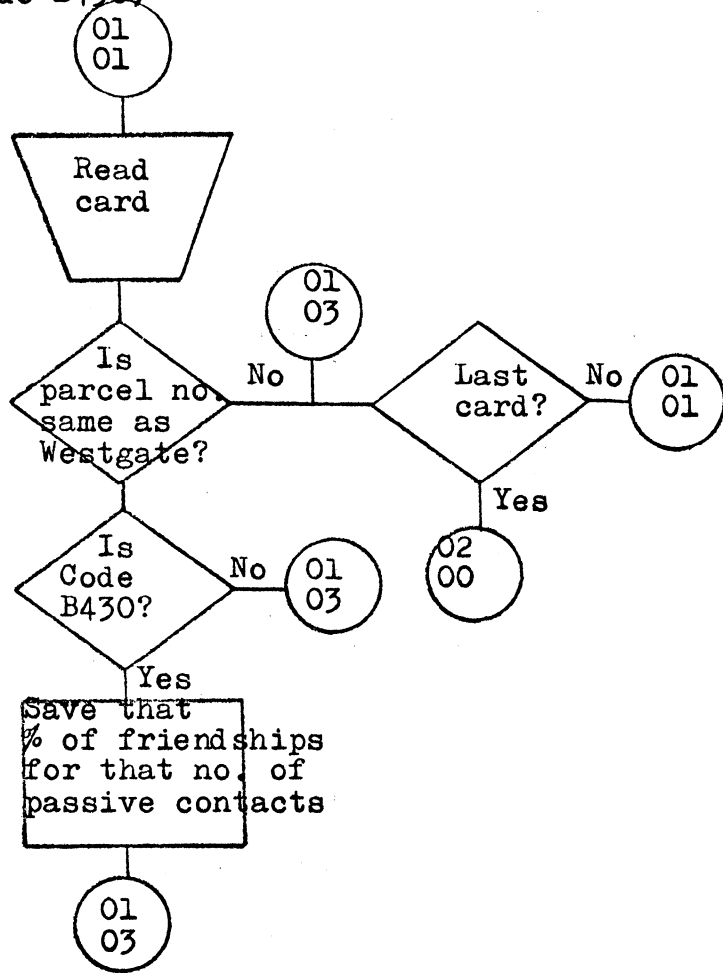
We find in the cross-reference directory the following subject headings for these codes:

F3291	Vacancy rate
F6345	Housing conditions (1 to 5, low)

Clearly, in this case, a need exists for additional housing because of the low vacancy rate and the need to improve the overall housing condition of the neighborhood.

Other departments would follow the same basic procedure with regard to utilities and capital improvements. Simply, the procedure is to scan for data elements pertinent to the problem area, either a parcel or aggregated parcel. As the user progresses through these steps, hypotheses may be formulated about relationships among cells or within a cell. The results are reported back to the city planning department, which then, again using the system by establishing the results as data elements, makes a final decision on each proposal.

First Run: To find Westgate
% of friendships (Parcel B2132P41)
(Code B430)



Second Run: To determine new site's
friendship statistics (Parcel B2132P42)

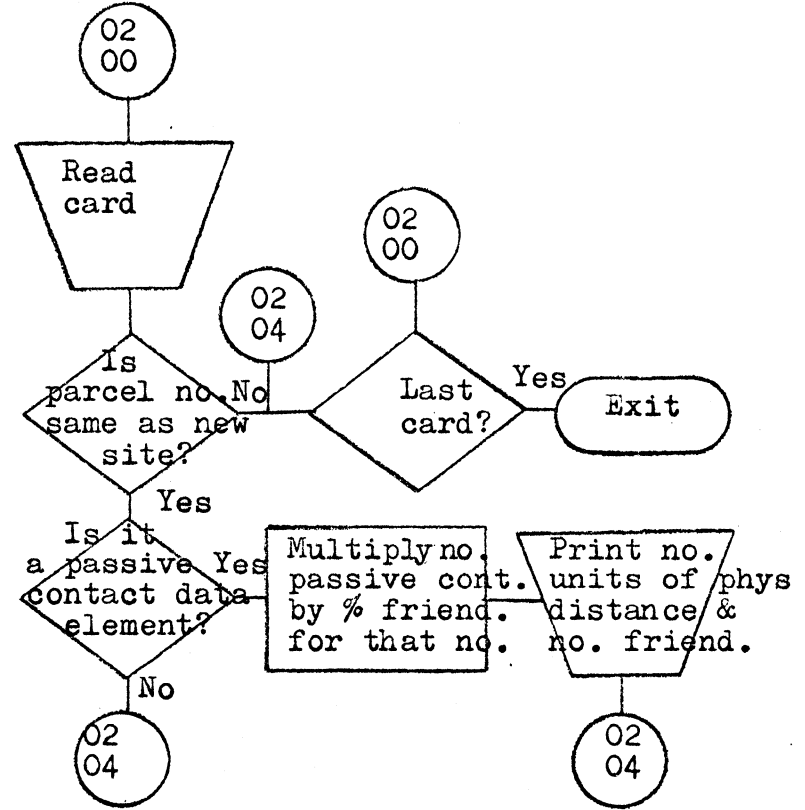


Figure 12. Flowchart

CHAPTER IV

A LOOK TO THE FUTURE

Possible Problems

There are numerous problems the system will encounter throughout its development. Some that may be visualized now are semantics, "universal" system concept, economic feasibility and human cooperation, which is, in reality, a part of the other three.

A semantics problem will definitely exist from initiation of the system. Each discipline has often developed its own connotation of a word or phrase that may differ from other usages. Standard definitions will be required, so that misconceptions may be avoided. Arriving at a standard definition will prove difficult in many instances, with each discipline desiring to maintain its own definition. The assignment of distinct code numbers to subject headings is a facet of this problem within the system. A sub-category may fall within one or more categories, unless explicitly defined. Thus, a user with one background might search in one area, while a user with a different background might search in another area, although both would be seeking the same data item.

There will be many misunderstandings as to when such a supposedly "universal" system becomes operational. Some

users may disagree with the concept that the system is operative with a small number of data elements. Thus, with regard to data, the problem will be to develop a working system and expand it in increments, rather than attempt to develop an all-inclusive system at the beginning. Participants initially will be overly enthusiastic in selecting data to be included in the system and will have a tendency to collect unnecessary information. Data must be collected in an orderly progression, accompanying refinements and expansions of the system. An attempt to provide a totally inclusive system at the beginning would lead to confusion.

As conceived, the conceptual information system provides a strong, highly permissive framework to relate to and work from. What is more important is not the system but the use of the system, since the system serves only as a means to achieve greater usage. This thought must be constantly kept in mind to avoid rigidity that would inhibit the development of its use.

The question also arises as to whether or not such a system would be economically feasible or possible. Can existing or projected hardware economically support such an effort? If one considers the tremendous expansion in technology within the last decade, especially the advancement of computer science, one would be inclined to say, "yes."

However, there remains the problem of convincing others as to the need for the system.

To assure human cooperation at all levels, it will be necessary to show how the system will benefit each area of concern. Continued participation by a department that furnishes input data requires that the system serve the department's needs, as well as others. To ameliorate the threat to the status quo that exists, the user must be educated to the use of the system, so that a desire is generated to utilize the system. A higher degree of human cooperation would hopefully ensue as the system becomes operational and the interdisciplinary interface is increased.

A Real Potential

A look to the future of a conceptual information system must consider two aspects. The first concern is the development of theoretical bases to support inquiries into environmental research. The second aspect, which aids and abets the first, is the progressive evolution of man-to-machine and machine-to-machine relationships.

Emerging theoretical orientations in environmental analysis will be affected by trends and countertrends. The field of planning, particularly, has been dominated in the past by architecture and landscape architecture, and is currently strongly influenced by transportation,

communication and economics. The dominance by one or several disciplines is beginning to ebb.

Environmentalists, in developing future approaches, are taking a multi-disciplined look in their attempt to discern relationships among key elements of the environment. Richard L. Meiers uses primarily a communications system for building a theory of urban growth, but in so doing he accepts Melvin Webber's framework, which emphasizes human interaction. Clearly, the direction is one of a larger awareness in the development and application of compatible theory.

The computer and supporting electronic media are encouraging this occurrence by providing on-line assistance. On-line computing is defined by Walter Bauer as, "the efficient use of a computer in a system in which the computer interfaces with man or other machines to which it reacts in receiving and supplying information."⁴⁴

For a conceptual information system striving to accommodate diverse quantities of data and approaches, an on-line system would be of tremendous assistance. This future assistance could be in terms of four kinds of on-line systems:

⁴⁴Walter F. Bauer, "On-Line Systems -- Their Characteristics and Motivations," in On-Line Computing Systems, ed. by Eric Burgess (Detroit, Michigan: American Data Processing, Inc., 1965), p. 15.

1. An inquiry system which allows people, possibly at different locations, to determine what is occurring simultaneously. The airline reservation system is a good example of the potential of this type.

2. Specialized on-line systems which are capable of performing complicated tasks in which a large number of people are involved. Mission Control for the Apollo moon flights has developed this basic type of system.

3. On-line programming systems, in which the total power of the computer is at the disposal of the user.

4. On-line problem-solving systems that are capable of doing simple to complex tasks without human help. This type of system will unite meaningfully the techniques for pattern recognition, process control and heuristic programming.⁴⁵

Another important benefit of an on-line system is its use as a communication medium between people. When a number of people work on a specific project, a communication problem is created. Each individual's concern is a separate part of the total problem. Each part of the problem must mesh correctly with the others, for each action of one individual

⁴⁵Ivan E. Sutherland, "The Future of On-Line Systems," in On-Line Computing Systems, ed. by Eric Burgess (Detroit, Michigan: American Data Processing, Inc., 1965), pp. 9-12.

affects the actions and results of others. An on-line system could provide immediate up-to-date information to the various users to preclude confusing tangles that might ensue.⁴⁶

Let us consider a future planning session of a city planning department. Everyone is seated in a room opposite a luminous screen which covers an entire wall. On it are displayed a number of charts and graphic two-dimensional and three-dimensional representations of the problem area being discussed. A division head begins the session by explaining that the meeting has been called to consider the implications of a possible route for a new thoroughfare passing through Renewal Area B. He walks up to the screen and with a thin, flashlight-shaped object, a light pencil, traces two routes that he considers appropriate. All members of the planning group seated at their consoles then consider what effect these two routes will have on their respective areas of concern.

The screen comes alive with additional charts. A sociologist has indicated that the first route offers fewer displacements of residents. An economist has

⁴⁶Edgar C. Gentle, Jr., ed., Data Communications in Business (New York: American Telephone and Telegraph Company, 1965), pp. 1-6.

discovered that the cost of the first route is less than the second and will remove fewer parcels from the tax roles. The pros and cons of each route appear on the screen. An engineer approaches the screen, picks up the light pencil, and elevates the thoroughfare above ground. The computer system takes these new instructions, and after a few seconds the charts are altered; it then appears that the modification will improve the total situation. In the few seconds of time that have elapsed, the computer has figured out all the complex direct and indirect effects of the change traced on the screen.

A planning session of this nature is possible within the very near future. Most of the equipment exists, although not in as sophisticated a form as projected. The major problem lies not in the technical facets of the system, but in the human ability to synthesize and utilize a conceptual information system. When acceptance does occur, it will signify a major breakthrough in planning and policy-making.

ACKNOWLEDGEMENTS

The author wishes to express his thanks to Dr. Eldon Miller for his guidance and assistance in carrying out the research for this thesis. His preliminary suggestions were highly beneficial in the organization of the thesis.

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A CONCEPTUAL INFORMATION SYSTEM
FOR
ENVIRONMENTAL ANALYSIS

by

Richard Roland Tangum

Abstract

This thesis suggests the rudiments of a possible conceptual information system. Much of what is utilized in this effort is drawn from work completed and in progress. The system proposed is a synthesis and integration of divergent areas, in hopes of providing a better mode of comprehending the environmental process.

The purpose of the thesis is to develop a system for handling data pertinent to environmental analysis within a conceptual framework. The thesis focuses on the initial conceptual information system analysis, which delineates the basic structure of the system. A conceptual framework proposed by Donald Foley is utilized as the beginning of the system. The conceptual framework consists of three levels (normative, functional-organizational, and physical), in which a further division is made by considering each level spatially and aspatially. Data is then stored within one of the six cells. A standard computer card format is suggested for data elements, and it is applicable to many varying situations.

What is presented is not an all-inclusive system, but a basic framework that can receive additional increments of knowledge as they become available through time.

Sample problems are injected to show how the system functions at various levels of concern. The passage of a sample problem through various components of the system by various agencies exhibits the system's ability to evaluate environmental phenomena.