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A SYSTEM APPROACH TO INFORMATION SYSTEM

DESIGN FOR A CITY PLANNING AGENCY

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Abstract—Information system design forms the most vital element in designing an organization. An information system for a city planning agency is a combination of people, computer hardware and software, a dynamic data base and a set of generalized interactive algorithms.

City planning agencies require complete and current information in order to provide input into municipal government decision process. This paper presents a model for an information system based on the operational functions of various city departments. The emphasis of this paper is on system engineering considerations and there is no attempt to provide a detailed programming solution. Basic considerations include: operational requirements, planning requirements, political environment and level of computer expertise. The basic components of the model are an on-line interactive system with a data-base shared by the participating departments.

USER BEHAVIOR ON AN INFORMATION SYSTEM

Information systems play an increasingly important role in an organization, as a decision-making tool as well as for routine information storage. People perform actions; people control actions. the relationships between behavior and control can be called the control function. When people cannot accomplish what they want to do on an individual basis, they group together in organizations; a prime example is government. The role of the government is to control the behavior of the people, i.e. the control function. Due to the ever increasing complexity of this control function, machines have been used in order to carry on the necessary tasks. In the control function one of the main processes is decision-making. A decision is made up of three parts—trigger, condition and action[1]. The trigger, input into the system, that causes activity, is acted on by a set of conditions, and it is these conditions that will determine the final action or decision. Government decisions are often based on political imperatives rather than on conditions offering a particular situation; some government officials are more sensitive to politics than to logic. The control function can be divided into discretionary control and reflex control. Discretionary control and discretionary decisions involve judgement on the part of the decision makers. Because the information about the conditions or the rules are not complete, the rules may not be known (how do you fight inflation?), or the interaction of the conditions, purpose, and actions may not be clearly discernible, therefore the outcome of the decision is in doubt.

A distinction can be made between mechanization and automation. Mechanization occurs within the behavior function, while automation is the application of machines to the control function. Any judgement on the part of the machine would be done to a finite set of instructions or rules that have been stored in the machine, thus leaving it capable of only reflex decisions and reflex control. In order for the control function to operate properly, it must be aware of conditions in its realm of interest. Conditions are reported to the control function as a series of input signals.

(1) Independent signals—originate in the environment and are unaffected by the organization (weather).

(2) External feedback signals—caused by organization's actions (payments are received as a result of mailing of bills).

(3) Internal feedback signals—originate in the behavior function, signals a condition of the organization to the control function (engineering tells the Mayor that Main Street needs repaving)

The conditions enter the control function as data items. Once in the function, these data items are identified by means of linkage to other data items, thus creating information. The data items—single family, 226 Main Street, residential—are useful when taken one at a time, but knowing that a single-family residential structure is located at 226 Main Street is useful information. Data is not useful for control, it must be processed into information in order to be operational. Information is of two basic types, routine and responsive. Routine information is triggered by a time or event, and procedures for its processing are clearly defined. The last day of the month means a payroll has to be prepared. Responsive information is in the form of answers to queries. How many acres of commercial property in Census Tract 36? This information is produced only on demand.

Output from the control function consists of instructions, still another type of signal, and the categories of discretionary and reflex can again be applied. Reflexive instructions are invariant and can be issued by a machine, example, a traffic light: discretionary instructions involve judgement and must be issued by a human, example, a policeman.

GENERAL DESCRIPTION OF URBAN INFORMATION SYSTEMS

This paper presents a model of an information system for a city planning agency, hence it is dealing with discretionary control. One of the main processes that occurs in this type of control is that of planning. The need for city planning is obvious; plans are made when there is no pressure for immediate implementation in order that at a future time more detailed plans can be joined together to produce consistent behavior.

Kit Grindley[1] describes that planning is influenced by four main systems within an organization and they are: the organization of the system, the motivation system, the workflow system, and the information system. The information system we are describing in this paper represents a unique interaction of signals, behavior, and control for a city planning agency.

The organization and motivation system cannot be man machine dependent, since human interaction, that is, discretionary control is a primary feature of these systems. The work-flow system offers the opportunity for mechanization, not automation, since it mainly concerns behavior. The information system, dealing with matters of control, is the prime target for automation in the planning process.

Numerous studies have been reported on different aspects of information system design for different types of organization, but little or no attempt has been made to develop a model of an information system for a city planning agency. Kraemer[7] has presented a paper on a model for urban information systems and his approach is based on system engineering considerations and does not deal specifically to a particular city agency. The model we present is related to earlier work on computers and local government, municipal computers: growth, usage and management by Kraemer, *et al* [2, 3, 7]. However, we concentrate on the information system design for use by small urban areas (population under 100,000) rather than an all-inclusive urban information system. Sears [3] describes a system approach to planning within the pluralistic political environment.

Justifications for the considerations of an information system for a government agency can be found in two areas: the human element of government processes and current computer usage in the urban government environment.

Present model

The paper presents an information system intended for use by small urban areas (population under 100,000). The information system being modelled can be inplemented with mini-computers, thus keeping expenditures within the reach of smaller areas. It is expected that the lack of trained personnel will necessitate a system that can be easily developed and maintained.

Overview of Urban Planning

The tasks of a city planning agency may be divided into two major categories;

(1) Comprehensive Master Plan—includes a land development plan, transportation plan, and public utilities plan.

(2) Implementation Functions—regulatory measures (zoning, subdivision control), public projects development (capital budgeting, urban renewal, and public support (public information). These implementation functions have been described nicely by Stuart Chapin [5] in his report on urban land use planning.

Due to the limitations that will be imposed on the information system, the topic of land use planning will have priority, utilities information will be included as part of the environmental conditions, the implementation functions will be incorporated, but the area of transportation will not be addressed. Transportation planning is a very complex field that cannot be adequately handled by the information system being considered. Most small planning agencies do not have the expertise to deal with transportation problems, and hence the exclusion of transportation considerations will not adversely affect the over-all benefit of the IS (information system) to the planning agency.

DESCRIPTION OF FILE STRUCTURES OF THE SYSTEM

Parcel identifiers and GBF-DIME† for information system

The main emphasis of the information system will be land use. The most effective way of organizing land data, in order to create information, is to relate the data to a geographic frame of reference. Two methods that will be used in this area and a parcel based file and a street address file. There are other methods of relating data to geography (latitude-longitude, state grid coordinates) but these methods are quite complicated, and in many cases cannot accomodate the polygon type of parcels that are typically found in urban areas.

A land parcel is a land ownership parcel, as described in legal records and listed in tax assessor's roles. The exact description (usually given in terms of a land survey) makes the land parcel easy to define and locate, thus giving planners a definite base on which to build information. Further, parcels are easily represented on maps, thus allowing a wide range of graphic representation (maps and graphics are very important rule in urban activities).

Associated with each parcel is a unique parcel identifier, a punctuated sequence of alpha-numeric characters, used to reference the parcel. The identifier is used in lieu of the complex legal descriptions, which many times can be deciphered only by a surveyor. "Parcel identifiers" serve not to "identify" the parcel, but to index data concerning the parcel, and it is this indexing function that makes the parcel identifier so important, if not indespensable, to land-use data information systems. Indexing allows data to be stored and retrived by faster more economical procedures, as opposed to conducting a search of all files whenever data is needed.

The aggregation of data to form information occurs across several dimensions—spatial, temporal and functional. Spatial dimensions describe the geographic locations relating to the data, and are used when an inquiry concerns a single parcel.

The parcel identifier allows aggregation of information that may have been collected at different times and for different purposes. Before issuing a certificate of occupancy, the zoning board might want to have access to Building and Permits information, in order to determine if certain unsafe conditions had been corrected. If Building and Permits keeps records only by data, then locating the pertinent information will prove to be quite difficult. The use of a parcel identifier to index the Building and Permits files would allow retrieval of the needed data in a fast and efficient manner.

Temporal aggregation is needed to build information about a specific time period. Functional aggregation involves such endeavors as tax assessment, title conveyance, building inspections, censuses. In both the spatial and functional dimensions, the parcel identifier serves as a tool to form the needed information.

There is one more advantage to using parcel-files. In many cases, such a file exists in the tax assessors office, so that a planning agency need only alter an existing file. By having the planning agency use the tax assessor's roles, a primary step in establishing an information system is taken. This ready made indexing file allows the agency to immediately start work on building a data-base for the information system. Often, creating the initial data-base is a

†Geographic Based File Dual Independent Map Encoding is a coding system devised by the U.S. Bureau of the Census that describes a region's geography[10].

monumental task that can prove to be quite discouraging; a ready-made base will benefit the agency by providing an immediate impetus, and by avoiding a costly and time consuming step.

Another method of relating information to geography is through the street address. The address is a commonly known element that can be used to store and retrieve data. Before going into more specifics about the address file, the major problem with using addresses will be discussed.

The same address can be written in a number of ways, i.e. free-form, hence when a computer tries to use the address in a file, it may not be able to decipher it. Here are several examples:

111 E. Main St.—Main St. E.
P.O. Box 130—Box 130
2000 Hwy 80 West—2000 W. U.S. Hwy 80
300 Capital St.—DGNB Plaza

The cases where a shopping center or office plaza is involved becomes more complicated due to the abbreviations used in coding.

The GBF-DIME (Geographic Based File-Dual Independent Map Encoding) is a coding system devised by the U.S. Bureau of the Census that describes a region's geography. The DIME System requires the encoding of lines on MMS (Metropolitan Map Series) Sheets; these lines represent physical features (Streets, railroads, streams, water bodies) and political boundaries. There is a logic associated with DIME, a logic that can be used to check the validity of the information. The Census Bureau has two main programs, Topoedit and Addedit, that check this logic as it applies to nodes and addresses, and provide diagnostic messages to help correct any problems.

The DIME file can be used in several ways:

(1) To summarize information by a given statistical or political areas (voting precinct, traffic analysis zone)

(2) To examine street segments by means of network analysis

(3) To provide a loop-up service for citizen information

Both the parcel file and the GBF-DIME file will serve as indices to other data files. Whereas the parcel-file will come into use with studies needing such information as acreage, building conditions, environmental conditions. The GBF-DIME file will be used for studies involving statistical groupings (Census Bureau Statistics by block face and census tracts), addresses related functions, and routing or dispatching applications. The combination of the two index files should facilitate the gathering of the information necessary for an urban planning agency to conduct its studies, by allowing for retrieval of data from direct access storage devices.

Descriptions of systems approach

Human systems are inconsistent, informal, and have a totally different range of capabilities. Human systems cannot be transposed into machine systems on a one-to-one correspondence of tasks. The system's approach has many names: systems management, system requirement analysis, systematics, system development process, program management, configuration management. For more details, please see Ref. (1).

MODEL OF AN INFORMATION SYSTEM

This section of our paper presents a conceptual framework design of a model of an urban information system. The model and its description will not deal in the specifics of hardware configuration or software design, variables that differ greatly from situation to situation. what is being stressed is an understanding of the information system environment, including interactions within the system.

Please note that the primary users of the Information system will be professional planners, clerical staff field inspectors, politicians, and citizens. Planners will require various summarizing and analyzing functions; clerical workers and field inspectors will need housekeeping functions; citizens will need look-up functions.

At this point of discussion, we are presenting a conceptual framework of the model of the Information System (illustrated in Fig. 1), the objectives of this system are:

(1) To establish operational procedures for the daily functioning of the planning, zoning, and building and permits departments.

(2) To enable the use of mathematical and analytical methods as tools in the decision making process.

(3) To maintain a current data-base that accurately reflects environmental conditions.

(4) To enable agencies to more easily comply with data requirements necessary in the application for federal funds.

(5) To give citizens the best possible service when dealing with government workers.

In attempting to define operational requirements there is a tendency to limit the range of possibilities to computer equipment design. System designers must be responsible for the overall design of all system elements related to the system operation, whether they are implicitly or explicitly stated.

Operational requirements will have to be specified by each individual department, the nature of the requirement will vary from city to city. One fundamental principle should be kept in mind: operational procedures should be structured in such a manner that the updating of the data-base is an integral system process, and not a separate application process. In order to accomplish this objective, great care should be taken in the design of the data-base, it should be designed so that the environmental conditions used by the planners are the conditions within the realm of the clerical staff and field inspection staff. Figure 2 is a diagram showing a generalized clerical function; this procedure can be applied to most clerical junctions included in the information system.

The Building and Permits Department issues permits for new construction work and renovations, and is made up of clerks, inspectors, and supervisors. The issuance of permits normall requires a field inspection, to approve the quality of the work and approval from zoning or planning, to control land use.

The model of the IS, (Fig. 1) is shown with a tape input from the Tax Assessor's Office, data on land values and parcel descriptions are received from here.The nature of this data is such that it need not be updated daily, so in order to keep the system small and less expensive, a magnetic tape can be used to send new data on a regular schedule. Although this amounts to a separate update application, economic factors would warrant its adoption.

The IS will be employed in two basic scenarios—a clerical work station and an office work station. In the planning offices CRT's and printers would be needed, one for look-ups and one for hard-copy reports. The planning department could probably manage with one printer for several CRT's. For this scenario important requirements would be simplicity, accuracy, and economy.

Simplicity can be achieved by having a "menu" style of interaction between planner and computer terminal, where data files and analytical functions are chosen from a list of all available resources. The planners is always aware of what is available, and infrequent users would not run the risk of forgetting how to use the system. Accuracy requires that the IS work as expected, this is a general system requirement. Economy requires the allocation of the optimal number of terminals and printers. There is no sense in having a terminal for every person if they are not used; finding the correct number will be a process of trial and error, since there is no prior experience to fall back on.

The prime requirement of the clerical work station will be fast response time. Clerks serving impatient citizens cannot afford to waste time, so they must have fast and efficient interaction with the system. A keyboard with function buttons, perhaps referring to different types of forms or permits, could enable the quick selection of the appropriate sequence. Information for the form would be issued only after all the information had been validated (exception—reporting reflex control). This procedure eliminates duplicate forms since the information is always available on request on a CRT (a possible saving in paper costs).

General outline of system design

The design aspects of the Information System is a crucial step in modelling process of an

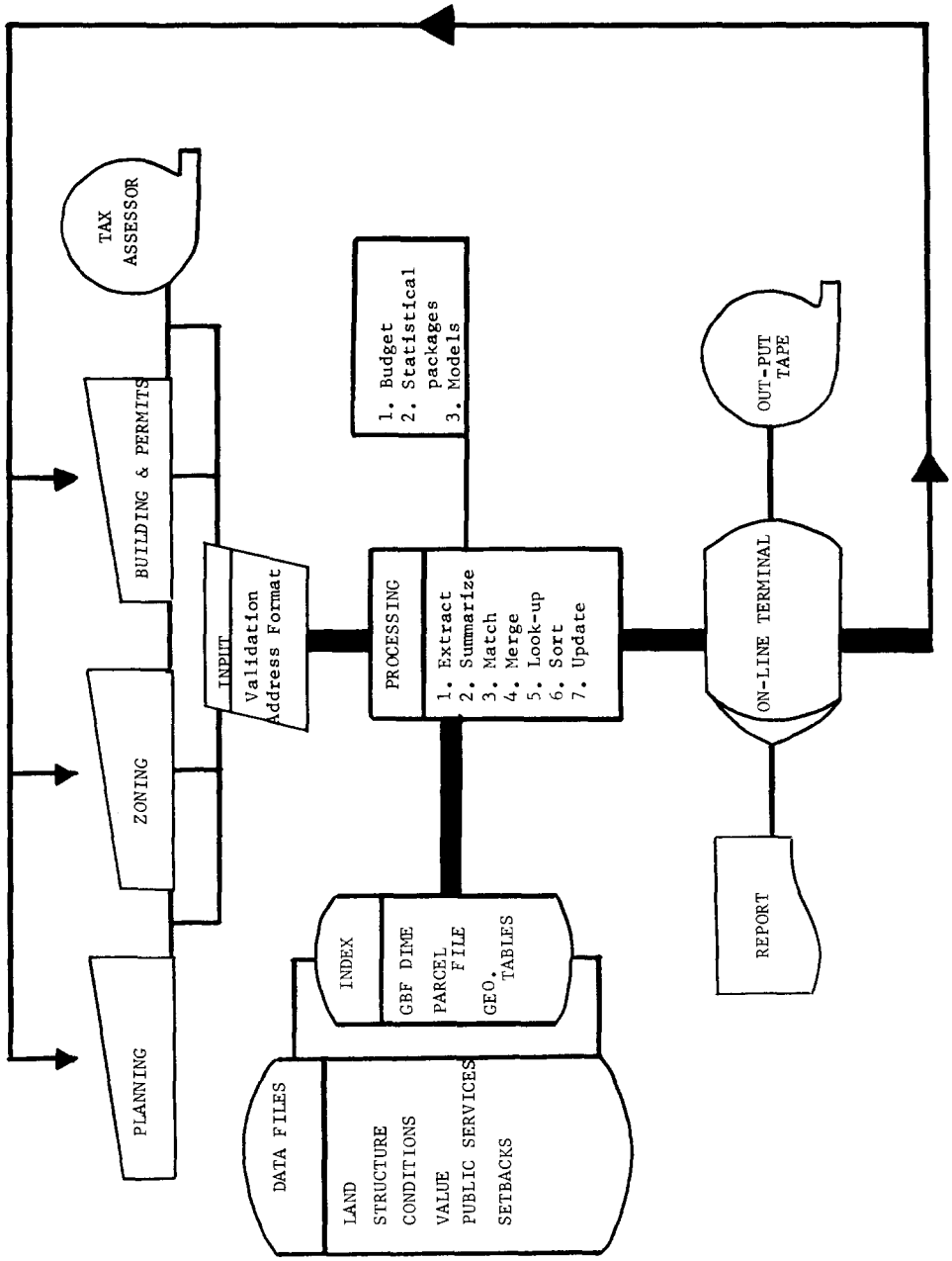


Fig. 1. Model of an "IS" for a planning agency.

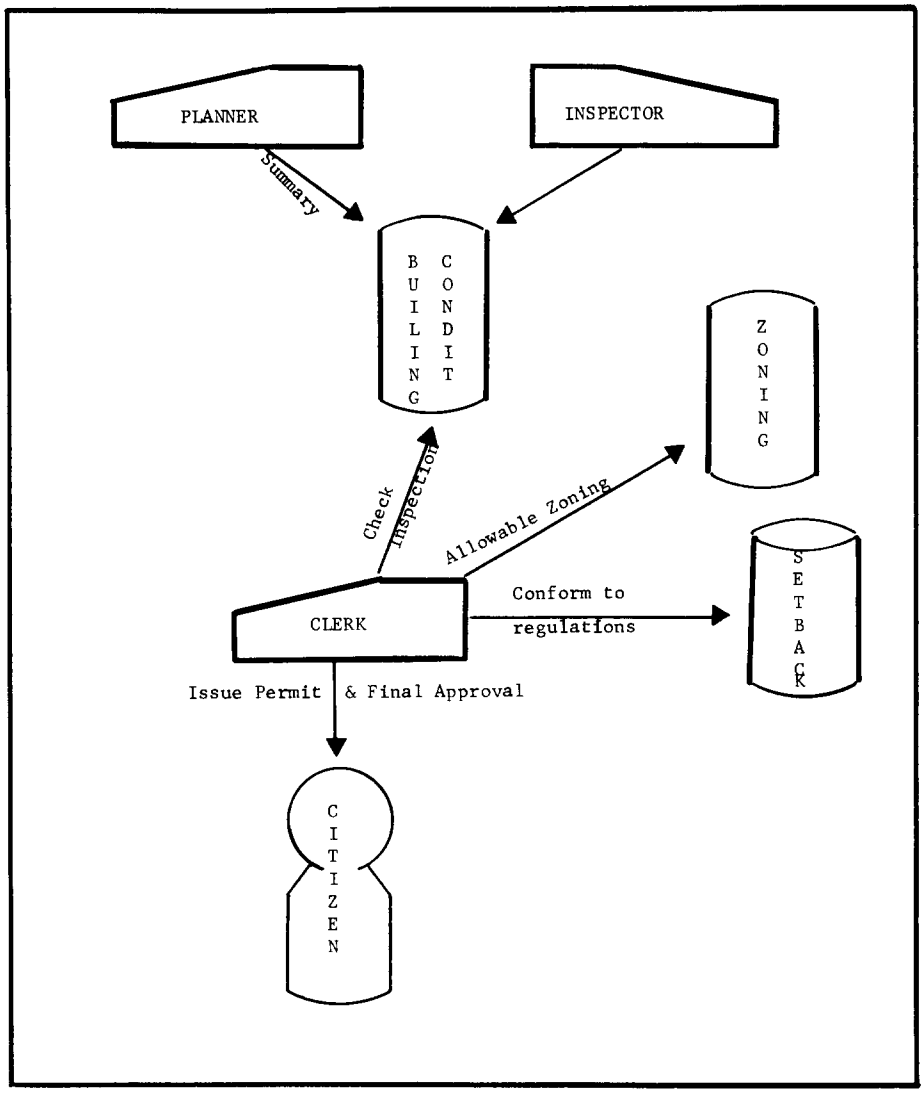


Fig. 2. Clerk station.

Urban Information System. The following factors will influence the design of the Information System.

1. EDP operations in small municipalities will be limited in terms of funds and personnel.

(2) The IS will provide input into the decision making process; the IS is not capable of making discretionary decisions.

(3) The decision making process in municipal governments is not an exact science; often, scientific methods are ignored in order to accommodate human wants and desires.

(4) Operational requirements must be efficiently designed, only then can the information for planning be generated.

Design of the data base organization

A data-base is a centralized collection of files stored for use by related sub-systems, and consists of three primary elements: physical storage structure, contents of data-base, logical relationships among data.

Physical storage structure is directly related to the storage media. Basically, it is an indication or index of storage address on th storage medium, and is determined by the density and number of recording surfaces. For example, a particular disk has 404 cylinders or arm-positions; each cylinder contains 19 tracks (reading surfaces); and each track contains four

blocks of 3156 bytes per block. Therefore, the disk can be indexed on the basis of $404 \times 19 \times 4 = 30{,}704$ contiguous blocks (a block is the basic unit of physical data transfer between the data-base and memory). Indexing files will specify the block in which the data for a particular parcel is stored.

The contents of the data-base will be the data necessary to fulfill the objectives of the IS. This data will consist of data files that document the environmental conditions of the municipality. Appendix A is an example of several files and their record contents. As was previously mentioned, the data files must not be designed purely from a computer technician's point of view. If the data does not meet the requirements of the users, then the IS will not be a successful operation. The primary element of a data-base is a data item, it is the smallest unit of named data and it can also be called a field within a record. In the Land Use file the Land Use code would be a data item. Data items are grouped to form records; in the Structure file each record is made up of six data items or fields.

The arrangement of files and records on the storage medium is assigned by specifying one or more areas in which records may occur. Records may be stored in two basic ways: all records of one file may be stored close to another record type, an intermingling of files. This is a technical decision that will affect system performance. Since the clerks will deal with one file at a time in the filling out of permits and applications, and since planners will need summaries of files representing a particular condition, the storage of records in one contiguous area would seem the most suitable.

The files should all be established in the same sequential order for the records, thereby allowing access to all files through on index. The index would provide the sequential location of each parcel. Once this is known the record can be easily found. The starting point of each file and the record length can be kept in a table and when the sequential number is known the physical address can be calculated:

sequence number—950
starting location of file—1000
record length—10 bytes
physical address—$1000 + (950 - 1) \times 10 = 10490$

The logical relationship between records depends on the particular application; planners will need to relate records that deal with a geographic area, hence the logical relationship will be described by a Geographic Table which will contain the indices of the parcels located in a particular political unit (census tract, traffic analysis zone, etc). Clerks will need to relate files on the basis of the permit being issued. Building information will have to be validated against the zoning file and any other appropriate regulations; the relationships will be specified in a table containing the needed checks for each type of permit issued.

Most data-base systems, incur a high overhead in terms of computing time and storage, however, the basic simplicity of the information system should keep these costs to a minimum. One of the important considerations in the design of a data-base is data independence. Data independence is the separation of data accessing procedures from the application program is not concerned with the physical storage of data. This method enables the changing of storage structures without a change in programming, and also enables the use of the data-base by different users in different languages.

Application oriented software

Application programs will be concerned with the following basic functions: Chapin charts showing the basic logic for these functions are described in [4].

(a) Extract—Each record in a file will be processed with reference to a specific set of needed information.

(b) Summarize—Records on a file will be compared to a control field: the result of this comparison will determine action to be taken.

(c) Sort—Input records are sequenced with regards to a control field.

(d) Update—This updates the transaction file.

(e) Match—Records from an input file are compared to control fields and master file records, the emphasis is on processing the input record with or without information from a master record.

(f) Merge—The object is to combine input and older master file to create a new master file.

(g) Look-up—Input records are compared to master records on a control field until a corresponding record is found.

Data relationships will be well defined in the operational procedures (clerical function) through established laws and ordinances. Input and output may be identified as two more functions. These functions will be dependent on the work station being used; planners will have need of displays and hard copy reports with little emphasis on the input, while the clerical stations will involve a heavy demand for input with a large variety of possible outputs (various permits and forms). It was previously mentioned that free-form addresses may cause processing problems, therefore the input function must take into consideration this aspect. There are two possible avenues of approach, to input the address free-form and correct it by programming, or to force the entry of addresses in the correct format. The second approach is easier to implement, it merely requires the prompting of an address one field at a time, recalling that DIME format has the address divided into prefix direction, feature name, and suffix direction. As each field is entered it could be matched against a table of allowable alternatives, and only correct data would be passed on for processing.

To correct the addresses by programming would involve a complex program that could not handle many valid exceptions; an example would be 100 South Park Circle Drive. It would be difficult to distinguish the feature type as a drive or circle, both allowable alternatives; however if one field was entered at a time, the feature name Park Circle would be acceptable, and would be classified as a "Drive". This situation calls for close co-operation between man and machine; a knowledgeable clerk would break the address into its correct components, and save much programming and execution time.

The output function will be concerned with the printing of reports, the issuance of permit forms, and the creation of magnetic tape files. These different forms of output can be localized to particular users, with clerks having no need for producing tape output and planners with no need for issuing permits. By localizing or limiting output, at each terminal two purposes are served, the issuance of permits in controlled and output programs can be assigned to intelligent terminals.

Data entry to the system

A major portion of the design will deal with data entry by clerks. Clerks serving impatient citizens cannot afford to waste time, so they must have fast and efficient interactions with the system. A keyboard with buttons, referring to the different types of forms or permits, would enable the quick selection of the appropriate sequence. Information for the form would be entered via CRT's and one completed hard copy form would be issued only after all the information had been validated (exception: reporting). Address can be difficult to handle in data entry. This problem stems from the free-form nature of addresses:

110 E. Main Street	110 Main St. E.
200 US Hwy 80	200 W. U.S. Highway 80
300 Capitol St.	DGNB Plaza

These cases where a shopping center or office plaza is involved becomes more complicated due to the many variations and abbreviations used. There are two possible approaches–input the address free-form and correct it by programming or to fact the entry of an address one field at a time (using the Census Bureau's DIME format).

The second approach is easier to implement; it merely requires the prompting of address field. As each field is entered it can be matched against a table of allowable alternatives, and only correct data will be passed on for processing.

Modular program design and system assurance

The general flow chart of modular program design for the Information System is shown in Fig. 3. This feature is a form of Chapin chart (developed by authors) showing the different modules for the clerical work station program.

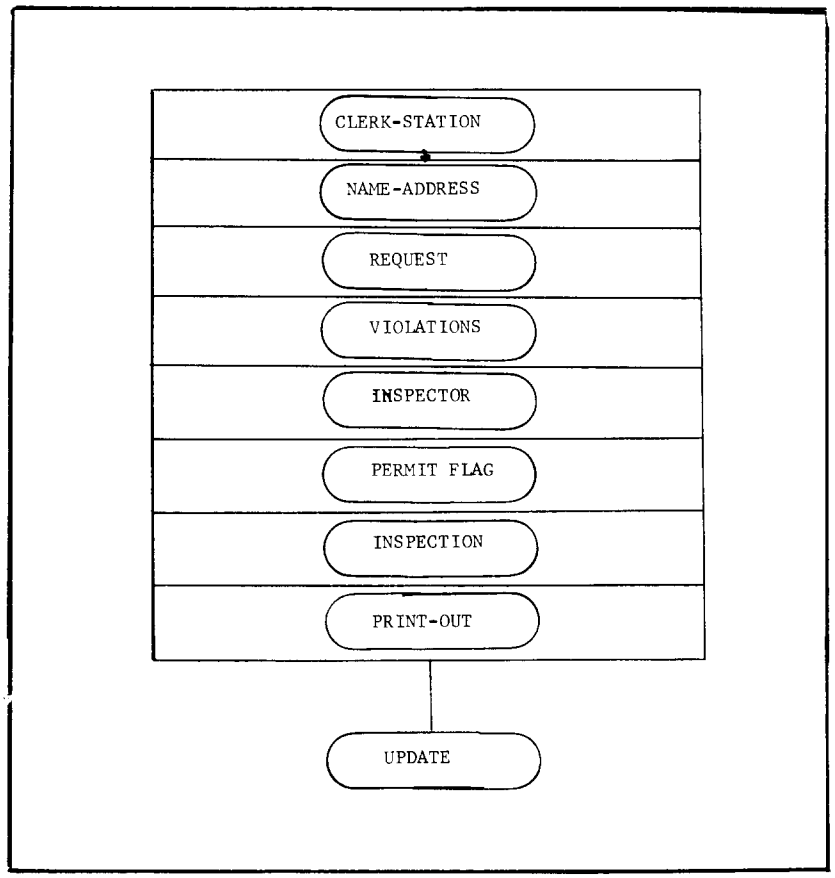


Fig. 3. Basic logic for clerk station.

The capabilities of a system can be seen at various stages of the System Development process, and by careful and early planning, a variety of tests can be designed that will assure the correct functioning of these elements. The testing strategy must account for every module described in Fig. 3 of the Information System.

Highlights and use of the proposed model

The Information System Model for a planning agency will be an on-line real-time system composed of distributed terminals that are controlled by a central processor. The proposed model is the first of its type and easy to implement on any computer system. The Information System should be developed in-house by the EDP staff working in conjuction with a consulting firm. Initially the hardware can be leased (with an option to buy), the software can be developed from several sources, including the purchase of software packages. The system should be based on the daily functions of the zoning department and the building and permit department, with operational procedures serving as the update mechanism. All relevant conditions are monitored by the clerical and inspection staff as part of their normal routine. Decisions regarding the contents of the data-base and the types of application programs should not be left to th computer professionals. Such a decision should be based on the needs of the users, as specified by the users.

CONCLUSIONS

This paper presents an Information System Model for an Urban Planning Agency based on System Engineering considerations. The type of system being proposed here will not require large computers and a staff of highly trained professionals. It is meant for the small to medium-sized cities that may want to gradually upgrade their orgainizations.

For more information on the development process of the information system, refer to discription given in Appendix A and B.

REFERENCES

1. Kit Grindley, *Systematics—A New Approach to System Analysis*, pp. 10 and 34. PBI Books, New York (1975).
2. K. L. Kraemer, W. H. Dutton and J. R. Mathews, Municipal computers: growth usage, and management. *Urban Data Service Reports* 7(11), 4 (Nov. 1975).
3. David W. Sears, *The Systems Approach to Planning within the Pluralistic Political Environment.* Computers, Local Government and Productivity, Vol. II, pp. 404–407. Urban and Regional Information Systems Association, Chicago (1975).
4. Gloria Harrington Swann, *Top-Down Structured Design Techniques.* Petrocelli, New York (1978).
5. Stuart F. Chapin, Jr., *Urban Land Use Planning*, pp. 353–355. University of Illinois Press, Urbana (1972).
6. Vincent Alia, A model of an information system for a city planning agency. MS Thesis, Dept. of Computer Science, Jackson State University, 1979.
7. K. L. Kraemer, *A Model for Urban Information Systems.* Quoted in Alan F. Westin, Information Technology in Democracy. pp. 60–64 and pp. 330–334. Harvard University Press, Cambridge (1971).
8. David Moyer and Kenneth Paul Fisher, *Land Parcel Identifiers for Information Systems.* Chicago American Bar Foundation (1973).
9. Ralph F. Miles, Jr. *Systems Concepts Lectures on Contemporary Approaches to Systems.* Wiley, New York (1973).
10. David H. Li, *Design and Management of Information Systems.* Science Research Associates, Chicago (1972).

APPENDIX A

File contents and record description

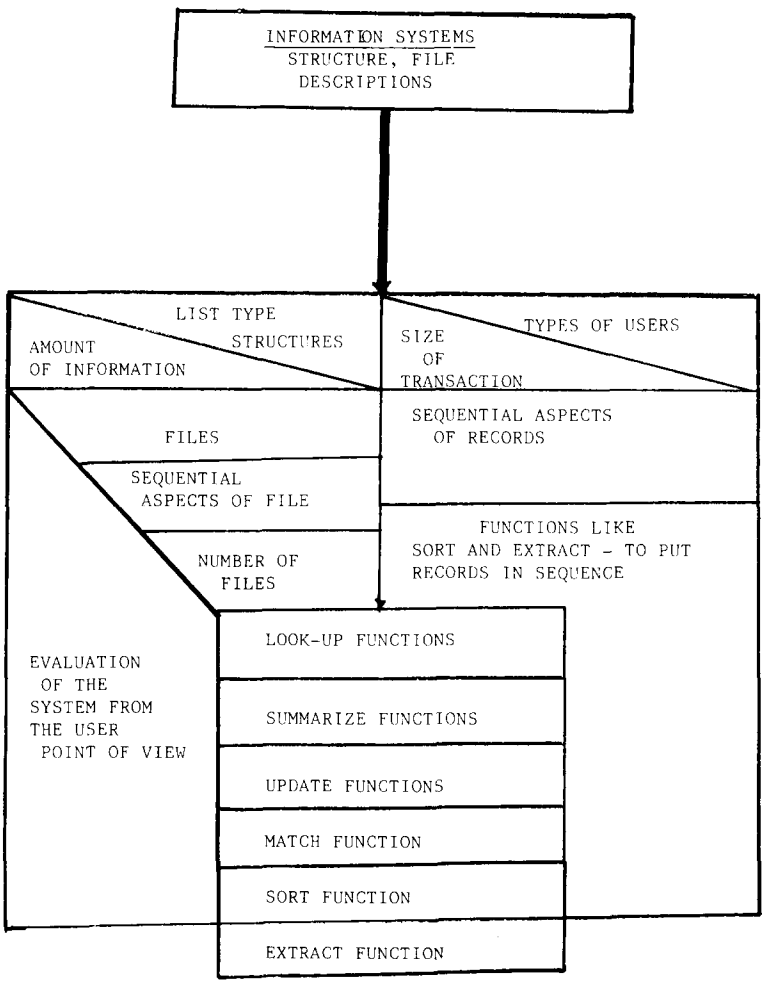
(1) Each Record contains data for one parcel.

(2) Letters preceding each field description, shows contents of field:

C—Code

N—Numeric value

A—Alpha numeric characters



For more information refer to Swan's book [4].

Land use

(1)Land use—Describes current land use activities, can be as detailed as desired. The *Standard Land Use Coding Manual* provides a description of standardized coding system.
(2) Land type—natural features of the land (marsh, woods, developed)
(3) Zoning—assigned zoning category
(4) Special exemptions—special zoning exemptions that have been granted
(5) Future land use—intended use of land, as determined from Master Plan

Structure

(1) Number of stories
(2) Number of rooms
(3) Foundation—type of material used
(4) Exterior wall—type of exterior surface
(5) Roof type—styple or structure of roof
(6) Roof material

Conditions

(1) Number of bedrooms
(2) Number of bathrooms
(3) Plumbing—violations of building codes
(4) Electrical—violations of building codes
(5) Interior finish—(paint, paneling, wallpaper)
(6) Floor code—material
(7) Heating—type of system
(8) A/C—type of system
(9) Year built
(10) Extras—(fireplace, swimming pool)

Value

(1) Appraised value of land
(2) Appraised value of improvement
(3) Legal description—metes and bounds; a surveyor's description of parcel (this field may vary widely).

APPENDIX B

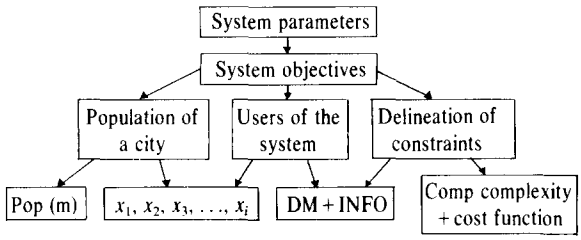
Algorithms for information development process

An algorithm may be regarded as a finite sequences of instructions to accomplish a particular task. Problems that are solved on digital computers have different complexities and a good algorithm provides a simple solution to complex problems.

The information system described in this paper has taken a compromise approach by combining several departments into one system. The following algorithm which is independent of any programming language is helpful in designing an Information System.

Phase A

Step 1: Define the characteristics of the system
The following tree structure can be used for the identification of systems characteristics:



Step 2: Define operational requirements of the system:
One fundamental principle should be kept in mind: Operational procedures should be structured in such a manner that the updating of the database is an integral system process, and not a separate application process.

Step 3: Define evaluation criteria:
Evaluating the information system will be the task of all users of the system. The following questions will be useful in evaluating the system.

(1) Is the general level of service improved?
(2) Is the system fair? Does it allow citizen input?
(3) Are over-all operating costs reduced?

Phase B
Design of the data base consists of three primary elements: physical storage structure, contents of the data base, logical relationships among data.

Step 1: Describe the file contents and sizes or records.
(1) Each record contains data for one parcel.
(2) Letters preceding each field description shows contents of the field:
C—code
N—Numeric value
A—Alphanumeric characters.

The standard land use coding manual provides a description of standardized coding system

Step 2: Develop th following functional processes for file requirements for classifying logic:

(1) UPDATE functions
(2) MATCH functions
(3) MERGE functions
(4) LOOK-UP functions
(5) SUMMARIZE functions
(6) SORT functions
(7) EXTRACT functions

Use Chapin charts to describe the basic logic for the above seven primary functions of the information system [4, 5].

Step 3: Selection of a programming language for implementation:
The main program is written with dummy modules, thus establishing the relationship between modules before the modules are actually written.

Step 4: Documentation aspect of the information system and should have the following characteristics:

(1) Availability
(2) Objectivity
(3) Suitability
(4) Completeness

Phase C: Testing of the system includes the following:

(1) Test planning
(2) A testing strategy
(3) Test data
(4) Function testing
(5) Acceptance testing