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**BIBLIOGRAPHY ON URBAN AND REGIONAL INFORMATION
SYSTEMS: FOCUS ON GEOGRAPHIC PERSPECTIVES**

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1. PREFACE

This bibliography is an extension of Council of Planning Libraries Bibliography 239--GEOGRAPHIC ASPECTS OF INFORMATION SYSTEMS: Introduction and Selected Bibliography.¹ Major changes include an additional 600-plus titles (more than 800 references in all), 600 plus entries in the author index, and a section which deals briefly with standardization-compatibility, transferability, confidentiality, and geo-coding.

Problems and questions related to latter-named topics are common to the conceptualization, design, development, and implementation of virtually any geographic-based information system program or project, and are inherent parts of the specification-acquisition-processing-dissemination-application chain of events which comprises data base development. The purpose of the section is to offer definitions and brief discussion of some of the issues surrounding those topics.

Since Bibliography 239 is superseded by this one, and will be allowed to go out of print, the narrative of 239 is retained.

2. INTRODUCTION

Within the span of a few years the information systems field has become a major growth industry in virtually every technologically developed country in the world. Although many manual systems were and are in operation, the development of high speed electronic computers has brought about a virtual revolution in terms of the

¹Barry S. Wellar and Thomas O. Graff. Geographic Aspects of Information Systems: Introduction and Selected Bibliography, Council of Planning Libraries Exchange Bibliography 239 (Monticello, Illinois: Council of Planning Libraries, November 1971).

3. CPL Exchange Bibliography #316-#317

quantities of data that are being requested, collected, processed, disseminated and applied at every level of government, in business, in universities and so on.

The term "information system" has been and is undergoing change in terms of what it means, and a considerable amount of effort has been expended in attempts at definitive statements. Rather than engage in semantic or philosophic arguments we proceed on the premise that an information system is simply a man/machine complex engaged in activities associated with the specification, acquisition, processing, dissemination, and application of the inputs and outputs of the system.

Our present concern is with the data elements, items, and formats² that enter and flow through the system, that is, the data base of the system.³ Each of the five suggested phases of data base development is briefly summarized as follows:

- Data element/item/format specification--involves defining that set of data elements and items and formats which comprise the input to programs, projects, data bases, etc., of the information system.
- Data item acquisition--involves the making and recording of observations (data items) that measure or report on the studies of data elements.

² A data element has two basic parts, a generic part which designates the unit of information and a specific part which, when recorded, designates a particular fact, condition, qualification, or measurement. These specific values or representations are called data items. For example, in the statement, "the speed limit is 30 miles per hours," "speed limit" is generic and "30 miles per hour" is specific. When related to a field of information, "speed limit" is called a data element name. Format refers to the way in which data elements and items are stored in files, fields, and records.

³ The relationship between data and information has also been the subject of some discussion. It has been suggested that information may be regarded as enhanced or useful data, and that data are a subset of information. To illustrate, if A plus B equals C, A and B might be regarded as data and C as information. In an information system context, then, data are inputs and the output of the system is information.

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- Data element/item/format storage, retrieval, and manipulation--are data handling or processing operations, manual and automated, that are performed upon raw, processed and semi-processed data.
- Data element/item/format dissemination--involves the delivery of data (elements/items/formats) to users (man and/or machine).
- Data applications--are performed by the users (man and/or machine) as they carry out their operations/control/planning-related activities.

As with any system interaction, feedback, and adjustment occur within and between or among phases over time, and the activities, operations, etc., in each phase are altered accordingly.

Based on the five proposed phases of data base development, it is possible to generalize and refer to Municipal Information Systems, Urban and Regional Information Systems, Management Information System, Geographic-Based Information Systems, and so on. For the most part there is a change in context involved whereby the orientation shifts according to subject matter, political boundaries, attributes of the data in the systems (e.g., geographic), the decision makers or decision-making processes, etc. However, in all these there is a chain of events involved that begins with the input of data elements and items and formats which comprise the system, the system's data base, and the output of information used for some purpose. By way of analogy, an information system may be likened to an assembly line in that an end product is achieved after specifying, collecting, processing, disseminating, and applying appropriate raw materials that meet the demands of the users or clients of the end products.

The necessity for a bibliography of this type, indeed for a variety of bibliographic types due to the rapid growth of the field, became apparent while conducting research for the Wichita Falls

Consortium Municipal Information Systems (MIS) Project, Contract H-1217--Municipal Information Systems, Federal Urban Information Systems Inter-Agency Committee, U. S. Department of Housing and Urban Development.⁴ Few cities, states, or federal agencies can afford to fully document all their activities, and as a result the researcher seldom knows just what has been conceptualized, designed, developed or implemented. And, although the listings of which agencies have systems up and running are growing, the listings do not provide the specific kinds of information that is included in this bibliography.

The utility of such a bibliography became even more obvious while conducting a seminar on information systems and computer uses in geography. One of the difficulties that all students faced was the diffuse nature of much of the literature, as it seemed to turn up in a wide variety of journals and conference proceedings in almost every discipline. There are undoubtedly others, both the commonality of the spatial characteristics of data elements and items to many papers further suggested the need to compile selected, and hopefully representative, references in a single volume.

The bibliography which follows, therefore, provides a guide to the diverse body of literature that deals with the geographic or spatial characteristics of the data elements and data items in each of the five phases. As such it should provide planners, geographers, economists, sociologists, and others with useful points of reference concerning one characteristic of data that is common to research efforts in a variety of fields.

⁴Barry S. Wellar. Evaluation of Selected Major Information Systems Research and Development Projects: Implications for the Wichita Falls, Texas MIS, Phase 1, Volume IV, Section 2 (Springfield, Virginia: National Technical Information Service, 1970), and Barry S. Wellar, A Working Treatise on Data Standardization, prepared for the Wichita Falls Consortium Municipal Information System Project (Lawrence, Kansas: Institute for Social and Environmental Studies, The University of Kansas, 1971).

3. BRIEF OVERVIEW OF SELECTED GEOGRAPHIC-BASED INFORMATION

SYSTEM THEMES: STANDARDIZATION, CONFIDENTIALITY,
TRANSFERABILITY, GEOCODING

Although the topics addressed in this section are part of a rich and growing body of literature, the authors have not yet located a document in the open literature which adequately defines and overviews standardization-compatibility, confidentiality-privacy, transferability, and geocoding in an information systems context, much less in the context of a geographic-based information system. A symposium and proceedings sponsored by the International Geographic Union and UNESCO will mitigate the problem somewhat,⁵ as will future meetings of URISA, AIP, ACM and other organizations listed in Part 6. For the most part, however, a newcomer to the field will still find himself in the position of scanning a number of papers and then having to tie together the viewpoints of several or a number of writers.

The definitions and/or discussions which follow are brief approximations, and represent our perception of some aspects of the state-of-the-art. Due to rapid and far-reaching changes in technology, attitudes, expectations and other variables including inter- and intra-governmental and public sector-private sector relationships, we are progressing at varying rates towards a convergence of opinion or fact about the status and role of each thematic component. We are merely trying to focus attention on several themes which are common to virtually any information system

R & D, with emphasis on those having a geographic-based component.

⁵The UNESCO-IGU Second Symposium on Geographical Information Systems is to take place in Ottawa, Canada, August 1-9, 1972, and is being organized by the IGU Commission on Geographical Data Sensing and Processing. For details about the Symposium and Proceedings contact Administrative Secretary, UNESCO-IGO Second Symposium on Geographical Information Systems, P. O. Box 2800, Ottawa, Canada.

1. Standardization-Compatibility

Standards and standardization procedures may comprise something as informal as precedents; for example, if data are first collected and used at the block level, a standard for future actions has been set, and remain in force until the next survey or application when it may be changed. At a more formal level, standardization may involve developing a documented chain of events whereby every data element, item, and format meets certain specified criteria related to the specification, acquisition, processing, dissemination, and application of each entry in the information system's data base.⁶ Examples of criteria include precision, accuracy, reliability, scale or level of aggregation, and temporality. In a geographic-based information system, these criteria would pertain to point, line segment, and areal (polygon) data item identifiers of spatially distributed data elements.

Achievement of standardization within systems in terms of geographic identifiers does not, of course, guarantee compatibility between systems. For example, one system (or part thereof) may treat a parcel as a point, and another may treat a block as a point. The potential for incompatibility exists because parcel-point data can be aggregated to the block level, but block data cannot be disaggregated to report on individual parcels. Although there are other causes of incompatibility within and between systems and their component parts, the spatial data item is the one which assumes a key

⁶An essay on a formal structured procedure for developing standards and standardization procedures, prepared by B. Wellar, is contained in The Wichita Falls Consortium Phase II Report, Volume XII, Conceptualization Themes (Springfield, Virginia: National Technical Information Services, December 1970), and Barry S. Wellar, "Some Paradigms for the Development of Standardized Data Bases," presented at Conference West, AIP Annual Meeting in San Francisco, October 1971 (Washington, D.C.: Information Systems Department, American Institute of Planners, 1971).

role in geographic-based information systems. Due to improved technology, particularly in terms of software, major advances are being made towards geographic data linking and interchange. However, for reasons related to confidentiality (and cost), constraints are imposed upon the level of disaggregation at which data can be released.

2. Confidentiality-Invasion of Privacy

The subject of confidentiality or invasion of privacy focuses on the abuse or misuse of sensitive data, which for the most part are regarded as data reporting on individuals. Along these lines, and particularly in the context of technological advance is the specter of Orwell's 1984, which in the minds of many people is already here. It might be inferred that a geographic-based information system incorporating point, line and areal data does not deal in personalities, and as such sensitive data are not an issue. As evidence of this, one could hold up land use maps found in virtually any planning agency's office which depicts some parcel data for entire cities.⁷ Further, if one has the patience, it is usually possible to obtain a great deal of data about parcels, structures, and activities if the data items are part of the public record.

⁷A limited survey reveals that planners differ considerably in terms of which disaggregate data are readily made available to the general public or researchers. In Lawrence, Kansas, for example, a land use map depicting use by type for each parcel is the only disaggregate data to be contained in a neighborhood analysis project report. Data on structures and environmental blight (junked cars, safety hazards, trash and debris) will be aggregated in the report, but apparently will be available at the parcel level to persons who call on the planners office. Both authors are involved in the project as consultants, and have bowed to the City Planning Department's informal policy not to plot these data at a parcel level in the report. It is unlikely that Lawrence or its current city planner is unique in this respect, which suggests that some public sector agencies are uncertain as to what constitutes unlawful release of data reporting on the private sector.

Cause for concern is tied, primarily, to computerized systems which provide for retrieval and organization of massive amounts of data in a short period of time. It would be possible, for example, to use a person's social security number to obtain income, tax, education, health, criminal and other data from a variety of files and thereby create a detailed profile on that person. One of the fundamental aspects of the issue is the trade-off between an individual's or group's right to privacy, and the larger community's or society's actual or imagined need to know.

In this report the bibliographic entries are those primarily concerned with spatial data, that is, what or who is where over time. Invasion of privacy seemingly occurs when the data items take on such specificity as to not only identify an individual, but infringe upon his rights to freedom from unwarranted intrusion. What remains unresolved in most contentious issues is the point at which this occurs. For example, if it becomes public knowledge or can be gleaned from public records that the structure at 123 Oak Street is rated as dilapidated, does it constitute an infringement of personal rights? Is the public entitled to know that the property at 863 East 11th does not have indoor plumbing? Although spatial data items have not yet received the attention that the more generally accepted personal identifiers have, it is unrealistic to expect that they will not come under the same kind of scrutiny in the near future.

3. Transferability

One of the goals of USAC,⁸ and presumably most R & D projects

⁸U. S. Department of Housing and Urban Development, Request for Proposals No. H-2-70 for Municipal Information Systems (Washington, D.C.: US DHUD, Urban Systems Inter-Agency Advisory Committee (USAC) 1970).

supported by public funds, is the generation of products and provision of insights into conceptualization, design, development and implementation processes which are transferable to other systems or users, thereby lessening overall R & D expenditures while improving overall performance capabilities. This does not say that re-invention of the wheel, for example, is necessarily bad, but rather, given finite resources (including expertise), it would behoove us to make multiple use of products and insights into processes (and expertise) generated by publicly (and privately) financed R & D projects.

In terms of actual kinds of transferables, the Wichita Falls Consortium dealt with several upon completion of the Conceptualization Phase of the Municipal Information System Project:⁹

- any entity having, let us say, 40,000 data elements and a million or so data items in its records at a point in time is faced with the problem of organizing the data.
- The Wichita Falls Consortium developed in excess of 100 Decision Information Set Centers (DISC's) which (1) define the characteristics of information used by specific municipal applications, (2) describe logical information flows within groups of applications, and (3) identify information uses and needs among subsystems. The DISC's, which are conceptual devices, facilitate modularity in systems design, and the analytical framework upon which each is based should render them transferable to other systems.

⁹ The Wichita Falls Consortium Phase II Report, Volume XII, Conceptualization Themes, op. cit., pp. XII-2-XII-6, prepared by Edward Hearle.

- experience in priority setting provides transferable insights. It is unlikely that the same priorities will hold between subsystems within the same system, or between two different systems, and it is equally unlikely that users of data and suppliers of data will have the same priorities. It is therefore necessary that criteria be adopted for setting priorities. In Wichita Falls two criteria--volume of regular output, and integration (of applications) impact--tended to account for the applications which received highest priorities among operating municipal officials. Similar criteria could be adopted for determining preferred spatial characteristics of data, although users and designers of systems may not be in agreement about criteria to be used in specifying data characteristics. Further insights on this topic should evolve when the project enters the development stage.

One of the major and increasingly apparent obstacles to achieving transferability is inadequate or non-existent documentation. In a previous report the senior author attempted to derive some "lessons learned" for the Wichita Falls, Texas MIS Project by analyzing six major information system R & D projects.¹⁰ Although it was often possible to determine what operational systems did do, it was not possible, as a rule, to determine why what was done was done. Similarly, reports on conceptual systems usually contained statements as to what would be done, but they did not offer much in the way of why they would do certain things should

¹⁰ Barry S. Wellar, op. cit., Evaluation of Selected Major Information Systems Research and Development Projects: Implications for the Wichita Falls, Texas MIS.

they become operational. As a result, there is relatively little in the literature which contributes to a more complete understanding of performance specifications, such as priority setting, or to an appreciation of the rules and procedures operating at the time when decision-making took place.

As noted above, however, piecemeal progress at least has been made towards transferability, particularly with respect to the development of computer programs for handling spatial data. One of the most important distinctions between the areas where transferability is and is not being achieved, is that in the case of the former, it has been possible to operate in a sphere which is not situation or phenomenon specific. For example, the by-laws operating in Wichita Falls may not be the same as those operating in Newark, and hence products and processes tied to the by-laws are not transferable. A similar situation would hold, in fact, as long as the products and insights to processes are tied to any policy which is unique to a given system. Spatial data associated with functional rather than jurisdictional entities, and available at varying scales, lend themselves more readily to intra- or inter-area comparisons and analyses. It is primarily for that reason that software packages treating spatial data comprise one of the more visible and demanded transferable products associated with information system R & D projects.

4. Geocoding

The practice of assigning geographic coordinates to phenomena occupying space led to the terms geographic data coding and geographic coding, and then to the terms geo-coding and geocoding. Geocoding is essentially a language whereby geographically referenced

data can be acquired, stored, retrieved, manipulated, disseminated and applied (by manual or automated means) by recourse to the coordinates which identify points, lines (or line segments) and areas (polygons). One of the main attractions of coordinates is that they are digital, and as such can be measured to varying degrees of precision for input to computers or automated data processing machinery.

The tremendous actual and potential benefits of geocoding by machine methods are of course closely tied to the standardization-compatibility, confidentiality, and transferability problem noted above. For example, there are a number of coordinate systems to choose from (geographic, stereo-graphic, transverse mercator, universal transverse mercator, polyconic, Lambert conical conformal, etc.) and a wide choice in coordinates and precision (latitude and longitude in degrees, minutes, seconds or by decimals, and directions and their associated measures in meters and feet). Although standardization may be developed within systems, communication may be impossible or difficult to achieve if the coordinate systems and coordinates are incompatible or require sophisticated translation algorithms. Further, disclosure rules may require that only aggregated data be exchanged between systems.

Hence, although computer software packages for handling geocoded data may be transferable from one system to another, the data elements and associated data items and formats may not be, due to problems associated with incompatibilities and confidentiality. It is already apparent that automated geocoding, and the handling of geocoded data by machine methods are enabling users to vastly improve their capabilities to work with spatially distributed phenomena. Considerable work remains to be done with

respect to the other themes (standardization-compatibility, confidentiality transferability) however, if we are to more fully realize the potential of communicating via geocoding languages.

The four themes, so-called because they are common to information systems activity in general and geographic-based information systems in particular, will continue to be examined at levels much more sophisticated than we have attempted to attain. They are discussed in this section to introduce newcomers to the field to some of the problems and prospects associated with them, and to focus attention on several issues associated with each which we feel warrant more consideration than has been shown to date.

4. SOURCES OF REFERENCES

Our objective is to compile a body of references which deal with the field in general, as well as with each of the five phases. For the most part the references included are those which have an information systems orientation or context. If we did not do this, we would be faced with the task of incorporating as a minimum all dissertations published in the field of Geography! It is recognized that information systems jargon is a fairly recent development, and as a result references are included that do not specifically refer to information systems. The criterion for selection in this regard is whether or not the paper contributes to the field on the basis of content.

The bibliography consists primarily of works that are available in the literature, or can be obtained from public sources such as the Government Printing Office or the federal government. On occasion reports are included that are not yet part of the open literature. They are included in the bibliography only if they are

regarded as significant pieces of research, and if they serve to identify persons or firms that are active in a particular field but for some reason have yet to publish their findings in the open literature.

To some degree the bibliography is eclectic, as no systematic body of literature has as yet developed to cover the spatial or geographic characteristics of data elements, items, and formats in an information systems context. This may be due in part to the many dimensions of the field, with the result being that researchers in various disciplines have concentrated on one or several phases or components of the field. Consequently we have not yet reached the point of simultaneously considering more than one or a few phases, much less formally integrating the methodologies and activities of the many involved researchers in their various disciplines. The bibliography is illustrative rather than exhaustive, then, and as such serves to indicate the potential for relating activities within and between a number of disciplinary and functional fields.

5. ORGANIZATION OF THE BIBLIOGRAPHY

Part I, "General Works," introduces the reader to books, reports, articles, etc., that deal with information system topics in an extensive manner. These may be general discussions of the field, or general discussions of the geographic or spatial characteristics of data.

Parts II-VI provide references for each of the five inter-related phases suggested as comprising data base development and maintenance in any information system.¹¹ Each phase is discussed

¹¹For a discussion of phases interrelationships, see Wellar, op. cit., "Some Paradigms for the Development of Standardized Data Bases," and Wichita Falls Consortium Phase II Report, Volume XII, Conceptualization Themes, op. cit.

briefly to explain the nature of the references contained in each section:

II. Specification. Regardless of whether the information system is in a federal agency or is maintained by a university researcher, the data elements and items contained in the system must be requested by someone. The data may be required by law, or may be included to permit the testing of a hypothesis. Hence, the references in this section are those which deal with requests, recommendations, or discussions related to spatial data in government and private sector statistical series, programs, projects, etc., and particularly those having an information system context.

III. Acquisition. After data elements and items are specified, observations, measurements, etc., are taken and recorded, such as during a decennial census. Or, data sets may be acquired by a local municipality from the Bureau of the Census. This section, then, contains references that discuss data collection or acquisition in terms of the spatial characteristics of data sets.

IV. Processing. After the raw data are collected, or processed or semi-processed data are acquired, they then become part of the data base under development. The data may be stored, retrieved, manipulated, etc., by manual and/or automated methods. The references in this section, therefore, are those which discuss progress and problems related to the handling of spatial or geographic data.

V. Dissemination. In many cases a central facility processes the data and then disseminates or has them delivered to users. Dissemination can, of course, occur after application. For example, a university researcher could perform his analysis and then disseminate his findings through a professional journal. The references provided

reports on dissemination as it relates to the spatial or geographic aspects of data in terms of graphic, statistical or other forms of output.

VI. Application. Data are requested, collected, processed, and disseminated for the purpose of being used by someone, or some agency. The works included in this section examine or report on the spatial characteristics of data which are used in an information system context in programs and projects of government agencies, university and other researchers, etc.

6. CODING SYSTEM AND BIBLIOGRAPHIC ENTRIES

In order to minimize repetition in referencing journals, proceedings, etc., of associations, organizations, etc., a coding system based on alphabetic ordering of the journals, associations, etc., has been devised.

ACRONYMS

<u>AAAG</u>	<u>Annals of the Association of American Geographers</u>
<u>ACSM</u>	<u>American Congress of Surveying and Mapping</u>
<u>ASPO</u>	<u>American Society of Planning Officials, Proceedings of</u>
<u>CG</u>	<u>Canadian Geographer</u>
<u>CLIPPP</u>	<u>Compatible Land Identifiers-Problems, Prospects,</u> <u>Pay-Offs, Conference on</u>
<u>COMRIM</u>	<u>Committee on Municipal and Regional Information</u> <u>Systems</u>
<u>HRR</u>	<u>Highway Research Record</u>
<u>JACM</u>	<u>Journal of the Association of Computing Machinery</u>
<u>JAIP</u>	<u>Journal of the American Institute of Planners</u>
<u>JASA</u>	<u>Journal of the American Statistical Association</u>
<u>MS</u>	<u>Management Science</u>
<u>PG</u>	<u>Professional Geographer</u>
<u>PE</u>	<u>Photogrammetric Engineering</u>
<u>PRSA</u>	<u>Papers of the Regional Science Association</u>
<u>SCRIS</u>	<u>Southern California Regional Information System</u>
<u>TPIS</u>	<u>Threshold of Planning Information Systems</u>
<u>UAQ</u>	<u>Urban Affairs Quarterly</u>
<u>URISA</u>	<u>Urban and Regional Information Systems Association,</u> <u>Proceedings of</u>
<u>3rd ACUPISP</u>	<u>Third Annual Conference on Urban Planning Information</u> <u>Systems and Programs (Chicago: American Society of</u> <u>Planning Officials, September 15-17, 1965).</u>

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