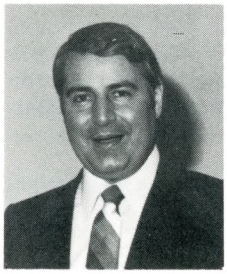

THE LAND SURVEYOR AND LAND INFORMATION

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Introduction

LAND INFORMATION Systems have existed since the development of the first property register. However, today's systems are becoming much more complex than we could have imagined a few years ago. The news I bring you in this article is both good and bad. The good news is that we, as surveyors, are now and always have been in the land information business. The bad news is that if we wish to continue providing a full service to our clients, we must provide our finished products not only in the present hardcopy form but also in a digital format compatible with their system.

Today's Land Information System - An Overview

Today's land information system (LIS) can be viewed as a collection of land-related information linked to a geographic coordinate system and stored in a computer database. Because this land-related information is in digital form and related to a common coordinate system, properly formated data can be input to the database in a random fashion from a wide variety of sources.

Since the geographic coordinate system is the foundation for LIS, it is safe to assume that the first step in initiating a LIS is the establishment of a control network. The system could use a Universal Transverse Mercator projection, or any other projection as long as it is related to latitude and longitude.

At this point, the LIS database will have a reference or coordinate base but no content. One of the first building blocks in the development of the content of the database is the compilation of topographic data via digital photogrammetric mapping. In developing this topographic database, digital files of both graphic entities and associated non-graphic attributes can be generated. As an example, the graphics may be the outline of a house while the non-graphic data may include the street address, occupant's name, age and so on.

The database of the LIS is further enhanced by adding additional layers (overlays) of land-related data pertaining to a variety of themes (e.g. property, forestry, utilities, assessment, etc.). By combining land-related information from a variety of sources, relating it to a common geographic coordinate system and storing it in a database, we have created an integrated land information system. Careful manipulation of this basic data can have countless applications.

The potential applications seem endless, limited only by the capabilities of the LIS and the contents of its database. Examples of these applications are emergency services, route selection, forest fire fighting, resource planning, and municipal information management. Many of the applications address the major requirements of decision makers to have current information that is readily accessible and that can be easily manipulated.

Components of a Land Information System

Complex or simple, the components of a LIS (Land Information System) may be summarized as hardware, software and data. Hardware and software are combined to perform the following functions:

(i) **Data Capture**
— ability to load in graphic and non-graphic data from a variety of sources and to maintain cross-references or links among related data;

(ii) **Data Editing**
— ability to update or to correct stored data; and

(iii) **Data Manipulation**
— provide a host of applications which use the existing data to produce a variety of end products (e.g. ambulance dispatch, route selection, thematic mapping, database queries).

This obviously oversimplifies the work that a several hundred thousand dollar system performs; however, irrespective of the level of sophistication of the system, these three functions (data capture, data editing and data manipulation) are the primary tasks undertaken.

The data for a LIS system is stored in a database or a series of databases which are repositories for the data in the form of files (with or without linkages to other files). When we look at the data that is stored in these databases, we realize at once that the surveyor plays a major role in the creation and maintenance of the database.

Role of the Surveyor Today

At the present, only the larger surveying and mapping firms are offering LIS services. However, if we examine the basic ingredients of a LIS database, we will see that the primary data collected relates to both large and small surveying firms. More importantly, it is the information, in a different format, that most of us have been gathering for years.

The foundation for the database of a LIS system can be summarized as follows:

(a) Common Reference Framework (geodetic networks)
(b) Topographic Detail (depicting the land)
(c) Property Delineation and Registration (establishing limits and ownership)

Without these base components, an integrated land information database cannot be created or maintained. All of these key components fall under the jurisdiction of the surveyor and mapper.

To provide a perspective of the role of the surveyor concerning the creation of an information database, let us discuss our possible involvement:

(a) Common Reference Framework

The surveyor to provide services in the establishment of geodetic networks is required to have both theoretical and practical experience in network design, least squares adjustment, error analysis and applicable standards and specifications. Field experience in reconnaissance and angular and distance observations is another obvious prerequisite.

Even with this experience, the surveyor is required to be familiar with the requirements of the potential client such that an acceptable proposal can be presented. A typical scenario for such a project may be as follows:

— proposal to explain benefits of a reference network,

— detailed proposal covering need, usage, design, costs and cost benefits, and

— implementation of control network with a report on results, proposed maintenance program, and potential future use.

(b) Topographic Detail

By scrutinizing a typical NTS map, we can appreciate the vast amount of topographical data contained on these maps. The method of collecting this data for inclusion in the database can come in two forms: photogrammetric mapping and total station field data collection. Total station instrumentation allows topographical data to be collected much more economically than ever before. This makes ground methods economically feasible for large areas where previously only photogrammetric mapping would be considered.

Photogrammetrically, much of this work is undertaken via the Ontario Basic Mapping program of the Ministry of Natural Resources. Often, this work is jointly undertaken between a local surveyor and a mapping firm. Such a project may require the following:

— a presentation to illustrate the benefits of the O.B.M. program and the potential of a digital mapping approach;

— subsequently, a detailed proposal is presented which outlines the mapping block, scale of photography, photo control, features to be mapped, and for digital mapping, associated non-graphic attribute data to be compiled.

One of the most important considerations will be the format of the digital end product and its compatibility with the clients envisaged Data Base Management System (DBMS).

The collecting of topographic detail by ground methods has been simplified by the use of the total station. However, if a bona fide digital product is to be supplied, the requirement of integrated surveys tied to control and acceptable digital files becomes imperative. The surveyor must therefore become concerned with the ability of his computer to provide such a product in a format that can be transferred to the larger LIS systems.

(c) Property Delineation and Registration

The property delineation and registration component of the database is of great importance since much of the land-related information is cross-referenced to it. The role of the surveyor in this regard may seem quite apparent - the determination of property extent is performed exclusively by the land surveyor. However, if we view the needs of a digital information system, we will find that the services provided must go well beyond those currently offered by most firms.

Cadastral and property mapping for an information database requires that it be stored digitally. For many the product produced is a graphical illustration of the survey in hardcopy form (e.g. mylar). This cannot be incorporated into the database in hardcopy form. It must be translated into a format the computer can store in the database (i.e. point coordinates, lines, arcs, etc.).

Providing the end product in digital form is one requirement of the surveyor; however, the role of the surveyor in providing this information involves more than a singular survey. To more fully understand our role in compiling property information, the following considerations are provided:

— the problems of compiling an entire city or province into an integrated series of map sheets illustrating a cohesive cadastral fabric;

— the need to determine all relevant sources of survey data and the task involved in determining the hierarchy of evidence from each of the sources;

— the problem of dealing with plan discrepancies and, the variation of survey methods and accuracies over the years;

— the need to relate all ground surveys to the geographic coordinate system;

— the difficulties encountered in attempting to deal with survey inconsistencies via balancing and/or least squares adjustments;

— the time required to certify the extent of ownership of these parcels.

The preceding illustrates that the process of deriving cadastral mapping for a LIS database is a formidable task and one that can only be performed by land surveyors. We must remember that while new technology provides exciting new opportunities, these opportunities can only be exploited by people who have the proper experience and expertise. In property delineation and registration, land surveyors, and only land surveyors, have this experience and expertise.

Potential for the Future

As previously noted, the surveyor's contribution to the LIS system covers a variety of survey disciplines. As such, the firms best suited to deal with the overall needs of these clients are those which have the expertise and resources in all of those disciplines. However, those survey firms who primarily perform cadastral surveys still have the potential to make a major contribution to the "Information System". A viable scenario for the future is the amalgamation of several firms into a consortium which provides the needed services based on the specialities of the individual firms.

Often when we speak of future potential, it is pertinent to review our past.

A 1981 special edition of the Canadian Surveyor dealt with "The Modernized Survey Profession". In that issue, the model presented illustrated the profession as having an exclusive role in legal surveys, and a leadership role in positioning and measurement, land information and land management. An article by C. H. Weir which equated the past (DLS Manual of Survey 1881) to the present stated:

> "these instructions show that in today's terminology the surveyor was expected to fill the roles of: resource specialist, environmentalist, hydrographer, geographer, geologist, pedologist, and information manager."

As we can see, the role played by the professional surveyor has greatly eroded over the years. But there is little reason why our profession cannot and should not undertake many of these responsibilities in the future. From that same publication, we should look closely at the words of John Matthews, then President of the Canadian Council of Land Surveyors:

> "In view of the increasing complexity of problems related to land use and development in a modern society, the provision of integrated land information and professional expertise in land economy have become essential services for ensuring the orderly development of land and the rational management of natural resources. Of all professionals, land surveyors are in the best position and are the most competent people to assume a leadership role in providing these services."

The leaders of our profession have clearly identified an exciting opportunity. It is encumbent upon our profession to accept this challenge and to revise our role as surveyors to include land information management.

Hopefully this change in our scope will happen gradually, and in a systematic evolutionary process. However, many of us have discovered that change is happening faster than anticipated due to client demands for "digital end products". For all of us, if we are to assume a leadership role, we must incorporate the necessary tools into our business.

The potential we have today is in the area of data gathering for the LIS system, and hopefully even the design and implementation of these systems for our clients. However, before this becomes a reality we must educate ourselves in both the multi-disciplinary, integrated approach to information gathering, and the concepts and management of computerized information systems. The problems are numerous, but the technology is available to meet many existing needs. Time is of the essence and we should embrace today's opportunities and work together in a coordinated fashion. The Surveying and Mapping Task Force Report stated that "data collection, data storage and data presentation should increasingly be in digital form. They (industry) could readily be involved in the development and management of information systems."

The potential for our future takes us beyond the role of information collector into roles such as information manager and land management. This potential is based on certain facts:

— the profession is providing and will continue to provide the basic components of the land information database: common reference framework, topographic data, and cadastral and property data;

— the profession maintains exclusive rights to delineate and describe land parcels which are the basic units that relate the socio-economic information;

— the profession with its intimate knowledge of the land, and its undertakings in the land development process is an essential component of the land management team;

— the profession embraces advances in new technology which is foreign and formidable to many other professions; and

— the profession provides a focal point for all parties requiring the establishment of an integrated land-related information system.

Our collective potential for the future is great; however, in any undertaking as complex as the ones we speak of, the road to success cannot always be clearly defined. As such, we must remain flexible and constantly evaluate the needs of our clients and society at large. To meet the needs of our current role and our future role, we must be prepared to update ourselves in both knowledge and resources. ●