THE FUTURE AND MUNICIPAL SURVEYORS

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INTRODUCTION

WHAT ROLE will municipal surveyors and mappers play in the operation and management of information systems in the year 2000? That is the question Mr. A. Hamilton asked me to address today. He is hoping that the input from various surveyors of different backgrounds, will enable the industry to, as he said, "find some light in the fog" and then to set its goals for the year 2000.

As background material, he asked me to draw on my perception of the future and my own experience, plus the 1985 Report of the Task Force on the Surveying and Mapping Industry in Canada, and the published proceedings of the 1986 seminars on "Land Information and The Land Surveyor".

GROPING FORWARD

The seminars dealt with the reactions of Canadian surveyors to the cadastral mapping system which has been used in Switzerland since 1912. There, a private practicing land surveyor receives a contract from the local municipality(s), to maintain current, master cadastral maps. In larger municipalities, a staff surveyor maintains the cadastre. The task force examined the composition and structure of the survey and mapping industry, the educational expertise of its members, its technological capability plus its market share, size, status and prospects. Then they recommend changes, mofidifications and improvements in administration, education, research and development and standards and marketing practices. The task force, for the most part, examined trends by looking at the industry from the inside.

In business, long term strategies are influenced more by perceived societal changes and demands than by in-house statistics and trends. Business leaders translate their perceptions into goals and indicators so they can bring saleable services and products to market, as needed. The openess of our marketplace allows new business to develop very quickly to fill gaps that are left by the existing establishments. Business executives try to exploit existing markets for as long as they are profitable and respond quickly to market changes. If they don't change, in time, someone else will fill the gap.

Municipalities and other political organizations rely on their elected representatives for their long term planning. Aspiring politicians, and politicians in opposition, advocate change, while politicians in power resist change and lead by projecting old trends until, from the back of the pack, they perceive a solid (politically safe) new social trend and adjust their programs accordingly. In addition, governments and large businesses are bureaucratically structured and it is difficult for them to change direction. Sometimes, this is an advantage because many trends are short lived or cyclic and are over before the bureaucracy can be re-directed.

The task force noted, in Chapter 14 - New Horizons, societal changes that require surveyors to adjust their services. These changes include for example: the placing of more emphasis on "the quality of life rather than material things (and) an increasing awareness and appreciation for the fragility and value of our physical environment". In addition, they noted the increased use of technology to collapse the "information float".

My own perceptions are consistent with those of the Task Force. In the late 1960s I presented a paper entitled "Future Shock - Survey Practice" to an annual meeting of The Canadian Institute of Surveying. At that time I pointed to the same social and technological trends and called for a review of the industry's goals. That was over 15 years ago. Fortunately, social changes, like natural changes, are usually slow and imperceptible. It is not very often that we suffer from sudden changes such as wars, revolts or earthquakes. Therefore, either the current social changes will have little effect on our industry or we have been slow adjusting to the changes.

As noted in the second paragraph of the Executive Summary of the Task Force's report - "This leadership role (of the Canadian Surveying and Mapping Industry) is being challenged by others . . . and a concerted effort will be required to maintain or improve (our) competitive position . . ." In other words, we have been slow adjusting to the changes, the "gap-fillers" are already at work and we may lose our markets. It is, indeed, time to examine the changes challenging us, to restate what business we are in and to set goals for the future.

THE CHALLENGE

Canada is changing from a resource based society to a knowledge and service based society. Just over three percent of our population is now employed in agriculture. Technology and science may allow us to reduce this number even further and still give us sufficient control over our food supply. Other resource sectors such as energy, lumber, mining and fishing are all suffering from industrial success. We have learned how to supplement man's muscles with machine power that lets us do a rough and dirty job. However, this has been very damaging. To protect the environment we now require impact studies. To show our concern we have animal rights groups, we buy the works of art of wildlife painters and we have started to talk about preserving the environment, not for years, but for lifetimes.

We are also starting to outlaw and clean up industrial pollutants that have fouled and violated mother nature. At the same time we are trying to police the new gene-splitters and chemical-mixers to make sure they don't ruin the fragile environment.

In addition, our interests are not limited to our own country. We have helped to find natural resources in other countries and helped them to establish industries. As we share the same space ship earth, we must be careful not to ruin their physical environment either.

The industrial sector is also changing. Robotics have given us hands, fingers and eyes that can be programmed to do manufacturing. In the industrial

sector we are also helping to create a pool of workers in third world countries through education programs. Again, we must be careful not just to exploit them and pollute their environment.

We all know that the service industry is growing. We often hear that it pays low wages to part time workers. This usually refers to personal services which we traditionally did not pay for. We are now adjusting our value system to give equity for services rendered. We are all really in the service industry; satisfying a need or performing a function which is required. The growth in the service industry indicates that due to our success in the food and product industries, we need or can demand, more personal services.

Several years ago, the population of Canada started to leave the farms and move to urban centres. These centres became large enough to support special services. Better roads were built to help move the food to the cities. As a side effect, farmers came down the roads to use the special services in the urban centres. This took work and income away from the small rural centres and resulted in more people moving to the urban centres. With the increased use of machines in the resource sectors, fewer people were needed and still more people moved to cities.

This brings us to the knowledge industry. This is a major social change. As with all major adjustments, we have fewer people employed in the traditional occupations and yet through the application of new tools, materials and methods, production goes up. At the same time, new occupations and unheard of new products spring up. The new occupations are in the information and education sectors.

In western society the ability to transport people, things, facts and ideas has been one of the basic corner stones of progress and growth. In today's jargon we call the improved transportation of facts and ideas collapsing the information float. We are using new technology to gather, store, process, analyse, communicate and utilize information.

The shift from a resource base economy to a knowledge society has also resulted in social disruptions and people moving to the urban centres. The opening up of communications networks or electronic roads may also result in more people needing urban homes. Changes in family size, age and income levels have resulted in people wanting different or new homes. The changes from manufacturing jobs to information jobs results in changing the physical workplace. All of these change the physical structure of the city and result in development and redevelopment.

The urban governments initially spent most of their tax money on hard services, roads, water etc. Currently, the shift is to soft services. Metropolitan Toronto, for example, spends over 60% of its budget on protection, public transit and social services.

The other half of the knowledge industry is education. We need to be educated to design and operate the communications networks and to gather and store the facts. But more importantly, we need it to help synthesize the data to create information, conceive of ideas, make decisions and prepare plans of action. We have already moved education out of the institutional classroom. Organizations are budgeting more and more staff time for preparing manuals, learning and training and for exchanging ideas. It is big business, we even teach people how to cope with being laid off and how to re-enter the work force in a new line of work. Education is also big business in our private lives. Television, radio, books and tapes all provide current affairs, how-to, science, hobby and educational programs. Our increased technical ability and willingness to handle and utilize information is providing not only new jobs and products but new hobbies and interests.

In the past, we used animals and then machines to give us extra strength, then we developed robots to give us dexterity. Now we have information systems to help us memorize, organize, utilize and exchange information. This new tool can hardly wait to be fed - who, what, when, where and why, so it can get to work.

THE SURVEY BUSINESS

Surveying has been defined in many ways. The definition is usually based on the practical tasks performed - to measure. Like all professions, surveying cannot be fully described by the practical tasks. A definition in information terms, would be - surveyors are in the "where" business; with a little bit of "what" and "when" thrown in. "Where" is place and land related. Surveyors are land professionals who provide "where" and correlate "where" data with "who", "what", "when" and "why" data. "Where" is a good business to be in. It is one of the basic 5 Ws and always in demand.

MUNICIPAL RECORDS

Municipalities have always kept "where" records. But in response to the demands of our knowledge and service based society, there is a need to do a better job managing all information including the "where" data.

A municipal cadastre contains "where" data about property boundaries. Cadastres have existed in Switzerland and many countries, for many years. They are updated on a transaction basis. In Canada, computer technology is making it easy to store, modify and plot cadastral maps, and new measuring systems have simplified field positioning.

The cadastre provides a foundation for land-related records and information such as ownership, assessment, municipal zoning by-laws, land survey measurement data etc.

A cross-reference identification number is assigned to each land parcel and to its associated ownership and assessment records. Zoning is usually shown as a polygon overlay. Survey records (position, firm, accuracy, etc.) are stored as nongraphic records against the corner or boundary they relate to. Municipalities, Utility Agencies and Provincial Offices all prepare cadastral type maps. There always has been a demand to collapse the information float regarding the approval for development projects. The new technology makes this possible only if the "where" data is input, managed and maintained.

Municipalities keep many other records about properties all the way from tax and water bills to building permits, fire inspections to dog tags, and meals on wheels recipients to break-ins. In almost all these cases "where" is expressed as an address. Street names and municipal addresses are likely the most important geographical names in the country. Untold dollars are wasted each year by people trying to match different address lists and place names (where) lists. Statistics Canada and the municipalities are taking the initiative to correct and organize them. They are inputting street centre lines and street names into their computers and assigning each address with a geocode (xy) identifier. The master address (where) list is then cross referenced to other administrative identifiers for the same property (tax roll number, water account number, etc.) and to the administrative polygons (voting, planning and school districts) and to place name lists (general hospital, city hall) and to postal code and company name lists. This master cross reference list is sometimes called a geo-

graphical reference system (GRS) and is usually maintained current on a mainframe computer. Users, on alphanumeric terminals perform day-to-day administrative duties, generate reports and can do statistical studies with otherwise unrelated records. Graphic terminals may also be available for on-line displays of index maps and to do map searches.

In the same way that municipalities keep detailed property records, they also maintain street segment and intersection records. These "where" records are cross-referenced to the street centre line via nodes, segments, arcs, polygons, block faces and address ranges. They may be used for recording traffic accidents, road permits, origin destination studies etc. They are also used for emergency dispatch purposes. The dispatcher sees the map on a graphic screen, an incoming 911 call is automatically linked to its phone number, address and geocode and displayed. In-vehicle computer maps show the driver where he is. The vehicle location is also sent to the dispatchers. The resultant records are also tagged with geocodes for statistical analysis. In addition to these soft services, street and utility centre line maps are used for infrastructure management. By monitoring maintenance, use, volumes, etc. the utilization of the existing utilities can be maximized, maintenance costs can be reduced and new construction minimized.

For utility - (water, sewer, gas, phone, electrical) design, construction and maintenance locations, usually relative to street line, is input into the computer. Each line and device (meter, valve, switch, pole) is given a geocode and an I.D. number for cross-referencing to detailed "what" descriptions and records. "Where" is critical for capacity calculations, for construction layout for digging, etc. The utilities are really transportation networks for special commodities. A knowledge society places high demands on reducing the float time for transporting commodities and information. Topographic maps provide the "where" details for roads, sidewalks, buildings, driveways, parking areas etc. Again, additional descriptive (what) records exist and these objects must be cross-referenced by I.D. numbers. An urban complex is like a large factory. A municipality needs a floor plan in order to administer, plan, design, construct, maintain and operate.

Municipalities must have the tools to manage and utilize the information they gather. They are establishing computer data banks and communications networks. These will provide a fast, secure and convenient way to intra- and inter-departmental and agency data sharing. The data should be entered once for use by all. There is usually a corporate data bank of common data, departmental data banks of specific data and even a user's personal data base. All would be networked together so there is only one source for each data set. Administrative procedures for transaction updating would help ensure that each user has easy, fast access to accurate, current data. The users will eventually be able to down load both the software and the data onto a front end processor to do their work. The networking of Federal data banks to Provincial and then to Regional Municipality data banks would provide an information road and encourage common standards and data sharing.

SURVEYORS ROLE?

The following scenario assumes that the survey industry will make very few changes during the next 15 years. The customers are not going to wait around for a surveyor to provide and maintain digital "where" data. They are going to find other suppliers and sources of data. Engineering, planning, computer and other organizations have user friendly digitizing, computing and interactive graphics systems. Similarly, a number of firms have easy to use measuring systems. In addition, engineers and some others have always had some expertise in measuring and draughting and more expertise than surveyors in the "what" information business.

Municipalities and utility agencies use engineers, planners and other firms as consultants. It is only human nature that they are turning to them for "what-where" data conversion, guidance and service. In addition, new firms are being formed to fill the gap and service this new market. It was estimated, in the AM/FM Market Report, that the market in the USA for the automation maps (AM) and for facilities management (FM) (data regarding utilities, roads etc.) and for related systems, will grow from $100 million in 1985, to over $50 billion. The competition for converting "where" data, is strong.

Private surveyors will, in some cases, be hired to help with the initial data conversion. However, it is not likely that they will assist with the street centre line mapping nor the input of administrative polygons. This is unfortunate because most street maps are very poor. Municipalities do not consider this survey work, rather it is the work of planners or chief draughtspersons, or of the computer staff. They will likely get a Statistics Canada area master file of street centre lines and move it onto a municipal system. Missing streets will be added, the addresses matched to the assessment files and polygon overlays digitized in. Unfortunately the centre lines will not match any of the other municipal maps. Gradually, the centre line maps will be upgraded in-house.

The in-vehicle computer maps and dispatcher's digital maps are derived from the 11 centre line maps and therefore they will not be supplied by the private surveyors.

It is unlikely that the local private surveyor will be hired to create the cadastral maps either. Municipalities already know surveyors cannot do this work, as witnessed by the fact their subdivision plans will not fit together. In addition, if a surveyor was hired he would likely recommend very expensive field survey solutions to this problem. A start on integrating surveys even using a local network, may have alleviated this problem. It is likely that an in-house surveyor, or more likely the draughting chief or an engineer will be called upon to do this job. If large private survey firms start an aggressive selling job they may convince municipalities and utility agencies to use their services for this job.

The development of utility location maps, based on street line maps, will likely be done by engineering firms because it is the associated engineering records regarding capacity, utilization etc., that are seen as being important and not the maps. Surveyors know too little about this aspect of the work to compete. If engineers are educated regarding the need to have good maps for facilities management, construction stake-out etc., then surveyors may help engineers do the conversion of utility maps.

The topographic mapping will not be done by the local private surveyors. An aerial survey firm will be hired. They will usually map each city twice. Once at medium scale (1:2 500 to 1:10 000) for planning and administrative purposes, and once at large scale (1:200 to 1:2 000) for engineering design and maintenance. To do this work the industry must establish good standards and practices. They are not selling graphical maps they are selling "where" data with I.D.s.

Where the local private surveyor will, or should, play a part, is in the providing of data for the maintenance of the cadastral records. The municipality should make it a condition of develop-

ment and subdivision, that as-built digital files be submitted including where the street and property lines are located as well as where the curbs, sidewalks, utilities, buildings etc. were built. All property line and construction stake-out data will be pre-calculated. Nearby control stations or GPS locations will be used as starting points. The surveyor only needs to stake out the corners and report back changes made in the field from the pre-computed locations.

What about retracement surveys and all the legal principles and methods used for preserving land boundaries? As we know, these methods only exist to overcome traditional, practical and technical problems. If owners are able to see and agree on their boundaries then the problems don't exist. As pointed out in the cadastral seminars, the surveyors in Switzerland have had a system since 1912 that helps minimize this problem.

Even if there are no master cadastral maps, all property points will eventually be maintained by reference to co-ordinates. Control stations plus GPS and other positioning systems will give technical personnel the capacity to reset any point once it is properly co-ordinated.

Photogrammetric and hydrographic surveys require expensive special measuring equipment. Once transformed into digital files, few re-surveys are required and many customized products can be derived. The updating will mainly be on a transaction basis from as-built records. On construction projects engineers and their technicians do most of the pre-engineering, construction layout and as-built surveys. There is no reason to believe private surveyors will start doing this part of the "where" business. With new measuring and computer aided design systems, it will become easier for engineers to do this work.

What about urban control surveys? GPS systems will be used to help set and replace ground control stations in urban areas. The costs to physically maintain a dense network of control stations may be drastically reduced within 10 years.

What about the mapping half of the business? Is mapping just the management and display of survey data? If it is, then many customers can already do this work on their data management and graphic display systems. Is mapping the effective communication of messages through spatial graphic images? If it is, then this aspect of mapping will grow more quickly outside the surveying and mapping industry than inside. There is a high demand for computer graphics and there will be a complementary high demand for improved communications through graphics. Cartography specialists may be in demand as educators, provided they teach business graphics and cartography.

It appears the small private surveyor will not capture any of the large data conversion market. In addition, his every day work will be made simpler. He will be on the edge of the "where" business in the technical measuring business. In fact, he could eventually be replaced for most work by junior technicians.

What about the municipal surveyor on staff? He is usually hired to keep outside survey costs down and to assist in administering the municipality's land records. Quite often he is not responsible for the engineering and construction surveyors nor the municipality's assessment maps or address and street name records. He is not in the computer or management information department. He is a property measurer and land clerk.

Unless the municipal surveyor starts an active campaign to present papers, speak at staff meetings and cultivate a network of supporters within the organization he, like the local private surveyor, will be by-passed. The municipal surveyor may know more about computer systems for geographic applications than anyone else in the municipality but those in charge have a clear mental image of what surveyors do. They do not run land information systems, they stand behind a theodolite. Besides, most municipalities think their maps can be digitized into a computer aided design system under the supervision of the draughting chief. Digitizing appears to be a draughting job.

TOWARDS THE YEAR 2000

If surveyors want to change both the image and reality of what they do they should start shortly. Timing is an all important issue. How quickly will the transition take place? Let's look at Metropolitan Toronto as an example. What records will be converted by the year 2000? The centre line and medium scale maps are done and the street line portion of the cadastral maps is scheduled for completion in the early 1990s. Composite subdivision maps are within two years of being completed for the City of North York and underway for the City of Toronto. The large scale topographic maps are 20% done. Several utility agencies are starting to convert their records.

What about other small municipalities? Will they convert their records very quickly once they start? Can they afford to start? Many have started. Technology is changing quickly. Low cost PC/UNIX systems now exist. It is reasonable to assume that most municipalities will convert all their "where" records by the year 2000.

It sounds like a black future if the industry continues to grope in the fog. We are moving into the knowledge age. There appears to be a need to educate the present surveyors about land information systems and not just the next generation. Surveyors do have a lot to offer and it is time to lead from the front of the pack.

Let us assume enough surveyors get involved in the land information business to make an impact. What then is their role in the year 2000?

They will need to become skilled managers of land-related information data banks and networks. It will not be sufficient to measure and map or to store and maintain "where" data on the computer. The real challenge is to bring together and administer who, what, when, where, why information. We have argued that "where" or geocoding is the magic that will provide for the integration of many diverse document sets. We had better be prepared to manage the integrated system. Either that, or accept the fact that measuring it is our business and we are not concerned with how the resultant data is used.

As a group, private land surveyors could control the conversion of street centre line and cadastral data. Collectively, they could form a cadastral data base company. They would create, maintain current and operate a provincial data bank. They could sell access to many customers including Federal, Provincial, Municipal, Utility Agencies, Real Estate Boards, etc.

It could be started by private surveyors agreeing that they are the registry office for survey (boundary) data. After all, the Act says they must keep the boundary records, known as field notes. To operate their boundary registry office they would form a company, buy a computer graphic system and network all private surveyors into it through their PCs. They could start by inputting road centre lines into a topological file. Then each surveyor would update the file for his own designated region. The next step would be to input all new surveys. If control stations don't exist, start with local datum and transform later. By now, the marketing should be well underway. Acquire converted records from any-

where you can. Sell street centre line and address match services. Acquire contracts to convert cadastral maps and promise to keep them current by having your own members file changes. The members would be charged for submitting changes to the official register; they in turn would bill their clients.

This may be too revolutionary a change for most surveyors. By the time they finish discussing the concept it may be too late. Someone new will have filled the gap or municipalities, utility agencies and land title and assessment offices will already have in-house cadastral mapping systems. What else can surveyors do?

They could lobby for legislature requiring developers, government departments etc. to relate all major changes (to the physical environment) to control and to file the results in a standard form. Those making changes should be responsible for filing as-built data. Several years ago I presented a paper at a CIS meeting on urban mapping. In it I outlined suggested changes to the Municipal Act. The draft spelled out the requirement to co-ordinate and file data. It proposed that a municipal surveyor manage the information. The municipal surveyor could be either a staff member or a private firm designated as the municipality's municipal surveyor.

The survey industry could lobby for a land information communications network that connects federal data banks to provincial and regional data banks. These in turn would be connected to operational data files of other data at the local, municipal departmental or agency level. To oversee such a network, a committee of provincial and regional surveyors could be formed. To complement this, the private surveyors' associations could lobby for, and support, common standards etc.

In order to be able to educate others, surveyors need to get hands on experience and educate themselves. This goes beyond seeing demos and hearing papers on how good users claim their existing systems are and what they are hoping for in the future. They need classes on how the systems work. They need knowledge on how engineers, utility agencies, planners etc. use the system and what data they need and why.

A simple step towards hands-on experience is to establish a field note bulletin board. Each firm would index its own field notes daily via a PC and telephone line to the central file. They would search the same way. The control survey records could be accessed the same way. The next step could be to share co-ordinates of surveyed corners, indexed to a set of common master maps. The master maps could be those prepared by the municipality or the registry office.

The sharing of co-ordinate data implies the tying of surveys to the provincial control stations or to local networks or base lines. Surveyors should start to measure from control to the property points, at least along street lines. In the future, subdivisions should fit together. Surveyors could also promote a program of co-ordinating street corners, similar to Ontario's program for recovering township corners.

By the normal turn of events, private surveyors will be using interactive graphic systems. The municipalities, engineers, etc. who receive data from surveyors will insist that the data be in digital form. Surveyors should volunteer to provide digital data to the province and municipalities. If digital files meet a common standard and are related to control, they can be filed in an information system even though the old maps etc. have not been input. Surveyors should start to show their expertise. In the Metro Toronto area a committee of government and private surveyors has been formed to document cadastral map requirements and exchange standards. Surveyors need to do the same for topographic, utility and thematic data.

Finally, the image problem. Surveyors, like the public, know what business they are in and it is not the land information or "where" business. The surveying industry just spent a great deal of time and effort, for economic reasons, re-fortifying the traditional image of surveyors measuring in the field. They have been encouraging owners to check for boundary problems and encroachments onto their properties. They have done a very successful job. They now need to direct as much energy selling themselves and the public on the surveyor as an information expert. This will be difficult to do. Surveyors are very busy with the current construction boom and with government contracts for digital topographic maps. But, this is a cyclic business and they need to lay the ground work now for their own future and the next slump.

Again, one last note of caution, most of us tend to rush history when we are acting as visionaries. Things usually evolve more slowly than we expect and because we are poorly aimed, things often work out differently but o.k. •