THE BURNABY EXPERIENCE WITH COMPUTERIZED MAPPING

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ABSTRACT

In 1976 the Corporation of Burnaby decided it was time to review its maps. We found that the old maps which had been produced prior to 1939 contained many errors and that the maintenance of our maps was very costly because of the variety and number of documents which were involved each time a correction and/or addition had to be made. It was also at this time that our Federal Government began talking about converting everything to a metric standard. Recognizing that the other utility companies, which serve our Municipality, would be faced with similar problems, we put forward a proposal to undertake a joint project to explore the computerized approach to map production and the handling of a broad spectrum of facilities information.

The pilot project (BJUMP) proved conclusively that computerization was a viable alternative to manual remapping and now, after some ten years of experience, we have come to the realization that the maps are only the tip of th iceberg. A greater benefit of having such a system is the spatial data base which allows us to use the system as a powerful tool for analysis and not just as a record keeping system.

CORPORATION RESOURCE

For the past 35 years, computing systems have been used by municipal governments to maintain financial records, issue cheques, record inventories of equipment, etc., in essence, most communities have a computer of some description. However, during the past eighteen months, we at Burnaby have been studying our information needs throughout the Municipality and with the assistance of our consultant, R. Liley and Associates, have concluded that more than 70% of the information maintained by Burnaby has a spatial or geographical relationship. Burnaby now considers **INFORMATION AS A CORPORATE RESOURCE** and as such, it should accommodate individual and departmental needs and be accessible by all. Although the current recession has put a very definite emphasis on restraint in every facet of our operation, the elected officials continue to demand a higher level of service and additional information to keep them well informed. It is our conclusion that the only way to meet this demand is with high tech information systems.

During the early 1970's we at Burnaby became increasingly aware that our 50-year old maps, plus or minus a few years, no longer

were adequate for the level of detail and accuracy required in a 1970's organization.

Although maps seem to be taken for granted and recognized as important documents, no one seemed prepared to budget for a new set of composite maps. It continually seemed that the cost of producing new maps was high and the benefit was "it only looked better".

Over the past ten years this perception has changed in Burnaby and we have come to recognize the importance of accurate maps. What brought about this change?

JOINT VENTURE

The Municipality of Burnaby is one of twelve communities making up the Greater Vancouver Regional District. Each of these communities, plus a number of private utility companies operate facilities within the Regional District and have historically drawn their own maps. Although each of these jurisdictions had different requirements for accuracy, level of information and purpose for the information, there was one common denominator; each agency is concerned about the same geographic area.

This lead us to believe that possibly other map users within our Municipal boundaries were also beginning to realize that they needed new maps.

The two major map users besides the Municipality are B.C. Hydro, representing gas and electric facilities, and B.C. Telephone, and upon enquiry we confirmed that both utilities were facing the same need to remap and, in fact, had already started to explore the application of computer assisted techniques.

At the same time, during the summer of 1975, the Canadian Federal Government indirectly came to the Municipality's aid by suggesting that Canadians would henceforth convert to metric measurement as part of Canada's push towards a closer trading relationship with the European community.

Recognizing the fact that we were having difficulty convincing our management to budget for manual remapping and the fact that two other prime map users in Burnaby were already involved in a remapping program with the use of computer assisted techniques, we proposed the formation of a task force composed of members from each of the major map users to investigate the feasibility of creating one common base map, with the aid of computers, to be used by each agency. In turn, each agency would enter their respective facilities onto the system so as to be available to all users.

The task force completed a feasibility report in 1976 January, which concluded that computer assisted mapping would:

(1) be approximately three times faster than the conventional manual approach;

(2) be less expensive, especially as the work volume increases;

(3) be easier and quicker to maintain and update;

(4) provide an "end" product which would be a total information base with infinitely more flexibility than the conventional map.

PILOT PROJECT

Formation

Although the CAM approach appears to be far superior to the manual approach, it must be pointed out that much of the data on the existing maps and the time, cost and performance projections were not very definitive, and that to obtain more meaningful information a significant amount of mapping would have to be performed using a CAM system.

From the foregoing conclusions came the recommendation that the participating agencies undertake a one year pilot project using a computer assisted mapping system to obtain more definitive information regarding manpower, equipment costs and overall benefits for computer assisted map conversion and maintenance.

The task force spent almost a year establishing the parameters of the pilot project, doing preparatory work such as field survey and photogrammetry, selecting a system supplier, negotiating with labour unions representing operators from each of the participants, selecting and training operators, and convincing their respective managements that the computer assisted mapping technology was sufficiently advanced to recommend the leasing of such a system for the pilot project.

Some of our more successful arguments were that firstly, our Federal Government was recommending that the country would convert to metric measurement and secondly, that some of the other large map users were "leaning" very heavily towards the use of computer assisted technology and we did not want to fall behind. A third argument, which may very well have been the most convincing one, was that in the long term there could be some staff reductions.

The Burnaby Joint Utility Mapping Pilot Project (BJUMP) began operation in 1976 December when we took delivery of a Synercom ST-700 mapping system. For the next fourteen months members of BJUMP worked with the technology to assess all facets of computer-aided map production and maintenance.

Level of Accuracy

Many papers have discussed the question of what level of accuracy one should aim for when developing base maps. We concluded that the agency with the highest accuracy requirements should be responsible for base map development, production and maintenance. In most instances this would be the municipality. Very early in the pilot project it became apparent to all participants that to digitize directly from the existing maps would not give us the ± 1 meter level of accuracy which we had set as our absolute minimum.

Our decision was to use coordinate geometry to enter each line mathematically. For the sake of saving time we chose to use photogrammetric methods to obtain our required control points. The latter consisted of survey monuments, survey pins, gas valve and manhole covers, etc., which had been painted to ensure identification.

These "targets" were all identifiable on aerial photographs, and by using analytical aerotriangulation were given Universal Trans Mercator (UTM) coordinates. (UTM coordinates are true rectangular coordinates on a grid parallel to a central meridian, which in Burnaby is 123 degrees west and perpendicular to the equator.)

Using these photogrammetrically derived control points and the original air photos, we were able to produce orthophotos which show the targetted control points, all of which can be used when digitizing directly from the orthophotos. This procedure increased our accuracy to something in the order of ± 0.2 m.

This method was the primary source for base map production in BJUMP. In some areas where there were difficulties in reconstructing the irregular and curved cadastre from the orthophotos, a method using coordinate geometry (COGO) was employed and the resulting maps are virtually of legal map plotting accuracy.

Although this decision contributed to a reduced rate of production and increased costs, we can now look back and state that it was well worth it as the benefits definitely outweighed the added costs of production delays.

Some of the benefits of having produced higher quality maps are that:

(1) we can extract and rotate any portion of the base map as necessary to suit the required orientation for construction plans and profiles;

(2) we can merge individual sheets or portions thereof and produce composites of a larger area at reduced scales;

(3) we will be able to use the information stored in the system for the future preparation of design plans,

profiles and cross sections; and

(4) we will not have to remap to improve accuracy because each facility will be referenced to true world positions.

DEVELOPING THE BASE MAP

Agreement

With the completion of BJUMP in 1978 February the Municipality exercised their option to purchase the Synercom system and established a work schedule to produce a complete set of new base maps which would serve the needs of the many users in our community.

The other two participants in BJUMP also gained the information they needed to convince their Board of Directors to purchase their own CAM systems, which each one has now done. Having purchased their own respective systems for province-wide mapping, each of the utility companies entered into an agreement with the Municipality to provide us a copy of their utility information in digital form in exchange for updated base maps from the Municipality.

Features

Some features of the Burnaby system which I would like to mention are map components, property identifiers, facets, versatility with respect to conversion between imperial and metric measurements and versatility with respect to isolating randomly sized "windows".

Maps contain three basic elements, namely, lines, symbols and annotation; our task is to develop a cartographic base showing the cadastre in a format that is acceptable and useful to a variety of users.

Illustrations 1, 2, 3 and 4 show how we have built our base in order that each user is able to display the cadastre in a form that he or she requires.

In Burnaby we have assigned a twelve-digit property identifier to each of the approximately 43,000 properties. This identifier consists of three basic elements; the first four digits represent the name of the street or avenue, the next four digits represent the civic address and the last four digits are reserved for the suite number. Using this number one can then get such information as the complete legal description, the street name, and the property owner's name. Other non-graphic statistics will be available in the future as other departments come on-line.

The creation of a uniformly sized facet (50 cm by 80 cm at a scale of 1:1000) covering an area 500 metres by 800 metres eliminates the problems of eighteen random sized strip maps as well as the problems of overlaying a strip map or portion thereof

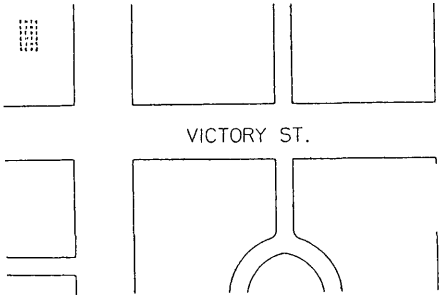

Figure No. 1

Block lines and street names

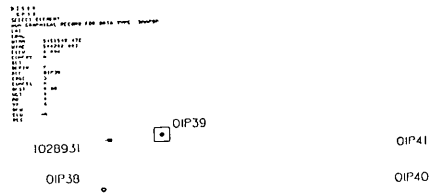

Figure No.2

Survey control information

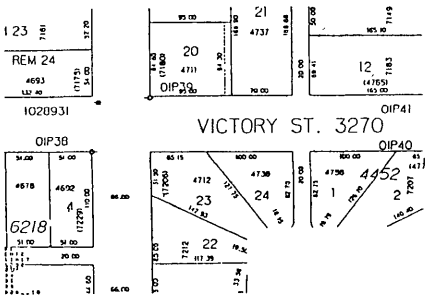

Figure No. 3

Civic addresses, dimensions and legal descriptions

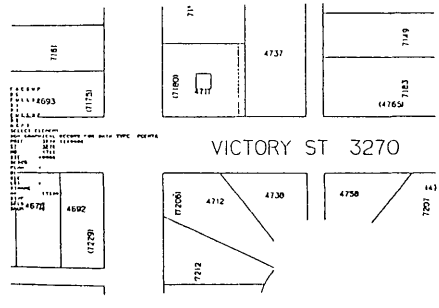

Figure No. 4

Attribute information pertaining to 4711 Victory St.

with a contour and/or facilities map. However, the user is not restricted to displaying only predetermined facets as the system has the capability of plotting any area, whether it be a part of one facet or whether it spans a number of facets. This allows the user to zero in on an area as small as a survey monument and display it at an enlarged scale.

The system also has the versatility to convert information which was entered in imperial units to metric units, and vice versa. It can also adjust the scale almost infinitely between 1:200 to 1:1,000,000.

FACILITIES

With the completion of our base maps, we now have the skeleton which is necessary to support facilities information, contours and countless other geo-based information. This phase is the core for an effective and efficient engineering office in a local government setting. We must have good quality up-to-date information which is readily accessible. We are currently involved in data entry (again using coordinate geometry) for the conversion of our facilities information such as waterworks, sewers, drainage, roads and street lighting networks to the computer assisted system. our current projection is to have this phase completed by the end of 1987.

Let's now look, in a little more detail, at exactly what we mean by facilities information. As an example, I will use a portion of Burnaby's waterworks system. The basic element in a waterworks distribution system is the water main or line which is generally located within the public road allowance. The second element is the water main fittings such as valves, service connetions, hydrants, meters, bends, adapters, couplings, etc., and the third element is the annotation relating to each of the fittings. This could include such information as size, type, date of installation, position (open or closed), number of turns required to open, manufacturer, reference number and condition. Everything, except the annotation, can be displayed graphically.

With all the aforementioned information loaded into the system, the computer can now exercise its capability to draw a map of Burnaby, or any chosen portion thereof, showing only 150 mm diameter water mains; or giving us a complete listing of all streets which have a water main less than 150 mm in diameter; or providing a complete tabulation of all asbestos water mains, including sizes and lengths. As you can see, this is the type of information which would be invaluable when preparing a water main replacement program.

As each of the facilities is entered into the system, we will have similar applications for each of them. To make such an analysis manually would have taken many weeks at a high cost. By using the system, the results were produced in minutes and at a

fraction of the cost. This is significant to our community because the infrastructure of water mains, sewers and roads is the backbone of the Municipality and a large percentage have been in service for over thirty years. It is therefore reasonable to project that much of our infrastructure will have to be replaced within the next ten to fifteen years.

However, facilities are not restricted to our physical infrastructure. They may include land use zoning, traffic accident details, crime statistics, population distribution, property ownership and much more.

MANAGEMENT INFORMATION SYSTEM

Although we are continually finding new uses for our automated mapping facilities management system, we must look beyond this to the broader subject of information management. At Burnaby we are in the process of developing an integrated information management system. We recognized that the computerized mapping technology was changing to concentrate on spatially-oriented data bases. We also began to recognize that the fragmentation of information systems was costly and prevented us from taking advantage of the inherent synergy of an integrated information management approach.

In order to further study the feasibility of developing a plan for integrating all of the Municipality's information systems the Municipality, in late 1983, retained the consulting services of R. Liley and Associates. The consultants report entitled "A Strategic Plan for Information Management" (Liley, 1984) included the following recommendation:

> "Information systems were required to support overall Municipal operations and management decision-making."

The report also presented a new configuration for Burnaby's electronic information network as illustrated in Figure #5 and outlined a system design concept based on the following premises:

(1) access to the computer systems will be provided throughout the Corporation. In most cases the manual systems will be replaced by a computer system;

(2) many of the applications will cross departmental boundaries and pervade the operation and management of the Corporation;

(3) individual applications will be conceived around data bases. This approach, rather than the more traditional one of appending data bases to specific applications, should significantly increase flexibility and result in systems which have longer term viability for the Corporation.

ELECTRONIC INFORMATION NETWORK OVERVIEW

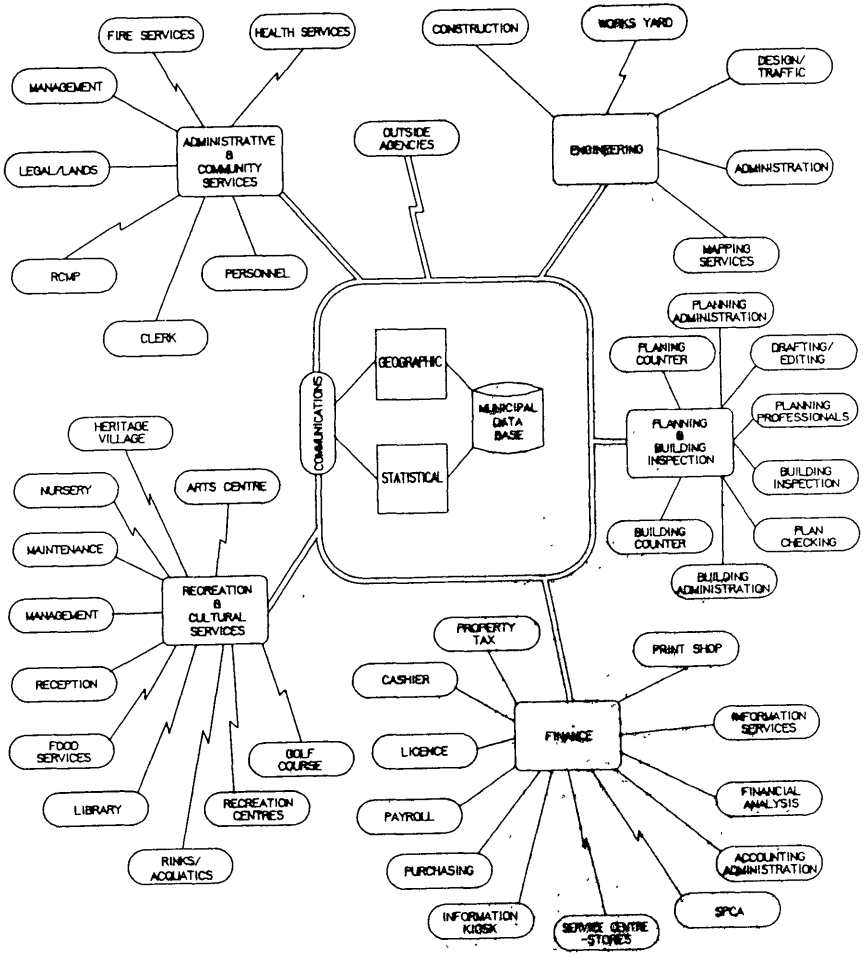

FIGURE NO. 5

Having come through the various stages of this evolution, Burnaby is only now beginning to reap some of the many benefits which will improve productivity and services at all levels. Benefits such as on-line inquiry through a single work station, paperwork simplification, staff cost avoidance, the ability to respond to a changing environment, the ability to control and manage costs, improved levels of service and management control. In addition there will be many intangible benefits such as the availability of more complete and better information for decision-making and planning, job enrichment as employees come in contact with the computer and greater reliability of information.

CONCLUSION

The Corporation of the District of Burnaby has been a leading user of information systems in local government. The Municipality has pioneered the use of automated mapping and, by virtue of having a digital map of the Municipality, has been able to proceed to the next logical step of marrying non-graphic geobased data to the mapping system. It is now moving successfully into the total integration of Municipal Information Systems, having recognized that information is a key corporate resource and should be managed as such. The use of electronic data processing to handle the routine day-to-day business of the Municipality will of itself realize significant benefits in terms of productivity and quality of services offered. The information that is captured through transaction processing will also provide significant benefits in terms of performance planning and measurement. However, the synergistic benefits arising from the integration of systems will potentially outweigh the routine benefits provided by automation of the normal transaction processing. This integration is vital because the majority of municipal data is geobased.

ACKNOWLEDGEMENTS

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REFERENCES

Liley, R.W. (1984) A Strategic Plan for Information Management.