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PROVINCE-WIDE EMERGENCY RESPONSE COMPUTER SYSTEM

Abstract: Federal, provincial and municipal governments must be prepared to react quickly to high risk situations. They must have access to the latest technological developments with which to minimize any human, property and environmental effects. Alberta Public Safety Services is tasked with co-ordinating provincial, municipal and industrial activities during man-made and natural disasters that are beyond the scope of a single organization. To perform this function, our Department is using UNIX computer systems running office automation software and a relational database. We have also been experimenting with an Expert System for emergency response. Our next target will be to develop a Geographic Information System that will be tied to our existing database and to the province-wide Land Related Information System which will be available in the early 1990's. We hope to ultimately integrate the GIS into a complete knowledge based Expert System. It will be used for planning, monitoring and co-ordinating emergency situations and any recovery programs throughout the Province of Alberta.

INTRODUCTION

Natural and man-made disasters can occur at industrial sites, on the highways and in the cities. The question has always been "How can we survive this with the least loss of life, property and environment quality?". Accidents happen but we can reduce their impact if we act quickly after initial notification.

For years the best method of co-ordinating information before, during and after an emergency has been the wall map, plastic overlays and hardcopy files. This procedure can work well if the responsibilities of the co-ordinating agency involves only: limited resources; limited co-ordination requirements; and a slow evolution of the data. This method can be considered to be a manual Geographic Information System (GIS) and is still in use today by many emergency response organizations.

One relatively new approach to assist the decision maker during emergency situations is a fully computerized GIS. This system allows for the electronic flexibility of handling both the site data and the geographic displays. These systems can be developed quickly for small geographic areas such as a plant site. Some municipalities are developing larger systems but that usually takes years. When you look at an entire province and ultimately an entire country like Canada the task of developing a computerized GIS is difficult.

Within the Province of Alberta the agency responsible for the co-ordination of response to large disasters is Alberta Public Safety Services (APSS). These disasters can involve anything from a small chemical spill to a declaration of War. APSS is committed to the development of a province-wide computerized GIS to assist in emergency management.

APSS RESPONSIBILITIES

Alberta Public Safety Services is charged with enforcing two provincial acts, the Transport of Dangerous Goods Control (TDGC) Act and the Alberta Public Safety Services Act. The first involves the handling and road transport of chemicals within Alberta. The second involves Alberta's municipal and industrial planning and response to disasters of any type. APSS has a co-ordinating role under both pieces of legislation.

We have established seven district offices throughout the province, a training school in Edmonton and a headquarters also located in Edmonton. A 24 hours Co-ordination and Information Centre is staffed in the

headquarters building. This Centre has pager contact with APSS Duty Managers and aurora telephone contact with our field staff. If a situation develops that requires greater resources than APSS itself can provide, a larger Government Emergency Operations Centre (GEOC) is activated. The GEOC, located at the headquarters building, provides co-ordination of multi-government resources to assist the municipalities with the disaster. Representatives from government, private and media organizations required to assist with the specific incident can be contacted and accommodated in the GEOC.

TDGC Act

This Act came into force in 1986. To enforce the TDGC Act, APSS has approximately 21 trained dangerous goods inspectors on staff. Seven of these are stationed in five of our district offices as full time inspectors of dangerous goods facilities. In addition, over 700 On-Highways dangerous goods inspectors have been trained by our Training staff. These include RCMP, various municipal police departments, Motor Transport Service field staff, and others. This number is continuing to grow.

APSS Act

This legislation was last updated in 1985. It requires all municipalities to prepare and exercise emergency plans and to designate a Director of Disaster Services. Over 340 municipalities and all hospitals in the province have prepared emergency plans. These plans are regularly updated and exercised. All plans include mutual aid agreements for the acceptance and transfer of the public and resources. Municipalities declaring a local State of Emergency could be helped by the provincial government through this Act. To assist the municipal organizations in fulfilling their plans many municipal staff have been trained in handling both man-made and natural disasters.

APSS maintains seven Disaster Field Officers located in seven district offices. Planning and Training Officers also are involved from our headquarters and training school.

A province-wide Declaration of a State of Emergency would be co-ordinated by APSS through this legislation. This includes action up to and including a Declaration of War.

Emergency assistance programs, which may be started by the Province of Alberta following a disaster, are also administered by APSS through this Act.

DISASTER RISK

But where should you start when you have to co-ordinate the disaster response for an entire province? The first step is to determine what hazards exist, which have an unacceptable effect and what can you do to reduce the negative effects at an affordable cost. If

RISK = HAZARD x FREQUENCY

then those responsible for the hazard mitigation must determine the frequency of occurrence of each type of hazard for which they are responsible. Table 1 indicates a classification system of hazard types that lead to a risk.

TABLE 1
CLASSIFICATION OF HAZARD TYPES*

HAZARD TYPE	DESCRIPTION	SUDDEN	CHRONIC
NATURAL	- naturally occurring energy releases, toxic substances and planet-wide events.	- tornado - floods - earthquakes - plant poisons	- radon gas - greenhouse - carcinogens - lightning
SOCIETY	- activities of groups of people, or circumstances which lead to risks for society.	- terrorists - crime - strikes - war	- AIDS - poverty - ignorance
TECHNOLOGY			
- product	- direct products of technology or production which present a potential risk, but also benefit society.	- LPG - gasoline - electricity - aircraft - surgery - guns - fast cars	- asbestos - carcinogens - drugs - pesticides
- by-products	by-products of technology or production which present a potential risk, but do not directly benefit society.	- transport of dangerous goods - radiation - war materials - dams	- radiation - hospital wastes - urban wastes - air pollution - workplace chemicals
INDIVIDUAL	- activities voluntarily chosen by people which lead to exposure to hazards for those individual.	- auto use - sports - boating - swimming	- smoking - poor diet - chemicals in hobbies - lifestyle

* adapted from: Institute for Risk Research (draft March 24, 1988). "Policy, Decision and Communications Research Project". Waterloo, Ontario.

APSS does not have any jurisdiction in the area of "Individual" hazards or direct chronic types of hazards. For those remaining hazards normally falling into the areas of public safety, APSS is working at understanding and assisting the interactions between the public and the decision makers.

Statistics Canada data for the number of deaths in Canada due to various causes for the years 1984 to 1986 are shown in Table 2.

TABLE 2
NUMBER AND CAUSES OF DEATH FOR 1984-86 IN CANADA

HAZARD	1984	1985	1986
Explosion by Pressure Vessel	1	0	2
Hot or Corrosive materials	1	0	2
Railway Accidents	4	3	15
Air Transport Accident	25	19	25
Drowning	31	23	29
Falls on/from Ladders/Steps	17	24	23
Pedestrians	39	34	49
Lightning	1	1	1

The first four data groups in Table 2 may fall under the broad area of APSS responsibility. Remaining data is shown to provide perspective. It is data such as this that can aid a safety organization in evaluating where it should concentrate its resources.

APSS COMPUTER SYSTEM TODAY

To assist in maintaining records APSS has been developing a relational database using a product called EMPRESS by Empress Computing Ltd. This product is Sequential Query Language compatible and is written in the 'C' language. To support this software and other office needs, APSS maintains several SUN and Convergent Technology (CT) UNIX minicomputers and IBM compatibles. These are connected with either an

Ethernet Local Area Network or packet switched communications. These computers and their functions are listed in Table 3.

TABLE 3
EXISTING APSS COMPUTER SYSTEM HARDWARE

Location	Computer	#	Function	# Terminals
Headquarters	SUN 3/280	1	database	30
Headquarters	CT Mitiframe	1	office	30
Headquarters	SUN 3/50	2	desktop pub.	0
Training School	CT Miniframe	1	office	8
Training School	IBM AT (compat)	1	desktop pub.	0
Disaster Assist.	SUN 3/160	1	database/office	0
Disaster Assist.	IBM AT (portable)	4	database/office	0
District Office	IBM XT (compat)	7	office	0

In addition to these standard computer resources, APSS has been working with the Alberta Research Council and Emergency Preparedness Canada on an Expert System using the 'LISP' language on a SYMBOLICS computer. This prototype system is called HERMES for "Heuristic Emergency Response Management Expert System". It is envisioned that this software will be adapted to run on a common platform such as a SUN workstation and it will provide emergency response personnel with help in determining how to approach a potentially hazardous situation involving dangerous goods. HERMES, when fully developed, will contain a complete GIS capability as well as many other functions.

GIS GENERAL

To efficiently handle the process of risk management, a public safety organization must have a method of keeping track of the risk assessment, planning, exercises, incident response and post-incident assistance. Almost all data that APSS uses is related to a geographic location. Examples are: municipal contacts (name, address, business #, residence #, etc.); assistance plan applicants (name, address, claim, etc.); chemical tank truck accidents (incident location, company, company address,

chemical, cleanup, etc.); and industry emergency plans (name, location, chemicals, evacuation plans, etc.).

A GIS can be any organized method of dealing with data that includes a geographic reference point. Usually the geographic reference is a street address. Sometimes it is a co-ordinate system value like latitude and longitude. Wall maps and filing cabinets have been used for many years to maintain and display this geographic data.

In the last ten years some organizations have begun using computerized databases to maintain some of their data. Also, within this same time period, graphics systems have been used to display some of this emergency response data. Only recently, however, have there been powerful and affordable computer systems which can be used to store, maintain, display and analyze all types of geographic data.

The strengths of a computerized GIS seems to be in the handling of relatively static data such as populations, highway systems, building structures and tax assessments. It allows for detailed analysis of this data but this can take hours or days to perform. This makes it suitable for planning purposes and for handling post-incident aid programs. For emergency situations, however, a GIS can be used but long analysis times are not acceptable. Many incidents can have a period of emergency measured in minutes. They can cover a very large geographic area where both general and detailed data may be needed. Often there is too little time to do much data analysis during the critical period unless it has been previously hardwired into a system. You can not even be certain that your source of raw data from the site will be immediately available during the disaster.

No GIS can operate without a large quantity of base data. For the Province of Alberta the development of the computerized version of this basemap information is being co-ordinated by the Land Related Information System (LRIS) group within Alberta Forestry.

MANUAL GIS

All organizations have a data collection and handling system. To maintain data records for anything from a small chemical spill to a war, APSS has maintained hardcopy sources for all data since the 1950's. Wall maps and overlays are the only geographic data display system presently used at our department. Unfortunately, hardcopy information quickly becomes out of date and of little value to a contemporary situation. Hardcopy backups will continue to be used in the future as a precaution

against computer system failure, however if you rely on them too greatly their static nature tends to discourage regular updating. This can lead to out-of-date data which could cause a delay during a vital emergency.

APSS COMPUTERIZED GIS

Beginning

A computerized GIS could better assist public safety organizations with their risk management planning and decision making. Incidents could be analyzed graphically much more easily than by hand. Examples of questions the planners might ask using a GIS are:

- What types of risk in this community are of critical severity and have frequent occurrence rate?
- What catastrophic events could occur within 50 miles of the community?
- What is the maximum number of casualties that any risk could generate in this area?

APSS has taken the first tentative steps towards establishing a computerized GIS. We have started to budget resources, we have an internal GIS committee and we have begun to participate in the development of the provincial Land Related Information System (LRIS) network. Our efforts are based on a few assumptions:

- APSS presently operates a manual GIS system;
- the department will benefit from complete or partial computerization of the existing manual GIS functions;
- the advantages of GIS are being considered by senior management;
- all staff will benefit from our intense short-term activities.

As part of the departmental planning process all managers were consulted during an internal workshop. This workshop outlined the first broad steps to take towards implementation of a computerized GIS within the department. Questions that were considered included:

- What do you want a computerized GIS to do for you?
- What type of data and how much is there to input and maintain?
- What data accuracy is needed for the various data types required?
- What data do you need from other sources?
- What type of data analysis do you need?
- What is the maximum number of users?

- What type of hardware do you need?
- How many trained users will there be to operate the system?
- What type of base map data will be required?
- How much data and what type needs to be available on site?
- What growth do you expect for your data and hardware needs?

LRIS Dependence

APSS cannot work towards any GIS implementation for the entire province of Alberta without help. The major assistance will come from the Land Related Information System being developed by Alberta Forestry. This system will be a mechanism to provide base mapping and thematic data for the entire province. The long-term goal of LRIS will be to coordinate the access to the many computerized databases now existing in the province. Any system we develop must be compatible with this network.

Future

The goal of the GIS activities of APSS will be to provide complete computer access to all province-wide LRIS data and internal GIS data to its staff. The task is difficult. By the very nature of an emergency, decisions must be made quickly and may affect many people over a large area. There often will not be time for a detailed analysis of all data. We would have to rely occasionally on detailed pre-planned scenarios with pre-determined analysis procedures. APSS must also be able to operate on a minimum of outside information. The base data must be available even if the LRIS system is lost. This may require large mass storage on site with frequent updating to cover all base map and thematic needs.

The steps APSS will be looking at internally to fulfill this idea of a computerized GIS include:

- get an agreement on the GIS concepts and design;
- define the hardware and software needs;
- purchase the base computer system;
- establish a connection with external data sources;
- train required development staff;
- get a pilot project operational in 1 or 2 work areas;
- create the department level database data dictionary;
- prepare a prototype of the department level GIS application;
- purchase remaining computer requirements;
- train all users;
- produce and implement the department level application;
- support the on-going project;
- do post-implementation review.

APSS will also be encouraging others to develop their own GIS applications for emergency response. Municipalities could prepare their own applications and link them to the LRIS network. Alternatively they could provide APSS with the raw data and we would apply it to our department application. Either way most data from the municipalities would become accessible to other organizations, public and private.

Even if a public safety organization chooses a fully computerized GIS, hardcopy records must continue to be collected and maintained. Despite all the standard precautions of: multiple computers, off-site backup tapes, emergency building power and an uninterruptable power supply, you never know when an incident will involve your own organization. Plans exist at APSS for the complete transfer of all resources to an alternate location. Two and three levels of data and handling system duplicity can be required.

A completely computerized GIS system sometimes is not the most economic and efficient option to choose. Depending on the size of the organization and its responsibilities, a mix of manual and electronic systems will be best for many organizations. A mixed system could also be used as an organization moves from a manual system of data handling to a fully computerized system. This approach of gradual implementation is the one APSS will likely follow.

CONCLUSIONS

Natural and man-made disasters will occur. To reduce the effects of these disasters all government levels and private industry must be prepared to react quickly. Often the only method available to handle a crisis is with manual map displays and maybe a computer database to display the site data. In the future, organizations must have access to the latest technological developments with which to minimize any human, property and environmental effects of those risks.

Alberta Public Safety Services is tasked with co-ordinating provincial, municipal and industrial activities during man-made and natural disasters when required. To perform this function, our department is presently using a manual map display system and a UNIX computer system running office automation software and a relational database. Risk management techniques can be used to determine where resources should be concentrated. Our next target will be to develop a computerized Geographic Information System. This will be tied to our existing database and to the province-wide Land Related Information System, which will be

available in the next few years. We hope to ultimately integrate the GIS into a complete knowledge based Expert System. The GIS will be used for planning, monitoring and co-ordinating for emergency situations and any recovery programs throughout the Province of Alberta.

Creating a computerized Geographic Information System is a long-term procedure but the results will make it worth while. We will be taking it one step at a time but it will become a reality.