"FOREST FIRE INFORMATION SYSTEM : WHAT QUEBEC IS UP TO"

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ABSTRACT

The forest industry is a driving force in Quebec's economy. Forest fire protection has made great strides since the mid-1970s with progress in the telecommunications field and the advent of computer technology. With its provincial computer network, Quebec uses a Forest Fire Information System (FFIS). This FFIS was developed with a module approach. Different modules serve different needs: access to all kinds of forest fire data, production of reports, inventory, graphic displays, etc. These products play an import part in deciding where to preposition fire fighting resources.

INTRODUCTION

The history and development of Quebec have been profoundly shaped by forest fires. Fire played a major role in the colonization process. It was used to help the settlers eliminate the forest to make way for agriculture. However, wild forest fires could also be a threat to villages.

The forest industry has always played a major role in Quebec's economy. Once considered an unlimited resource, government officials realized at the beginning of the 20th century the necessity to protect the forest against fire. Forest companies and government then decided to put resources and equipment into place to face the problems created by fire. The system has since evolved with mechanization, radiocommunications, better roads, aviation, etc.

Since the 1970s, tools used to suppress forest fires (pumps, hand tools, helicopters, water bombers, etc.) have evolved but only slightly compared to the progress made in telecommunications and especially computers technology. The amount of information involved in forest fire management activities is considerable and its interaction very complex. The Quebec organization started collaborating with the Petawawa National Forestry Institute (PNFI) of the Canadian Forest Service (CFS) in the mid-1970s. This collaboration was mainly oriented toward the use of computer technology, helping us to integrate and manage the differents types of information. This paper will summarize the development and the current status of the Forest Fire Information System (FFIS) used in Quebec.

BACKGROUND

Forest fire protection in Quebec is assumed by one organization over a territory of more than 500 000 km^2 in the intensive protection zone. In that territory every fire is attacked rapidly and aggressively to minimize the damages and losses.

The organizational structure is composed of a provincial fire center and four regional fire centers. It has been established that to be efficient, the regional offices and the provincial center need the same information in "real time." Moreover, this information had to be organized in a way to take advantage of the technologies. Using of the Forest Fire Information System and a provincial computer network meets these needs.

This system originated in the early 1980s and was first developed on a mini computer with a few working stations. The information was centralized at the regional fire center and the speed of the computer limited applications.

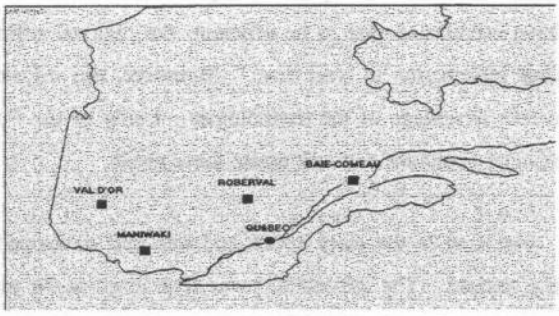
The data on the computer was also limited to weather observations, a rudimentary fuel type data base and historical fire data. The outputs met the needs at the time but the computers were neither very powerful nor fast.

In the mid-1980s we added lightning detection data to the system. PCs were becoming affordable and computer power was increasing rapidly. Over the years we refined the system and its products in order to meet the operational needs for an organization facing emergency situations.

COMPUTER NETWORK

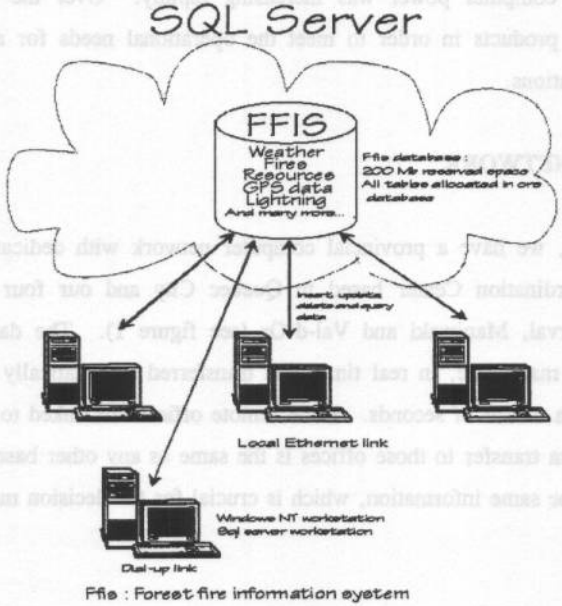
Since 1994, we have a provincial computer network with dedicated lines between our Provincial Coordination Center based in Quebec City and our four main bases in Baie-Comeau, Roberval, Maniwaki and Val-d'Or (see figure 1). The data is entered into the system at each main base, in real time, and transferred automatically to all other points of the network in a matter of seconds. Some remote offices are linked to the network with dial up lines and data transfer to those offices is the same as any other base. With that approach every PC has the same information, which is crucial for the decision making.

Figure 1



The network (see figure 2) consists of one server at each point of the network and each working station is an IBM compatible PC. The whole system runs under Windows 3.1 or greater and the development of programs is primarily made with commercial software such as Visual Basic.

Figure 2



Ffis : Forest fire information system

FOREST FIRE INFORMATION SYSTEM CONTENT

The system is built with a module approach. We can add or delete a module without modifying all the system. However, some links can be made between modules for certain applications.

The first module gives access to the mail and determines the level of access for each user. Anybody can consult the FFIS but security codes give limited access for data input.

The second module gives access to data input programs. We have databases for weather observations, weather forecast, fire information, lightning, ground, aerial and heavy equipment resources, forest fuel types and equipment inventory.

Some data is manually entered, e.g. weather information and some is automatically updated e.g. lightning. The forest fuel type database is updated once a year to include all modifications since the previous year, e.g. area burnt and area harvested.

The third module is for producing all kinds of reports. Current and historical data (up to twenty years of fire and weather) can be questioned for statistical purposes.

During the fire season, active fires can be monitored and this allows the managers to evaluate the situation. All reports are accessible to all personnel.

The availability status of fire fighting equipment inventory is also included in this module.

The fourth module is for graphic display. Using different scales, the user can graphically visualise all of the available information. It is mainly with this fourth module that the FFIS is most useful. From each database we can obtain different products to help the fire managers in the decision making process. The first product is the calculation of various

indices that show how dry the forest is. In other terms it is the susceptibility of the forest to burn: how easy it can ignite, how deep the forest floor can burn, how fast the fire can spread, etc. Those indices combined with the forest fuel type give us two other products: the rate of spread and fire intensity. The rate of spread is used with the productivity rate of the different resources used. Fire intensity is used to determine the resources required to fight the forest fire. Every type of resource has its limits.

A fourth important application is the monitoring of our detection aircraft. During the summer we have under contract thirty-three single engine aircraft for fire detection. Each aircraft is equipped with a GPS that regularly transmits the position of the plane. This information is received at a base and is sent automatically on the network. Without speaking to the pilot we can follow the aircraft. This fulfils security requirements and gives us pertinent information on the flight: aircraft identification, altitude, speed, position, direction, date and time of position. The GPS is used to pinpoint the location of every forest fire detected and this position is also radio transmitted to our computer network. Another application made possible with the GPS is the mapping of forest fires perimeter. When the aircraft doing this mapping returns to the base the information is downloaded to the computer and becomes available throughout the network.

The location of all our resources is regularly updated so the managers can follow their deployment and know what is available for fighting new forest fires.

The last main application in the graphic display module is lightning detection. From a provincial network of lightning detectors the position and time of arrival of each cloud to ground strike is recorded and transmitted to the computer network in real time. We can easily monitor the pattern of thunderstorms then afterwards carry out detection patrols to find any lightning fires. It is also very useful for the safety of our air operations.

The graphic displays allow us to add layers of information or to split the screen in four different displays. It is also possible to change the scale of each display. A topographical

background can also be added to the display. These topographical maps are stored on a laser disc.

In the fourth module there is a sub-module used when we have a new fire. By entering the fire's position, the system will pinpoint it on a 1:50 000 topographical map retrieved from the laser disc. The system will also automatically retrieve for this territory weather and indices, fire behavior (rate of spread and intensity), available resources and their distance to the fire and the information on the nearest municipality.

The fifth module consists of a statistical application for reports and a fire behavior prediction sub-module to evaluate simulated conditions.

The sixth and last module is used to map out the daily aerial detection routes. These detection patterns are based on the indices, lightning activity, visibility, weather, etc.

CURRENT APPLICATIONS

The FFIS is designed to incorporate as much information as possible to help the managers in forest fire management duties. It is primarily used to anticipate forest fire activity. First there is the occurrence of new fires and second the activity of existing fires.

This anticipation leads to the prepositionning of resources at strategic locations. For that, we have to determine what length of time is acceptable between the time a new fire is reported and the initial attack.

Once a new fire has been reported, forest fuel type and indices information are combined in the fire behavior prediction module so we can anticipate the level of fire activity.

SHORT TERM DEVELOPMENTS

Currently, predicting the occurrence of forest fires is done by people. However, some models have been developed for human causes and lightning. We will test those models and try to adapt them to our context. This would help us to anticipate the level of fire activity before prepositionning resources.

This prepositionning is also done by people. The expertise of managers is the key factor for that activity. Again some models have been developed and we will try them.

LONG TERM DEVELOPMENTS

The aerial detection planning has to consider many factors on a day to day basis and some elements can vary from one year to another. Some development has to be foreseen to optimize this very costly activity. A computer program that would incorporate all factors and constraints is needed but its development could take years.

We think that remote sensing will eventually give us the capability to detect forest fires. For the moment no satellite or sensors can fulfill our need for early detection of fires.

CONCLUSION

The management of emergency situations requires a lot of knowledge but also acurate information on the situation. The development of the FFIS over a period of 10 years has taken this into consideration. It would have been impossible without computer technology.

The situation we are now encountering are more and more complex, pressure to protect wild areas is increasing, budgets are shrinking, etc. We have to develop tools to help us to fullfil a more demanding mandate with equal or less resources. The use of fast and reliable information systems is crucial. The FFIS has become indispensable in our fight against fires.