Calculating probability to improve emergency coverage

A real-time automated planning tool that calculates the probability of emergency calls is helping Surrey Fire Service in B.C. provide more thorough, responsive and cost-efficient emergency coverage.

As B.C.'s largest composite fire department covering one of the province's fastest-growing communities, Surrey Fire Service faces the ongoing challenge of maximizing its resources while responding to unpredictable emergency incident rates in different neighbourhoods.

In its search for a solution, Surrey Fire began exploring "move-ups" two years ago – that is, temporarily moving its career resources to provide emergency coverage when and where it is required. Using Deccan International's automated Live Move-Up Module (LiveMUM), the department has been able to predict where coverage will be needed and shift its resources accordingly.

It's a different approach from the tradition of providing full standby fire coverage for all areas at all times – to the point that stations are backfilled even when the chance of a call is minimal.

"The goal is to be in the right place at the right time, and these tools allow us to do that," explained Surrey Fire Chief Len Garis. "It's like Wayne Gretzky's approach – being where the puck is, instead of chasing the puck."

LiveMUM interacts with the city's Computer-Aided Dispatch (CAD) system in real time to determine when and where move-ups are necessary. For example, when the closest units to a particular neighbourhood will not be available for a significant period of time, a move-up may be needed.

However, simply looking to address coverage holes would result in numerous unnecessary move-ups, because many times such holes may not get any call to make the move-ups worthwhile. Thus, an accompanying risk-assessment mechanism has been added to help ensure that any relocated resources will actually be put to use.

This critical component of LiveMUM uses historical data to calculate the probability of a call occurring during the time period when units are not available in a particular neighbourhood. Factors such as location, time of day and day of the week are part of this calculation. As a result, a move-up into a particular area would be recommended at times/days when the area's call volume is typically high, but not at times/days when it is typically low.

The system employs what is known as Bayesian inference to probability calculations – a simple mathematical formula that determines the probability of an event occurring based on past incidences of the event.

An example of this approach is a gas station owner who operates a convenience store and a car wash, but has only one employee to work at the two sites. At different times of the day, the owner wants the employee to be at the location where the demand is greatest.

He decides it is only worthwhile to post the employee at the car wash if there is at least a 50 per cent chance of having four car-wash sales per hour. Using historical demand at other similar car-wash operations, he can use the Bayesian calculation to determine the probability of a certain number of car-wash sales per hour – zero, one, two, three, four or more – at different times of the day, and then place the employee accordingly.

LiveMUM applies this same approach to determine the probability of at least one emergency call occurring in a particular neighbourhood on a particular day and at a particular time, based on the history of calls in the area. The system will only recommend a move-up if the probability of a call occurring is above the threshold determined by Surrey Fire Service.

The user-friendly format uses colour-coded maps to illustrate various levels of move-up necessity for different types of apparatus in various areas.

For example, if two adjacent fire halls are out on calls, a red colour on the map would indicate where a move-up of a pumper, ladder or rescue truck is required, based on the probability of a call occurring while the units are in use elsewhere. But if a move-up is not necessary due to historical call infrequency at that time, the area would be coloured orange indicating a hole in coverage but not enough calls to warrant move up.

Colour-coding also shows where the level of coverage is acceptable (yellow) and optimal (green) throughout the service area. As well, fire stations on the map are colour-coded to show if they have units available, no units available or no units assigned. Detailed station-by-station unit information is also available.

The system accommodates multiple concurrent scenarios – an important feature for a department the size of Surrey Fire Service, which has 17 fire stations covering a service area of 317.4 square kilometres and a population of about 450,000.

The historical data LiveMUM uses to calculate probabilities is routinely updated, ensuring its move-up recommendations remain accurate and can be trusted.

This type of risk-based approach to providing public-sector services is not new, particularly in Canada and the United Kingdom, where it is becoming popular in healthcare and other public-sector realms.

Chief Garis noted that a risk-based approach makes sense for any organization that wants to maximize its resources while ensuring thorough and responsive service – particularly communities facing ever-increasing emergency response costs and increasing demand for service from the public.

For the City of Surrey, he said, LiveMUM enables the Fire Service to dynamically apply its resources in an efficient, targeted manner, with no reduction of service. “In fact, the use of LiveMUM could actually improve overall fire service to the community because we are at the right place at the right time.”

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