

Cadcorp SIS is a desktop Geographical Information System (GIS) which West Midlands Fire Service (WMFS) utilise in their risk management process. One of the many components of this software is a bespoke; add on piece of software called Incident Analyser. This software has the ability to predict at which of our stations the available appliances (fire engines) should be based to best address the predicted level of demand. This is called 'Predicting Demand'.

The output of the model is in the form of a spreadsheet which shows how the available number of each type of appliance should be distributed, to achieve the most efficient and effective response to emergency calls.

## Inputs

The Predicting Demand model requires various inputs from the user which are defined, dependant on the scenario the user wishes to simulate. These include callsign data (all vehicle movements, excluding exercises and standbys), the location of the stations (eastings and northings) and also the number and type of vehicles available. The locations of these vehicles can be defined or undefined depending on whether the user wants the software to decide on the vehicle distribution to a greater extent, or to allow for the operator to use professional judgement in interpreting the results.

In this instance the inputs were defined to best reflect the reality of mobilisation in WMFS. 3 runs were completed for 3 different time periods.

The constant inputs were as follows:

- ❖ Number of Appliances: 61 Pump Rescue ladders (PRLs) and 2 Targeted Response Vehicles (TRVs) located at their home fire stations Dudley and Hay Mills.
- ❖ Station Locations: WMFS' current 39 fire stations
- ❖ Mobilisation criteria: Nearest station to the incident via a straight line methodology, target vehicle attendance time of 2 x 8 minute target\*, seed an appliance where the callouts exceed a 10% threshold\*\*.

The varying input was as follows:

- ❖ Callsign Data: 2006/9, 2007/9 and 2008/9.

\* A 2 x 8 minute target time was used to account for variability around the 'average' 5 minute target attendance time used within WMFS.

\*\* Seeding appliances at fire stations ensures that the PRLs are located at the busiest stations. Without this option the PRLs would be located on a first come first served basis.

## How does the Predict Demand model work?

The model goes through 168 time slices (24 hours x 7 days of the week). When all of these slices are complete the model takes the maximum number of appliances required for that day and hour slot and produces an output.

The Predict Demand model goes through a number of steps for each incident that occurs. The number of incidents it examines depends on how many incidents the user inputs into the model via the callsign data. The basic steps are as follows:

1. Is there an appliance available at time of request assignment at the nearest station to the incident?
2. If yes then mark the appliance as busy until the request release time and get the next request.
3. If no then is there an appliance free at a neighbouring station?
4. If yes then mark the appliance as busy until the request release time and get next request
5. If no, see if the initial station has capacity for another vehicle (if we have one left in the unallocated pool)
6. If a vehicle can be placed at this station then do so and mark it as busy until the release time
7. If no then see if another vehicle can be placed at a near station
8. If yes then place a vehicle at the near station and mark it as busy until the release time
9. If no, then the model cannot respond to the request and the total for 'Un-resourced' in this hour is incremented.

These steps are heavily influenced by the user's mobilisation options, for example the seeding option and target vehicle attendance time.

A further point to note is that the Predict Demand model always takes the maximum number of pumps required for each time slot analysed. Therefore the Predict Demand model is heavily influenced by large/ resource intensive incidents and always gives a worse case scenario output for each time slot.

## How much incident data do we examine?

We have to strike a balance between analysing several years' data to give a reliable picture of past experience and performance, against the need to look more closely at the most recent incident data- so that we take account of recent trends and do not rely on information that is dated, or losing its currency.

Taking these factors into account, we normally use 3 years' data, which still amounts to something like 130 000 incidents.

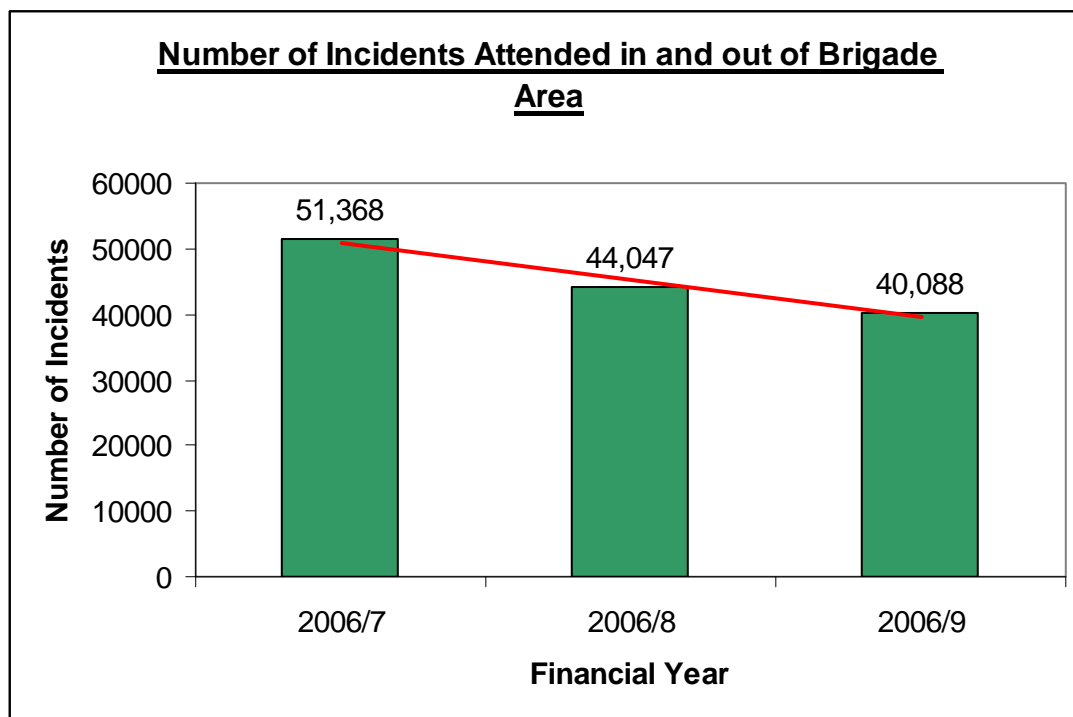
## Analysis Results

**2006/9:** The 2006/9 analysis describes the familiar pattern of the 'average' response curve: The smaller number of PRLs being required in the early hours of the morning and the larger number being required in the evening period. The peak however occurs between 23:00 - 23:59 at 47 PRLs, at this time there are only 48 PRLs on the run and so capacity is almost reached.

The analysis portrayed that WMFS was over resourced at 19 fire stations, 19 fire stations have the correct number of resources and 1 fire station is under resourced

It is important to note that this analysis is heavily influenced by resource intensive incidents and so allocated PRLs may have only been required for 1 hour across a three year period.

It is also important to note the reduction in the number of incidents over the last 3 financial years; the significant decrease can be seen in the graph below.



If we take this reduction into account we can see that the 2006/9 analysis will have used 2006/7 data in the main as it looks to a maximum number. Therefore it is important to examine the more recent financial years on an individual basis for a more accurate reflection of the present decrease in demand and resource requirements, even though this entails the use of a smaller dataset than normally employed.

**2007/9:** The 2007/9 analysis uses the same parameters as the 2006/9 analysis with the exception of the callsign data which is the last 2 financial years as apposed to the last 3 financial years. The graph above shows that approximately 84,135 incidents are used by the model to predict demand and produce the final outputs.

Again the Predict Demand model produced the familiar hour by hour pattern of quiet mornings and busier evenings. Again the peak occurs at 23:00 but this peak shows a lower resource requirement than the previous analysis. In fact this shows a reduction in resource requirements for each hour slot.

The analysis states that 29 fire stations are over resourced, 9 fire stations are correctly resourced and 1 station is under resourced.

**2008/9:** The final analysis and output describes the resource requirement using only the most recent financial year's data. The graph on the previous page illustrates the reduced number of incidents being used to answer this question (approximately 40,088).

The peak of resource requirement (34 PRLs) occurs earlier in the evening during this analysis at 18:00 which is more typical of the familiar resource usage and incident curve which is produced each year. There is however an atypical drop in resource requirement at 20:00 to 27 PRLs which then increases again to 30 at 22:00. As mentioned previously this analysis is highly influenced by resource intensive incidents and so the occurrence of a number of these at around this time of day, could explain this anomaly.

34 fire stations are deemed to be over resourced by the analysis and 5 are stated to be resourced correctly. In fact 13 of the 39 stations were given a PRL for less than half of a 24 hour period. 2 of these 13 stations (Perry Barr and Handsworth) received just 1 PRL for a 1 hour period.

## Conclusions

The above analysis is based purely on historical data and can take no account of the possibility of large simultaneous incidents. This is why we must have a resilient buffer of PRLs during peak activity times (10:00 - 22:00) in case this occurs. The analysis illustrates that WMFS are adequately resourced, allowing WMFS to not only meet 'average' activity but also provide a resilient buffer for periods of peak demand.

The buffer of PRLs also helps to reduce service interruption. The current business rules allow 15 PRLs to be 'off the run' during the late shift (10:00 - 22:00) to do activities such as prevention work and training. These appliances are given a protection time in which to be recalled if required, which means that service interruption is minimised.