The Full Picture: Assessing the Present and Future Roles of Technology on Firegrounds

Z.Phillips
NSW Rural Fire Service

Abstract

There has been a requirement identified for Incident Management Teams (IMTs) to have knowledge of personnel competencies and training levels to enable formation of effective fire crews. There has long been a desire by IMTs for in-depth knowledge of the fireground location and quantity of equipment and resources placed at their disposal for fire-fighting purposes.

This study, undertaken in 2002 and 2003, documents the issues surrounding the flow of information on firegrounds and incorporates:

- An assessment of the suitability of new technologies to the Australian fire fighting environment
- An assessment of the barriers to the adoption of these technologies and what needs to be done to overcome them.
- Recommendations for FULL and other technologies for Australian fire agencies, including how these technologies may be incorporated to ensure they are capable of incremental development, optimising a return on investment.

The information obtained may help agencies in all Australian states and territories to plan their technological development in fire personnel management and assess personal safety, training and competencies. Ultimately, such a system could be implemented incorporating GIS-based technology to give IMTs accurate, secure, real-time information on the geographical location of these resources.

All opinions, unless stated otherwise, are that of the author and may not be representative of those of the NSW Rural Fire Service, the Australasian Fire Authorities Council, or any of the agencies, companies and individuals who have assisted in the project.

Introduction

Bushfires have been an integral part of the Australian environment for millions of years. Vegetation in fire-prone areas has not only become fire-tolerant; it has become a regenerative fuel source for fire. As Australia has populated, large proportions of urban areas have been situated around these high fire risk sites. The need to protect lives and property from the threat of fire has grown with the increase in urban-wilderness interface zones (UWIZ), resulting in the subsequent growth of volunteer rural fire brigades (Luke and McArthur, 1978).

Australia's reliance on volunteer fire personnel is rarely emulated in countries threatened by wildfires. Whilst the training among volunteer brigades is of a high quality, the continued monitoring and evaluation of personnel capabilities has to date been restricted to professional land management agencies involved in fire suppression (Cheney, pers.com).

The inexperience of personnel, or lack of information about personnel capabilities for reference by fire ground leaders, has been a cause for concern for many years. Inexperienced crews can find themselves placed in situations beyond their capabilities. This, combined with a lack of communication, can place personnel in grave danger. Unfortunately, these situations, such as Linton, can prove fatal (CFA/NRE Report, 1999).

The importance of knowing facts in a timely fashion escalates with the magnitude of the emergency. The complexity and variability of firegrounds has always ensured that this concept remains a challenge to agencies, incident management teams and firefighters alike. With the advent of new and improved ways of fire suppression and management has always come resistance and skepticism; the attitude of 'if it isn't broke, don't fix it' is still alive and well within the brigades and agencies.

Technology has evolved so rapidly over the past few decades that, to many people, it is now incomprehensible. The primary purpose of this study has been to take technology down off its pedestal, to examine its many forms for what they are, what they should be and ultimately what they can do to help agencies improve communications systems, management systems, training operations and hopefully, save lives.

All opinions, unless stated otherwise, are that of the author and may not be representative of those of the NSW Rural Fire Service, the Australasian Fire Authorities Council, or any of the agencies, companies and individuals who have assisted me in the project.

Outline

The FULL PICTURE project was concepted as being a feasibility study for the implementation of a comprehensive information management system with a GIS-based wireless locator core to provide field operations officers and incident management teams with real-time information. This information has included knowledge of fire personnel (including their skills, competencies and movements on the fireground), resources, and fire behaviour parameters such as meteorological conditions and topography. The project structure is detailed in Appendix 1.

The study comprises three sections:

- An assessment of the suitability of new and existing technologies to the fire suppression environment;
- An assessment of the barriers to the adoption of these technologies and what is need to overcome them; and
- Recommendations for FULL PICTURE and other systems for Australian fire agencies, including how these technologies may be incorporated to ensure they are capable of incremental development, optimising a return on investment.

The suitability of new and existing technologies explores the benefits and problems associated with individual elements of a FULL PICTURE system including radiocommunications, mobile networks, GPRS and WAP, infrared detection and satellite communications and imaging.

Barriers to technology uptake and usage, their identification and paths to adoption incorporate the findings from a survey undertaken of volunteer and professional fire personnel.

Recommendations for technology development and uptake within fire agencies explores the importance of planning technologies, the road mapping process, incorporating technologies for optimum performance and how fire agencies may be influenced by technological growth and demand within the industry.

All working systems are continuously in a state of metamorphosis, adapting and growing as the inputs and outputs are subjected to change. It is the construction of a system to allow the incorporation of new variables while retaining its integrity and purpose that poses a challenge for the future, not only for the technology, but also for the people who interact with it.

Technology

Fireground technologies are fundamentally purpose-driven modifications of military or general applications and can be divided into three main groups:

- Communications
- Data Systems
- Imagery and Location

Communications

Fireground communications incorporates predominantly hardware radiocommunications including trunk and digital, mobile telecommunications and data networks such as WAP and GPRS. New South Wales, and indeed most of Australia, provides many challenges to even the most robust communications systems. Varying in geography from densely wooded, mountainous areas to vast plains, NSW relies heavily on the Government Radio Network based PMR system and it's related simplex channels to ensure solid communication lines between brigades servicing a fire ground. Unfortunately, this network is incompatible with those used in other states, including the ACT, which NSW surrounds – a problem that was highlighted during the Canberra fires. Although there has been ongoing discussions on this issue, an agreement on a nation-wide radiocommunications network is still deeply bound in political red tape.

There are some areas of the state that suffer black-spot problems, usually due to communications shadows cast by mountains or by sheer distance. In these cases, fire crews are often relying on UHF radios to communicate with others, relaying messages from incident managers. There are Communications Units equipped with repeaters within the agency, however in difficult terrain such as the Blue Mountains, Morton and Kosciusko National Parks or the Brindabella Ranges, deploying these units to improve coverage is not always possible.

A lesser problem is the devices themselves. Externally mounted whip aerials can become disabled if the vehicle is overrun by the fire or has an altercation with overhanging tree branches. While this problem could easily be fixed with a flat-mounted, polymer-cased aerial, the number of vehicles in the RFS soon puts a large price tag on such an exercise.

Mobile telecommunications, although vastly improved from the metro-centricity of past years, are also patchy with coverage. In large-scale incidents, the limited bandwidth also presents a problem where there is coverage, as it can become easily congested and therefore rendered inoperable. Use of dedicated bandwidth may be a feasible option for emergency services to consider if necessary, however the location of many fires in no-service areas of the state could restrict the efficiency of this.

The sending of data is, at the present time, mostly confined to Fire Communications headquarters and other fixed monitoring points, although the use of wireless communications devices at remote staging areas is increasing. The development of General Packed Radio Service (GPRS), a continuously connected yet discretionary technique, is improving network capabilities by only reserving transmission space when data transfer is requested, rather than continuously occupying resource space when the device is connected. This allows more than one connection to share a channel without having to re-connect to the network. The downside of GPRS is that the 'packets' of information are sent independently of one another, and so may arrive at the intended destination out of order.

Data Systems

Data systems are software applications, either custom built or off the shelf products, used by agencies to record and analyse personnel, incident, and logistic knowledge on an individual, regional and incident level. The systems rely heavily on 'clean' data; data that current and is entered with accuracy. 'Dirty' data such as incomplete entries, wrongly spelt details or entries in the incorrect fields can damage the integrity of results and reporting. The systems in place are slowly becoming accepted, although, like radiocommunications they are not interoperable with other states or indeed even other services such as the State Emergency Service. This flaw presents an issue when interstate crews attend Section 44 emergencies, or when fire personnel transfer to the Rural Fire Service from another state.

One way of overcoming such a problem would be the implementation of a national volunteer firefighter card, much like a drivers licence, that had the ability to store basic information such as address, brigade details, qualifications and perhaps medical details. There are systems available that would allow some of the information on the card to be updated as necessary, for example via a laptop at a staging area, while ensuring only accredited training officers could update the qualifications of individuals. The issuing of a number with the card would mean personnel could be identified to incident management teams even when out of region, or over a radio. It could also stop confusion where there is more than one person with the same or similar name.

While a card could improve the monitoring of personnel, there are privacy and financial issues that would have to be overcome. The setting up of a national database would take considerable time and resources, not to mention the capital outlay in the manufacturing and distribution of the cards and related hardware. This aside, the sharing of information between states will assist incident teams and increase firefighter safety. Ensuring privacy of information is difficult, but not impossible. For example, medical details if included on the card could be restricted viewing and only accessible to medical personnel or hospitals.

Imagery and Location

Imagery and location involves the usage of hardware, such as Global Positioning System (GPS) handsets, and software, such as ARCview and MapInfo, to produce accurate two or three-dimensional maps of incident areas. Location data from fire boundaries, backburning operations and dozer lines is taken by GPS readings from aircraft (usually helicopters) and relayed by radio to ground control, where data is entered into a spreadsheet. This location data is then overlaid with topographical and infrastructure information to provide planning and operations teams with maps of the fireground. From these maps, predictive modelling using weather forecasts, topography and aspect, and estimated fuel types and loads is applied to the mapped area to produce a possible scenario for up to 24 hours. The accuracy of the maps is heavily reliant on the quality of the data collected – and on availability of and favourable flying conditions for, the aircraft to collect data.

UAVs, or unmanned air vehicles, have been the favourite toys of defence forces around the world for several years. Able to carry infrared and video cameras silently over enemy lines and transmit clear, accurately mapped images back to a central point in real-time, they have become the most effective and efficient information collection vehicle. Available for a fraction of the price of a fixed wing or rotary craft, UAVs are able to fly in any conditions – including heavy smoke and at night – without risking personnel lives.

While the UAV may seem extravagant, its applications are many and varied. Apart from fireground, or indeed any emergency area including flood mapping, uses could include:

- Acting as an airborne repeater for radiocommunications
- Monitoring arson target zones such as National Parks on high fire danger days when arson activity is most likely
- Coastal search and rescue
- Planning for hazard reduction and UWIZ management
- Traffic control

Aside from the initial cost involved in acquiring the UAV, there are a few other issues – the most contentious being the availability of airspace around metropolitan areas. In the event of heavy smoke, passenger aircraft may be diverted away from the area, but discussion with the Civil Aviation Authority would be needed to develop a protocol for use of the UAV when required.

Although aviation personnel have been using GPS for many years, handheld GPS devices are gradually being acquired by brigades for use in ground vehicles to assist in the accurate location of resources on the fireground. As demonstrated in Figure 1, the results of the survey conducted operator confidence is low with over 80 percent of respondents indicating they were not confident in the operation of a GPS handset. This strongly illustrates the need for specific training to ensure that new technologies are used correctly and that personnel are comfortable and confident enough to use them.

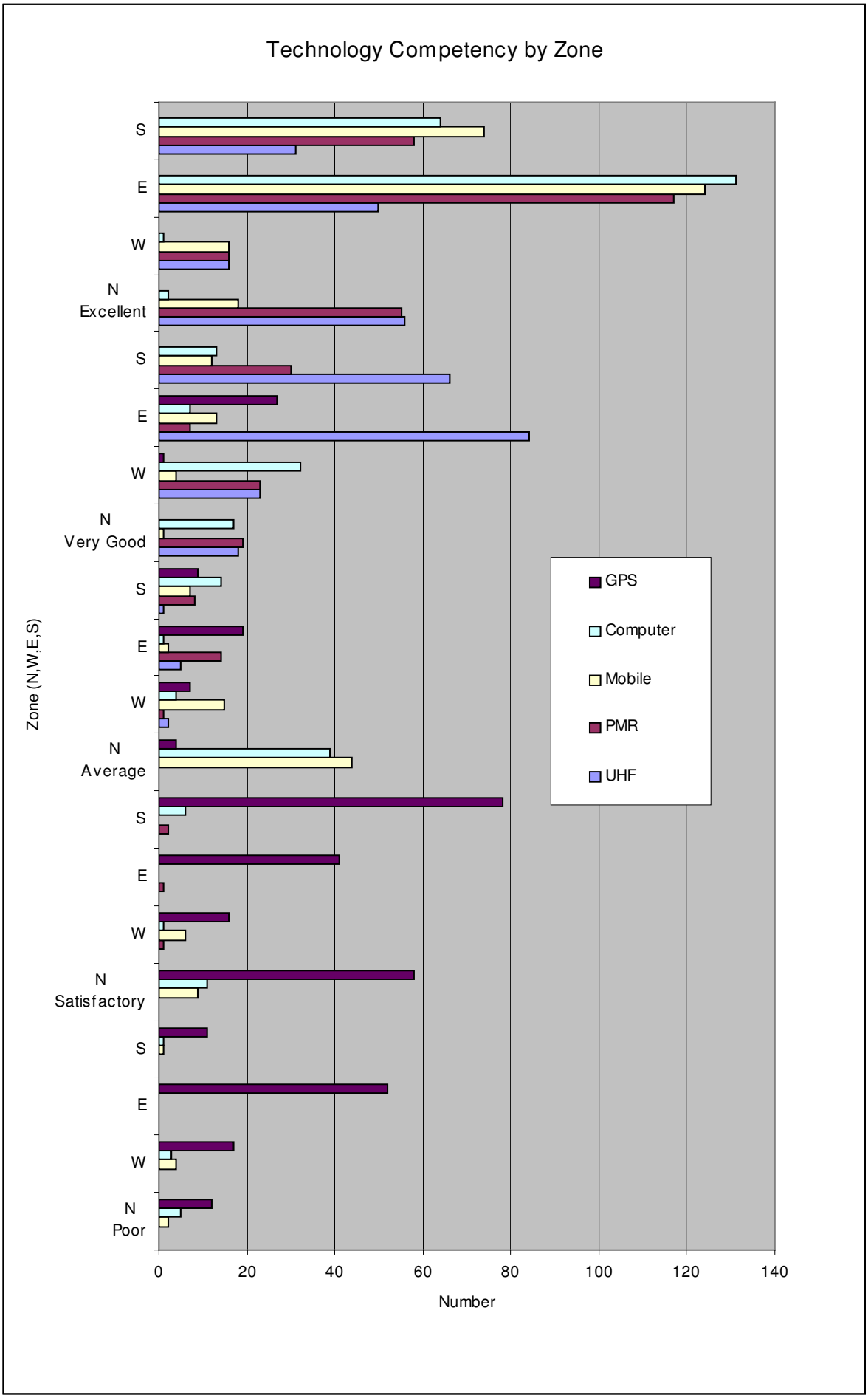

Figure 1. Self-rating of NSW Rural Fire Service personnel on competency with common fireground technologies. Personnel are divided into their brigade zones, North, West, East and South.

Roadmapping Technologies

This study highlighted one key fact. Australian fire agencies are not ready for new technologies. The overwhelming bureaucracy and complete lack of willingness by the states to establish commonality will prevent agencies from making progress and will continue to cost the community for years to come.

The hurdles faced by fire agencies when planning for the future are many, not least being the lack of consultation between states and territories to ensure interoperability. This was made painfully clear in the Canberra fires of January 2003, where the communication flow between NSW and ACT brigades was severely restricted. This is not unique to Australia; provinces and states around the globe have similar problems, some legendary.

Wildfire is not a sport. There is no room on a fireground for rivalries, yet as long as there are state-based agencies there will be conflicts. The recommendations arising from this study are as follows.

1. That a working group is established to develop a set of standardised communications operating procedures, and ultimately systems, for all state agencies.
2. That states actively seek to establish interoperable radio and communications systems through the lobbying of Federal Government.
3. That specific technology-based training programs are offered to volunteers and career firefighters on a regular basis, and that competency in these areas are demonstrated before personnel are required to use them on an active fireground.

References:

LUKE, R.H. & McARTHUR, A.G. (1978); *Bushfires in Australia*, Australian Government Publishing Service, Canberra

MISCELLANEOUS (1999); *CFA/NRE Operations Review Team Report*, Department of National Resources and Environment, Australia