

Post Black Saturday: Development of a bushfire safety system

Lisa Sturzenegger and Terry Hayes examine Country Fire Authority's post-Black Saturday bushfires Bushfire Safety System.

ABSTRACT

Following the devastating effects of Black Saturday, Country Fire Authority (CFA) in Victoria developed the concept of a 'Bushfire Safety System' to address issues within its community preparedness programs. The Bushfire Safety System demonstrates that there is no single solution to creating safer communities and that there is a strong relationship between the role of government, community and individuals to build a safer environment. This approach to community preparedness will strengthen the resilience of our communities and reduce bushfire risk.

- Community warnings and community information (when and how warnings are received),
- Vegetation management (creating and maintaining a defensible space around homes)
- Building codes (constructing buildings to withstand the passage of fire and severe ember attack), and;
- Planning laws (where people are allowed to build), refuges and evacuation (Teague, McLeod, Pascoe 2010).

CFA recognised that an improved approach was required to address these issues, and in the months following Black Saturday developed the concept of a 'Bushfire Safety System' based on systems theory (Robbins, Barnwell 2002). It was designed to combat the impacts of bushfire in Victoria and acknowledge that there is no 'silver bullet' or single risk reduction measure that could be effective in isolation.

Introduction

CFA is responsible for the delivery of fire prevention and suppression services to over 3,000,000 residents in Victoria. Many of these services are now in the urban/rural interface where some 484,000 people reside, with approximately 250,000 people living in the 52 towns identified as being at high-risk from bushfire.

The 2009 bushfires brought unprecedented destruction and loss of life to Victorian communities, many of which were unprepared. Community preparedness was severely compromised by more than a decade of drought and a record breaking heatwave in late January, which coincided with the highest temperatures ever recorded across much of Victoria (Tolhurst, 2009). Combined with strong, dry, hot winds and uncharacteristically unstable atmospheric conditions, the result was a number of catastrophic fire events (Bushfire CRC, 2009). The devastating fires compromised every line of defence and affected approximately 430,000 hectares of public and private land, claimed 173 lives and destroyed over 2,000 homes and 61 commercial premises (VBRC, 2009).

Key issues that emerged from the 2009 Victorian Bushfires Royal Commission (VBRC) included:

What does a bushfire safety system look like?

In designing the Bushfire Safety System, the first consideration was to look at the risk reduction measures (also known as treatments) that were available to be implemented ahead of the forthcoming fire season that would address the issues emanating from the 2009 Victorian Bushfires Royal Commission Interim Report (VBRC, 2009).

The issues that emerged from the VBRC could be described as complex or 'wicked' (Australian Public Service, 2007). A 'wicked' problem is often described as being beyond the capacity of any one organisation to understand and respond, and there is often disagreement about the causes of the problems and the best way to tackle them.

Using a systems approach to 'wicked' problems is not new in its application – a system is quite simply a recognition that there is a set of interrelated and interdependent parts. The unique characteristics of the systems viewpoint is the inter-relationship of parts within the system. Every system has diverse forces: differentiation and integration (Robbins et al, 2002).

Figure 1 (below) illustrates an overview of a Bushfire Safety System (BSS). The model operates as a matrix of interdependent and interactive risk reduction measures that take into account the roles, capacities and responsibilities of government, communities and individuals. The weighting and scale of responsibility in each quadrant are not equal and highly dependent on the level of investment placed into a risk reduction measure. Acute focus is often placed on the individual/household

The BSS recognises that both active and passive measures are important to our bushfire safety outcomes. An active measure is one seen as an individual having to make an active decision or action; whereas a passive measure is one that generally occurs without notice to an individual (for example a airbag).

There are four quadrants shown in the BSS with examples of risk reduction measures:

- **Enforcement/Economics** (incentives or disincentives to do or not do something)
- **Education/Empowerment** (educating and empowering people with the responsibility to act)
- **Engineering** (using design/technology to solve a problem)
- **Environmental Modification** (modifying the environment to reduce the risk)

Each element of the system contributes to a risk reduction measure. When delivered together these elements aim to reduce the number of holes that are described as the 'Swiss Cheese Theory' (Reason, 2000) and thus improve the overall safety.

(Brunner, 2009) describes the "Swiss Cheese Model" and how each layer of cheese represents a barrier that will prevent an unacceptable event from occurring, however each barrier has holes in it. When all the holes

in the barriers line up then an unacceptable event may occur.

Risk reduction measures (treatments)

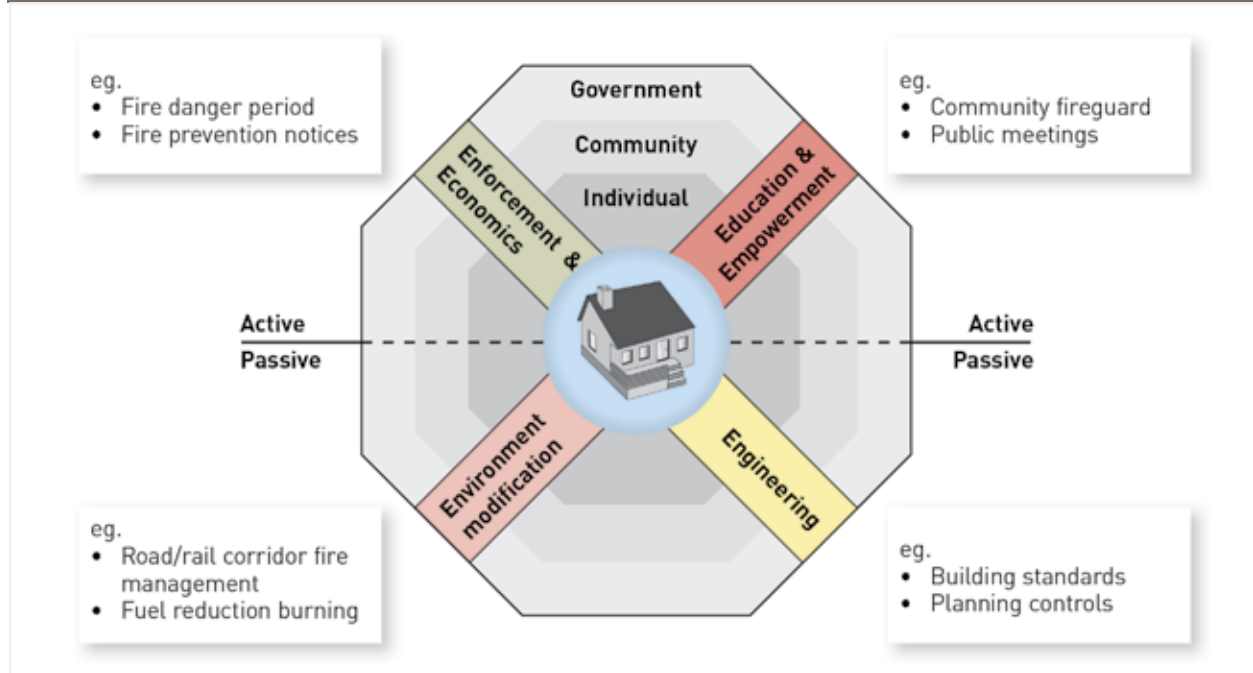
No single measure provides an absolute solution to reduce the risks from bushfire. Bushfire agencies within Australia have stated publicly over the years that they do not have the resources to defend every property that may be in danger when a major bushfire occurs.

In the past decade or so there has been a clear movement within fire agencies and emergency management organisations more generally to acknowledge that by increasing knowledge and understanding about bushfire it is possible to reduce bushfire risk (Elsworth et al, 2009).

Most emergency management agencies in Australia have adopted a risk management approach using the AS 4360 or ISO 31000 risk management standards with a clear focus on prevention, mitigation and community preparedness (Smith, Nicholson & Collett, 1996).

This transformation in thinking from the traditional bushfire response to preparedness of communities in Australia has international parallels in the fields of emergency management, crime prevention and public health and is broadly described as the 'community safety approach' (Elsworth et al, 2009). These community safety approaches cut across each other and are often underpinned by differing paradigms including the medical, health education, public health and system engineering paradigms (Hanson, Vardon & Lloyd 2007).

FIGURE 1. Bushfire Safety System Sturzenegger et al 2010.



Applying a systems paradigm to bushfire

Within the aviation industry these paradigms are referred to as a concept known as the 'Swiss Cheese Theory' (Reason, 2000), which is based on the idea that it is extremely difficult, if not impossible, to get a single risk reduction measure absolutely perfect and therefore reliably mitigate risk on its own. This is why robust safety management systems are constructed of multiple overlapping, even redundant controls.

A risk reduction measure here can be thought of as a slice of Swiss Cheese with a number of random holes, each representing a weakness or service delivery gap. The worse the design and implementation of a measure the more holes it has. The fewer measures (or slices of cheese) there are in place, the more likely it is for the holes to line up and mitigation strategies to be unsuccessful. When layers of Swiss Cheese - or rather multiple measures are combined even imperfect controls are remarkably effective.

The experience of the February 2009 fires in Victoria showed that some of the risk reduction measures adopted by CFA were not aligned and there were some weaknesses in their application. Even with many layers (defined here as the broader emergency services, including the government, communities and individuals themselves) to the State's risk reduction strategies, catastrophe can still occur. This then drives the need to implement many layers of risk mitigation, considering how each risk reduction measure as an isolated and imperfect control can fail without understanding its relationship to another risk reduction measure. This forces us to consider each measure in terms of 'systems thinking'.

Understanding how each measure interacts with the other will allow for strategies aimed at preventing the Swiss Cheese holes from aligning. It demonstrates the need to look at how individuals, communities and governments risk reduction can work together to create an effective Bushfire Safety System.

Social systems that involve people are acknowledged to involve a number of complex subsystems. *Figure 1* endeavours to demonstrate how individual systems, community and government subsystems interact with a range of other subsystems (that may be outside of their control). Within each quadrant there is a system within itself that provides a risk reduction measure, and this can occur at the individual, community or government level. For example in the education quadrant, the individual will be educated by their own experiences, beliefs and attitudes, along with the experiences of their community, and then a program delivered by CFA. Education therefore comes from multiple sources all looking to produce a safety outcome at each layer of the hierarchy (McNamara, 2006). It also comes through many programs that reflect differences in individual and community needs, priorities and capacities as well as the diverse range of issues being addressed through a range of 'safety issues' e.g. road safety (Gilbert, 2007).

CFA used this thinking in its design of the Bushfire Preparedness Program (BFPP). The BFPP was developed to have risk reduction measures sitting within each quadrant of the Bushfire Safety System and subsystem at an individual, community and government level. The ideal model ensures that all levels are well resourced and complementary to each other, which then allows for elements of failure in an individual's risk reduction, compensated by the government or vice versa, the objective being to have redundancy and increase 'fail safe' measures.

Beginning the journey – putting theory into practice – developing the Bushfire Preparedness Program using Systems Thinking

The BFPP was instigated in mid 2009 to immediately address some of the inherent weaknesses within community preparedness programs that were apparent on Black Saturday, as well as in response to the Victorian Bushfires Royal Commission Interim Report.

It was also critical to prepare the state of Victoria for the coming fire season. The program comprised 42 projects allocated across six emergency services agencies and government departments, and CFA was responsible for the delivery of 32 of the 42 projects. They aligned to four themes: community education and engagement; warnings to the community; land and vegetation management; and bushfire operations (Table 1).

BFPP and the bushfire safety system

Within the BFPP the community education projects efficiently align with the Education and Empowerment quadrant of the Bushfire Safety System, whilst the land and vegetation management projects are parallel to the Environment Modification quadrant. Some aspects of the warnings to community projects aligned with the Engineering quadrant and there were no projects that specifically addressed the Enforcement and Economics quadrant - as enforcement activities take many resources and require robust policing systems this quadrant was left to be addressed in later evidence in the VBRC in 2010.

Whilst on the surface it may seem uncomplicated to make linkages between the projects within the Bushfire Preparedness Program and the Bushfire Safety System, there is a complex set of interdependencies and interrelationships between each of the projects, with a number of the projects playing an enabling role to one another.

Within the community education and engagement theme there were 21 projects ranging from the development of the Household Bushfire Self-Assessment Tool through to the development of children's bushfire education resources. Land and vegetation management encompassed two significant projects around environmental compliance and quality assurance systems. The warnings to communities extended across

Table 1. Bushfire Preparedness Program Projects.

Theme	Quadrant in the Bushfire Safety System	Projects
Community education and engagement	Education and Empowerment	<ul style="list-style-type: none"> • Victorian Fire Risk Register • Neighbourhood Safer Places – Places of Last Resort • Township Protection Plans
	Education and Empowerment	<ul style="list-style-type: none"> • Fire Ready Victoria Community Meetings • Review and improvements to the Community Fireguard Program • Household Bushfire Self-Assessment Tool resource • Advice to property owners • Localised place-based campaigns • Children’s bushfire education • Tourism initiatives • Diverse populations programs • Development/review of publications • Brigade community safety support • Bushfire related research
Warnings to the community	Education and Empowerment	<ul style="list-style-type: none"> • Development of standards and delivery of training • Kits for information gathering and analysis • Community information warnings
	Engineering	<ul style="list-style-type: none"> • One Source One Message (OSOM) • Establishment of online registration and booking system • Household Bushfire Self-Assessment Tool (software)
Land and vegetation management	Environmental Modification	<ul style="list-style-type: none"> • Vegetation Management on Roadsides • Ecological management and environmental management of roadside burning
Bushfire operations	Engineering	<ul style="list-style-type: none"> • Existing building upgrades and modifications to existing buildings • Upgrading of IT infrastructure • FireNet connectivity updates

the information flow spectrum from field intelligence gathering and analysis to the issuance of warnings to the community via the One Source One Message system (designed to deliver warning messages via short message service, radio or via the internet).

Discussion

Before Black Saturday CFA delivered some of the most comprehensive programs that developed community preparedness for bushfire. These programs were not delivered through a comprehensive systems approach but were targeted in an ad-hoc way to communities perceived as at risk. Its flagship programs such as Community Fireguard and Fire Ready Victoria programs were often adopted by other fire agencies and were well acknowledged in the VBRC final report (Teague, McLeod, Pascoe 2010 Final Report, Vol II, pt 1, p 23), but their application was seen as limited in reach and homogenous across diverse communities. It was decided that programs needed to be complemented with other risk reduction measures for those members of the community that did not attend these programs. A need to make use of both active and passive parts of a

system needed further development so the benefits of using a systems approach to underpin the development of the BFPP could be fully realised.

Benefits of using the bushfire safety system

Using a systems approach to the development of the BFPP created the opportunity for a strategic conversation around the outcomes that needed to be provided by government agencies. This approach made it possible to conduct a gap analysis of the elements that had little or no activity or investment at an individual, community or government level, ensuring a more targeted approach to program delivery.

CFA, with the Department of Sustainability and Environment (DSE), integrated a number of data layers to support local decisions makers to identify 52 high risk towns across the State. This project provided a critical focus to inform where and what risk reduction measures should occur. This galvanised the intention to target activities to those at ‘most risk’. Through using a ‘systems approach’ it brings many agencies’

key strengths into play and the relationships across government agencies have strengthened as a result.

The identification of communities at risk from bushfire has now been formalised through the Victorian Fire Risk Register.

Limitations of the Bushfire Safety System

There are many influences that can affect the desired performance of elements of the Bushfire Safety System. Currently there are no economic measures and limited enforcement measures in place. Appetite for incentives and disincentives of bushfire safety outcomes can be influenced by tolerance and political climates.

We can note that the amount of fire prevention burning can be influenced by delivery capacity (in the Environmental Modification quadrant), timing and weather.

While informational/educational/engagement/empowerment activities can influence issues such as immediacy, accessibility and priority – planning and design elements within the engineering paradigm are often future focussed and generally subject to the outcomes of cost-benefit equations which vary with the status of economic, personal and community attitudes.

The Bushfire Preparedness Program sees significant investment into the Education and Empowerment Quadrant which is often seen as the least effective 'risk reduction' control hierarchy (UNSW, 2007), whereas major investments in long term engineering solutions such as community refuges are yet to be realised in their value.

Conclusion

The Bushfire Safety System is the first documented approach in Australia to describe bushfire mitigation in a "systems thinking" context to reduce bushfire risk. In its development and design, the BFPP acknowledges that a BFPP using a systems approach is a significant first step on a journey that may take many years.

It is apparent from a closer examination of, and lessons learned during, the BFPP delivery in 2009/2010 and a refinement and understanding of the 'systems approach' that there is an imbalance in risk reduction measures. It is now evident that there is an over-reliance on *community education and empowerment* risk reduction measures within the emergency management system. This dependence leads to an overemphasis on the need to change behaviours and provides a tremendous challenge.

What is required in the future is more emphasis on engineering and environment modification wherein the solution to improved safety lies further up the hierarchy of control. Behaviour modification can then be driven

non-coercively and information and incentives can be enhanced to better influence within a narrower context.

It is recognised that a number of the current initiatives described in BFPP have not reached the limits of their cost-effective potential for all groups within communities and locations throughout Victoria. The next delivery of BFPP during the 2010/2011 fire season will focus on continuing effective risk reduction measures, enhancing these measures to help them reach their full potential and introducing new risk reduction measures – focussing more heavily on the Enforcement/Economics quadrant.

The concept of a Bushfire Safety System is in its early stage of thinking. It demonstrates that there is no single solution to designing out the bushfire risk and creating safer communities. It shows that there is a strong relationship between the role of government, communities and individuals that collectively contribute to an improved system of bushfire safety. This will contribute to strengthening our communities' resilience, decreasing the risk of bushfire and create safer communities.

We all have a role in the Bushfire Safety System.

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About the authors

Lisa Sturzenegger is currently the General Manager, Operations with WorkSafe, Victoria. Her role up to April 2011 was CFA's Director of Community Safety, and was responsible for all prevention and preparedness programs across Victorian communities until March 2011. Lisa holds a Masters in Human Services Management, along with two Advanced Diploma's in Public Safety (Community Safety) and Emergency Management. Lisa can be contacted on Lisa_sturzenegger@worksafe.vic.gov.au.

Terry Hayes is the Executive Manager Fire Management Planning Systems at CFA. Terry holds an Advanced Diploma in Public Safety (Community Safety) and in Emergency Management.

