Abstract: AESOP 15 Jan 2012

Accepted to Track 12: VULNERABILITIES, RISKS AND MITIGATION PLANNING

Title:

Resilience in complex adaptive systems: the relationship between planning and institutional resilience in bushfire prone regional Australia

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Abstract:

Research on institutional resilience in complex adaptive systems such as regional towns in Australia has demonstrated that resilience in bushfire events is a product of complex interactions between capabilities held by different organisations and indeed the individual community members at different scales. However in the face of disaster (the breakdown of most or all of these capabilities) the ultimate level at which resilience will be found is in individuals. This reality suggests that measures introduced in planning must be mindful of their effect, not just on the resilience of the organisation to which they are targeted, but also on the resilience of individuals in the community. This has implications for the traditional institutional separation of disaster functions: Preparation, Response, Relief and Recovery, particularly where the professionalization of bushfire services creates increased separation between agencies and individuals in the community. This paper will present the findings of research into institutional resilience to bushfire through a case study of the Australian regional city of Bendigo during the 2009 bushfires.

Key Words:

Bushfire, Planning, Resilience, Complex adaptive systems

The Relationship Between Planning and Institutional Resilience in Bushfire Prone Regional Australia.

1. Introduction

Planning for the management of bushfire risk requires the coordination of a wide range of activities. This is because planning for management of bushfires, and individual survival in the case of bushfire disasters, requires development of a set of capabilities that run across the disaster domains of prevention, preparation, response, and recovery. These domains of action take place at different times in relation to any particular bushfire event. They are acted upon by a complex array of institutions operating at a variety of scales, from individual, local to state level, of which urban planning is only one. Because urban planning affects the spatial layout and functions of urban systems, its activities can impact many features of disaster resilience.

The functions of institutions and a given community interact in a complex adaptive system (which is, to a degree, self-organising) including a range of monetary, governmental, ecological, individual and other elements that influence resilience to threats such as bushfires. Key adaptive capacities sets identified by Norris et al are (2008) 'economic development, social capital, information and communication, and community competence' (p.127). The ways that these capabilities are built upon and modified by institutions after disasters, such as the Australian Black Saturday Bushfires of 2009, interact with the ongoing self-organisation of the complex adaptive systems of regional towns, impacting upon the overall resilience of the system. In disaster events, which are understood as the breakdown of all or most of institutional support systems (Handmer and Dovers 2007), the final expression of resilience will be by individuals acting within any remaining systems. This research examined the implication of this: that individuals' resilience in a disaster will be a product of the remaining capabilities available to them. Accordingly, planning for bushfire disasters must always seek to enhance resilience in ways that appreciate impacts that any actions may have upon complex adaptive systems. This perspective creates a new imperative for planning for bushfires and explains concerns expressed by interviewees in our research. It is argued in this paper that improvements in professional urban planning, response and communications relating to bushfire may actually reduce community resilience, resulting from mismatches between government expectations of self-reliance and community belief in improved professional abilities and disaster resistance.

This paper firstly outlines the methods of our research, and provides background on the regional city of Bendigo, which was chosen as a case study. It then sets out a discussion of the theory of resilience in complex adaptive systems, followed by contextual information regarding bushfire management in Australia, the concept of 'shared responsibility', and concerns over the professionalization of bushfire

services. We then provide an example of one set of capabilities (namely "communications") which are subject to planned changes across a variety of institutions. The example includes an exposition of the communications failures experienced by Bendigo, the nature of proposed changes in capability and the concerns expressed by interviewees about the likely impact of those changes on community and individual resilience.

2. Method

The questions examined in this paper arise from research into institutional resilience and bushfire conducted by the University of Melbourne. The research was undertaken by a multidisciplinary team from planning, social work, marketing and geography. Leveraging concepts of resilience, complex adaptive systems, and capabilities, the team developed a working theory of the nature of resilience in complex adaptive systems (see section 4). To begin to test the usefulness of the working theory, a case study was developed on the institutional response to the Australian Black Saturday 2009 bushfires in the town of Bendigo in regional Victoria, Australia. The research included reviews of changes to policy introduced since the fires and in particular in response to the Royal Commission of Inquiry conducted by the State Government of Victoria. A description of the institutions central to prevention, preparation, response and recovery of disasters in Bendigo was developed. Seventeen qualitative interviews with members of these various institutions both within Bendigo and at the state level were undertaken. Based on the key elements of resilience forming the basis of enquiry for the study (set out below), the interviews focused on institutional capabilities, how they had responded in the event of disaster, and what had occurred since. The use of a detailed case study of communications systems was used to allow deeper understanding of adaptive change in one feature of the complex adaptive system, from which conclusions could be drawn back to the theory of resilience, adaption and complex systems, rather than the entire complex adaptive system itself (Yin, 1993).

3. Background

On 7 February 2009 the State of Victoria in Australia experienced severe bushfires across much of the state. The day has become known as Black Saturday. One area affected by fire on that day was the regional city of Bendigo. Bendigo is a major regional city, part of the City of Greater Bendigo which encompasses both the urban area of the town of Bendigo and outlying towns spanning an area of approximately 3000 square kilometres. Bendigo lies approximately 150km North West of Melbourne, with an estimated population of 91,713. The fire started within the municipal boundaries about 8 km from the central business district. Before being brought under control, it came within 2km of the central business district and within three blocks of the main police station. One fatality occurred. A spot fire threatened a major hospital and an adjacent retirement home, and 61 homes and 125 sheds were damaged or destroyed.

Fire agencies and emergency services across Victoria were aware several days before the event of the forecast weather and fire conditions for the weekend of 7th February. In preparation, the Country Fire Authority had prepared a level 3 Incident Control Centre (ICC) in Bendigo which was fully staffed and linked with central command centres in Melbourne. A secondary level 2 ICC was established in Bendigo to handle any smaller incidents which might occur. At 15:11 a fire commenced at Coliban Park Road, Redesdale, a small community which was partly within the region of Greater Bendigo. The level 3 ICC in Bendigo responded to the fire by sending trucks and equipment, and commencing coordination of efforts to fight the fire at Redesdale. At 16:20 another fire commenced in the city of Bendigo itself.

4. The nature of resilience in complex adaptive systems

To consider how institutions have sought to improve disaster preparedness in Bendigo, this section sets out key concepts used in the study. The concept of resilience varies considerably between its "origin" disciplines of physics, psychology and ecology (Norris et al 2008). In ecology, resilience is said to be the amount of disturbance a system can absorb before shifting into an alternative regime (C. Holling, 1973). Under this understanding resilience is therefore improved by improving the capacity of the system to *resist* disturbance. One key method developed in human systems for improving this type of resistance to disturbance (or even avoidance of disturbance) is risk identification and mitigation (Beck 1992).

In physics, resilience is about the ability to "*bounce back*" after a serious shock. In this understanding things are resilient if they do not break when placed under pressure, nor do they change their fundamental properties (for example change to gaseous form, become permanently more brittle). In psychology, this idea of resilience has been applied to individuals, whereby an individual's resilience is a measure of their ability to maintain a stable equilibrium (Bonnano 2004). Applied to human systems this understanding leads to a concept that resilient systems are typically those which have developed, through experience, mechanisms to cope with "shocks" so they can return to normal states (B.H. Walker et al., 2006).

In a disaster, the fundamental conditions which formed and maintain the system in normal states are changed. In these circumstances "bounce back" to previous states isn't necessarily possible nor desirable. This has led to a concept that in disaster terms, systems can be considered resilient when they are capable of *adapting* (Handmer, 2007). Or put another way, systems can be considered resilient when they are capable of adapting, while maintaining their essential identity. "By resilience we mean the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes and feedbacks" (Adger et al 2005 p. 1036).

An additional concept is that human settlements such as the regional city of Bendigo in Victoria can be understood to be *complex adaptive systems*. Complex adaptive

systems are systems that adapt and evolve while self-organising over time (Urry, 2005). They include a number of inter-related functional components: social networks, institutions and inter-related systems of economics, ecology and physical structures. The capabilities of each element and their interaction produce the self-organisation of the system. Perturbances caused by the interaction of these elements are necessary to the ongoing adaptation (or maladaptation) of these systems (Cork, 2010, p.133). The scale at which these systems interconnect, the level of connectedness and ability to adapt to different shocks will be variable (Cilliers, 2005, 257).

Taken together, the concepts set out above suggest that resilience in the context of regional communities and bushfire can be understood as a set of dynamic capabilities. These capabilities firstly allow the complex adaptive system to *resist* being effected by the bushfire, but then in the event of failure of the response capacities (disaster), would ideally allow rapid and appropriate '*bounce back*' to normal states, and where necessary, positive *adaptation* to new circumstances over time. That is, resilience is a set of capabilities built up and utilised before, during and after emergencies. It is "a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance" (Norris et al, 2008, p. 130). Where adaptive capacities are defined as "those with dynamic attributes, that is resources which are robust redundant and rapidly accessible" (Norris et al., 2008, p. 131). These adaptive capacities include dynamic capabilities such as management processes, organisational structures and competencies which are internal to a community (Teece & Pisano, 1994). They can be improved through longer term strategic policy in emergency management (Handmer & Dovers, 2007).

According to this framework, improving disaster resilience can be understood as a broad approach to a cycle of activity which encompasses the general contexts of planning, preventing, responding to and recovering from disasters. Disaster resilience requires a suite of capabilities across a range of organisations, institutions, communities and places, at a variety of scales to be effective, integrated with predilections for adaptive learning across scales (Gunderson et al 2008).

This understanding of resilience is depicted in simplified form in diagram 1, where resilience is shown as responses to an event in one of three ways (resistance, bounce back, or adaptation). Timeframes will differ for specific capabilities and in each of the elements. Because of the systems' complexity, capabilities within given elements may take any one of the responses, self-organising over time to form a new set of pre-event capabilities adapted to the environment developed in the intervening period. Thus resilience has to be understood as a process which is constantly developing and changing in response to a myriad of factors across the complex system.

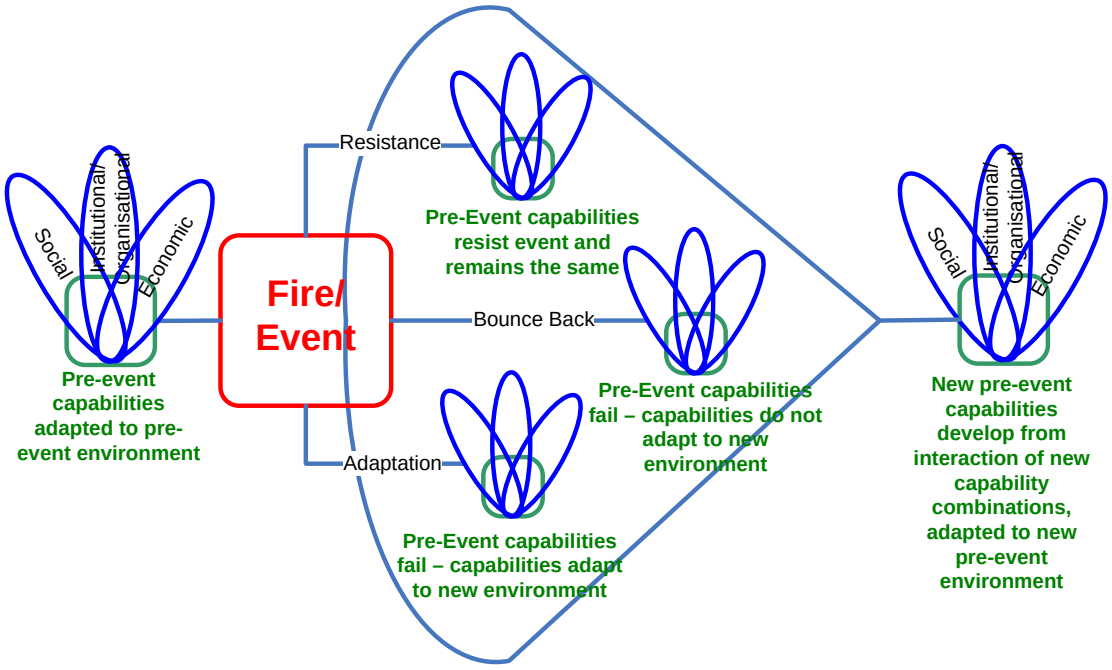

Figure 1: Resilience in Complex Adaptive Systems

Our research suggests that increased disaster resilience exists in communities and within agencies that empower the lowest possible levels to take responsibility for their own preparedness and recovery, while at the same time developing close working relationships across the community. As we will demonstrate with an example below, this means that actions to increase resilience in one area or one organisation need to be coordinated and planned so that they do not destabilise resilience in other sections of the complex system as it self-organises in response to changes.

5. The structure and professionalization of disaster services – and their separation from the community

In Victoria the key institutions involved in bushfires are organised across the activities of prevention, preparation, response and recovery as listed in table 1. Each agency is separate and has developed specialised capabilities and increasingly professionalised delivery of services. They are often multi-scalar, operating at both State and local levels. This presents challenges for the integration of service delivery and for understanding their interaction and the interaction of their capabilities within complex adaptive systems.

Table 1: List of Main Institutions involved in Victorian Bushfire by Domain of Action

Domain of action	*Institution*

Prevention of fires or reduction of intensity	*Planning System* (Bushfire Management Overlay; building codes) *Department of Sustainability and Environment* (management of forests)
Preparing for the event of fires or reduction of intensity	*Country Fire Authority* (education of community) *Private Landholders* (Clearing around houses, maintenance of private property)
Responding to fires	*Country Fire Authority* (direct fire management and containment) *State Emergency Service* (Logistics assistance, assistance with emergency centre staffing, assistance with provision of camp services for front line fire-fighters *Local Government* (Municipal evacuation centre, emergency relief, coordination of local resources – bulldozers, fuel, clearing equipment) *Police* (road blocks, assistance with coordination of evacuation centres, logistics, management of the public) *Red Cross* (registration of persons in distress)
Recovering from fires	*Department Human Services* (short term provision of emergency accommodation, longer term counselling services) *Department of Planning and Community Development* (longer term community recover, community engagement officers, economic recovery, distribution of longer term aid) *Health Services* (ambulance services, hospitalisations, dealing with injured in direct aftermath)

Professionalism, as a system of allocating specialised roles and responsibilities to experts, has traditionally been seen as a guarantee of high standards, delivering overall benefits to the public, but at the risk of distancing the public excessively (Koehn, 1994: 147; Friedson, 2001: 217). A theme that emerged in the research was that "planned" and agency based responses to bushfire risks have increasingly professionalised and institutionalised action in many ways that separate the public from bushfires, while paradoxically seeking to "share responsibility" a theme taken up in the Council of Australian Government (COAG) documentation on National Disaster resilience (Ellis et al., 2004) and reiterated increasingly after the 2009 fires, including in the Final Report of the Royal Commission of Inquiry (2009: Volume 2).

In contrast to professionalization of bushfire response is the long tradition of volunteerism in the Country Fire Authority (CFA) of Victoria. This has engaged large numbers of the public directly with preparation and response processes over a long period. The CFA's focus upon local provision of fire preparation and response, has long been intertwined with volunteerism and community engagement (Murray & White 1995). The brigade structure which still exists today, and which was originally entirely self-funded and relied entirely upon volunteers, was formed in 1926, in response to serious bushfires in Victoria, although its history goes back to the 1870s. In 1945 the CFA was formed to coordinate the brigades at the recommendation of a Royal Commission of Inquiry into the devastating 1939 bushfires. Over 1,200 brigades now exist in Victoria, only some of which are staffed by a core of 629 professional firefighters in larger regional centres supported by some 60,000 volunteers (Strachan Research, 2000; CFA: 2012).

Largely in response to the disaster of 2009, recent changes in Victorian fire risk management systems have been dramatic by comparison to previous progress, with the introduction of significantly stricter policies via urban planning and building regulations in 2011. The introduction of planning and resource management controls over time increasingly map, assess, design and seek to reduce bushfire risks through expert and centrally derived urban planning mechanisms. In summary, these controls have been oriented to improved building and construction standards, combined with urban design and forest management mechanisms that modify vegetation near to buildings and settlements. In addition attention has been given to the distance of buildings to fire sources and provision for response and escape routes.

Australian Standard 3959 establishes a scale of building performance levels against Bushfire Attack Levels (BAL), progressively requiring more resistive structures as the risk level of the environment increases. In parallel, the Wildfire Management Overlay (WMO) which was previously applied only to limited spatial areas, has been replaced with the Bushfire Management Overlay (BMO). The BMO, used in parallel with the BAL, provides for development setback distances and "asset protection zones" according to the nature and level of the bushfire threat in an area, thus combining building and planning mechanisms. The BMO and BAL "tests" must be used in all areas designated to be "Bushfire Prone" according to recent mapping which has identified most areas outside established towns and cities as being at risk. Finally, the state has committed to an extensive ongoing fuel reduction programme, requiring 5% of all land or 390000ha of bushland to be treated each year (VBRC 2009). While the long term impacts of these changes, focused upon developing *resistance*, remains unclear the following sections consider the impacts of these institutional changes upon the complex adaptive systems in which they are implemented.

6. An example of a planning measures which effect institutional resilience and individual resilience.

We have argued above that in complex adaptive systems resilience is a product of capabilities developed by and available to individuals and institutions across a range of timeframes. These capabilities develop and interact across the complex system, and thus learning in one institution, which changes the capabilities of that institution, will affect capabilities unevenly across the wider system. In some cases the improvement of capabilities in one area, may actually destabilise disaster resilience in other areas. This occurs because in the event of disaster, when normal capabilities are overwhelmed (Handmer and Dovers, 2007), the capabilities left to individuals on the ground need to be 'theirs', and cannot be sourced in a professional organisation that will 'save them'. We argue that given this reality, care needs to be taken with the context in which improvements to capabilities are made, so that they provide for generalised improvements to resilience of the system overall. To achieve this, the interconnections and context of the complex adaptive system must be properly understood.

An example allowing us to explore this theory is the development of communications capabilities since the 2009 fires. To understand the impact of changes to the information capabilities within and between response and recovery agencies on the resilience of community members, it is first important to understand the context of information failure during the fire of 2009. This example will therefore provide firstly a basic description of the communication failures during the 2009 fires. The response of the Royal Commission of Inquiry held by the Victorian government will then be examined before the data collected on agencies concerns about the impacts of changes to communication capabilities is presented.

6.1. The problem of information in the Bendigo fire of February 2009

From the beginning, fighting the fire in Bendigo was plagued by difficulties in communication. For example, there was a failure in the central emergency control centre for the State of Victoria so that telephone calls could not get through. The first report of the fire was provided by residents who drove to Eaglehawk Country Fire Authority (CFA) base to report the fire in person. The Eaglehawk pumper was en route before being paged by central command which had eventually been contacted by phone. ("Redesdale and Bendigo Fires Submissions of Counsel Assisting: Letters Patent ", 2009)

During the initial stages of fighting the fire communications with those at the fire front were limited. Communications between the ICC and central command were also limited. The Regional Emergency Control Centre was alerted to the Bendigo fire by Eaglehawk CFA, and moved to establish who would take control of incident management for the fire. At 16:45 the level 2 ICC at Adams Street in Bendigo ('Adams St') was given the Bendigo fire to manage. Adams St was unable to make radio contact with the crews on the fire ground using the CFA Regional channel, the trunking system[1], or fire ground channels. There was also very limited communication between the two ICCs. The level 3 ICC sent a number of staff to the fire front without informing Adams St that they had done so. One of those was Mr A, an experienced field controller. ("Redesdale and Bendigo Fires Submissions of Counsel Assisting: Letters Patent ", 2009).

An example of the lack of communications is the lengths Mr A[2] went to to bring about control of all aspects of the fire fighting effort. Initial incident control was undertaken by Mr B of Eaglehawk CFA who was first on scene at 16:40, established a command centre, sectorised the fire as he saw it and commenced fighting it. At about 19:15 Mr A, having driven around to find Mr B and a number of others now fighting the fire, held a meeting and from a map drawn on the bonnet of his car, re-

[1] *Trunking systems* are complex multi-channel radio system managed by a computer that allow higher numbers of simultaneous users on a given frequency.

[2] Names have been changed to protect anonymity as per human ethics requirements.

sectorised the fire and allocated command points to those present (Interview Gilmore). At 19:45 Mr A was contacted by Mr C at Adams St, who asked him to come and provide a briefing. This was done at 21:00. Consequently the Adams St ICC was largely irrelevant in fighting the fire. The crews on the ground were largely responsible for controlling the fire, with almost no communications and assistance. ("Redesdale and Bendigo Fires Submissions of Counsel Assisting: Letters Patent ", 2009)

Further evidence of difficulties were apparent in communications with the public. One issue was that on a very hot day, most people were inside their houses with curtains drawn to prevent heat entering, in the main watching cricket on television, rather than tuning into local radio stations (Morris 2009). As a result many residents who were under direct threat were unaware of the problem until the police or a neighbour knocked on their door to advise them. The police communications were overwhelmed, both at the level of contact with the public and the police radio band (Interviewee 1 Victoria Police). An initial evacuation centre was set up at Eaglehawk which was subsequently threatened by the predicted wind change. A new evacuation centre was established at Kangaroo Flat. 60 persons were relocated from relief centre at Eaglehawk to Kangaroo Flat (Morris 2009). The radio stations made mistakes concerning the location, directing people to Eaglehawk even though it had been moved due to threat from fire.

The broader community of Bendigo became aware of the fire, if through no other medium, via the amount of smoke in the vicinity. Embers and ash fell on areas of the town south and then east of the fire, up to 7km away from the actual fire (Interviewee 1 Bendigo Business Council). Many members of the community thus experienced considerable uncertainty, which given the lack of knowledge about the exact location of the fire front was not able to be ameliorated by announcements being made from the ICC (Interviewee 1 Community Sector). In fact, conflicting announcements were made. For many members of the community, this lack of information was unexpected and unacceptable.

Information required for critical forward decisions on the distribution of resources in recovery was also limited.

> “The bits we didn’t do all that well in was the initial 24 hours after. From 6 on the 8th feb until 6 on the 9th feb I reckon we were in absolute trouble. Because couldn’t get the picture right. We couldn’t work out how many people didn’t have a home. We couldn’t get the data and information to make good decisions.” (Interviewee 1 CFA).

The only element which seemed to do a reasonable job with regard to information was the sharing of information on what had happened between recovery agencies after the initial recovery period

> "With the bushfires we managed that (the distribution of welfare payments) better because agencies shared information about who exactly had been effected. We share information well. Early on we got an agreement that so long as we collected the information for this purpose we could share it " (Interviewee 1 Local Government).

6.2. Post-Disaster Response of Agencies to the issue of Information

These types of communication difficulties were repeated across the state.

> "Clearly the gathering of information was overwhelmed, there was no capacity to collect the amount of information that needed to be collected, considering what was going on. But when you think about it, it still was pretty good. We knew the regions that fires were in – not necessarily where they were" (Interviewee 2 CFA).

Unsurprisingly, the Royal Commission made many recommendations relating to communications. In summary, the recommendations involve improvements to information provided to community prior to bushfire seasons to enable them to be better prepared (recommendation 1, 2, 7 37, 44) and to provide for improvements to on the ground communications between response agencies in the event of a fire (recommendation 14, 22 and 23). These recommendations collectively provide a clear message that the community members will be informed of how best to protect their families and property in the event of fires, and that during the actual event fire response agencies will be able to communicate and accurately know where a fire is and to predict its movements.

At the same time that these recommendations concerning information were made, two other recommendations of relevance were made. Recommendation 3, essentially provides for municipal authorities to plan for the identification of and evacuation of vulnerable persons. Recommendation 5 provides for the opportunity to encourage people to evacuate where circumstances indicate that will be a safer option than staying to defend properties. Both these recommendations radically change the nature of Australia's long-standing 'leave early or stay and defend' policy. They provide a clear message to the community that in the event they are at serious risk, they will be instructed to evacuate, and that prior to this they will have had all necessary information at their disposal.

The complete wording of each of these recommendations is included in the table below.

Table 2: Recommendations of the Victorian Royal Commission into 2009 Bushfires pertaining to 'communications'

Recommendation 1: The State revise its bushfire safety policy. While adopting the national Prepare, Act, Survive, framework in Victoria, the policy should do the following:	Recommendation 7: The Commonwealth lead an initiative through the Ministerial Council for Police and Emergency Management, facilitated by Emergency Management

- Enhance the role of warnings – including providing for timely and informative advices about the predicted passage of a fire and the actions to be taken by people in areas potentially in its path
- Emphasise that all fires are different in ways that require an awareness of fire conditions, local circumstances and personal capacity
- Recognise that heightened risk on the worst days demands a different response.
- Retain those elements of the existing bushfire policy that have proved effective
- Strengthen the range of options available in the face of fire, including community refuges, bushfire shelters and evacuation
- Ensure that local solutions are tailored and known to communities through local bushfire planning.
- Improve advice on the nature of fire and hose defendablity, taking account of boarder landscape risks.

Recommendation 2: The State revise the approach to community bushfire safety education

Recommendation 3: The State establish mechanisms for helping municipal councils to undertake local planning that tailors bushfire safety options to the needs of individual communities. In doing this planning, councils should:

- urgently develop for communities at risk of bushfire local plans that contain contingency options such as evacuation and shelter
- document in municipal emergency management plans and other relevant plans facilities where vulnerable people are likely to be situated—for example, aged care facilities, hospitals, schools and child care centres
- compile and maintain a list of vulnerable residents who need tailored advice of a recommendation to evacuate and provide this list to local police and anyone else with pre-arranged responsibility for helping vulnerable residents evacuate.

Recommendation 5: The State introduce a comprehensive approach to evacuation, so that this option is planned, considered and implemented when it is likely to offer a higher level of protection than other contingency options. The approach should:

- encourage individuals—especially vulnerable people—to relocate early
- include consideration of plans for assisted evacuation of vulnerable people
- recommend 'emergency evacuation'.

Australia, to develop a national bushfire awareness campaign.

Recommendation 14: The Victorian fire agencies amend the AIIMS framework before the 2010–11 fire season in order to do the following:

- designate the Information Unit as a separate section reporting directly to the Incident Controller and require that the Information Unit contain a dedicated Public Information Officer whenever a full incident management team is required
- specify a set of functions in relation to which the Deputy Incident Controller for a level 3 incident will have oversight, which may be adjustable for a particular incident by agreement between the Incident Controller and the Deputy Incident Controller
- ensure that an individual with local knowledge is incorporated in an incident management team.

Recommendation 22: The Country Fire Authority and the Department of Sustainability and Environment standardise their operating systems and information and communications technologies with the aim of achieving greater efficiency and interoperability between agencies.

Recommendation 23: The Country Fire Authority review and improve its communications strategy as a matter of priority and develop a program for identifying and responding to black spots in radio coverage.

Recommendation 37: The State identify a central point of responsibility for and expertise in mapping bushfire risk to:

- review urgently the mapping criteria at present used by the Country Fire Authority to map the Wildfire Management Overlay, to ensure that the mapping used to determine building and planning controls is based on the best available science and takes account of all relevant aspects of bushfire risk
- map and designate Bushfire-prone Areas for the purposes of planning and building controls, in consultation with municipal councils and fire agencies
- finalise the alignment of site-assessment methods for planning and building purposes, taking into account bushfire risk to human safety as well as to property.

Recommendation 44: The Country Fire Authority produce for community guidance material on fire-resistant landscape and garden design, including a list of fire-resistant species

6.3. Analysis of likely impact of information recommendations on institutional and individual community member resilience

Taken together with the changes to the wildfire management overlay and changes to the planning provisions, the community could be forgiven for expecting that they will be protected by the State both before and during bushfires. As one senior government interviewee put it:

> What have we done? Well if you live in a bushfire area well you need to be prepared and plan to leave, but if you get caught short, first of all you will get information, you will probably get a fire truck rolling up, DSE will keep the forests safe in any case (and if it isn't then it is their fault), the CFA will tell you how to build your house. You have this place you can go to – which you will be told in plenty of time to go there – and if that doesn't happen then the police will order an evacuation and they will organise to send you somewhere else. And if you are vulnerable then DHS will have a plan to deal with you (Interviewee 2 CFA).

The conflict between this set of community beliefs and a disaster management system which is based on shared responsibility is perhaps obvious. Concerns were raised by interviewees that the recommendations and improvements to institutional capability are likely to create unrealistic expectations concerning the capacity of response agencies during disasters and the role of the community in shared responsibility.

> But the other thing is that you can't separate the emergency service from the community. So the commission has also decreased community resilience. The treatments it came up with have built an … expectation of a place to go, an expectation that information and expert advice will always be available, … . All of that is in parts of the recommendations coming out of the royal commission, which is completely contra to the COAG disaster resilience strategies for community. We (COAG) talk about communities talking to each other, taking each other on the journey, looking after each other, knowing that it is going to happen (Interviewee 2 CFA).

The specific concerns raised by interviewees were as follows. First it is considered critical for CFA functioning that front line response personnel make decisions in a timely fashion, a long standing disaster response principle. These front line people need to be able to make a decision on low levels of information.

> When you are at the sharp end, what you are relying on is having people who are able to view the situation and see a number of options, and choose one. Choose one based on the knowledge they have available to the then, and act on it (Interviewee 3 CFA).

Thus in situations of fighting bushfire it is necessary to make decisions with minimal information. This is as true for central command as it is for the front line. Indeed evidence shows that acting decisively is critical for survival at the individual level (Interviewee 3 CFA).

> Resilient organisations have people who have the experience base, or the place to go, or the processes by which they are able to make decisions

> without all of the information they would normally have. The worse a situation is, the more difficult to it is to get information (Interviewee 2 CFA).

Not only does the findings of the Royal Commission potentially destabilise individual decision making, the fact that it also sought to determine blame for individuals, based upon 'who knew what, when', further destabilises the capacity of response agencies to function.

> When you are pushed outside of normal routine operations, and I am talking about within the emergency management scenario, in the ones where the agencies have to come together, then you need to be adaptable, flexible and supported in making decisions. You only make decisions with the information that you have at that point of time, and it is challenging to do that (Interviewee 1 State Government).

Without support in making decisions, there is a risk they will not be made because information is not available, or that unreasonable levels of resources will be put to documenting the exact nature of information available on which the decision was made.

> The big issue is being able to justify your decisions after you have made them and the problem with that is that the worse the disaster gets the less information is available to you. The system of information gathering breaks down or at least provides you with less information the worse things get (Interviewee 2 CFA).

The second big issue is that the CFA now feels that it has a responsibility to provide the community with information.

> The other big change is that we are a lot more aware of our responsibility to provide public information. It is really annoying at times when you are trying to work on a fire. But we feel we have to do it. We track fires, and now we want to know what will be affected in the future, with a public message that we can get out immediately it becomes necessary… . Now we accept that we need to tell people what is going on, even if it is just where the smoke is from (Interviewee 3 CFA).

This is despite the fact that in many cases of bushfire, this information is not known during the response phase, and the fact that any system will be subject to overload and dysfunction at some point in a disaster. Given that the CFA increasingly feels it is responsible for disseminating information, combined with the technical and professional work being undertaken by various agencies to increase capabilities to give information, it would hardly be surprising if that created an expectation in the community that information will be available on which to make decisions. Indeed there is evidence from the Bendigo Community Recovery Plan that the community

does indeed expect better information in the future. Under the heading "Community Awareness/Planning for next time", they have highlighted the need for "communication and fire warning". Noting that the community was unprepared and no fire warnings were universally recognisable on Feb 7th. They felt there was a need to facilitate community preparedness and awareness of where to go and what to do in case of evacuation in any natural disaster (Victorian Bushfire and Recovery Authority 2009).

A concern with this expectation of information being available on the day, and during, a disaster is that it will also destabilise efforts at preparation and even prevention. Recently improved building codes provide for buildings to be located in areas at risk of bushfire, assuming that preventative and protection measures are carried out, especially in maintaining vegetation distance from buildings. This requires ongoing action by individual property owners in perpetuity. As individuals' expectations of information and advice increases, it is possible their attention to messages of prevention and preparation will decrease. Thus, even with an increase in the amount of messaging and awareness of the risk of bushfire, the effect on actual preparation is possibly diminished. As one CFA interviewee put it:

> The message is out there more, and the expectation that information will be better is out there. I worry about if we do a code red day, and people's expectation about what they should do and what that means. I don't think we have changed this personal responsibility issue. We know that if you can stay at home and do all those things I was talking about before within the community, looking after yourself and neighbours, stay informed and aware of what is going on around you. Then if you are told you are under particular threat you will make good decisions. I don't think we are at that point. I think that if there is a fire out there at Castlemaine or somewhere, people will be flocking in to the Neighbourhood Safer Place with carloads of stuff and pets and all that thinking that it will be open and there will be people there to feed them and stuff like that. So I think that some people will do better, but that will be offset by people doing stupid things and chewing up resources unnecessarily (Interviewee 3 CFA).

This is therefore a good example of a situation where planning for increased resilience by improving the system of communications could potentially lead to a destabilisation of resilience in the people who will need it in the event of disaster. In the final analysis we can return to Norris et al (2008) who state that 'information increases survival only if it is "correct and correctly transmitted". Closer local sources of information are more likely to be relied upon than unfamiliar distant sources' (p.140).

7. Conclusion – Avoiding Maladptation and Reduced Resilience

In this paper we presented a working theory examining the relationship between institutional actions post-disaster, and the resilience of the wider complex adaptive system affected by the changes. The study examined the case of Bendigo after the 2009 Victorian Bushfires, particularly communications breakdowns in response phases. The study shows that building the capacities of institutions active in the domains of prevention, preparation, resisting and responding bushfires can raise significant doubts as to the ongoing resilience of local communities to bushfire risks, particularly in disaster situations where "normal" processes of response are overwhelmed. The interconnected and largely self-organising response of citizens to the institutional changes in capabilities may be to increasingly rely upon formal system of communication for information about fire risks and evacuation decisions.

Further, ongoing changes to forest management and building and planning systems give the impression that existing settlements have become less risky. In fact, the effect of these actions will be realised at vastly different time scales, due to the slow rate of ongoing change allowed by development control systems in planning. In addition, the focus of planning and building controls upon improved resistance will lead to greater expectations of safety based upon underlying expert processes, aided by improved professional response abilities facilitated by better communications. This suggests that actions to increase resilience in one area or one organisation need to be coordinated and planned so to minimise destabilisation of resilience or maladptation (Adger, 2005) in other sections of the complex system that self-organise in response to changes.

This research points to methods and a need of researching how increases in state intervention and improvements to institutional capbaility can lead to decreased individual responsibility, capability and resilience. Further research is required into the nature of the complex adaptive systems which are our regional towns if improvements in capabilities are going to lead to the desired outcome.

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