

Knowing fire: exploring the scope and management of the tacit fire knowledge of agency staff

Anthony English, Parks Victoria, explains the uses and value of tacit knowledge to meet the objectives of fire agencies in Victoria. [®]

ABSTRACT

Tacit knowledge is knowledge that is not easily written down and derives from observing and doing. It is drawn from a person's subjective insights and intuitions. It is not easily expressible and is difficult to formalise or transfer. Tacit knowledge is a key driver of personal decision-making. This paper explores the extent to which the tacit knowledge of fire held by staff in land and fire agencies is valued, critiqued and used by these agencies. It is argued that while the role of tacit knowledge in shaping fire practice is substantial, its scope and influence is poorly understood. The paper draws on research in workforce planning and knowledge management, as well as the author's operational fire experience to review how agencies in Victoria could recognise and use tacit knowledge to drive emerging strategic objectives.

Introduction

In 2015 the Victorian Government released a document titled 'Safer Together: A new approach to reducing the risk of bushfire in Victoria' [State of Victoria 2015]. Drawn from the hard-won lessons of the last few fire seasons this report emphasises that government and the community will take a new and collaborative approach to identifying and managing fire risk. The concept of knowledge is a critical element of the document. It emphasises that using scientific research and modelling, as well as local community understanding of landscape, will drive this change.

It is timely then to analyse more closely what constitutes fire knowledge. This paper focuses on one element that, like community-based knowledge, has tended to be overlooked. This is the tacit knowledge held by staff of land and fire agencies in Victoria. It explores the extent to which staff member's tacit fire knowledge is valued, critiqued and used.

Fire knowledge is attained by staff in a range of ways. Training and related activities focusing on the transfer of formal or explicit knowledge are important components of knowledge development. However, much if not most, knowledge development is the result of practical involvement in fire management and can be classed as tacit knowledge.

Tacit knowledge is knowledge that is not easily written down and derives from observing and doing. It is drawn from subjective insights and intuitions, is context specific, is not easily visible or expressible, is difficult to formalise or transfer, and is a key driver of personal decision-making [Kakabadse, Kouzin & Kakabadse 2001, Linde 2001, Stenmark 2001]. It is argued here that tacit knowledge, and its use, is one of the primary determinants of how staff members apply fire management on the ground. People use their tacit knowledge to respond to situations in the field, and to interpret and apply formal training and agency procedures and policies.

The tacit knowledge referred to here exists at a variety of scales. It can include personal understanding of fire behaviour in specific landscapes, or awareness of how lighting patterns can be used to achieve planned burn objectives. Such knowledge, despite its elusiveness, is critical to the development of fire practice as it reflects the development of insight gained from years of observation, trial and error.

Drawing out and recognising tacit fire management knowledge

There are at least five primary reasons why fire agencies need to recognise and draw out the tacit fire knowledge of staff.

1. Tacit knowledge is a primary determinant of staff behaviour, decision-making and performance. An employer can only manage and understand the skill base of their employees and gain insight to their work practices and culture if they appreciate the scope and form of their tacit knowledge and its influence on their decisions.
2. Tacit knowledge is valuable and pivotal to driving organisational performance. It forms part of what Cabrera and Cabrera [2005] refer to as the

'human capital' of organisations. In a fire agency it represents knowledge that can drive and generate efficiencies, overcome problems and provide insight for more formal research and planning. It contributes to what Roux *et al.* (2006) refer to as the co-production of knowledge across the science-operational divide.

3. Despite its value and influence, it can be fragile and easily lost. When an experienced staff member leaves they can take with them knowledge and insights that cannot be replicated or easily captured in explicit forms like manuals and procedures.
4. Tacit knowledge has local and cultural dimensions that can have a resonance with the community. Unlike explicit or formal knowledge, tacit knowledge and associated ways of working may reflect awareness of the needs, values and views of the local communities which agencies serve. Staff may use their tacit knowledge, which includes their social awareness, as a context to carry out their work in ways that engender community support and partnership.
5. An organisation that recognises internal tacit knowledge will be better able to recognise the knowledge that exists in the community as it will be open to learning and engagement in its truest form.

Most importantly, recognition of staff tacit knowledge is an essential pre-cursor to the development of innovative organisations. Roux and colleagues (2006) demonstrated that recognition is essential to the 'co-development' of knowledge across the science management divide. They argue that innovation in land management practice is constrained in agencies by the presence of separate 'operational' and 'research' cultures that struggle to communicate and share knowledge. Valuing and drawing out the tacit knowledge of operational staff is shown to be a critical factor in breaking this barrier down.

In Victoria, this divide is real, and perhaps best illustrated by the challenge of integrating fire ecology practice into operational fire management. The initial interviews conducted with staff revealed that they

possess significant knowledge about the relationship between fire and ecological condition. Despite this, they are rarely asked to reveal, critique or discuss this knowledge and have little direct exposure to structured fire ecology research programs.

Understanding the tacit dimension in fire management

As Stenmark (2001) notes, tacit knowledge can be elusive. We are not necessarily aware of the tacit knowledge that we possess, we may have little personal reason to share it, and may perceive sharing it as a reduction of competitive advantage. Its elusiveness can hide the fact that tacit knowledge is highly valuable and a critical driver of personal behaviour, attitudes and performance.

Sitting behind tacit knowledge is the formal or explicit knowledge that is relayed to staff in training courses, manuals and procedures. Referred to by researchers such as Polanyi (1966) as 'context-free theory', this formal knowledge is then applied, used and reshaped in its application to suit specific circumstances in practice. It is here that tacit knowledge shows its influence as staff members rely on the observed behaviour of their peers, their personal experience, and their interpretation of procedures, to direct their actions and decisions.

Blair and colleagues (2010a, 2010b) argued that land and fire agencies in Victoria have tended to see knowledge as an object to be imparted, rather than as a process that is embedded in social systems and personal experiences. This has meant that formal rather than tacit knowledge has been a focus of knowledge development and exchange systems in these agencies. They argue that this view of knowledge has restricted agency capacity to recognise and respect community-based fire knowledge. It is argued that this view of knowledge has also impacted on the recognition and understanding of staff member tacit knowledge by land and fire agencies.



Ecological burning in a Parks Victoria grassland reserve, south of Ballarat.

Methodology

Two methods were used to conduct a preliminary assessment of the scope and influence of staff member tacit knowledge on fire practice in Victoria. The first involved the author's personal review of how fire knowledge has developed, and is developing. This approach shows the observed value of reflection as a learning tool (Kakabadse, Kouzin & Kakabadse 2001). The second involved conducting a small number of interviews with staff who focused on their own knowledge development, and on specific elements of their tacit knowledge. This approach relied on the efficacy of learning history approaches to organisational knowledge gathering and exchange (Linde 2001, Department of Defence 2010, Parent & Beliveau 2007, Elliot *et al.* 2009).

Personal reflection

Review of the author's personal experience in fire management can be used to shed light on the way that tacit fire knowledge is developed and used by individual fire practitioners. Personal tacit knowledge builds as one plans and conducts subsequent planned burns. For example, the author's awareness of how different vegetation and fuel types respond to varied lighting patterns continues to develop each season. This allows refinement of tactics that enhance crew safety, and the achievement of burn objectives that balance agency and community expectations. Familiarity builds over time as one plans and conducts subsequent planned burns, particularly with how different vegetation and fuel types in central Victoria responded to varied fire lighting patterns. This knowledge and perspective has been shaped by conversations with others (social), developed within a specific set of landscapes and activities (context), shaped by training, observation and doing (process), and by sight, sound and smell (modes of being). This personal experience of knowledge development accords with the definition of knowledge applied by Blair and co-authors (2010a). It reveals that formal training in planned burning is only one element in knowledge development and, in turn, only one influence on how to conduct activities on the ground. Therefore direct experience influences how to place the formal or explicit knowledge gained at training into a context.

The author's observation of work practices by teams at planned burns reveals the critical role played by tacit knowledge in shaping fire practice. This observation suggests that individual teams derive localised techniques for applying fire to the landscape. Observation of individual teams that have derived localised techniques for applying fire to the landscape during planned burning that reflects their particular knowledge of landscape and fire behaviour. When discussing tactics and techniques it is common for staff to refer to previous experiences to illustrate the insight they gained over time. This reflection is used to help justify or explain the way they carry out their work. It is not unusual to hear staff referring to crews sent to work in their area from other locations as requiring specific direction to ensure that they work in a way that

matches local conditions and, by extension, associated norms and expectations. Published research has revealed similar insights to the role played by past experience (tacit knowledge) in shaping staff decisions and actions. A good example is cited in Elliot, Omedei & Johnson (2009) who report that staff experience of near misses and accidents is a major influence on their future planning and decision-making.

Interviews with staff

The small number of interviews conducted with experienced staff revealed information about how tacit fire knowledge is developed and applied. These interviews explored specific elements of a person's tacit knowledge. Staff members were asked to reflect on how their understanding of the influence of variables such as season, vegetation types, crew behaviour and terrain on planned burning outcomes had developed across their career. This revealed the complex interplay that exists between explicit and tacit knowledge and reinforced the hidden but critical role played by the latter in shaping both decisions and outcomes.

Using the outcomes of these interviews and author reflection, Table 1 shows some of the key factors that may be critical in shaping staff tacit fire knowledge in a fire agency. Their relevance and influence needs to be tested through structured inquiry.

Organisational strategies for recognition and transfer of tacit knowledge

Significant research has been undertaken that explores how organisations can tap into and facilitate the transfer and sharing of tacit knowledge (Kakabadse Kouzin & Kakabadse 2001, Stenmark 2001, Cabrera & Cabrera 2005, Roux *et al.* 2006). A common thread that occurs is that agencies need to understand what tacit knowledge is, and then understand how it is used, withheld and shared by individuals within organisations.

This body of research reveals that tacit knowledge can be leveraged, exchanged and transferred within an organisation if a number of elements are present. Fundamentally organisations need to understand what Cabrera and Cabrera (2005) refer to as the 'social-psychological determinants' of knowledge sharing. They discuss the theories of reasoned action, social capital, social dilemma, and social exchange to highlight four propositions.

1. Positive attitudes toward knowledge sharing in an organisation will be positively related to intentions to share knowledge (theory of reasoned action).
2. Social ties and shared language help create an environment that supports knowledge sharing (social capital theory).
3. Trust and group identification encourage positive attitudes toward knowledge sharing (social capital theory).

Table 1: Potential factors shaping the development and use of staff tacit fire knowledge.

Factor	Knowledge impact
New legislation, policy and operating procedures.	Generates changed procedures and practices that over time become embedded in staff behaviour and norms. As an example, comparison of workplace safety practices over the last 20 years reveals that significant change has occurred in staff behaviours and expectations associated with safe working procedures.
Community based debates and expectations, for example about the value and conduct of prescribed burning.	Staff members are embedded in social systems so they absorb debates and points of view being expressed in the community. This and their personal values shape their attitude toward fire practice over time.
New technology and equipment.	Staff members learn how to do tasks differently and more effectively. This can accelerate staff capability and innovation and generate flow-on changes in fire practice.
Personal experience over time such as exposure to different seasonal conditions and landscapes.	Improved staff awareness of factors that shape decision-making and the outcomes, such as the relationship between fuel types, topography, fire behaviour and operational tactics.
Team dynamics.	Staff may have access to significant levels of tacit knowledge within their teams. This knowledge helps form workplace norms or peer-generated views about tactics, standards and procedures. See for example Hayes, Omedei & Johnson 2013.
Change in a staff member's personal fire role such as from a fire fighter to a planner or incident controller.	Staff will re-evaluate their knowledge as they move into different roles and become exposed to different expectations, perspectives, information and systems.

4. Perceived rewards and expectations of reciprocity are required to encourage knowledge sharing (social dilemma theory).

Kakabadse and co-authors (2001), like Blair and colleagues (2010a, 2010b) argue that knowledge sharing is a 'socialization process' and not simply the provision of information in explicit forms such as manuals and procedures. They highlight the presence of trust and an egalitarian culture is essential to support tacit knowledge exchange. This is echoed in the research of Edmondson and Lei (2014) who refer to the concept of 'psychological safety'. When this is present, people share and express ideas without fear of negative repercussions. Establishing a workplace culture where this is possible requires leadership and an explicit recognition of the value of tacit knowledge.

Current approaches in Victoria

This research can be used to assess how current approaches to knowledge management in fire agencies in Victoria may support or constrain the recognition and transfer of tacit knowledge.

Positive dimensions

There are positive dimensions of tacit knowledge review and exchange in Victoria:

- The ongoing informal conversations, mentoring and debates about fire practice that occur at the local team level. These may constitute small or local communities-of-practice. Roux and co-authors (2006) define a community-of-practice as a self-forming collective of individuals who share knowledge about a matter of common interest, and who develop individual and collective knowledge through sharing stories, insights and information.

- The presence of extensive and high-quality formal training that has the effect of increasing the confidence and self-efficacy of staff. This provides them with a context as individuals in which to develop and review their tacit knowledge. Publications used in fire training have at times sought to combine operational and research based knowledge (Tolhurst & Cheney 1999).
- A strong sense of team and shared identity that allows some elements of social capital theory to thrive (Cabrera & Cabrera 2005).

In addition, the use of systems of competencies for fire roles is also bound up with the management and recognition of knowledge. Operationally, there are also numerous knowledge gathering or exchange processes in place that are routinely used in fire management settings. Common tools are debriefs, or After Action Reviews (AARs) that occur after events such as a prescribed burn or, on a larger scale, after a fire season. AARs can identify important improvements to practice that can be implemented by teams on the ground. The improvements identified are often derived from the expression of, or reference to, staff tacit knowledge.

Negative dimensions

These positive elements are combated by a number of factors:

- A tendency (as noted previously) for agencies to view knowledge as an object to be imparted, rather than being a process (Blair *et. al* 2010a). This generates a consequent lack of recognition of tacit knowledge and an inability to understand how staff knowledge is used in context.
- An emphasis on hierarchical structures that support command-and-control that run counter

to the importance of egalitarian workplace cultures (Kakabadse, Kouzen & Kakabadse 2001) and psychological safety (Edmondson & Lei 2014) in supporting knowledge exchange within organisations. This specific challenge has been noted as affecting emergency services organisations in Australia (Owen *et al.* 2015)

- A related fragmentation of operational and research knowledge sets and a retention of the operational-science divide (Roux *et al.* 2006). This mitigates against the co-production of knowledge.
- A strong reliance on formal knowledge management techniques such as AARs and debriefs that reflect a preference for hierarchical structures.

Changing the approach

Four changes are needed by land and fire agencies to develop new approaches to knowledge exchange and development.

1. Establish new workplace systems such as communities-of-practice, cross-functional teams, and performance management norms that create an egalitarian workplace culture and support the interaction between researchers, community and staff members.
2. Adopt new forms of operational analysis that explore how staff use and develop their knowledge in context. Oral history and learning history approaches (Parent & Beliveau 2007) to knowledge

gathering and review should form core elements of this approach. This may involve but not be limited to, pre-event review of the operational and policy context that staff rely on when planning an activity. This could be followed by observation of staff behaviour and decision-making at actual events, and then by post event interviews and comparative analysis that explores how tacit and explicit knowledge have variably influenced staff decision-making and action.

3. In line with this, agencies should rethink the design of existing knowledge exchange processes such as AARs to better support recognition and evaluation of staff tacit knowledge. This can be connected to more formal processes and ongoing conversations occurring within communities-of-practice and other egalitarian forums. AARs could adhere more closely to the community-of-practice model and allow for constructive debate rather than old-style military review. The Students of Fire model, (Stebbing & Strickland 2014) is an example of a community-of-practice that is already active and could be adapted to suit agency needs.
4. Tap into the revolution occurring in the design and conduct of serious accident investigation by United States land and fire agencies. Exemplified by Pupalidy (2009), this work recognises that decision-making in dynamic situations like wildfires is shaped by tacit knowledge. In this setting, investigations focus not on finding errors and ascribing blame to individuals. Instead, they seek to understand the context in which decisions were



Aerial view of planned burning operations conducted in 2015 at the Macedon Regional Park, central Victoria.

Image: Tony Morris, Parks Victoria.

made and the conditions which prompted them to be formulated. This approach is a shift away from simple casual analysis to one that replaces use of hindsight with recognition of how knowledge is used by staff in certain circumstances. Pupulidy's review of the Panther Fire Fatality Incident¹ in California in 2008 is an illustration of the presence of tacit knowledge in a workplace and its influence on decision-making. It also highlights how tacit knowledge can be adapted and used to drive improvement. This approach can be broadened beyond accident investigation to looking at how tacit knowledge is used in standard operational settings.

If designed well, adopting these four changes could form a self-sustaining loop of knowledge development and exchange.

Conclusion

Recognition of staff tacit knowledge and its effect on operational practice is a critical step if agencies are to achieve strategic objectives in land and fire management. Numerous benefits would flow from this for the agencies involved and the communities they serve. It would contribute significantly to agency adaptability, openness to learning from the community, and the ability to exchange ideas and knowledge across the science-operations divide.

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About the author

Anthony English is a District Manager with Parks Victoria and undertakes the roles of Burn Officer in Charge and Operations Officer Level 2 at bushfires. Anthony has also worked in park and fire management in New South Wales and the Northern Territory. He has a strong interest in workforce planning and a background in cultural heritage management.

¹ Panther Fire Fatality Incident. At: www.wildfirelessons.net/orphans/viewincident?DocumentKey=bf7fa21a-4c22-4d58-b568-a1dec4aa2945.