

Hazard Identification and Risk Assessment – Understanding the transition from the documented plan to assessing dynamic risk in BioSecurity emergencies.

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Abstract

This paper addresses the fundamental change in thinking that by having documented hazard identification and risk assessment plan all options have been covered. The next step is understanding the challenge of assessing “risk on the run”, often referred to in Australia, New Zealand and Britain as “Dynamic Risk Assessment”. The case study will look at the changing face of risk management in emergencies focusing on BioSecurity and the areas of animal and plant disease. In recent years and changing weather patterns in Australia the increased incidence of emergencies has challenged previous thinking, and required innovative ways of meeting the changing needs in managing risk. The very nature that individuals see things differently only increases the challenge; what one person may see as a risk, the next may not. Through understanding the cognitive limitations of individuals, problems encountered in making decisions in ambiguous and time pressured situations, emergency managers can start to understand where things may go wrong and therefore establish contingencies. Protecting emergency response personnel and members of the public is a key safety issue in containing any emergency and the provision of rapid resolution to emergencies is something that is driven at many levels from government to the responders themselves and also meeting community expectations. Hear how these challenges are being met in the Australian context.

Introduction

The risk management activities in emergency response can be complex and present a variety of challenges that are not always evident in the workplace. The dynamic nature of different emergencies and all too often the ambiguity of the situation can create gaps in risk awareness. It is for these reasons that establishing robust risk management plans prior to an emergency form a critical component of the overall risk management program. This often involves establishing documented plans and documenting hazard identification and risk assessment processes, the question is when the situation is dynamic and the plan does not cover all potential scenarios what do we do? It is this area that the process of dynamic risk assessment comes into play. Dynamic risk assessment does not take away from the established documented processes, but rather enhances the overall risk management process.

Biosecurity Emergencies

The effects of global warming, increasing globalization and the capacity of disease to readily spread through the increase of air and other means of travel presents challenges to agencies responding to biosecurity emergencies. The increasing spread of disease and evolving new diseases and ongoing threat of emergencies faced by agencies and the community is often influenced by adverse seasonal conditions that can cause drought, exotic diseases in plant and animals or the

risk of impact of pests such as plague locust. Agencies and personnel protecting the agricultural and food industries from exotic pests and disease are faced with a diverse set of challenges. Pest and disease in plants and animals can range across a broad spectrum and include Anthrax, Avian Influenza, Equine Influenza, Newcastle Disease, Foot and Mouth, Australian Plague Locusts, Queensland fruit fly and the management of weeds that may impact on native vegetation. In Australia, Animal Health Australia is the custodian of the Australian Veterinary Emergency Plan, this is commonly known as AUSVETPLAN (2008). Plant Health Australia is likewise responsible for PLANTPLAN which details the Emergency preparedness and response guidelines for Australia's agricultural industries (May, 2009). These plans have been historically focused directly on the management of the animal or plant risk being managed with a strong scientific focus. Safety is slowly being reflected in the plans and would seem to be evolving slowly within the plans developed to include aspects of safety of personnel. Both plans set overarching principles on the management of hazards and their associated risks and are specific in some areas such as the management and impact of chemicals. AUSVETPLAN as part of the suite of documents provides a risk management manual which establishes a framework and this "...forms the basis of a standard process by which jurisdictions and industry can estimate the overall level of risk through determining the likelihood and consequence of potential risks." (p.1) The establishment of these documented processes are important in understanding the potential level of risk or threat and adopting ways of mitigating or managing events. It is the move from these documented plans to the front line that pose one of the many challenges.

Hazards and their Risks

As previously mentioned the management of emergencies often presents agencies and their response personnel with unique challenges. The management of hazards and their associated risks is one area that has seen a shift in recent years in thinking. There are many pieces of legislation that require employers to manage hazards for example health and safety Acts and Regulations. Although the Statutory rules vary in wording across the nation the intent is predominately the same, that is

to ensure that hazards are identified and risks are controlled. The manner in which this is achieved can be as varied as the nature of the hazards themselves. The impact of a financial risk will be different to that of the risk of electrocution so the impact itself can often influence the level of acceptability and choice of controls. This is further complicated by many other factors such as the impact that it may be perceived to have on those undertaking the assessment. Thus gaining an understanding of what is risk can be confusing particularly in managing emergencies (Clancy, 2005). This often creates a difficult situation for those trying to accurately perceive risk and is also dependant on how they will be impacted. A hazard is "*a source of potential harm*" and risk is "*the chance of something happening that will have an impact on the objectives*" (Standards Australia, 2004, p.4). In plain English a hazard is 'what can harm you' and risk is the 'outcome of the hazard'.

Gaining this understanding of risk is often made more difficult due to a lack of commonality of definition of risk across health and safety disciplines which hampers progress in the field (Viner, 2003). Another problem is that the concept of risk has been found to be subjective and contextually driven (Adams, 1995. Reason, 1997). This only serves to increase the challenges to emergency response agencies in ensuring that response personnel operate in the safest possible manner. Adams (1995) suggests that "*our anticipations are formed by projecting past experience into our future. Our behavior is guided by our anticipations. If we anticipate harm, we take avoiding action.*" (p. 30). Organisations often place a lot of emphasis on having documented risk assessments completed as part of their ongoing planning. For organisations charged with managing biosecurity emergencies processes established at government level also provide direction to what is required.

Situational Awareness

As part of undertaking a risk assessment the operator requires a sound knowledge of their environment. In order to maximize knowledge of the complexities of dynamic risk assessment it is important to review the concept of situational awareness. Situational awareness allows the operator to identify key aspects of what is occurring in the environment and without this knowledge the activity of dynamic risk assessment

will be flawed or gaps in the process may occur. Endsley (1995) defines situational awareness as *"...the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future."* (p.36) Situational awareness at this level can be broken down into three defined cognitive function 1. perception, 2. comprehension and 3. projection. At the first level the operator must be able to perceive all the elements within the environment. This is made up of many factors and can include some of the following your current position, resources at hand, how the emergency has progressed to the current point in time and what is being impacted. The second level (comprehension) is understanding how all the elements perceived in level one interact for example should insufficient resources be on hand and the event is developing rapidly can more resources be obtained quickly and what will be required. The third level projection (prediction) is understanding based on the components of levels one and two what will happen, what are your expectations of the event and how may it play out. Endsley and Garland (2000) make the point that situational awareness is separate to the overall process of decision making and operator performance and *"...therefore is represented as the main precursor to decision making; however many other factors come into play in turning good SA into successful performance."* (p.8) Therefore to proceed through the process of dynamic risk assessment the importance of accurate situational awareness will have a strong bearing on how effective is the knowledge that has been formed of the environment.

Dynamic Risk

All aspects of what we do in daily life have a certain level of dynamic risk, dynamic risk is best defined as the changing risk presented in a constantly changing environment. Dynamic risk assessment is a term that is has been used frequently in emergency services over the past 15 years. Dynamic Risk Assessment the ongoing assessment of risks within the individuals environment based on cognitive information processing or in simple terms its an ongoing risk assessment done in your head. This is an important factor as was found with firefighters when responding to changing risks they *"...need to be*

able to think on their feet and act accordingly." (Clancy, 2005, pg.40). Often an area of misunderstanding is the fact that we are all well versed in completing dynamic risk assessments. It is a cognitive process that on many occasions we put little directed thought into, it just happens. Think about driving a car, there are many things you do automatically with little conscious thought, using indicators, adjusting speed, braking, changing position on the road, this is one of the benefits of our complex minds they take a lot of the mental workload off us. Now go back to a time when you were first learning to drive, lots of things to remember, when to look in the mirrors, when to change gears, what road hazards are around you but as time went by a lot of these things just happen automatically. This all occurs as our brains are powerful tools and just as they can help make our decision making easier for us there are a few hidden traps as well. Understanding where we will make errors in our decision making can aid us in understanding when things are going wrong, sometimes we will persist with things when we know things wont change but we apply the optimistic bias hoping that things will change.

Recently one of the authors was on a flight when about a minute into take off a few seats ahead the oxygen masks dropped. Being in a position to observe (as there was no obvious emergency) the flight staff went about rectifying the problem. The first action was to put the masks back by bundling the hoses and masks together and pushing them back into the storage area. Once completed the hatch was closed. The problem was it would not re-latch and the masks once again fell down. A second attempt was made with the same result, then more staff came to assist, safety in numbers but still to no avail. In all the same activity was tried a total of 10 times before it became obvious (to those attempting to rectify the problem) that it was time for plan "B". Plan "B" ultimately saw a medical kit accessed and tape used to hold the panel in place. This provides a rich example of people undertaking an activity, doing the same thing and expecting a different outcome. Now the situation above was not an emergency, however highlights the need to understand when it is time to cut your losses and use another plan. You do not need to be a psychologist to understand some of the problems we have from a cognitive perspective when making decisions in emergency response. In

some ways we are all experts in the field as we have all experienced them, often we just don't realize it.

Risk Perception

Risk perception plays an important role in emergency response as the environment is often dynamic with changing requirements and all too often ambiguous information available. The existing research literature finds that risk perception is likely to vary considerably between individuals (Lupton, 1999; Reason, 1997; Slovic, 2000. Clancy, 2005). Perception of risk is further compounded where time pressure is a factor and is likely to be subject to errors and biases (Slovic, 2000). Those with greater experience in a domain have been found to have more accurate perception of risk (Barnett and Breakwell, 2001), therefore it is reasonable to conclude that for personnel managing biosecurity emergencies their perception of risk will vary depending upon their experience at emergencies. Previous research has also found that more accurate risk perception is associated with higher education (Lupton, 1999, Clancy, 2005. Holgate & Clancy 2007).

Biases

As humans we are prone to cognitive biases, and we are therefore prone to making mistakes. This is not to suggest that people who make erroneous decisions are poor at their job, what it does highlight is that understanding where things may go wrong in our decision making processes may greatly enhance our decision making ability. Kahneman and Tversky's work in the early 1970s and 1980s was revolutionary in understanding the area of human decision making (Ripley, 2008). *"they explained that people rely on emotional shortcuts, called heuristics, to make choices"*. (Ripley, 2008). Heuristics as described by Clancy (2005) are essentially "rules of thumb" and *"...are fundamentally useful aids that assist in reducing the complexity of the task..."*(pg.51). Other areas are how a scenario is framed, if it is presented in such a way as being out of control it is most likely that people will rate it higher than if it is played down and not presented as an area of concern. There is an exception to this however, where experts work in hazardous environments it has been found that what could be described as expert decision makers will assess the same scenario

presented in two different ways equally, that is they look at worst case scenarios, novices were found to have the greatest variability (Sadler, Holgate & Clancy., 2007.) There are many other biases such as sunk cost bias, this restricts our ability to pull out of a situation and increases that difficulty, the more we invest in it hoping that things will go right. Confirmation bias provides us with similar problems in that the more we invest the more we dig a hole for ourselves which is difficult to get out of. Optimistic bias is another area where we think things will be alright, it is often difficult to say 'well we got that wrong lets go back to the drawing board', but sometimes this is the best way. In fire response research another key bias was "overutilization of resources" it was found that if the resources were available they should be used, this can present those managing an incident with the problem of managing resources and the logistics associated with those resources unnecessarily as well as exposing personnel unnecessarily to risk as well as cluttering an incident scene.

What is acceptable risk?

Defining acceptable risk will vary based on the type of emergency and is influenced by a myriad of factors. For the incident controller at a biosecurity emergency it will not only be specific incident hazards such as confining an outbreak, ensuring quarantine zones are not breached or that chemicals are managed effectively. Other factors may be politics, that is that you can appease the government that your actions are appropriate, ensuring the community is informed. Fischhoff, Lichtenstein, Slovic, Derby & Keeney (1981) define acceptable risk as the "risk associated with the most acceptable option in a particular decision problem" (p.3). At the other end of the scale the personnel physically on the ground dealing with the emergency are faced with a different range of hazards and risks and therefore may have a different opinion altogether. The further removed from the incident site the less the personal impact will be from a physical injury or illness. This remoteness from potential impact can lead to situations where a decision is made that will potentially have far greater ramifications than expected. A key to managing this potential risk is the flow of information between those controlling

the incident that may be removed from the scene and the operators on the front line.

Memory

Memory plays a vital role in emergency management, firstly short term memory or working memory. Working memory allows us as humans to attend to a number of items at one time, however it is limited in capacity, this is where we hold information temporarily for further processing. Working memory is considered to be able to handle 7 pieces of information plus or minus 2 (Miller, 1956) at any one time. Short term memory is a useful aid and allows the emergency responder to attend to several things at once, the problem however is that this will decrease significantly the more complex the situation become, if the situation is stressful or the operator is under pressure (Klein, 1998. Plous, 1993. Weick & Sutcliffe, 2001). The benefit is that the retrieval of information is immediate and requires little conscious thought as it has not left the conscious mind. Baddeley (1992) reported that when this decrease in working memory occurs in situations such as under stress errors will start to occur as the operators tend to focus their attention on the centre of the situation and they will therefore miss important pieces of information on the periphery. This decrease in situational awareness will also impact directly on the individuals risk perception. Long term memory is the information that is in effect stored away, this information is not as easy to retrieve. Endsley (1995) when discussing situational awareness proposes that we have mental models and that these influence preconceptions and expectations of a situation which will affect the speed and accuracy of our perceptions significantly.

Mental Models

Mental models are cognitive tools that help operators make sense of what they see or are experiencing. Slovic (2000) describes mental models as being "...detailed representations of a person's knowledge and beliefs about a hazard or a consequence." (p.272) these mental models are developed over a lifetime and are composed of an individuals knowledge based on education, experience, attitudes, beliefs and impressions (Clancy, 2005). Klein (1998) suggests that an operators mental model will tell them "...how

tasks are supposed to be performed, teams are supposed to coordinate, equipment is supposed to function." And the goes on to describe that they allow the operator "...know what to expect and lets them know when expectancies are violated." (p.152) mental models play an important role in the perception stage and ongoing assessment of the emergency response. Mental models also play an important role between the experienced operator and the novice with regard to risk perception with greater variation or inability to accurately perceive risks in novice operators (Lupton, 1999. Slovic, 2000).

Framing Effects

Framing effects can provide the emergency responder with valuable information or conversely with a misguided view on the environment. The detail of information is provided and how it is presented (framed) will influence how the operator conceptualizes what is being presented about risk as well as many other aspects of an emergency (Perrin, Barnett, & Walrath, 2001; Tversky & Kahneman, 1981). Framing effects are described by Reyna (2004) as shortcuts that enable people perceiving risk in order to quickly make sense of the risky situation. (Reyna, 2004). How information is presented to the operator will influence how they perceive risk. Research has shown that given the same scenario framed using different descriptors for example a contained incident as compared to an out of control incident will impact on the perception of the level of risk (Sadler et al, 2007).

Conclusion

As has been discussed there are many complexities in the overall process of hazard identification and risk assessment. Occupational health and safety laws are one key driver that require organisations to identify hazards and control risks. Documenting potential hazards and establishing controls prior to an event allow agencies tasked with managing emergencies to establish be prepared. It is the dynamic component that presents greater challenges as information is often ambiguous and constantly changing, there can be many unknowns and competing priorities. The discipline of psychology plays a strong influencing role in understanding the complexities of the problem for

agencies, managers and responders themselves. Fortunately in recent years significant research has been undertaken to assist in understanding why we do what we do and why we see what we see. In cases where things go wrong the challenge for organisations is not to identify why a bad decision was made and by who, but rather understanding all the factors that went into the decision and where and how gaps occurred.

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