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DECISION MAKING, TEAM MONITORING AND ORGANISATIONAL PERFORMANCE

Part one: executive summary

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Cover: Victoria's State Control Centre is a hub of activity during an emergency.

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TABLE OF CONTENTS

END USER STATEMENT

By Keith Fitzgerald, New South Wales SES

I am pleased to be asked to provide an end user statement for this project. Overall, I am convinced that the research project and its three intertwined streams, offer to the emergency management community, the opportunity to better serve their communities, through improved decision making in complex situations. The three streams of research can be viewed as standalone, however there are obvious synergies between the three and these interrelationships will become more apparent toward the end of the latter phases of the research project. I would like to thank the research team for their work to date and for being responsive to the needs and input from the end users.

The decision making research stream offers clear opportunities in terms of viewing emergency management decision making as a framework rather than a set of decision tools in isolation, while the team performance monitoring stream and the notion of 'coping ugly' offers keen insights into disruptions to team functioning. The need to better improve our monitoring of team performance offers significant advantages in terms of optimising team performance and reducing the stress on individuals by better recognising how they are functioning. Finally, the organisational performance research stream provides insight into the modern emergency management environment where the better defining of successful operations and the need to better learn lessons across agencies and environments is becoming increasingly clear.

I have been impressed with the input from end users across all agencies and all hazards; ultimately I think we all see the benefits of this research at a national level. The next phase of the research will necessarily involve focusing the research effort within a smaller number of agencies, however the need for ongoing input from all end users is essential to the future benefits realisation. I look forward to the next phase of the research and encourage all end users to stay involved, finding time now to safeguard our future is difficult, but we need to stay the course. I look forward to your continued input as this project continues.

EXECUTIVE SUMMARY

This research report is an interim report for the Bushfire and Natural Hazards CRC project **Practical Decision Tools for Improved Decision-Making in Complex Situations.** The project plan for this research includes three main research streams: Decision making, team monitoring and organisational performance. The initial work in the project has identified that the three research streams in the project are best treated as interrelated but distinct bodies of work.

For ease, these have been published as separate documents.

- This Executive summary is published as Part 1
- The Decision making section has been published as Part 2
- The Team performance monitoring section has been published as Part 3
- The Organisational performance section has been published as Part 4.

All parts can be located at www.bnhcrc.com.au, under the **Practical decision tools for improved decision-making in complex, time constrained and multi-team environments** project page.

Each of the research streams has been coordinated by one of the principal researchers in the project and each research stream is thus considered discretely in this report. While we have chosen to present the research streams individually here there is a large degree of interrelation between the streams, particularly between the team monitoring and organisational performance streams; and both are informed by the decision-making tranche of work. The interdependence of these streams will be emphasized in later phases of the research project.

DECISION MAKING STREAM

This research stream investigates strategic decision-making by our research end-users during emergency events. Decisions are key points in response and recovery because they inform strategy and allocate resources and therefore strongly influence performance. The research has a specific focus on how coordination occurs at regional and state levels of Emergency Management (EM), although it does not exclude the interactions Regional and State levels and the IMT. We are also focused particularly on decision-making for level 3 incidents or what sometimes are referred to as 'out-of-scale' events. The aims of the research are as follows:

1. To understand current decision-making processes in emergency management in Australia and New Zealand (outlined in this report);
2. Identify opportunities to improve decision-making (outlined in this report) and,
3. To test heuristics (cognitive rules of thumb) and other strategies to improve decision making in controlled environments to assess their validity and reliability (future research activity).

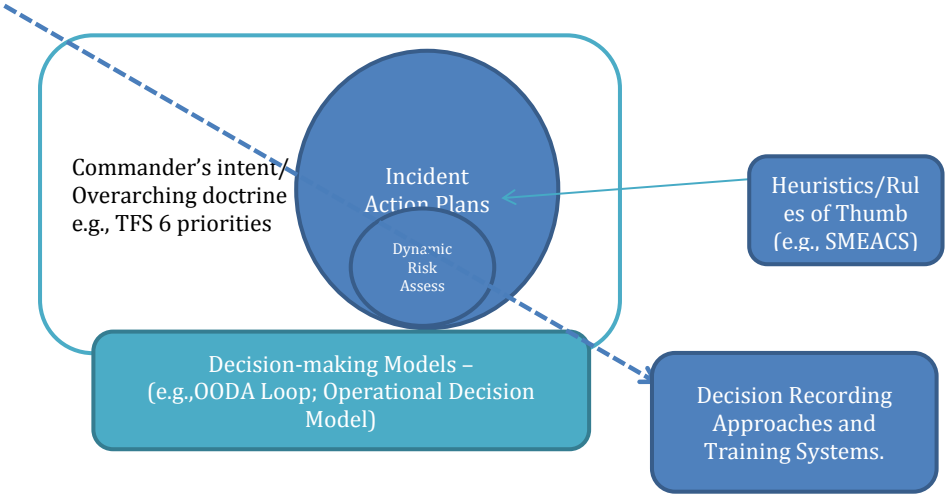
DECISION-MAKING

Decision making in emergency management can be challenging and stressful due to the dynamism, complexity, uncertainty and temporality that occurs in this environment (Brehmer, 1987; Danielsson & Ohlsson, 1999).

- Emergency events 'don't play by the rules'. All levels of the EM command structure have to make decisions in complex and demanding environments.
- Decision-making comes in different 'styles' – Flin (2008) indicates there are four – creative, analytical, procedural and intuitive. In practice these are decisions that differ in terms of the amount of conscious effort required and the strategies applied can also vary. At different phases of an emergency some or all may be necessary.
- It is likely that decision-makers will need to regularly shift between what has been referred to as 'Type 1' decision-making (automatic, heuristic, intuitive) and 'Type 2' (conscious, analytical, reasoning and reflective).

UNDERSTANDING HOW DECISIONS ARE MADE WITHIN EMERGENCY MANAGEMENT – THE DECISION FRAMEWORK

It is important to recognise that the system for managing decisions is much larger than just a decision-making tool – such as a rule of thumb, a decision-model or an aide memoir. The doctrine, policies, procedures and other organisational systems that wrap around the decision-maker all influence, and are therefore all part of the decision-making process. The diagram below attempts to identify these components and interpret at a very coarse level the relationship between them. It suggests that a group of elements impinge on decision-making at the IMT level – broader doctrine, operational guides, IAP processes, risk assessments and heuristics. Everything is underpinned by the decision-making model and the recording approach cuts through all of this to influence outcomes.



Opportunities to Improve Decision-making

A number of issues have emerged from the investigations conducted in this phase of the research. These issues are associated with an interpretation of EM decision-making as a framework rather than considering decision tools in isolation. We see that there are opportunities to:

- Support improvement in Agency decision-making within the 'framework' – this might be through the improvement of decision recording approaches (e.g., recognising the influence of bias, the limits of human cognition, the need to adapt to different styles of decision-making), adapting or implementing decision models, developing heuristics, or supporting changes in doctrine/policies/procedures.
- A lack of role clarity at strategic levels is a confounding issue in developing these improvements.
- The development of any tool is likely to need to be supported by training systems that build strategic knowledge and skills about decision-making.
- Decision-making is supported by physiological functions such as peripheral vision, memory and creativity. A growing area of research has established that the association between cognition and brain plasticity - changes in neural pathways and synapses due to changes in behaviour, environment, neural processes, thinking and emotions. Many of these functions can be improved with skill-based training and the most complete decision-making improvements are likely to come through the pairing of cognitive strategies and brain plasticity training modules.

TEAM PERFORMANCE MONITORING STREAM

In Australia, emergencies are managed by a complex network of teams. As operational teams engage in their tasks and deal with performance disruptions they can be said to move around a notional space of safe and unsafe operations. If the operation is particularly difficult or there are unresolved disruptions to performance the team can move out of the zone of safe operations, firstly into the zone of coping ugly and then into the unsafe zone where incidents and accidents are more likely to occur. Figure 1 depicts this notional safety space.

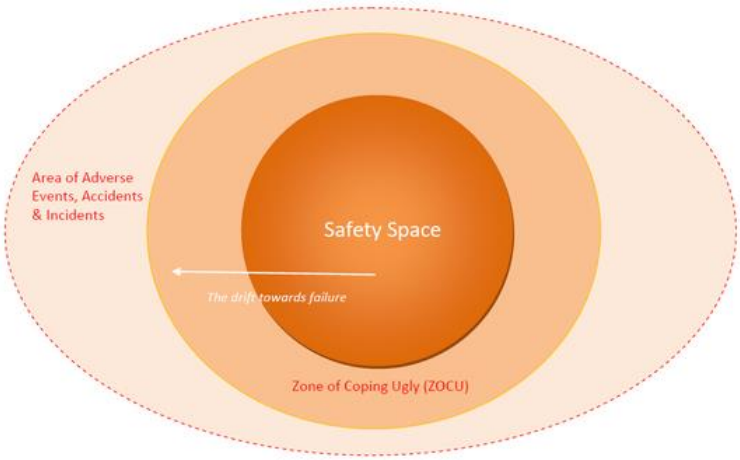


Figure 1. Notional space of safe and unsafe operations (from Brooks, 2014)

One of the important roles of regional and state level emergency managers (SEMs) is to monitor teams that are operating at their level as well as below them in the structure of the organisation to determine how they are performing. This provides an important safety and quality assurance function for agencies that operate in inherently risky environments. However, there is currently limited guidance on how this should be done in emergency management.

The research literature on team performance monitoring in other high risk industries suggests a number of methods that can be used to monitor teams, such as: monitoring team outputs, mapping team information flow, inspecting linguistic correlates, examining team-based behavioural markers, and assessing individual team members. Each of the approaches to team performance monitoring has different strengths and weaknesses. Of these methods, perhaps the weakest approach is to simply monitor the output of teams. This approach does not consider team processes and will not necessarily detect problems in team performance. Given the strengths and weaknesses of the different approaches it is best practice to use a number of different methods in combination. There has as yet been little or no translation of these methods into the emergency management domain.

To explore the issues around team performance monitoring and to understand how SEMs are currently doing this task the research team visited eighteen agencies in Australia and New Zealand. Many (although not all) of these agencies are participating in the Bushfire & Natural Hazards CRC Cognitive Decision Strategies project. The team has discussed the research and/or collected data with a number of different people in agencies, including: chief officers, deputy chief officers, principle rural fire officers, senior officers, state coordination personnel, regional coordination personnel, and incident management team personnel. These people represented: the National Rural Fire Authority, urban fire brigades, rural fire agencies, land management agencies, state emergency services, council officers with responsibility for search and rescue and the Red Cross.

As part of our exploration of the issues around team performance monitoring we conducted two qualitative interview-based research studies with SEMs. In the first study eleven people from a wide range of emergency management agencies participated in a semi-structured interview about their current practice and issues around team performance monitoring. In the second study fourteen regional coordinators from two different emergency management agencies participated in a desktop simulation and semi-structured interview about detecting breakdowns.

Based on the information that we collected, it appears that only one agency uses a formal method for monitoring the performance of teams. This method is used by senior officers who, as part of a broader approach comment on: team unity of purpose, team communication, team effectiveness and team cohesiveness. This method of team monitoring is used when it is requested by the incident or regional controller or if a senior officer deems that there is a problem. It is typically not used as a matter of course in emergency management. Since this method uses a team of senior officers it can be challenging to resource.

However, a number of informal methods that SEMs used could be identified. These methods could be grouped into three main categories: prevention, identification and resolution methods. The prevention strategies that SEMs used were based on: preplanning, exercising and building a safety culture. The identification strategies were based on monitoring information flow, intuition and detecting non-verbal cues. The resolution strategies were based on: delegating the resolution action, delegating a representative, providing additional resources, mentoring, asserting authority and replacing staff.

Comparing the data on what SEMs do to the literature on team performance monitoring shows that there are a number of opportunities to enhance how SEMs monitor team performance and to develop more formal processes. For example, in addition to monitoring information flow, a more comprehensive list of things to look out for could be developed and used together with a set of behavioural markers of breakdowns and effective team performance.

Such initiatives need to be developed together with industry partners to provide a set of approaches that are specific to emergency management, can be used by people who are not co-located with the team and can be used to monitor multiple teams. The exploration of these opportunities and challenges forms the basis for detailed discussions with our industry partners, which is the next stage of the project.

ORGANISATIONAL PERFORMANCE STREAM

The third stream in the research project is investigating the need for and application of organisational-wide performance evaluation indicators for learning from emergency events. The processes by which emergency events can be evaluated and what lessons can be drawn from them has long been an area of concern and is receiving increasing attention.

The focus in this stream is on examining the tools agencies are developing to conduct post-hoc analyses of incidents and following a season of events to identify lessons that can be learned for continuous agency-wide organisational improvement.

An environmental scan was undertaken with end-user agencies to ascertain what strategies they currently have in place to assess performance following an incident, or season of events. This revealed that there is considerable activity occurring in agencies to capture lessons that may be learned from after action reviews and post incident review. Nearly all agencies, for example, are developing their own localised processes to evaluate performance and to learn including

- Developing processes and strategies to systematically review data and insights collected from other forms of monitoring, including real-time performance monitoring.
- Appointing personnel to be responsible for analysing patterns in after action reviews and seasonal debriefs to ensure that actions taken to redress problems as well as that there is alignment between organisational policies, procedures and training.
- Establishing lessons learned databases and lessons management systems.

However challenges remain. The ways in which agencies are evaluating previous incidents, or periods of activity is highly variable. In addition it appears that there is high variability in the training provided to personnel to conduct these evaluations of performance. There appears to be limited systematic sharing of learning from evaluations across the sector. This is in part is a cultural issue because agencies are not keen on airing their problems with others. In addition, there are structural impediments to sharing reviews and evaluation of performance across the sector. These include agencies using different terminologies and no shared language with which to aid collective understanding.

Having established that, whilst there is much localised activity occurring within agencies, there are challenges and no overarching framework in use to provide a cohesive approach across the industry, a secondary analysis was conducted on survey data collected from 36 fire and emergency services agencies in Australia and New Zealand on questions included in a national survey to investigate perceptions about measuring emergency management performance. In addition a pilot workshop with an end user agency was conducted to test a consultation process that can inform the next stage of the consultation process.

The data collected identified the perceptions of senior emergency management leaders on what constitutes successful emergency management performance as well as what constitute indicators of "trouble" that may signal that an emergency response system is moving toward vulnerability; as well as what they believe are the indicators that major events had been well managed. Finally a pilot workshop was held with personnel from emergency services in Tasmania to evaluate the veracity of the initial findings and to test a consultation process that can be used in the future consultation phase to identify future requirements.

One of the issues emerging from this part of the research project is the increasing awareness of the importance to make explicit the underpinning values and trade- offs that also need to be managed as a basis for understanding the needs and requirements of an evaluation system. This is because, firstly, without values there is no means of assessing whether the system's performance was successful or not.
Secondly, competing needs such as financial and resourcing constraints must also be named up because failure to do so leads to over simplifying managing emergency events and can undermine the goals of resilience. With all emergency events comes risk that can only be managed within the means of the resources available.

Understanding practitioner perceptions about their own environment in terms of what constitutes effective emergency management objectives, indicators of trouble and indicators of successful emergency management provides a useful insight into existing need and establishes a foundation for developing a framework to support future reviews and practice, as well as informing the next stages of the research project.

The overall themes found within responses to each question suggest values placed on (i) being prepared and ready for large scale events; (ii) having

strategies in place to ensure that the emergency response system is managing appropriately (iii) effectively coordinating with other emergency services stakeholders; (iv) maintaining the confidence of the affected and general public and their elected leaders and (v) supporting whole of government decision making for longer term consequence management. Underlying these needs are values associated with the primacy and sanctity of life; supporting a healthy resilient workforce, facilitating cultures of learning, empowering of emergency services personnel to be able to be flexible in their decision-making and actions, as well as contribution to public service.

However within each of these themes senior managers also need to address latent and active tensions. These include tensions within the emergency services sector and broader community about the degree to which emergency events can be "controlled", requiring changes in both community expectations and emergency services cultural identity; and tensions emerging from continued policy and legislative silos from disconnections between planning and response. The trade-offs between these values and complexities will need to be worked through with stakeholders in the next phase of the project in order to advance the development of appropriate measures by which of emergency management systems can be evaluated.

NEXT STAGES OF RESEARCH PROJECT

The next stages of the project require the research team to go back to End-Users to assess the preliminary findings and decide on a path forward that will lead to the design of tools to support the End-Users around the three key issues of cognitive decision tools, team performance monitoring and measures that are non-outcome based and at an organisational level. Here we outline a process and a significant confounding variable that we believe will determine the type of tool we develop for individual agencies.

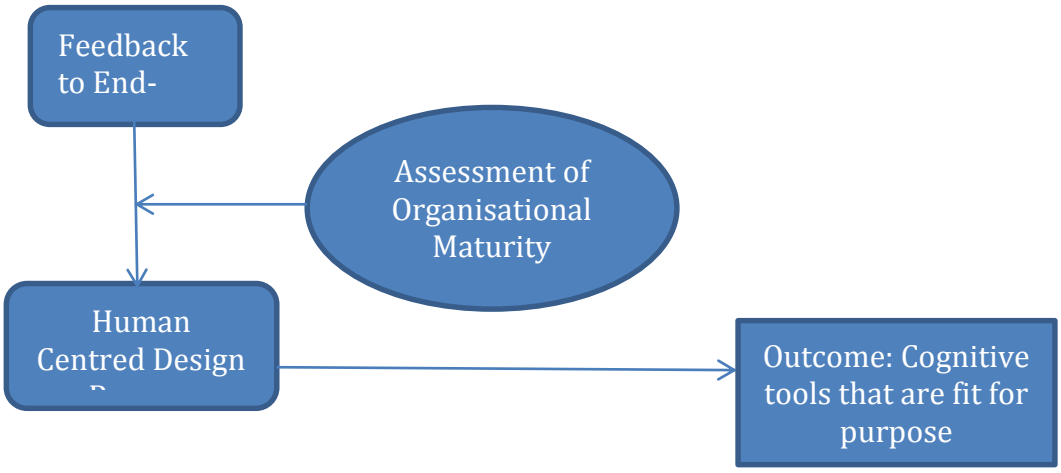


Figure 5: Future Research Process

HUMAN CENTRED DESIGN (HCD)

The basic premise of Human Centred Design (HCD) is that systems are designed to suit the characteristics of intended users and the tasks they perform, rather than requiring users to adapt to a system. Usability Testing (UT) is a key component of HCD and uses methods that rely on including users, or user-based design principles, to test the ability of systems to support user needs. UT helps to identify potential problems and solutions during design and development stages by using an iterative approach to testing. Establishing such a design process can help ensure the usability of systems by addressing human element, software quality and other technical issues.

As specified in the HCD guideline a central pillar within any HCD framework is the consideration of so called design usability principles which consider human cognitive limitations and provide a first step in establishing a base for an understanding of good human centred design practice. Figure 6 shows a simple model relating to how each design usability principle is linked to the primary goal of achieving usability and safety in emergency management.
As indicated by this model the importance of ensuring that the right design usability principles are used prior to selecting the Testing, Evaluation and Assessment (TEA) method (i.e. Quantification (data required), Measurement (so called 'test beds') and the Data Collection) is critical as this will be the basis on which effective user performance is ensured. The TEA concept forms part of each phase of the system lifecycle and HCD activities. TEA may cover a number of

potential methods (i.e. heuristic evaluation, questionnaires, link analysis, walkthroughs and user tests) that could be used to evaluate system usability within each phase of the HCD process.

The ISO set of standards for usability includes ISO 9421-110. This standard identifies seven design usability principles as being important for the design and evaluation of interactive systems – and can reasonably be applied to the design of the sorts of tools proposed in this project. These can serve as a set of general subject areas for the design and evaluation of e-navigation systems forming part of the usability evaluation activity. This however, needs to consider the balance required of the various design usability principles to achieve the goals of usability and decide on their relative importance. This study aims to achieve this by evaluating these design usability principles against a number of criteria.
The following provides a definition and brief description of each of these seven design principles as highlighted in the ISO 9421-110 standard:

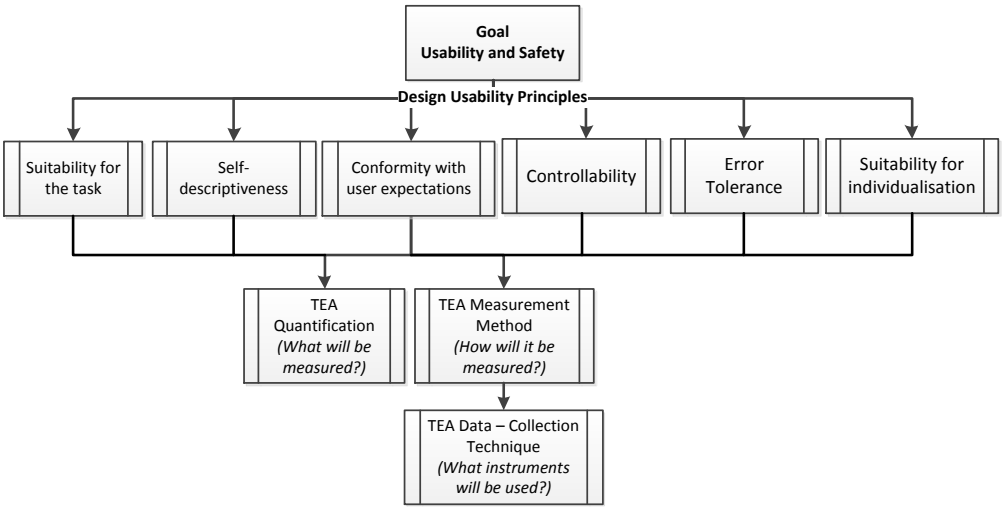


Figure 6: Model of Usability (adapted from Nielson, 1993)

- Suitability for the task: Supports the user in the completion of the task
- Self-descriptiveness: At any time, it is obvious to the users which mode they are in, where they are within the mode, which actions can be taken and how they can be performed.
- Conformity with user expectations: Conforms with user expectations if it corresponds to predictable contextual needs of the user and to commonly accepted conventions
- Suitability for learning: Suitable for learning when it supports and guides the user in learning to use the system.
- Controllability: System is controllable when the user is able to initiate and control the direction and pace of the interaction until the point at which the goal has been met.
- Error Tolerance: A system is error-tolerant if, despite evident errors in input, the intended result may be achieved with either no, or minimal, corrective action by the user.
- Suitability for individualisation: A dialogue is capable of individualization when users can modify interaction and presentation of information to suit their individual capabilities and needs.

HCD therefore helps ensure that human factors related knowledge and techniques in system design and development processes are addressed to ensure user needs and safety are achieved by focusing on the users and use of a system. HCD is driven by knowledge about use, derived from evaluation and testing with users, the results of which drive a formal feedback loop in each of the design stages to ensure usability and continued performance outcomes. EM systems (and therefore the tools developed in this research project) should aim to ensure that associated tasks are effectively supported, with usability being the measure that is tested to ensure that this is achieved.

Figure 7 shows the following typical project lifecycle stages recommended as a minimum for the application of HCD for e-navigation systems. This figure also outlines the activities that should be undertaken in each of the HCD lifecycle stages, illustrating the interdependence of each activity. A strict linear development process is not implied but each stage does make use of outputs from other HCD activities. The following HCD activities are carried out to inform development throughout the lifecycle:

- Pre-activity: Conduct Early Human Element Analysis;
- Activity 1: Understand and specify the context of use;
- Activity 2: Specify the user requirements;
- Activity 3: Produce design solutions to meet user requirements;
- Activity 4: Evaluate the designs against usability criteria;
- Activity 5: Maintain Operational Usability.

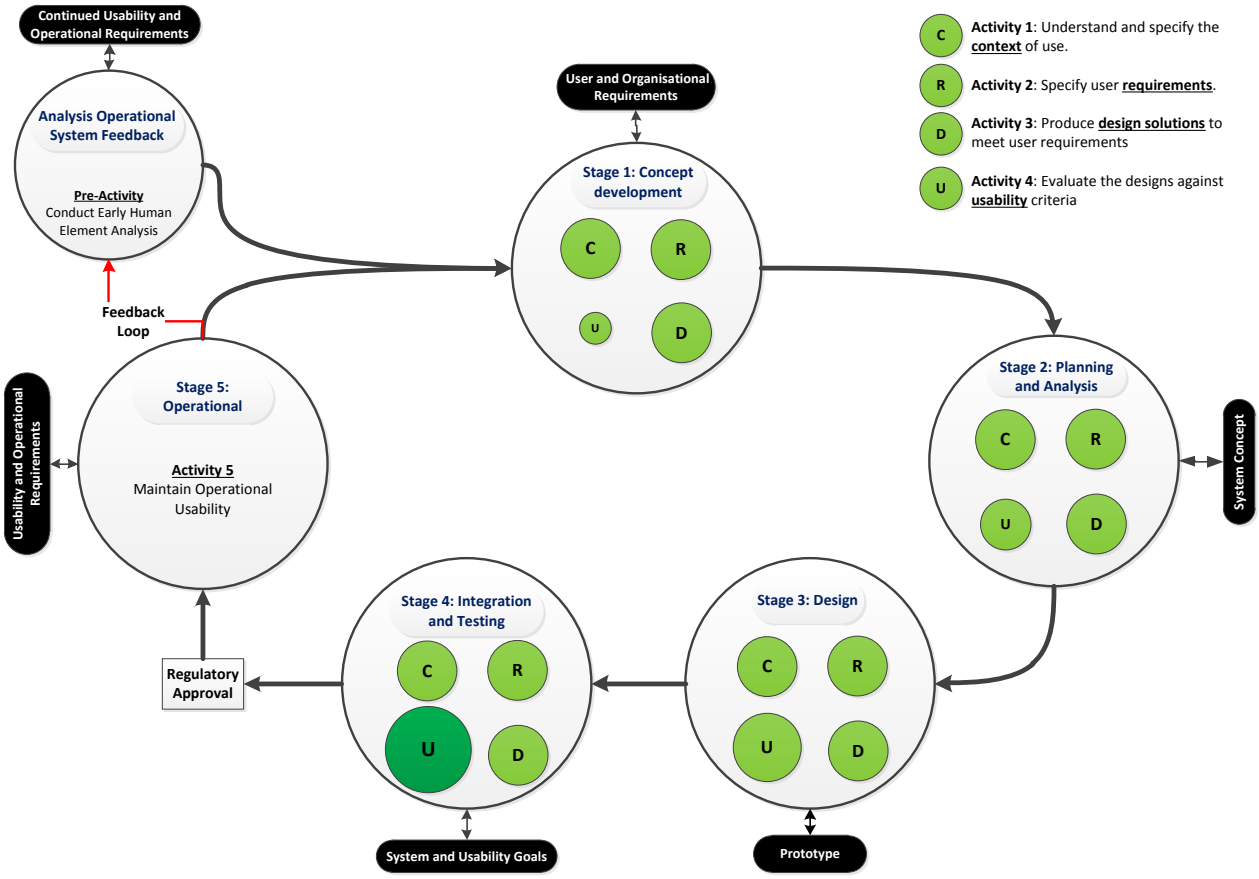


Figure 7: Overview of Human Centred Design

ORGANISATIONAL MATURITY

Emergency management organisations are required to manage and improve operations in an environment of fiscal austerity and increasing complexity. In similarly challenging environments, other high risk organisations have used Safety Maturity Models (SMM's) to track and improve operational performance. Reported SMM benefits include better management systems, improved coping with complexity, and better organisational learning. We also assert that safety maturity is itself likely to influence an agency's readiness to accept safety interventions, given that these interventions (e.g., checklists, decision-models, training approaches) themselves vary in maturity/sophistication. For this reason it is our intention to embed an assessment of system maturity in the HCD process.

Previous work performed by our team in this area (Lock, 2014) surveyed 15 senior staff from an emergency management agency. These participants were asked to rate their organisation's safety performance using Hudson's safety maturity framework. This framework contains concrete elements (about management systems) and 'Abstract Elements' (e.g. employees' attitudes and behaviours). 18 different criteria were rated for a total of 270 individual ratings. Half the responses were classified at the highest level of maturity, one third at the second highest, and the remainder at lower levels of maturity. Participants also considered the management system to be in greater need of improvement than staff attitudes and behaviours.

We plan to deepen our understanding and sharpen the focus of the maturity research around the three issues of decision-making, monitoring of team performance and establishing process-based indicators of organisational performance.

Our initial theoretical position to commence this next stage of the research is that there are theoretical limitations of Hudson's framework, and these are associated with the categories Hudson uses, the levels of the model and also the implicit notions of what 'maturity' actually means in the context of emergency management – which may be quite different from maturity in other types of organisations.

To this effect we have derived a new safety maturity model, derived from the 12 step-program. While the use of the 12 step program (originally developed for recovering alcoholics) might seem tongue-in-cheek, we demonstrate that the application of these 12 steps has content validity because it assesses maturity on a number of important elements including organisational learnability, use of evidence to support change, recognition of the fallibility and ingenuity of the human condition and continual improvement across the EM system. Our position is that this more complex approach to maturity adds value through providing greater discrimination between types of maturity appropriate to emergency management, and will lead to development of tools that are a better fit for the organisation.