Simulation Background Document

imttp
Incident Management Team Training Project

FIRE SERVICES COMMISSIONER VICTORIA

CFA

State Government Victoria
Department of Environment and Primary Industries

MFB

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Produced by the Incident Management Team Training Project

February 2014

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Document Version Control

Version No	Issue Date	Nature of Amendment
1.0	05-May-2014	First release

1 Executive Summary

This document briefly describes the characteristics of simulation and provides examples of how it is currently used by the County Fire Authority (CFA). Simulation practice in related agencies and other industries is also reviewed, providing insights on how CFA may extend the use of and improve its management and support of simulation. This information forms the background to a wider discussion on the future role, management and support of simulation in CFA.

Simulation is widely used in many industries to support training such as:

- to practice working in environments that may otherwise be too dangerous
- to experience situations that occur infrequently
- to learn to operate equipment and facilities that are costly or unavailable.

Simulation is also used in a decision support role to analyse plans and courses of action. It is an effective tool for research and experimentation in new capabilities, procedures and doctrine. The ability for simulation to illustrate and explain complex concepts and systems makes it suitable for community education and engagement.

The emergency management environment is undergoing significant long term change. Simulation is a tool that will help manage the changes and assist with the transition.

The CFA currently has a number of disparate simulation programs and approaches scattered throughout different sections of the organisation and geographical locations. These range from computer based simulation to support exercises, to simple table-top tools used for illustration and discussion.

Developing a simulation strategy will coordinate these efforts, provide consistency in terminology and tools, and provide a framework for the support and management of simulation.

2 Introduction

2.1 Context

The Incident Management Team Training Project (IMTTP) addresses the State Government's response to the recommendations of the 2009 Victorian Bushfires Royal Commission Final Report. It is focused on those recommendations directly related to the training and development of Incident Management Team members to create consistent and improved standards of performance.

The Capability Frameworks, Programs and Strategies Project (CFPSP) is a sub-project of the IMTTP aimed at developing multi-agency frameworks, programs and strategies that enable the development of human incident management capability.

The Simulation Strategy is one deliverable of the CFPSP that addresses the strategic role of simulation for achieving CFA's mission and how simulation will be integrated, supported, managed and delivered in the future.

2.2 Scope and Purpose

The purpose of this document is to present the results of research into CFA's current approach to and utilisation of simulation and identify relevant academic literature that may inform the development of the Simulation Strategy.

It is not intended to provide a comprehensive catalogue of all simulation capabilities within CFA, but to identify broad categories and provide examples to illustrate their use. The document includes an initial list of issues relating to the use of simulation that were identified during the research and consultation.

Whilst the IMTTP scope is generally confined to delivering products to enable improvement of incident management learning and development, the Simulation Strategy goes beyond incident management. It will look at all forms of simulation and any use of simulation that advances CFA's strategic mission.

2.3 Audience

The audience for this document is the members of the team developing, reviewing and endorsing CFA's Simulation Strategy. While information from this document will be used to develop discussion papers and other material, it is not expected that this document itself will be widely distributed.

3 Background

3.1 What is Simulation?

A simulation is "the [purposeful] imitation of the operation of a real world process or system over time".[1] Simulations are simplifications, abstractions or distillations of reality that can be used to illustrate different elements of that reality in different contexts for different uses. Simulation offers the opportunity to observe characteristics of the system being simulated in a safe, contained, comfortable, repeatable, controllable, measurable environment. Unusual situations can be simulated that would otherwise be too rare to provide opportunities for observation and dangerous situations can be simulated in relative safety.

For example, the *Phoenix RapidFire*[*] fire spread model represents the behaviour of a bushfire over time, on a given piece of ground, under given weather conditions and other environmental factors. Similarly, fire behaviour tables use an adjustable frame, real fuel and real flame to simulate the behaviour of a fire given fuel and slope.

Simulation is often thought of as computerised or computer based. However, many simulations do not use computers. Many drills and practical sessions are a form of simulation. Even where computers are used, they often only form part of the simulated experience. The continuum from manual to automated simulation systems share common concepts, techniques and frameworks. Demarking a specific line between computer based and non-computer based simulation is problematic and risks understating the importance of non-technical attributes.

The term 'simulation' is used in many contexts and can have confusing connotations. Field exercises, incident management team exercises, drills, part task training and fire behaviour demonstrations are all examples of simulations. Simulations are sometimes categorised as Live, Virtual and Constructive (LVC) but most forms of simulation are some hybrid of two or more of these modes.

Form	Explanation
Live	Real people operating real equipment in a simulated setting.
Virtual	Real people operating simulated systems.
Constructive	Simulated people operating simulated systems with or without real operators.

[*] See Appendix A for a description of computer based simulation systems mentioned in the document.

A recent issue of the Journal of Simulation and Gaming noted 'simulation' encompasses terms such as: gaming, serious game, computer simulation, computerised simulation, modelling, agent-based modelling, virtual reality, virtual world, experiential learning, game theory, role-play, case study, and debriefing.

Simulation is a cross disciplinary topic. It includes elements of:

- training and instruction
- operations research
- economics and game theory
- artificial intelligence
- geographic information systems
- information technology
- psychology and human factors

Maintaining currency across all of these developments and research is problematic. Sources for advice and "good practice" are diverse, and sometimes obscure. As an example, in 2010 David Crookall[2] identified over 40 professional journals relating to simulations including:

- Games and Culture
- International Journal of Computer Games Technology
- International Journal of Engineering Simulation
- International Journal of Modelling and Simulation
- International Journal of Game-Based learning
- Journal of Policy Modeling
- Journal of Simulation
- Simulation & Gaming
- Simulation and Gaming for Education and Development
- Simulation in Healthcare
- Training and Simulation Journal

Additionally, many articles on simulation appear in specific subject matter journals such as the Australian Journal of Emergency Management.

Because a simulation imitates a real system, it can be used for a number of tasks such as to:

- illustrate or demonstrate the behaviour of the system and how elements interact
- illustrate the effect of changes to the system
- learn or practice operating simulated equipment or procedures
- test components (procedures, equipment or facilities) of the system
- explore 'what if' scenarios and courses of action.

Simulations are particularly useful for:

- understanding concepts for which experience alone deepens understanding
- acquiring knowledge that might otherwise take a long time to gather

- practising decision making for critical situations, and
- experiencing something otherwise not directly available[3].

Some simulations are non-interactive. That is, they are started and they continue to execute until some pre-defined end point with no further input from observers. Other simulations are interactive. For example, the weather in a *Phoenix RapidFire* scenario can be changed and the simulated bushfire behaviour will change accordingly. Similarly, the fuel can be added or changed on a fire table and the fire will burn at a different rate.

Real people and real equipment can also be part of the simulation. For example, a recent field exercise held by the CFA West Gippsland Group included Strike Teams moving between three sectors and completing a number of practice activities, all coordinated by the Incident Management Team in a Local Command Facility.[4]

A simulation activity may involve multiple layers of, or roles for, simulation. For example, an Incident Management Team training exercise might use some form of computer based simulation to represent the simulated incident and track resources; it will include individuals playing the roles (simulating) of the various members of the team and people with whom the team might interact; and it might use predictive simulations to aid in planning decision making. The computer simulation used to drive the exercise will include models of the terrain and environment, fire (or other hazard) behaviour, weather and the physical characteristics of simulated vehicles, equipment and personnel.

Importantly, simulation spans all three learning domains (psychomotor, cognitive, and affective) and offers unique opportunities to combine learning in multiple domains.

3.2 History of Simulation

General History of Simulation

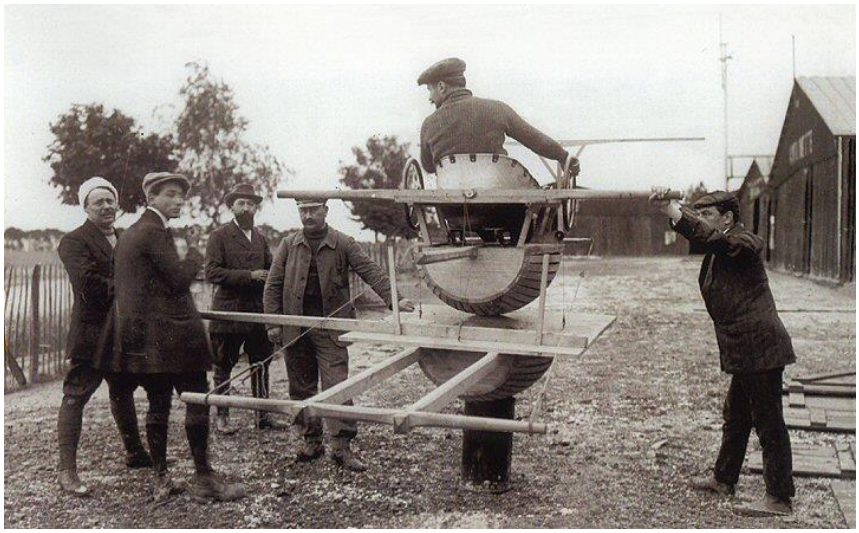

Figure 1 The 1909 training rig for the Antoinette monoplane.

Simulation for learning and experimentation has a long history. War games dating to the early nineteenth century[5] and flight simulators of the early twentieth century[6] are often cited as early examples of simulation. However, sand tables for visualising the battlefield and creating a shared 'common operating picture' date back to at least the Roman Empire

and board games depicting military tactics and terminology date back even earlier still[7]. Guided practice, part task training and drills are all forms of simulation with a long history.

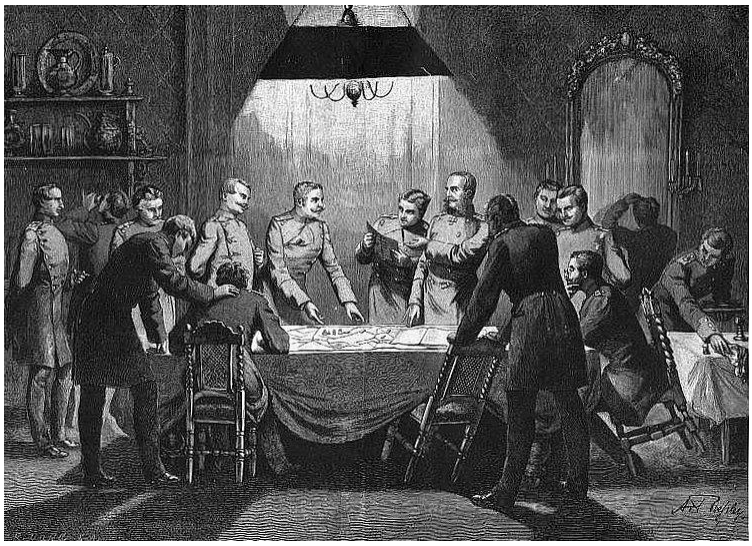

Figure 2 Officers conducting a war game (kriegsspiel),
wood engraving after a drawing by Adalbert von Roessler, circa 1884.

More broadly, simulation was widely adopted as an educational tool by the early 20th century and grew as the various independent developers built a community. The International Simulation and Gaming Association formed in 1970 along with the multi-disciplinary journal Simulation and Gaming.[8] Many industries, such as health, mining and aviation, now incorporate simulation in both practice and training and there are over 40 professional journals related to the study of simulations and games.[9]

By the 1960s, computers were increasingly being used to host complex mathematical simulations and they continue to develop as technology evolves.[10] Computer based simulation is now the medium most associated with the term simulation. The game technology developed since the mid-1990s is increasingly being applied to non-entertainment applications such as training simulation. Mobile games and persistent virtual worlds now exist for training and community building in almost every discipline. Many businesses use games and simulations for marketing and attracting customers.

As technology develops it is becoming common to incorporate location aware devices, such as smart phones, into live training and operational support. These devices improve data recording from live exercises and assist in the after action review. The camera and video capabilities of such devices also enable live simulation to use augmented reality, where virtual images or additional information are overlayed onto a live scene of the real world.

History of Simulation for Emergency Management

Simulation for emergency management has a similar history to other disciplines. Drills and part- task skills based training are customary. Paper based exercises are used by all agencies and have a long history. For example, in the 1990s a game called *Black Christmas* was developed for emergency management team exercises[11] and evolved into exercises run by the Australian Emergency Management Institute.

Exercises are a widely accepted means of delivering training for incident management teams. The Victorian Emergency Management Reform White Paper (VEMRWP) and the

Victorian Bushfires Royal Commission (VBRC) both identify exercising as important and call for an increase in their use. The need to improve the quality of incident management training and increase the number of qualified personnel for incident management roles will necessitate more exercising and more complex exercises[12]. However, those roles rely on a skills development pathway where all stages could and should be supported through simulation based training.

3.3 Simulation Applications

There are many ways in which the potential applications of simulation are categorised. Two such models are those proposed by Shubik[13] and Jain and McLean[14].

Shubik	Jain and McLean
teaching and training experimentation entertainment therapy operations	analysis and decision support systems engineering and acquisition planning and operations training exercises and performance measurement

This paper proposes five categories that summarise the above lists and reflect the way simulation is used and organised in CFA.

- training and development
- exercising
- operational and decision support
- organisational planning
- community engagement and resilience building

Training and Development

Education is the most often cited use for simulations. This is generally based on the principles of active learning, student motivation and “learning by doing”. This includes learning specific skills and practicing and maintaining those skills as individuals and teams.

The potential benefits of using simulation to support training include:

- reduced risk to personnel and operational equipment
- reduced cost
- opportunity to simulate dangerous situations or applications
- the opportunity to train in an observed, controlled, supported and repeatable environment
- opportunity to gain experience through unusual or costly scenarios.

Simulation offers the opportunity to train for low frequency, high impact events for which it is difficult to gain practical experience. A balance between training for business as usual and training for the unexpected is an important consideration.

In addition to being used in the training delivery phase, simulation can be used in the needs analysis phase to identify training requirements. It can also be used in the evaluation phase to determine if the training has delivered the desired outcomes.

Exercising and Readiness

Exercising is a form of simulation that can be used to support training, where staff are exposed to new equipment, facilities or procedures and learn to work together as a team. However, exercising is also an important tool for preparing teams and facilities for operational deployment.

Exercises are used to test the readiness of facilities and teams and identify areas for improvement. They are used to practice procedures, drills, communication and teamwork. They are also used to orientate, or reorient, personnel to the work environment and conditions.

In this context, simulation offers the opportunity of actually taking on a role and experiencing not just the decision making activities of that role, but also the emotions and what it is like to perform the role. Simulation offers the chance to combine all three learning domains* in a way not available in other situations. Simulation also provides opportunities to demonstrate and develop the attributes associated with competencies in certain roles.

Operational and Decision Support

Operational support covers two related activities: decision support and mission rehearsal. Decision support includes using simulation as a predictive guide to the future and using that capability to evaluate and plan potential courses of action. In the Emergency Management context, this includes supporting response plans and mitigation plans. For example, the *Phoenix Rapidfire* System can be used to forecast the likely spread of an existing fire and to assist with the development of fuel mitigation plans.

Mission rehearsal is generally focused on planning and practicing for a specific task, prior to its actual conduct. Thus it is often undertaken as part of the operational planning of a task and may include elements of evaluation and refinement of the plan.

Organisational Planning

Simulation may be used to model how an organisation works in order to identify efficiencies and bottlenecks in organisational flow. For example, a hospital emergency centre might be modelled to attempt to understand how procedures can be optimised.[15] In this role, variables can be changed to see what effect they will have on the organisation's objectives.

Additionally, experiments can be conducted examining potential changes in equipment, procedures or doctrine. This is often applied to the needs analysis phase of equipment acquisition where a gap in capability is identified and various options for filling that gap can

* In the context of learning domains, KSA refers to skills, knowledge and attitudes. The Emergency Management Sector often uses "attributes" when describing competencies.

be tested to define specific requirements for new capabilities. The Australian Defence Simulation Office (ADSO) has published a series of guides that fully explain how simulation can be used in all phases of the capability lifecycle.

Community Engagement and Resilience Building

In many respects, the role of simulation in community engagement is an educational one, similar to its role in training. However, the focus is less on teaching and more on partnership, communication, sharing and discovery. Simulations and games are used to engage people with subject matter and with each other.

One of the most powerful aspects of simulations is that they can illustrate and explain complex systems. This is increasing in importance, and becoming technically easier to achieve as a means of informing communities.

As a community based organisation, engagement is a core activity for CFA. This engagement includes:

- providing information to the community
- consulting with the community to develop policies
- forming partnerships to develop and implement plans
- supporting the community to take responsibility for decisions and planning
- recruiting and retaining volunteers and staff.

Multiple Uses

- A given simulation system or facility can potentially be used for a multitude of tasks beyond its primary design scope. This would include training for different roles and at different levels of skill but also across the application domains. For example, a given system may be used to support training, but may also be used to support experiments to evaluate new and proposed equipment. Acquisition, management, support and delivery all need to be cognisant of the potential for multi-use.
- However, while using one tool for many tasks offers potential cost savings, it does not always produce the most effective results. The desire to create ‘efficiency’ through multi-use can result in compromises that undermine some of those potential uses.
- Simulation is also likely to have multiple uses at the same time. For example, a training exercise may be primarily run to provide training to an incident control team. However, it will also be simultaneously testing the equipment, facility and procedures. For example, the 2012 Phoenix Parsons Report, which was aimed at reviewing the training objectives of the exercises, identified procedural issues relating to radio communications and the flow of information to the various ICT cells.

3.4 Elements of Simulation

All forms of simulation share a number of common elements. An understanding of these elements, their relationships and dependencies helps to frame the application and development of simulation.

Purpose

Simulation is not just the replication of a real world process or system; it is replication for a purpose. Identifying the purpose and developing an appropriate scenario are critical elements in creating an effective simulation activity. As a starting point, some form of analysis is conducted that identifies the need for the simulation.*

The centrality of the purpose is illustrated in the following diagram.

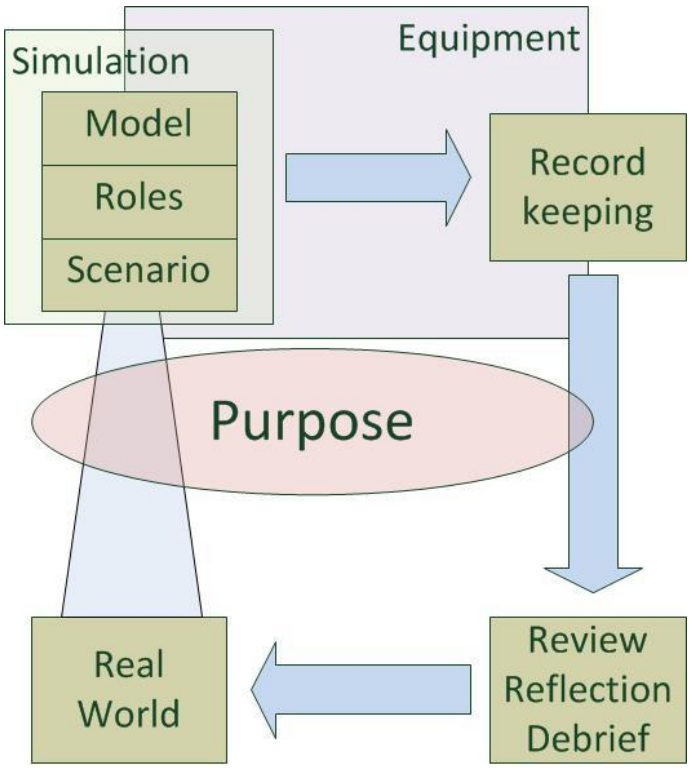

Figure 3 Simulation Process Model

To get the most out of a simulation, and relate what they have learned back to the real world, participants need a clear understanding of the purpose of the simulation[16]. The purpose is used as a lens to filter the elements of the real world that need to be incorporated into the simulation. It will determine the form of the simulation, the model, roles and scenario.

Understanding the purpose of the simulation is necessary when determining requirements for acquiring or developing simulation systems. Characteristics such as fidelity, resolution, and type of simulation are dependent on how the simulation will be used. The purpose needs to be more than just a simple generic application such as training. Each simulation activity should be defined quite precisely and measurably.

The purpose of a simulation can often be expressed as a learning objective. Learning objectives are not restricted to training; other applications of simulation, such as research and capability development can also be understood using learning objectives. For example, using simulation to model and predict physical phenomena (such as bushfire) supports the *understanding* and *analysis* of facts and concepts and may lead to insights that result in the *creation* of new knowledge. Similarly logistics modelling and process modelling may help to *refine* and *coordinate* new ways of operating at an organisational level.

* Refer to section 4.1 for a description of the Systems Approach to Training that describes the analysis phase.

Scenario

The scenario describes the setting of the simulation and forms the vehicle for the realisation of the purpose. The scenario designer must have a detailed understanding of the problem and work closely with the sponsor to ensure their goals are met.

The scenario will include an outline of the background situation, the intentions and goals of the various participants and the general physical and environmental conditions. It will identify the resources available to each participant and any constraints that apply to their use, such as their disposition, relationships, organisation, and capabilities. The level of detail in the scenario description should be appropriate to the activity. Often this description will result in a set of exercise papers, outline plans and orders etc.

Briefings should be provided for the simulation controllers, analysts and participants that include information specific to their roles in accordance with the simulation purpose. The scenario needs to be broad enough to provide credible scope for participant actions, but narrow enough to focus the activity on achieving the objectives. It will dictate to some extent, the flow of the simulation and may prescribe that certain events must or must not occur.

The level of experience, task complexity and whether the aim is acquiring new competencies or maintain existing ones must all be considered in developing the scenario. One scenario with one level of complexity may not be sufficient for a range of training tasks and may require adjustment and adaption to meet expectations.

Model

The model describes those elements of reality that are represented in the simulation. That is, it 'models' an element of the real world. Models take many forms such as physical models or mathematical models. The choice of model will depend on the objective of the simulation and how that is represented by the scenario. Some scenarios may not be feasible with certain types of models.

Models are often described by the term fidelity, which is related to terms such as accuracy, realism, precision and credibility. The level and form of fidelity in the simulation needs to be appropriate for the purpose[17]. Insufficient fidelity risks making the simulation irrelevant for the participants, while too much detail may be distracting and confuse the learning objective. Fidelity is also highly context dependent. A high fidelity simulation in one context may be a low fidelity one in another.

Fidelity comes in many forms including: physical, cognitive task and functional.[18] It is the psychological fidelity of the simulation that is of most importance in the context of incident management team training. While visual fidelity is frequently emphasised, other attributes such as sound, smell and heat, may be more important in some circumstances.

Hayes et al[19] raise the importance of the appropriate level of fidelity and aligning the form of fidelity to the desired learning outcome. This is a factor that must be considered when acquiring, developing and delivering simulation systems. One simulation may appear to represent all of the attributes of a system, but may not do so in a way suitable for all applications.

Equipment

Most simulations will require some form of equipment, even if it is nothing more than paper and pen. Equipment may include:

- physical props or representations of real equipment
- real equipment and tools, including office and administrative equipment
- maps (paper and/ or digital)
- manuals and reference material
- computers to run simulation software
- audio visual equipment to record simulation events.

Planning and maintaining equipment is often a complex element of the simulation activity. Many items require power or have other operating constraints that must be considered. Some equipment requires particular skills to operate. Complex simulation systems can create considerable equipment and configuration management overheads.

Participants and Roles

There are two categories of participants in a simulation: those who are participating in the simulation and those who facilitate, manage or control the execution of the simulation. The selection of what roles are required within the simulation will depend on the purpose and the scenario.

The Australian Emergency Management Institute has developed a framework of exercise management roles.[20] The framework is scalable over small and large exercises. For small activities one person may perform multiple roles, while for large exercises, each role will require a team of people.

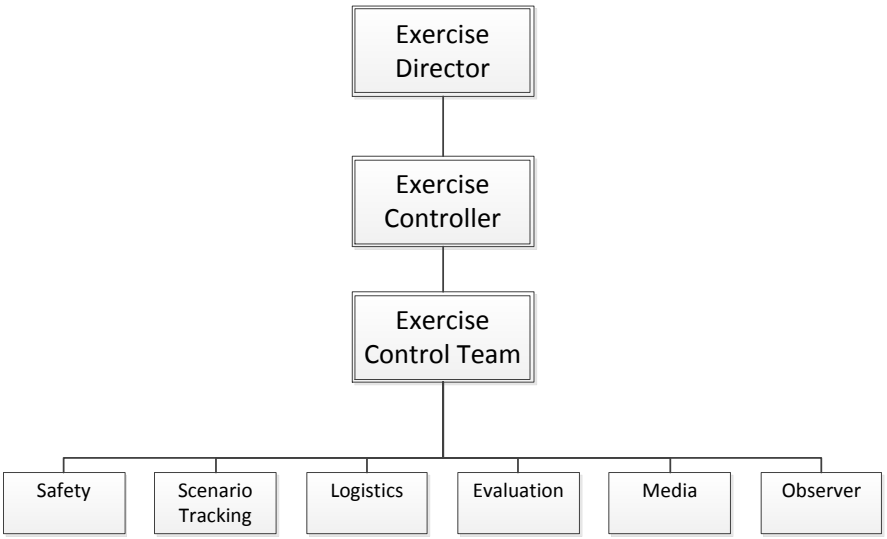

Figure 4 Exercise Management Roles

The framework is not only applicable to training and exercising but to any use of simulation, including organisational development and operational support. When planning a simulation activity, consideration should be given to each of the functional roles. Complex activities can require considerable planning and support which must be factored into the development plan. Similar models are used by military forces.[21]

Procedures

Procedures govern how the simulation is managed and executed. It includes procedures for:

- running the activity
- briefing participants and facilitators
- decision making during the activity
- transporting, setting up, operating and packing up equipment
- safety

Data collection and review

In order to relate the learning form the simulation to real world application, it is important to review and reflect after the simulation activity. Collecting data and observations during the simulation execution is crucial in enabling and conducting the review.

It is also important to collect data for evaluation and assessment of the activity against the intended purpose. The Systems Approach to Training* emphasises continuous evaluation of the activity and represents best practice in managing simulation programs.

* Refer to section 4.1.

4 Simulation as a Learning Tool

While simulation has many uses, the purpose of simulation is usually learning. Terms such as: teach, illustrate, explain, study, explore, experiment or evaluate are often used to describe the objective of a simulation. Simulation offers the opportunity to learn about:

- physical systems
- organisations and composition
- communication and relationships
- procedures and dependencies
- teamwork and interaction
- personal attributes and abilities

Users of simulation from many disciplines have developed a variety of concepts, procedures and tools that contribute to the success of simulation based learning. A program that does not incorporate those elements may not realise the full potential of simulation.

In addition, the delivery and support of simulation relies on a team with a mix of appropriate skills and experience, while the credibility of the simulation depends on subject matter experts in the relevant field.

4.1 Systems Approach to Training

The Systems Approach to Training (SAT) is a common framework for designing training. It comprises the phases: analyse, design, develop, implement, and evaluate.

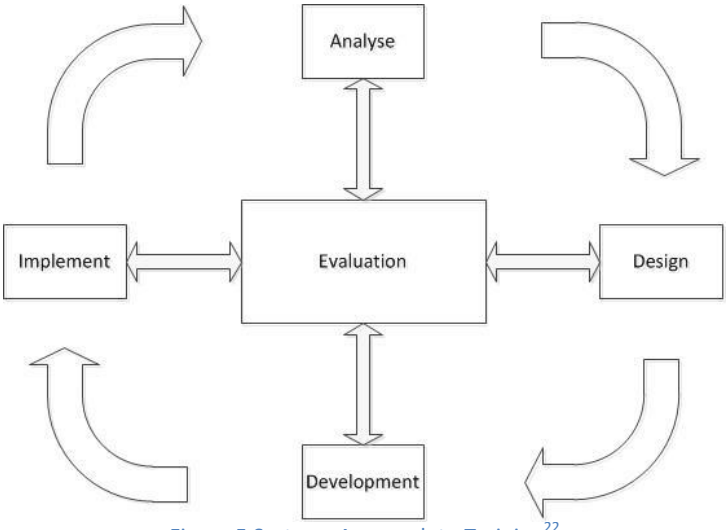

Figure 5 Systems Approach to Training[22]

- The analyse phase refers to collecting and analysing information about the training need, the learners and the environment.
- The design phase then uses that analysis to design a program of activities that will satisfy the training need.

- The develop phase encompasses the production and development of the activities and resources needed to implement the program.
- The implement phase is the delivery of the program that is developed.
- Evaluation is both continuous and summative and ensures that the goals of the program are being met at each stage.

This approach is commonly applied in training situations where simulation is chosen as the means or one of the means for implementing the training program. For example, Emergency Management Australia (EMA) applies the following model for managing exercises.

Figure 6 Exercise Management Model*

However, simulation is not simply a means of implementing training and learning. Simulation can be used in the analysis phase to help identify gaps and training needs. It can be used in the design phase as a means of prototyping potential implementation plans. It can also be used in the evaluation phase to confirm that the desired learning occurred.

4.2 Adult Learning

Simulation is particularly appropriate for adult learning. The principles of adult learning[23] should be considered when developing a simulation program or system.

Adult Learning Principle	Relevance to Simulation
Adults are internally motivated and self-directed.	Simulation should allow participants to explore areas of interest.
Adults bring life experience and knowledge.	Simulation should provide opportunities for participants to apply their unique experience.

* Australian Emergency Management Institute 2012

Adult Learning Principle	Relevance to Simulation
Adults are goal oriented.	The purpose of using the simulation should be clear to participants.
Adults are relevancy oriented.	The relationship between the simulation and the real world role of the participant should be clear. This often occurs during after action review and reflection.
Adults are practical.	Simulation is inherently a hands-on activity.
Adult learners like to be respected.	Simulation is often used in a team context where participants have the opportunity to cooperate and collaborate.

4.3 70:20:10 Learning and Development Model

The Fire Agencies in Victoria have adopted The 70:20:10 Learning and Development Model as the basis of its professional development process. This model suggests that approximately:

- 70% of learning occurs through experience on the job
- 20% occurs through coaching, mentoring and working with others
- 10% occurs through formal learning and courses.[24]

Simulation is inherently a means of learning through experience that crosses all three domains of this model. It is often used in formal courses, for instruction and assessment. Coaching, mentoring and learning in a team occur during exercises and group activities. Simulation is often the only way to gain experience of some rare events such as managing serious natural disasters and frequently uses case studies and 'what if' scenarios to explore concepts. Simulation supports the "learning by doing" approach.

4.4 Experiential Learning

Simulation is one of the three primary forms of experiential learning, along with games and case studies, proposed by Henry Ellington and colleagues[25]. Games tend to be rule and outcome-oriented and are interactive and participatory. Simulations are more open ended and behaviour or process oriented. Case studies are analytical, detailed and focus on results. The relationship is illustrated by the following Diagram.

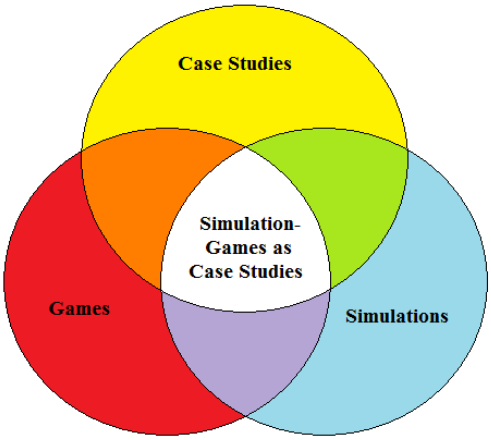

Figure 7 Forms of Experiential Learning[26]

Most experiential learning activities fall somewhere between the three major categories. For example, an exercise incorporates simulation elements in its replication of real world systems, but it also has elements of a game in that 'players' or participants follow rules, make decisions and see the outcome of their decisions reflected in the changing state. It is, however, in the reflection and analysis after the activity that the greatest learning potential exists. Hence, most exercises could be described as a simulation-game used as a case study.

4.5 Learning Objectives

Understanding learning objectives and how simulation can be used to support their achievement is important to appreciate the applications of simulation.

When describing the purpose of a simulation, it is helpful to have a consistent and clear language. Learning objectives, such as those developed by Bloom and others[27] are commonly used for that role. The taxonomy divides learning objectives into three domains: psychomotor, cognitive and affective. These are often referred to as skills, knowledge and attitudes[*] respectively. Within each domain, objectives are classified in a hierarchy beginning with basic competence and developing to mastery.

The psychomotor domain refers to the ability of the learner to physically manipulate objects and themselves to perform tasks. In the psychomotor domain, learners may use simulation to: observe and copy operating a piece of equipment; demonstrate the performance of basic operations; practice to refine their skill; combine multiple operations, and multiple devices, to perform a complete task; and practice safely and cost effectively to achieve mastery of a skill.

The cognitive domain refers to knowledge of a particular subject. This includes knowledge of facts, terminology, concepts and procedures. In the cognitive domain, learners may use simulation to: activate multiple pathways to aid memory and recall; observe and understand the parts of a system; observe the effects of a sequence of actions; analyse the relationship of constituent parts of a system; evaluate decisions and courses of action; and discover new ways to solve a problem.

The affective domain describes a learner's understanding of attitude, interests and values and the way they respond emotionally to situations. In the affective domain, learners may use simulation to: become exposed to certain attitudes; respond to the attitudes of others; appreciate the importance of attitudes and emotions; integrate and reinforce a mixture of values and responses; and demonstrate that attitudes have been adopted.

[*] In some contexts, 'attitude' is substituted with 'attribute' or 'ability'. In the context of learning objectives, it is 'attitudes' that are learned. 'Attributes' may be inherent or developed and are relevant to defining suitability for roles. 'Ability' is an overall summation of someone's capability, including skills and knowledge.

5 Current Simulation within CFA

CFA makes extensive use of simulation in a variety of areas. No single CFA Division is responsible for all forms of simulation.

5.1 Training and Exercising

Training and exercising share many attributes. Similar simulation tools and approaches are used for both. Within CFA, exercising and readiness is generally the responsibility of operational elements of the organisation, while training is conducted centrally.

Computer Based Simulations

CFA has been using computer based simulation to support training activities since 1996. The computer simulation delivery team is currently part of the IMTTP. They are based at the CFA Training College Fiskville campus, but deliver training to all regions. CFA currently operates three training systems which are described in Appendix A.

Computer based training simulation is used to deliver training to tactical leaders and to support incident management exercises.

Tactical Training

Tactical training is used to support Crew Leader, Leading Firefighter and Station Officer promotional courses. It is also delivered directly to brigades for volunteer training. It is coordinated through Regional Training Managers or Station Training Officers. Regions are currently allocated 20 sessions per year. Volunteer training usually occurs in the evening or on weekends, while career staff training occurs during allocated training times. Delivery is supported by one computer simulation technician from Fiskville and a facilitator normally supplied by the region.

The demand for tactical training using computer based simulation was reviewed in 2011[28]. This resulted in the addition of two simulation technicians who concentrate on tactical training. The third member of the simulation team now acts as coordinator and focuses on development and supporting incident management exercises. However, the funding for the additional technicians ends in June 2014 and will significantly affect the simulation delivery capability.

Figure 8 Participants in a Vector-Tactical activity

In 2012, 94 tactical sessions were delivered to 660 participants and in 2013 this grew to over 99 sessions and 805 participants. Not all regions chose to use the system.

Incident Management Exercises

Incident management exercises are designed to exercise level 2 and level 3 incident management teams. They are delivered to regions and coordinated through Regional Training Managers.

Under current guidelines, each region is required to undertake at least one incident management exercise per year. However, they are not obliged to use the computer simulation system to support that activity.

Figure 9 Participants in an IMT Exercise

Exercise Phoenix Parsons was a series of exercises developed over 2011-12 as part of the IMTTP Level 3 Incident Controller Accreditation Program. It was created in response to feedback from candidates for Incident Controller Level 3 roles who felt they had not received sufficient opportunities to develop their capabilities. The exercises used the computer simulation system to drive the scenario and relied on an exercise control staff of at least eight people. To maintain consistency, the same scenario was used for each exercise and as far as possible, the same exercise management team was deployed.

In 2012 ten exercises were run as part of *Exercise Phoenix Parsons* and an additional one incident management exercise was run at the Mooroopna Incident Control Centre. In 2013, a further six computer based simulation exercises were run with 146 participants.

Brigade and Local Initiatives

Many brigade members have expertise or interests that lead to the development or innovative use of simulations. One such example is a PhD student from the Newham brigade, Brian Quinn, who developed an iPad application that used off the shelf game development software to explore the use of such technology for training.[29] Brigade members have many interests and skills that could be employed by CFA to develop innovative ways to use simulation.

Non-Computer Models

A variety of manual simulation tools are available to regions and in formal courses at CFA campuses and training grounds.

Live Training

Live training takes many forms. It includes practice drills, such as burn over drill and using breathing apparatus. CFA has a number of field training grounds around the state where a variety of skills can be taught and practiced in a live simulation environment.

Burn Tables

CFA uses a "Bushfire Simulator", or burn table, originally introduced by DEPI in 2010[30]. This is a portable table covered in hessian that the instructor is able to cover with props such as leaves and twigs and set them alight to demonstrate some aspects of bushfire behaviour. It can be used to demonstrate basic bushfire science principles such as heat transfer, radiant heat, convection and conduction. It also demonstrates the rate of spread of fire due to slope and fuel type. It can also be used for community education programs. CFA uses burn tables in its training and community education programs.

Map Exercises

Many brigades and groups use map based exercises for training and planning. For example, the Alexandra brigade has a set of vinyl maps that they use for exercising. These maps can be drawn on using markers to represent the fire (or hazard) spread, the location of responders and other information needed to run the exercise.

In a similar vein, trainers in District 7 have augmented the map based exercise with imagery produced by the computer simulation team that shows a top down aerial view of the fire ground. This shows snapshots of the fire spread and helps the exercise team 'visualise' the fire and the danger to local assets.

Mobile Training Props

A range of mobile props have been developed to assist in training volunteers and supplement the use of fixed training facilities. The aim is to "take simulated structural fire training directly to brigades"[31] to support remote brigades, increase capacity to deliver hot fire training and support skills maintenance. The pilot program includes three scenarios: a car and garage; a kitchen and lounge room; and a small industrial scenario.

Figure 10 Mobile Training Prop in use

5.2 Community Engagement

CFA has a number of community engagement activities that use simulations and games.

Kids and Schools Program

The Kids and Schools Program includes a number of resources for teachers and students to learn about fire safety and the role of the CFA and other agencies. This includes a number of games aimed at primary school students and interactive fire behaviour tools for secondary students.[32]

The Casey Safety Village also includes both computer based multi-media and live simulation to teach fire and general safety to children (and families). It includes a 'simulated home environment', developed by the CFA, used to teach home and fire safety.[33]

Figure 11 The CFA simulated home environment at the Casey Safety Village

Gippsland Region Community Bushfire Exercises

This program is a partnership between CFA (region, district, group and brigades), community liaison facilitators, local government, the Office of the Emergency Services Commissioner, DEPI and local community members. It was designed to raise community awareness of bushfire and help develop a bushfire survival plan. The map based scenarios were created with local input to incorporate local knowledge and aid realism. They were based on historical fire and weather patterns and used a burn table to illustrate fire behaviour.[34]

Harrietville Community Engagement

Following fires near Harrietville in early 2013, the CFA initiated a program of engaging the community to help all parties understand the community risks and the support capabilities of the emergency services. As part of this program, the CFA simulation team used one of the simulation tools, *Fire Studio*, to produce some imagery for use in training and briefings. This imagery is going to be used to complement a *Phoenix RapidFire* scenario and other material for a community education session in early December.

5.3 Operational Support

Fire Behaviour Simulation

CFA uses or has access to a number of simulations, such as *Phoenix RapidFire*, that can be used to predict the spread and effect of fire and other hazards. These are primarily used in the decision support role, often within an incident management team where the predictions can be used to assist in the development and testing of plans. The role of Fire Behaviour Analysts (FBAN) is described in the *Multi-Agency Predictive Services Strategy*.[35]

However, a limiting factor in the use of such models is the training and level of expertise required to interpret their output and to operate the complex interface. These models also require significant input data and the collection, validation and management of that data is difficult and time consuming.

Chemical/ Toxic Plume Modelling

CFA has developed a computer simulation for assessing the potential impact and spread of hazardous plumes.[36] The system combines a number of predictive models, a custom Geographic Information System (GIS), and a web interface. It is currently only available to Scientific Officers[*], but the products of the models are planned to be available to all personnel including other agencies such as the Department of Human Services (DHS) and Ambulance Victoria.

It is designed to answer the questions:

- Where is the hazard going?
- When will it get there?
- In what concentration?
- Who or what is it going to affect?

In addition to its use in actual hazardous material events, it is also used to assess the risk of routine chemical shipments to develop contingency plans. Incident controllers or regional duty officers can request modelling of an incident or it can be initiated by the scientific officer. Station officers and brigade captains can also request models of hazardous sites in their area.

The hazard models include:

- chemical fires
- nuclear detonations
- radiation dispersal
- chemical agents
- biological agents

[*] Scientific Officers are part of a specialised response capability under the Fire & Emergency Management Division (F&EM) in the CFA on a roster basis.

While scenarios are developed by the CFA team, the hazard models are sourced from a variety of developers, many from overseas. Coordination and integration is managed within the Fire & Emergency Management Division, with support from IT, and relies on contractors for any coding requirements.

Evacuation Modelling

In 2011-12, RMIT in partnership with CFA and DEPI, developed an agent based simulation to model evacuation from a town threatened by a large fire. While that activity was a prototype study, it did suggest that the use of similar models to help predict and plan evacuations and contingency plans would assist with large scale disaster management. It also identified the potential to use this form of simulation to raise community awareness of issues.[37]

5.4 Organisational Planning

Outside CFA, simulation is widely used to support capability development, equipment procurement and other planning activities. This does not appear to be common within CFA, but is a technique that could support some of the goals of the CFA Strategy.

Process Modelling and Requirements Definition

One example that is being considered is using simulation to model an emergency call centre. The Victorian Emergency Information Line (VEIL) project sits under the Fire and Emergency Management portfolio. It aims to investigate how a multi-agency, multi-hazard emergency information service could be developed that can cope better with call surge demand during large scale incidents whilst remaining as user friendly as possible for the community. The VEIL project considers simulation an important tool as it enables CFA to better assess resourcing requirements for managing the service and better plan for call volumes/surge capacity of the information line.

Equipment Procurement, Testing and Experimentation

It is unclear if CFA has any experience using simulation in this role. A number of tools exist outside CFA that could support such activities.

The CSIRO bushfire simulator[38] is used to test vehicle protection, impact on fencing, water tanks and other home infrastructure. It consists of a system of propane fuelled nozzles that can produce a variety of precisely controlled flames to simulate different fire front intensities.

CSIRO also operate a “Pyrotron”[39] at the National Bushfire Research Facility. This is a fire proof wind tunnel that is used to study the spread of fires under controlled conditions. This assists in the improvement of bushfire models, and the design of large scale field experiments.

Figure 12 CSIRO Pyrotron*

The Victoria University Centre for Environmental Safety and Risk Engineering (CESARE) conducts research into a number of environmental hazards such as fire and smoke. These facilities are suitable for testing the combustion properties of building materials and construction methods as well as the behaviour of smoke and fire under a variety of conditions. They maintain a test facility collocated with the CFA campus at Fiskville.[40]

5.5 Relationship with Other IMTTP Activities

Within the IMTTP, the Capability, Frameworks, Programs and Strategies (CFPS) project aims to develop multi-agency frameworks and supporting policies that enable incident management team capability development. All elements of this project are intended to complement and support one another.

Accreditation

The Accreditation Framework is built upon a pathway for training and accrediting individuals to perform certain roles in incident management teams. This requirement imposes standards on the way in which that training is conducted including authorisation of simulation tools, systems, procedures, scenarios and evaluation. The simulation strategy needs to consider these implications and ensure that those requirements are reflected in the acquisition, management and support of simulation capabilities.

Accreditation also relies on consistent objective assessment and evaluation. Hayes[41] noted that assessment during IMT exercises is weak across all agencies and exercise design should

* Photo Credit: Andrea Wild CSIRO http://www.scienceimage.csiro.au/mediarelease/mr08-216.html

consider this requirement. The data capture capabilities of some simulation systems, combined with audio-visual systems and other technology may support the objective assessment of participants.

Case Studies and Staff Rides

Case studies are related to simulations in that both are forms of experiential learning. They share many elements such as debriefing and reflective learning. Case studies may influence the development of training themes that become scenarios for simulation. Simulations based on case studies form another way of drawing lessons from experiences. Both activities should complement each other in training and development plans and schedules.

In the future it is possible that staff rides will be enhanced through the use of augmented reality and simulation. This is the capability to use devices such as smart phones and tablets, to overlay information and images onto the scene displayed through their inbuilt camera. For example, a tablet can be held up to view the scene from a 'stand' on the staff ride and the software can overlay information about the event and what is being seen, or overlay images of the fire or incident that occurred at that location to simulate what may have been experienced at the time.

Coaching and Mentoring

Simulations and exercises provide opportunities for coaching and mentoring activities and help identify strengths and weaknesses of individuals and teams. The simulation strategy needs to foster opportunities for those activities and consider the requirements in simulation program development.

Exercises

Incident management team exercises are an important form of simulation used to develop and practice individuals and teams for high risk situations. Such exercises will often, and perhaps increasingly, rely on computer based simulation to drive the exercise events. Because of the significance of this training, the requirements of these activities will have a significant influence on the acquisition, management and support of simulation systems and support services.

Predictive Services

Predictive Services primarily refers to the use of specialist Fire Behaviour Analysts (FBAN) who support bushfire management through predicting fire behaviour. The Predictive Services Strategy deals with embedding the services of these specialist roles into the emergency management decision making process. As this relies on investing in tools such as simulation to support that activity, the simulation strategy must complement the goals of the Predictive Services Strategy. It needs to promote simulation management processes that take into account the requirements of the predictive services function, including supporting the training of predictive services officers.

6 Simulation within Other Organisations and Industries

A review of how other industries and organisations have approached simulation may provide guidance on how CFA should proceed. An awareness of the resources available through other organisations may also help develop a strategy that reduces unnecessary duplication.

6.1 Other State Agencies

A number of other state based agencies work with CFA in emergency management. The simulation capabilities and requirements of these agencies overlap to a degree. The VEMRWP notes that, where possible, resources should be shared between these agencies. All organisations make use of non-computer based simulation such as drills, table top exercises and role plays. Most agencies also use a variety of computer based simulation systems, such as Vector-Tactical, XVR, and Hydra/ Minerva. These are described in Appendix A.

Members from CFA, the Metropolitan Fire Brigade (MFB), Victoria Police (VicPol), State Emergency Service (SES) and the Department of Environment and Primary Industry (DEPI) have come together to form the Victorian Incident Management Simulation Information Committee (VIMSIM)[42]. This is currently an informal working group where representatives from the respective agencies can exchange ideas and discuss computer based training simulation issues.

Department of Environment and Primary Industry

DEPI has initiated a small pilot project to use computer based simulation for IMT training. This is still in the early stages of approval and definition. More broadly, DEPI use non-computer simulation and exercises for a variety of training activities in a similar manner to CFA.

DEPI make use of *Phoenix Rapidfire* for decision support during incidents in the same way that CFA does. However, it is also used to assist with long term planning of planning fuel management.

Metropolitan Fire Brigade

MFB are completing the construction of a new training facility at Craigieburn known as the Future Organisational Learning and Development (FOLD).[43] This facility is specifically designed to “include training environments that simulate real life hazards”.

As part of the planning for this facility, MFB are seeking endorsement through their union consultative committee for the use of computer based simulation as an additional training tool. They are also seeking budget approval for on-going operational costs.

Indications are that this will be viewed favourably and a pilot program has been initiated where the whole of the Craigieburn facility has been modelled in 3D for use with a

computer based simulation system.* It is expected that this system will be used to support basic skills training in safety, ladders and equipment, incident commander, leading fire fighter and station officer courses. They intend to expand this capability to include incident management training and multi-agency activities for all hazards.

MFB plan to have a computer simulation centre operational by October 2014.

Victoria Police

Victoria Police have completed a new simulation facility at the Police Academy in Glen Waverley. This includes a central briefing area and a number of small syndicate rooms. All of the rooms are linked to a central control room via audio/ video where facilitators can observe group discussions. They have purchased the Hydra-Minerva system and expect to have the facility operational in early 2014. They are also interested in evaluating other computer based tools, such as XVR and expressed an interest to complement the capabilities of other agencies.

State Emergency Service

In the past, SES have relied on table-top exercising for IMT roles and use live training as a primary means of skill development.. They have recently commenced a trial of the Avalias† system in conjunction with the NSW SES.

6.2 Interstate and Federal Agencies

Australian Emergency Management Institute (AEMI)

AEMI is part of the Emergency Management Australia division of the Federal Attorney-General's Department. It offers an Advanced Diploma of Public Safety (Emergency Management) and related short courses including "designing and managing exercises". It does not operate computer-based simulation, but instead use the capabilities of its computer based command and control system to provide a realistic training environment that closely matches the operational environment. It also runs seminar style simulations and exercises.

It offers training for communities and schools including web based computer games and tools.[44]

Bushfire and Natural Hazards Cooperative Research Centre

The Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC)[45] was established in 2013 to conduct interdisciplinary research to improve disaster resilience. This is a national organisation that includes academics, students and emergency service representatives. It, and its predecessor the Bushfire Cooperative Research Centre (BCRC)[46], has a number of research programs that relate to the use of simulation. These include:

- simulation for forecasting floods

* This has been done as a prototype using the XVR simulation system. See Appendix A for information on XVR.

† See Appendix A

- simulation of fire behaviour
- modelling of urban landscapes and structures
- analysis of building loss and human fatalities
- disaster scenario analysis
- building community resilience
- decision support tools
- assessing the capability needs for emergency management organisations

Australasian Fire and Emergency Services Authorities Council (AFAC)

AFAC is the peak body for fire and emergency services. It includes public and private organisations responsible for emergency management across Australasia. AFAC is responsible for publishing the Australasian Inter-service Incident Management System (AIIMS).

AFAC was responsible for embedding the Vector suite of simulation systems among the various fire agencies and have been managing the contract on behalf of those agencies since 1996. AFAC collects a management fee for this service. This has created the perception of the potential for a conflict of interest and preferential treatment of the Vector system and vendor. AFAC is currently reviewing the terms of reference for the simulation reference groups.[47]

As part of the coordination role, AFAC developed a set of guidelines for developing Vector scenarios. The “Instructional Kit Tactical Scenarios” describes the steps required for specifying, developing and validating Vector Tactical scenarios, while the “IMT Instructional Kit” does the same for Vector IMT scenarios. Both processes would be adaptable to other simulation systems or a generic system.

Government Skills Australia (GSA)

GSA[48] is responsible for developing the Public Safety Training Package (PUA12) which covers many of the training requirements for CFA. Many of the units in this training package identify simulation, exercising, case studies, table top exercises, scenarios and role play as means of demonstrating competence. Some units also specify simulation within the range statement.

The variety of terminology used in this and other training packages demonstrates the lack of clarity surrounding the use of the term “simulation”.

Interstate Fire Agencies

In matters of computer based simulation, the interstate agencies cooperate with one another through the AFAC simulation reference groups and informal links between individual members. Many of the other states use the Vector system for computer based training, however, some have begun trialling other systems. For example, NSW and QLD have been trialling XVR.

Fire & Rescue NSW have also been trialling a form of distance education using the Vector Tactical system. They called it the Incident Management Distance Simulation Training (IMDST). The trial relied on an existing "Adobe Connect" configuration. This allows the 3D image to be displayed remotely and relies on telephone for voice communication between the trainees and the simulation operator. It is far from an ideal solution, but the trial has shown it to have some utility.

F&R NSW have a variety of educational computer games for children.[49]

6.3 Defence Industry

The defence industry, including the Australian Department of Defence (Defence), is one of the most sophisticated users of simulation, and spends considerable sums of money on developing and managing simulation. Many of the issues identified by Defence are likely to be applicable to emergency services organisations. Although Defence uses live training and part task simulators, as well as real equipment, for many training activities, the Defence Simulation Strategy focuses on computer based simulation.

Defence categorises simulation into eight domains, with an emphasis on phases of the Capability Systems Lifecycle[*].

- research and development
- capability development
- life cycle and logistics management
- acquisition
- options analysis
- training
- mission rehearsal
- support to planning

The Australian Defence Simulation Office (ADSO) has developed a number of documents that assist in managing simulation projects. Information from these documents provides guidance and insights into developing a simulation strategy for the CFA. For example, the Simulation Proposal Guide delivers a general purpose method of defining a business requirement and developing a proposal for introducing a simulation.

Defence also places great emphasis on using simulation in the organisational planning role to support capability development. ADSO has published a set of guides for using simulation in all phases of the capability life cycle.[50]

The Defence Simulation Strategy asserts the need to centrally coordinate the development and governance of simulation systems and their associated data in an enterprise wide fashion. It acknowledges the pace of technical, social and organisational change and

[*] The Defence Capability Systems Lifecycle is the method used to procure complex defence equipment and capabilities. http://www.defence.gov.au/dmo/about/Capability_Lifecycle.pdf

attempts to identify how the use of simulation will respond to and accommodate those changes.

Defence operates a mixture of fixed training facilities, including computer simulation centres and deployable and distance capabilities.

The US Department of Defence created the innovative computer game *America's Army* in 1999. This was developed to educate the community on the characteristics and benefits of an army career, and encourage recruitment. Fundamentally, the game is a 'first person shooter', where the player sees a 3D view and controls the movement of their character. However, it is designed as a team game where players cooperate to protect one another and achieve the scenario's objective. The game is designed to demonstrate the core army values: loyalty, duty, respect, selfless service, honour, integrity and personal courage.[51]

6.4 Health Industry

Simulation is widely used in clinical education[52] for medical, nursing, midwifery and allied health professionals at undergraduate level and for continuing professional development. In the clinical context, simulation covers everything from practicing inserting needles into foam pads, to fully immersive scenarios in simulated intensive care suites with sophisticated mannequins (robots). A focus of much of the simulation based training is on teamwork and communication and role players are often used to create realistic situations.

Clinical education, particularly for high risk scenarios, has adopted the Crisis Resource Management model (CRM) developed by the airline industry[53]. This emphasises human factors such as incident leadership and communication. Simulation is particularly applicable for exploring these issues.

In 2010 Health Workforce Australia initiated the Simulated Learning Environment (SLE) Program. The Simulation Educator and Technician Training Program was established to support the adoption of simulation. In phase one the training program aimed to train up to 300 clinical educators (training 230) who would then in phase two, train up to 6000 further educators. This program is currently on-going.

This SLE program recognised that enabling and expanding the simulation capability required more than building facilities and buying training equipment such as mannequins. To sustain the delivery of simulation based training, educators needed to be trained in its use and provided with resources to help them deliver the training. A particularly important element of the program was the collection of high quality academic research to support the use of simulation and to provide guidance and advice to clinical educators.

The program includes two core modules and eight electives that cover technology based simulation (high technology mannequins), simulated patients (human role players) and virtual environments.

Clinical simulation is such an important element of clinical education that most university level qualifications include at least one subject on clinical simulation. For example, both the University of New England[54] and Flinders University[55] include modules on simulation in their Graduate Certificate in Clinical Education and Monash University[56] offers a Graduate Certificate in Clinical Simulation.

6.5 International Emergency Management Industry

United States National Institute of Standards and Technology

The US National Institute of Standards and Technology (NIST) and the US Department of Homeland Security (DHS) held a workshop in 2008 to discuss modelling and simulation (M&S) issues that span emergency response, healthcare and homeland security domains. NIST stated that existing M&S activities undertaken by government agencies tended to be ad hoc and lacked interoperability and re-use. They proposed the development of standards as a means of improving this situation. Their current vision is that "integrated M&S and gaming techniques could be used to support education and training, research and development, system and process improvement, and planning for the emergency response community."[57]

United Nations Emergency Capacity Building Project

This is a five year collaborative project involving six of the largest international non-governmental organisations (NGO): CARE, Catholic Relief Service (CRS), MercyCorps, Oxfam, Save the Children and World Vision; supported by the UN, UKAid and USAid. [58] The goal is to use simulation to build trust and networks, pre-position relationships and build staff confidence. Phase two is running from 2008 to 2013. It has included over 17 simulation events held over five years in five pilot locations (Bangladesh, Bolivia, Horn of Africa, Indonesia, Niger).

The project identified four objectives for using simulation:

- To identify the skills of an individual staff member that need to be strengthened before an actual disaster occurs.
- To develop and practice preparedness and contingency plans.
- To develop and practice organisational preparedness and relationships.
- To build organisational capacity.

The project identified a number of lessons including:

- choosing the right simulation for the context, relevant to country/ region, disaster profile
- ensure attendance of the right people
- good planning improves a simulation (exercise)
- management commitment and appropriate budgetary support.

Applying Military Simulation to Emergency Management

In the late 1990s, the US Institute for Simulation and Training in Florida developed a computer simulation system called Terra, for exercising emergency management teams.[59] This system was based on a military training simulation called Janus. The intent was to build a simulation system that could be used to support training of emergency response teams. The system modelled hurricanes, fires and floods and represented civilians and response teams moving around on the digitised map, as well as damage to buildings, road blocks and other hazards.

Other tools originally developed for the military have also been applied to emergency management in the USA, such as the Joint Theatre Level Simulation and the Joint Conflict and Tactical Simulator.[60]

6.6 Professional and Academic Bodies

It is important to establish and maintain links with organisations and institutions who are leading the development of simulation. As technology evolves, CFA will need to rely on specialist expertise to understand and apply that technology to support the delivery of services.

Simulation Professional Bodies

There are two Australian professional bodies related to simulation: Simulation Australia (SA)[61] and the Modelling and Simulation Society of Australia and New Zealand (MSSANZ)[62].

SA is the industry peak body for simulation in Australia. Its goals include advancing research into simulation and increasing the use of simulation across industry, academia and government. SA includes a number of special interest groups or divisions, including Emergency Management & National Security, Learning & Development/ Human Factors, and Modelling & Decision Support. It recently commenced a study to review the training and certification guidelines for simulation related roles in industries such as health, mining and emergency services. It also contributes to the development of interoperability and data representation standards.

MSSANZ is an academically oriented organisation that focuses on the study of modelling and simulation technology and techniques and their application in all areas of research. Significant areas of interest include the simulation of the natural environment, hazards and construction materials and methods.

Within Victoria, the Victorian simulation interest group (VicSim) is primarily comprised of academics and researchers. Many of the members of this group have been involved in emergency management related research projects.

AFAC also coordinates a simulation user community through two groups, the Simulation Management Reference Group (SMRG) and the User Reference Group (URG). In the past, these groups were mainly concerned with the management and use of the Vector-Command* simulation products. This arose because the contract for supply Vector-Command to the various fire agencies across the country was managed centrally through AFAC, who also received a small management fee. This arrangement is in the process of being changed to be less focused on specific products and on computer based simulation more generally.

Academic Bodies

The various universities within Victoria and around the country offer a variety of capabilities that relate to the development, support and use of simulation. As an example,

* See Appendix A.

the Royal Melbourne Institute of Technology (RMIT) has a number of academics who currently have or have recently had links with CFA and individual CFA members. For example:

- The Centre for Risk and Community Safety, led by Professor John Handmer, contributes to the Bushfire CRC Effective Communications projects. Their role is to coordinate research to increase the self-sufficiency of communities in managing risk from bushfires.[63]
- Staff from the School of Mathematical and Geospatial Sciences have supervised a number of research activities in partnership with CFA and CFA members. The department offers expertise in Geographic Information Systems (GIS), geographic visualisation, remote sensing and photogrammetry, intelligent (location aware) devices, augmented reality and modelling of terrain and environmental effects on vehicular mobility.
- The School of Computer Science and Information Technology offer a number of courses relating to game development. Computer game technology is prevalent in the development of computer based simulation, especially the new generation of tools that are built on game engines. There is potential to utilise students at various levels in their degrees to work on projects that may assist the development of simulation assets, such as 3D models of vehicles and equipment.
- The Agent Group, led by Dr Lin Padgham, belong to the School of Computer Science and Information Technology. They have partnered with CFA and other EM agencies to develop a number of computer simulation models, such as Bushfire BLOCKS, which integrated *Phoenix RapidFire*, a traffic simulator called MATSim and an agent based model to explore evacuation scenarios.[64]
- The Games and Experimental Entertainment Laboratory (GEELab) is part of the School of Media and Communications. They have research interests in games for non-entertainment applications, virtual and augmented reality and the relationship between games and popular culture.

6.7 Other Organisations using Simulations

Other organisations make use of simulations and games for community engagement and education, particularly web based games and mobile applications. While not directly related to CFA activities, the examples may suggest ways in which CFA can use these tools to help affect cultural change and build communities.

- The United Nations International Strategy for Disaster Reduction developed a game, called *Stop Disasters* to educate children about the risks of natural disasters.[65]
- World Vision has developed a game called *Hunger Town*[66] to illustrate how abundant resources can coexist with communities in need. It shows how small changes in individual behaviour can lead to greater communal benefit.
- The University of Denver ran a disaster relief exercise in May 2013 for students in the Masters of International Disaster Psychology. This combines exposing the students to the problem of displaced persons, and requires them to develop a response plan.[67]
- The NSW Department of Education has contributed to the development of an on-line community for teachers, called the Pathway for Learning Anywhere, anytime: a

Network for Educators (PLANE).[68] This includes a virtual world and offers a variety of resources for professional development including game based learning.

- The *Games for Change*[69] movement seeks to use games and simulations to change attitudes and behaviour and support education and humanitarian efforts.

7 Conclusion

A simulation strategy will help CFA coordinate the various simulation programs and activities and focus on supporting core priorities.

The CFA makes extensive use of simulation as a training tool and is increasingly using it to support community engagement. As a very practically oriented organisation, CFA members intuitively understand the benefits of using simulation to explain and demonstrate complex concepts. Other simulation applications, such as organisational planning are in their infancy, if used at all, or are the domain of small groups of specialists.

Simulation tools that have been procured for one application have the potential to be used for other purposes. Broadening the understanding of the applicability of simulation and making it more widely available, will create opportunities for innovative solutions to problems. However, integration of simulation across programs requires coordination and effort. Interoperability issues, such as data management, need investigation and resolution.

The National Resilience Strategy, the Victorian Emergency Management Reform White Paper and CFA strategy documents provide guidance on the future of the CFA. A review of these documents is contained at Appendix B. These documents specifically identify simulation as an important tool to support training and preparedness. However, they also emphasise the importance of community education and partnership. CFA is well positioned to lead this initiative as it is the largest emergency management organisation in the state and its volunteer members are already leaders in their communities.

Other industries and agencies are at various stages in developing strategies and approaches to using simulation. These may provide guidance on the development of a simulation strategy for CFA. For example, the Australian Defence Department has one of the most mature and comprehensive strategies, with a strong emphasis on requirements driven acquisition, but has limited its focus to purely computer based simulation. This is summarised in appendix C.

Health Workforce Australia has identified that supporting the educators who use all forms of simulation is more important than facilities and equipment. CFA is in a position to learn from these programs and find its own balance of priority and emphasis.

CFA is embarking on a significant period of change. Simulation is one of the techniques that could be used to explore the impact and shape of those changes. Changes can be tested, evaluated and refined through simulation before they are implemented. The ability of simulation to illustrate complex concepts may also ease the introduction of many changes.

Technology is also undergoing rapid change. This affects the way simulations are developed and constructed, but also changes what needs to be simulated. CFA needs to partner with leaders in the technology fields, but also utilise the broad expertise of its members, to drive and exploit technological change.

A holistic approach to simulation in the form of a corporate wide strategy will create the framework to realise the benefits of simulation.

Appendix A Computer Based Simulation Systems

CFA Training Systems

Vector Training and Exercising System

Referred to as Vector-IMT, it was introduced in the CFA in 2006 to support Incident Management Team training. It is developed in the UK by VectorCommand LTD[70].

CFA has three licences for the system. These were purchased through AFAC as part of a national program that equipped most states with some capability. Licence and administration fees continue to be paid to AFAC, who coordinate scenario development across Australia and liaise with the developer. Coordination is managed through the Strategic Management Reference Group (SMRG), which meets annually, and the Technical Group (TG) which generally meets twice a year.

This system is delivered to local regions and has been used on the Station Officer course. It requires one operator (sometimes two) and at least one facilitator depending on the size of the exercise.

Vector-IMT uses a 2D top down map display to track the fire (or hazard) and maintains a database of what assets have been deployed to reduce it. The scenario includes a series of time sequenced injects, such as audio clips that are sent over the radio into the Incident Control Centre (ICC). The intent is to feed information to the ICC to exercise the facility and the IMT procedures. The simulation control team (often one operator) also acts as the initial Incident Controller and other on-scene elements, and has to respond to information requests from the IMT. Depending on the complexity of the scenario, other role players may be included, such as the Regional Duty Officer.

The tools exist for CFA to develop new scenarios. However, this is a time consuming process that can take up to a year for a Level 3 incident.

Old scenarios are not compatible with the latest version of the system. This means that the old version must continue to be used until the scenarios can be redeveloped.

Vector-Command Tactical Command Trainer

Referred to as Vector-Tactical, it was introduced to the CFA in 2002, although it was not widely used until 2006. It is developed by VectorCommand LTD in the UK along with Vector-IMT.

This system is delivered to local regions for a variety of training sessions and is used on the Crew Leader, Leading Firefighter and Station Officer courses at Fiskville. It requires one operator and one facilitator.

It runs on a PC (laptop) and uses an extended desktop to display a 3D view of the incident scene. In operation, this is usually sent to a projector to display for the participant view. Movement within the 3D scene is controlled by a hand held controller. Participants respond to what they see on the screen and discuss issues, such as size up, with the facilitator. As they request additional assets, the operator adds them to the scenario. The primary role is to provide talking points for the facilitator and participants to discuss decision-making cues and options.

New scenarios can only be developed by the parent company (in the UK). The support arrangement stipulates that new scenarios will be developed as part of the contract fee, but no new scenarios have been delivered for a number of years.

The existing scenarios are all based on structural fires and only one is in a rural setting. This does not match the hazard profiles of most regions and limits the relevance of the system.

Although no new scenarios can be created, the existing scenarios can be customised to a limited degree. Buildings can be 're-skinned' to make them look different. For example, a regular suburban house can be altered to look like a drug lab and provide the opportunity to discuss the relevant cues and responses. However, the geometry of the house, location and progress of the fire can't be altered.

Some regional (volunteer) instructors have been trained as facilitators for the system, but its use is still dependent on a simulation operator.

Fire Studio

Fire Studio[71] takes user supplied digital images and allows the scenario developer to overlay smoke, fire and other hazards to create realistic scenes. These can be used to supplement other training media, such as power point, or *Fire Studio* can be used in an interactive branching story mode. This latter capability can be time consuming to develop.

XVR

XVR[72] is a new system being reviewed by CFA (and interstate agencies). It is developed in the Netherlands and is widely used in the UK and Europe. It has a similar role to Vector-Tactical, although the developers are working on expanding the scope of the system.

It is built on the unity game engine[73], which is a common tool used for other educational simulations and games. *XVR* appears to be more flexible than Vector-Tactical, but it is also puts more onus on the simulation team to develop scenarios. It has a wider range of scenarios including flood and wildfire.

Training Systems Used by Other Agencies

There are a number of other computer based simulation systems that have the potential to meet CFA requirements. The following list is not exhaustive, but serves to illustrate some of the capabilities.

Hydra/ Minerva

The *Hydra Minerva* system is a flexible immersive simulation system that can accommodate a variety of tactical and strategic command training. It is aimed at providing participants with experience of incident command that are readily transferable to the real world but can also be used for non-operational simulation such as office workplace scenarios.

Minerva is a training method that uses multi-media rich audio and visual injects to immerse participants into situations as close to a real incident as possible. It responds to the participant's actions and reactions and allows an incident to unfold and develop as a consequence of decisions in real time. The software is delivered to syndicate rooms and a central plenary room where students use it to engage with the scenario. Hydra adds the ability to capture the information flow and decision making. This is used to support learning through interventions and after action review.

Experience based on the NSW police force notes that the skills required to operate the system and act as facilitator is highly specialised.[74]

Avalias

Avalias[75] is a computer system aimed at automating and enhancing elements of a desktop exercise. In particular, the system emphasises the capture of actions, information and decisions to assist with the after action review. It is in use with the NSW SES.

Advanced Disaster Management Simulator

ADMS is uses a computerised 3D virtual world and realistic physics based models of a variety of hazards and scenarios. It includes embedded artificial intelligence to represent common behaviour such as police road blocks. It can simulate a wide variety of emergency situations for training on-scene incident commanders.

It relies on a proprietary operating system and requires dedicated computer hardware. Users are unable to add their own environments or 3D equipment models and must rely on the developer to produce new settings. However, the user can create new scenarios within the supplied setting.

Decision Support Models

Phoenix RapidFire

This is a simulation developed by the University of Melbourne (UoM) under the Bushfire CRC[76] specifically for Australian conditions. The aim was to develop a fast operational model to support decision support requirements. It models ignition and the spread of fire and helps determine the likely path of a fire to assist in determining the impact on the community.

This tool is now available to CFA Fire Behaviour Analysts (FBAN) to support decision making in incident management teams and for planned burn programs. The software is not yet simple enough for anyone to use, and interpretation and manipulation of the results is as much art as science. Training with the tool is provided by UoM. Initially trialled in 2009, it has been in widespread use in Victoria since the 2010-2011 fire season.[77] It is also in use in QLD, NSW, SA and TAS.

The core software is maintained by UoM, but the user interface can be modified by user agencies. There is no formal support arrangement between UoM and CFA, but updates are readily supplied. There are issues with version control of the software as multiple versions are in use by different individuals. There are also issues with version control of data and other configuration management and governance problems.

Provision of input data such as topography, fuel characteristics and disruptive features (roads, rail and hydrology) and the updating of those data to reflect seasonal changes, land use and other factors are also problematic. This is an area where cooperation and coordination between agencies could result in improvements in quality and lower cost.

Phoenix RapidFire has also been used to support community risk assessment and engagement activities. In this role it is used to illustrate the potential impact of fire hazards. This role could be expanded, and, with the development of fire suppression models, it could also be adopted to support IMT exercises in the future.

An extension of *Phoenix RapidFire* is the Bushfire Decision Support Tool (DST) under development through the Bushfire CRC. This enhances the predictive capabilities of Phoenix by combining multiple predictions based on variations in weather and other attributes along with information on assets and structures under threat. It provides an estimate of the probability of fire affecting different areas and assets nearby the fire.[78]

Forest Flammability Model

Another approach to modelling fire behaviour is based on 'complex system' modelling. The Forest Flammability Model developed by Philip Zylstra[79] attempts to apply physical mechanisms to determine fire behaviour. It models the physical capacity of fire to propagate based on the availability and characteristics of fuel from the surface litter layer to the crown of the canopy.

While this is not yet incorporated into a real-time simulation, development is continuing and insights and lessons are being incorporated in other models.

Other Fire Prediction Models

The *Australis wildfire simulator*[80] is being developed by the University of Western Australia under the Bushfire CRC. Unlike *Phoenix RapidFire*, it uses a cell based model to predict fire spread which is intended to be faster and simpler. The project also focuses on using historical data and satellite imagery from major fires to develop the fire behaviour model. It is a core element of the Aurora wildfire prediction and early warning system[81], but is not in widespread use in Victoria.

SiroFire[82] is an older fire spread model developed by the CSIRO. It was used as the basis of the Phoenix model.

Appendix B Review of High Level Documents

A number of higher level strategies and documents provide the context for the use of simulation in the CFA.

CFA Corporate Strategy 2013-18

The CFA corporate strategy identifies five priorities, each of which has the potential to be supported through the use of simulation in a variety of ways.

CFA Strategic Priority		Relevance to Simulation
Priority 1	Effective, efficient and sustainable frontline service delivery, through supportive doctrine, process and infrastructure Our volunteer and brigade based service delivery model is sustainable. Appropriate strategies and actions are in place to recruit, retain, support and train our volunteers and staff. Volunteers are empowered with an increased and broader range of opportunities. Support services to our front line people are delivered in an agreed and timely manner. Our asset management is based on risk, efficiency and being fit for purpose.	Simulation is an important tool for training volunteers and staff. It can play a role in recruitment and retention of staff through demonstrating CFA capabilities and roles, providing challenging situations and offering opportunities to apply one's knowledge to new projects. Simulation can provide a means for volunteers to train for situations outside their usual activities and hence gain exposure to a broad range of hazards and skills. Delivery of simulation to support front line services must be appropriate, flexible and timely. Management of simulation equipment must be in-line with existing policies. In particular, being fit for purpose must be a key element of simulation procurement decisions. In the organisational planning role, simulation offers a means to assist with the acquisition and through life support of new equipment.
Priority 2	Shared emergency risk management with the community of Victoria. Our capacity and capability to prevent, prepare and respond to emergencies is understood and shared with Victoria's at risk communities. Joint (sector and community) local action plans are implemented in Victoria's high risk communities. An increased number of Victorian at risk households demonstrate appropriate action to ensure their own safety before, during and after an emergency, based on	Community resilience building may be enhanced by using simulation as part of a suite of tools. Simulation is an important mechanism for developing, testing, improving and rehearsing community action plans. Simulation is one means to educate communities about risks and mitigation strategies. Actively engaging with communities, in a flexible way, will enhance the standing of CFA in the community. Adapting to and using changing technology

CFA Strategic Priority		Relevance to Simulation
	sound advice. Stakeholders provide positive feedback on our collaborative efforts.	for community engagement activities will portray CFA as an innovative organisation.
Priority 3	Enhanced performance of the built and natural environment. Evidence based risk analysis informs planning decisions and resilience programs. Our advocacy drives improved planning, design and management of the built and natural environment which mitigates risk while reflecting community values. CFA minimises its environmental footprint. Stakeholders provide positive feedback on our collaborative efforts.	Simulation is a key means of performing risk analysis and evaluating mitigation strategies. Data from simulation based experimentation can inform decision making regarding new materials, construction guidelines, and environmental and community planning. Simulation can augment field training activities, maximising the benefit, while reducing the environmental impact. Active participation in planning for the future will enhance the CFA reputation in the community.
Priority 4	Improved and flexible delivery of services. Our service delivery approach aligns services and resources to risk and operational need across Victoria. Our organisational focus is on supporting frontline service delivery. Our partnerships are constructively focused on mitigating risk and building resilience. There is understanding and communication of our progress on our intermediate and long term outcomes. Regular service innovation and adjustment is made to remain effective. Stakeholders provide positive feedback on our collaborative efforts.	Simulation can aid in identifying risks and particularly in tailoring profiles to specific regions. Regional delivery plans can be tested using simulation where all relevant partners participate. Simulation development, procurement and support needs to respond to changing circumstances.
Priority 5	Our people are safe, respected, capable, engaged and share a common purpose. Our members feel valued and share our direction. Our people are our leaders in community engagement and capably deliver our mission and vision. We have improved the safety and wellbeing of our people. Our workforce can adapt to risk and local needs with agility.	Simulation programs need to incorporate feedback from users. Brigade members need the opportunity to influence the development of simulation systems and how they are used in the community. Using simulation can improve the safety of training activities. Simulation can be used to help identify risks and mitigation strategies. Simulation encourages systems thinking

CFA Strategic Priority		Relevance to Simulation
		and dealing with complex issues.

CFA Fire and Emergency Management Training Strategy 2013-18

Simulation is an integral part of CFA training programs. The simulation strategy needs to closely align with the CFA training strategy.

Training Strategy Statement	Relevance to Simulation
CFA's training programs are aligned to the Chief Officer's service delivery priorities.	• Simulation development and delivery must respond to and support CFA training priorities. • Simulation must support delivery of training by brigades, districts and regions. • Simulation can assist in planning training as well as its delivery. Training plans can be tested by 'walk throughs'. • Simulation can form part of the training needs analysis by helping to identify gaps and weaknesses. • Simulation as a generic tool, as well as specific simulation systems, must be continually evaluated against training needs. • Simulation may assist in distance and distributed training. • Simulation support must include a means of capturing techniques, artefacts and lessons from users.
Leadership: Current and emerging CFA leaders are supported to develop and succeed.	• Simulation can support the development of leaders at all levels. • Simulation provides opportunities to learn, practise and experience leadership and decision making. • Simulation can be used as a tool for coaching and mentoring. Simulation can support that process by collection and analysis of data and replay capabilities. • Simulation as a decision support tool can assist leaders performing their roles. • Simulation needs to reflect the multi-agency environment and be available and consistent across the agencies.

Training Strategy Statement	Relevance to Simulation
How our people learn: CFA provides opportunities for members to learn in ways that meet their learning styles.	• Simulation development and acquisition needs to be requirements driven. • Simulation use needs to be supported with adequate training materials, facilitators and other support systems. • Simulation must be available to brigades to support all levels of training. • Simulation is only one means of training and needs to complement other methods and learning styles. • Supporting instructors, trainers and facilitators to use simulation is as important as the simulation systems themselves. • Real hazard situations need to be used to calibrate and evaluate simulation models. • High quality simulations of real events (simulated case studies) may be an effective tool to augment opportunities to attend real events and share insights. • Simulation is an opportunity for members to gain the skills necessary to progress to the next level of responsibility. • Simulation offers a way for members to demonstrate existing competence.
Facilities and equipment: CFA gets maximum value from its training facilities and equipment.	• Simulation is one of the forms of facilities and equipment that offers training opportunities, particularly rare and specialised situations. • Management of simulation facilities and equipment must be included in the management of training campuses. • Simulation acquisition and support must include all lifecycle phases including maintenance, replacement and disposal. • Simulation can relieve the pressure on expensive live training facilities, and improve the preparedness of learners prior to using expensive equipment. • CFA simulation systems should be accessible to other EM agencies and in some cases, the community
Flexible learning delivery: All members have a range of training and learning options	• Simulation systems and support needs to be accessible to all members.

Training Strategy Statement	Relevance to Simulation
available to them.	• Simulation systems should be available for use in brigades and by volunteer instructors. • A range of simulation systems with varying degrees of complexity, realism and support requirements should be maintained to cover a wide variety of training situations and opportunities. • Support arrangements should adopt a scaffolding approach to assist brigades build capacity and confidence. • Where appropriate, scenarios, lesson plans, facilitator guidance and other support material should be developed along with the simulation. • Simulation management should include approaches and guidance for measuring the effectiveness of simulation based training. • Where relevant simulation systems and/ or facilities and instructors exist outside CFA, their use should be fostered. • Simulation can be used to develop 'simulated case studies' that highlight specific lessons or issues. • Using the NBN or other means should be considered as a means of delivering distance and distributed simulation for local training. • The proposed training hub should include the capability of storing simulation related material.
Training Consistency: All members receive equitable access to quality training that is consistent in format, delivery and outcomes.	• Simulation and scenario development needs to be traced back to CO priorities. • Simulation needs to support the goal of providing consistent training. Data captured by simulation may assist in this measurement. • Investment in simulation and simulation supported training needs to be transparent. • Interoperability standards and approaches should be applied wherever feasible. • Investment in simulation should be in partnership with other agencies. • Where feasible, simulation systems should reflect all hazard and inter-agency capabilities to facilitate interoperability training.

CFA Service Delivery Strategy 2025

A discussion paper was released for the development of this strategy in July 2013. It identified a number of trends that would influence the delivery of CFA services into the future. These include: changes in weather and hazard risk, changes in demography and population growth, changes in the makeup of CFA membership, and changes in technology. The paper then posed a series of questions relating to how CFA might respond to those trends.

While no definitive strategy has yet been proposed, many of the trends identified in the paper have ramifications for the use, development and support of simulation.

The delivery strategy speculates that the role of CFA will change. As this occurs, training and the use of simulation will need to keep pace with those changes. Similarly, simulation may also help the CFA explain the changes and their effects to its members and the community.

More importantly, activities to build community resilience will drive some of those changes. Simulation will be a key medium for the community and the CFA to work together to understand local hazard profiles and develop appropriate response strategies. This is likely to continue to grow, particularly as it becomes easier to support with improving technology and becomes part of the way many organisations relate to the community. Involving the community in exercising and preparedness training will build on relationships with community leaders.

Simulation may also serve as an organisational planning and experimentation tool that may assist in planning how best to deliver emergency services across the organisations, what mix of roles each agency should encompass and how to manage the changes over time. The different emergency service organisational structures can be simulated and evaluated to both optimise the structure and identify issues that need to be managed as changes are implemented.

Changes in the manning of brigades, technology and hazards will result in changes to training requirements. New technology will change the way hazards are mitigated, detected and responded to and change the way information is passed and situational awareness (on the ground and in control centres) is maintained. Simulation will be an important element of developing, maintaining and upgrading skills required by members. It will need to be flexible enough to support the membership across a wide variety of regional situations. Simulation also has an important role to play in determining what capabilities are required in the equipment fielded by the CFA. Questions can be explored through simulation such as – what mix of light and heavy vehicles provides the most cost-effective coverage of various hazard profiles?

Victorian Emergency Management Reform White Paper (VEMRWP)

The VEMRWP was released in 2011 and sets the context for CFA operations. It has five strategic priorities.

1. Building community resilience and community safety

   Maintaining and improving the resilience and safety of the community is a primary goal of the State strategy. As a community and volunteer based organisation, CFA is likely to be at the forefront of these activities. Simulation is an effective tool to provide community members with additional understanding of the impact of fire and other hazards and the level of preparedness required.

2. Streamlining governance arrangements

This includes renaming and restructuring a number of organisations and roles. Simulation based exercises will need to reflect these new arrangements and may be used to train personnel within them. Changes of this nature are likely to take some time and/ or be repeated and refined over time. Therefore the simulation and scenario development process needs to be flexible enough to adjust as organisational changes are introduced.

3. Establishing clear and effective response and control arrangements

   As legislative and other arrangements are refined, agencies such as CFA will need to exercise within those structures and procedures. Exercises may also be used to test organisational structures and evaluate and refine command and control arrangements, information flow, policies and procedures.

4. Strengthening emergency management planning processes

   This includes an increased focus on regional responsibilities and an 'all hazards all agencies' approach to responding to incidents. As roles and relationships change, exercises will need to be adapted to reflect those changes. Because CFA has a significant regional footprint, it is likely to be an important agency in building the new relationships and procedures. Exercising with local governments, aid organisations and other community based organisations will become more important. Future simulations will need to represent the capabilities of those organisations in order to run effective exercises.

5. Building capacity and capability of the emergency management sector

   This strategic objective specifically identifies interoperability as an important enabler. This applies to functional interoperability and technical interoperability such as information, communications and technology. It also identifies volunteers, training and leadership as important elements. Specifically, exercising and simulation are identified as means for developing multi-agency competencies.

National Resilience Strategy

In 2011, the Federal Attorney-General's Department released the National Resilience Strategy. This emphasises the role communities play in their own hazard management and the importance of partnerships between agencies and community. Simulation, and games and other techniques, are important and growing means of engaging the community.

Volunteerism is also a theme running through the resilience strategy. The simulation strategy must take account of the role volunteers' play and support and reflect that role.

Preparing to respond to an emergency has always been a critical element of each of the relevant agencies, such as the CFA, the new strategy emphasises prevention and recovery as equally important areas of concern. The use of simulation as an organisational planning tool can help develop risk prevention and preparedness strategies.

The strategy also acknowledges that new technology has an important role to play in communicating risk, informing appropriate action, and evaluating the cost/ benefit of mitigation strategies. In all of those roles, simulation as a planning and research tool has an important role to play.

For technology to be effective data sharing and inter-operability must be coordinated between agencies and information must be available to the community in accessible ways. One of the initiatives in this area has been the development of a simulation-game called *Before the Storm*.[83]

Appendix C Summary of the Australian Defence Department Simulation Strategy

The Australian Defence Department has one of the most comprehensive approaches to simulation, in the form of the Defence Simulation Strategy. It has the potential to serve as a model for developing a CFA and emergency management simulation strategy.

The Defence vision for simulation is: “Simulation is an integrated enterprise capability then enables defence to: lift the excellence of individual and collective training by enhancing the realism of training; analyse and fully understand the cost of ownership of capability; and provide enhanced support to decision makers in a cost effective and efficient manner.”

The efficiency and effectiveness of simulation is further elaborated:

- **It enhances capability** by improving personnel and equipment readiness and sustainability. Simulation augments force structure by releasing real equipment from training tasks to operations, and by providing practicable methods to achieve and maintain the required operational level of capability. Simulation also enables various processes that determine the composition and effectiveness of Defence capability elements.
- **It saves resources** directly through savings in operating costs and extended service life of equipment and indirectly by improving the quality of decision-making.
- **It reduces risk** by reducing exposure to hazardous situations and allowing the likely implications of decisions and changing circumstances to be assessed in advance.

To achieve the vision, Defence has stated the following strategic goals for simulation:

- Increase simulation support to capability analysis, development and acquisition.
- Utilise simulation to enable preparedness.
- Increase simulation support to operations.
- Develop a common synthetic environment.
- Develop, reshape, rebalance and grow the simulation workforce.
- Manage simulation effectively.

The last goal acknowledges the investment simulation represents and the responsibility to realise and demonstrate the maximum benefit from that investment.

Defence is an extremely large organisation with silos at many levels. The defence simulation strategy places considerable emphasis on the integration and reuse of systems and components and reducing duplication and consolidating support arrangements. The geographical dispersal of Defence establishments also drives many of the simulation issues.

Defence identified the following gaps:

- Defence could make greater use of simulation to support operations analysis, tactics development, team training and mission systems analysis during the needs analysis, requirements, acquisition and in-service phases of the capability life cycle.

- Availability of simulation systems is constrained by limited resources and a focus on supporting major exercises.
- There is still a perception that simulation replaces rather than enhances live training.
- Generation Y is used to conducting globally distributed networked activities while sitting at their personal computer.
- Exploitation of low cost joint training options has been limited.
- Logistics training is limited due to a lack of real world data.
- The ability to stimulate real time command and control systems is lagging.
- Constraints in ICT infrastructure, data and expertise limit the use of simulation support to operations in theatre.
- Validation of data against real world operations is essential to test and adjust plans, techniques, procedures and doctrine.
- Simulation systems require interoperability and connectivity and to support real-time distributed activities.
- There is an insufficient pool of suitably qualified and experienced simulation personnel to meet current and future demand expectations.
- A clear statement of requirement linking strategic plans, priority and resource allocation remains elusive.
- Standards defining the type, format and method of transfer of environmental and entity data.
- Interoperability and the requirements for the acquisition, use and re-use of future systems.
- Clearly identifying who is responsible for the provision and maintenance of data, models and simulations.

Definitions

Unless otherwise specified, terms used in this document have the same meaning as detailed in the Australasian Inter-service Incident Management System (AIIMS) 4th Edition and Victorian Legislation.

ADSO	Australian Defence Simulation Office
AQTF	Australian Quality Training Framework
Augmented Reality	A live view of a physical, real-world environment whose elements are *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data
Fidelity	The degree to which a model or simulation reproduces the state and behaviour of a real world object, feature or condition
IMTTP	Incident Management Team Training Project
Model	A representation of empirical objects, phenomena, and physical processes in a logical and objective way
Simulation	The purposeful imitation of the operation of a real world process or system over time.
VEMRWP	Victorian Emergency Management Reform White Paper
VBRC	Victorian Bushfires Royal Commission

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