04D027I

Project Code: IQP JRB 0401 - 41

Key Performance Indicators for Computer Fire Models

AUSTRALASIAN FIRE AUTHORITIES COUNCIL

An Interactive Qualifying Project Report

Submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

In partial fulfilment of the requirements for the

Degree of Bachelor of Science

by

Brian D. Kuhn

Angela M. Martino

Mark B. Moseley

Matthew M. Souza

Date: 4 March 2004

Approved:

Professor Jonathan R. Barnett, Advisor

FPA AUSTRALIA

AUSTRALASIAN FIRE AUTHORITIES COUNCIL

ABCB

Abstract

This project, commissioned by the Australasian Fire Authorities Council (AFAC), justifies the need for guidelines in computer fire modelling, recommends practice guidelines for the standardization of the use of computer fire models across Australasia, and compares the differences in the use of computer fire models between Australasia and the UK. A survey was conducted in Australasia along with numerous discussions with key professionals from which a comparison with a similar UK study was conducted, along with the justification and development of recommendations for practice guidelines.

Key Words: Australasia, survey, guidelines

Executive Summary

In June 2001, the Building Research Establishment (BRE) of Garston, England began a project titled, "Development of KPIs for Fire Safety Engineering." This three year study set out to establish Key Performance Indicators (KPIs) for the fire safety engineering design process including the use of computer simulation tools. BRE used a questionnaire to learn how Computer Fire Models (CFMs) were being used throughout the UK.

Professor Jonathan R. Barnett of Worcester Polytechnic Institute (WPI) proposed doing a study similar to BRE's in Australasia. The Australasian Fire Authorities Council (AFAC) based in Melbourne, Australia, expressed interest in supporting this study. A project team consisting of four undergraduate students from WPI completed this project from the AFAC office.

There were three goals of this project. First, results were to be obtained for a comparison with the BRE project. Second, the justification for the need of guidelines was to be developed. The final goal was the development of recommendations for practice guidelines regarding the use of CFMs in Australasia. While the title of the project is 'KPIs for Computer Fire Models in Australasia,' this wording is more historic than a true reflection of the work. It was determined that the term 'Practice Guideline' was more suitable than 'Key Performance Indicator.' The three sponsors of this project were the Fire Protection Association of Australia (FPAA), the Australian Building Codes Board (ABCB), and AFAC.

A literature review was completed at WPI, which included a study of social science techniques needed to complete the study. This literature review also included an

in-depth study of the BRE project. Some challenges of the project included identifying differences between Australasian and British language terms. Research was conducted on the various fire safety associations, the role of designers and authorities having jurisdiction in the FSE field, interested parties in Australasia, and other related groups in order to better understand the project audience. The role of CFMs in Australasia was also examined.

Once in Melbourne, the background material was presented to sponsors and key players in the FSE field to spread awareness of the project that would be taking place. The questionnaire was completed, Australasian contacts were identified, and a distribution scheme was developed. The FPAA, the Society of Fire Safety (SFS), the Australian Institute of Building Surveyors (AIBS), and the New Zealand Fire Service (NZFS) all agreed to provide assistance with distribution of the survey through their organizations.

Once all surveys were distributed, electronically or via post, a Microsoft Access database was created to store and analyse survey results. This database was equipped with tools that proved extremely helpful to the project. A unique feature of the database is the possibility of future continuation. The database has a form that mimics the questionnaire for easy data entry, along with numerous reports for analysing information. Reports display all inputted data in a categorized format, along with specific queries that cross-tabulate different fields.

When survey responses were received, the data was immediately entered into the database. Approximately two weeks were allotted for surveys to be returned. As the deadline for completion of the survey approached an evaluation of fire practitioner responses was completed, which showed that there was an uneven response amongst roles. Many fire safety engineers had responded, but more participation from building surveyors and fire service members was needed. People in these fields were targeted via phone calls, more surveys were distributed, and as a result those responses increased.

The results were evaluated and compared to those of the BRE study. This comparison identified the differences between the FSE fields in the UK and Australasia, and these differences do indeed justify the need for the study in Australasia overall, computer fire models are used more in Australasia, and practitioners are more trained to use them.

The analysis of the results shows the need for practice guidelines. One critical, unexpected finding was that almost half of all respondents that used CFMs were not confident in whether their models were 'fit for purpose.' This shows the need for more specialised training or the need for more models that people are confident using. Many of those using CFMs indicated that they had little or no specialised training. A large number of participants also answered that CFMs were not used because 'modelling software is too complex.' Again, this demonstrates the need for more specialised training in the field.

To accomplish the third goal, the development of a draft set of practice guidelines began based on the data that had been received. To help with an analysis of the results, a focus group was conducted. This Focus Group included eight fire professionals from Australia and New Zealand, and proved extremely beneficial to the outcome of the project.

The guidelines that were developed fit into three main categories: Model Use, Qualification, and Verification. The Model Use category included guidelines that determined if models are needed, and what models should be used. The Qualification category dealt with the need to ensure that all participants in the FSE process had sufficient qualifications for their work. Finally, the Verification section of the Practice Guidelines contained parameters relating to how tools other than just models should be used in the design process.

In conclusion, this project accomplished its three main goals. The BRE project comparison demonstrated the differences between the FSE fields in the United Kingdom and Australasia. Evaluation of the results showed a need for Practice Guidelines. Lastly, a draft set of guidelines was developed and recommended to the Australasian Fire Authorities Council. The draft guidelines will be published by the Society of Fire Safety and later finalised and appended to the SFS Code of Practice.

Authorship

For this report all team members, Brian Kuhn, Angela Martino, Mark Moseley, and Matt Souza have agreed that all work was divided evenly between them.

Brian Kuhn was the main liaison for contacts in the Australasian fire engineering field. He gathered most of the contact information for survey participants, and he organised the focus groups. Brian was also the main contributor to the guideline justification portion of the final report.

Angela Martino was responsible for the majority of data input from the survey responses. She also chaired the focus group meetings and was responsible for the creation of the final PowerPoint presentation. Angela was the main contributor to the results section of the final report.

Mark Moseley was responsible for the creation and modification of the Microsoft Access database used for this project. He also created all reports that were used to analyse and display survey results. Mark designed the online survey webpage and the final report webpage for the project.

Matthew Souza was the main contributor to the introduction, methodology, and BRE comparison portions of the final report. He also was responsible for the modification and finalisation of the Australasia survey.

It must be noted that all team members have completed any sections not specifically mentioned above in a combined effort. Typically, when one team member was finished working on a section the other team members would edit and correct that section. By using this method, each team member had input on every section.

Acknowledgments

The project group would like to thank the following people and organisations for their help and contributions in the completion of this project:

Rob Llewellyn
Brian Ashe
Ross Hodge
Jarrod Edwards
Paul England
Roger Marchant
Peter Johnson
Stephen Kip
Stephen Wise
Dave Boverman
Peter Phillips
Jeff Knight
Simon Davis
Mike Thomas

Parkan Behayeddin
Bob Hook
Paula Beever
Ted Bauress
Professor Jonathan Barnett
Australasian Fire Authorities Council
Fire Protection Association of Australia
Australian Building Codes Board
Society of Fire Safety
Australian Institute of Building Surveyors
All the Survey Participants
Richard Custer

Table of Contents

List of Figures

List of Tables

1 Introduction

Sponsored by the Australian Building Codes Board (ABCB), Australasian Fire Authorities Council (AFAC)[1] and the Fire Protection Association of Australia (FPAA)[2], this project provides recommendations for the development of practice guidelines regarding computer fire model (CFM) use for fire engineering design in Australasia. The outcome of this project shows that these guidelines are needed in the Fire Safety Engineering (FSE) field. Lastly, it looks to compare the similar survey results from Australia to those gathered by the Building Research Establishment (BRE). BRE did a project in the UK that established Key Performance Indicators (KPI) for all of FSE, while this project concentrates on providing suggestions for practice guidelines specifically for computer fire models. These recommendations will hopefully lead to the standardisation of CFM use in building design throughout Australasia.

As it stands now, a building owner in Australasia must always abide by national and regional requirements[3]. However, he or she may fulfill these requirements laid forth by the Building Codes of Australia (BCA) in one of two ways. The first is to follow the more traditional path by adhering precisely to the codes and standards commonly referred to as compliance with the deemed-to-satisfy solutions (DTS). The other path, which is becoming increasingly more popular, is to follow an alternate solution that satisfactorily indicates that the solution abides by the DTS[4]. An assessment of the solution is then

---

[1] Appendix A
[2] Appendix B
[3] Llewellyn, Rob. Feb. *Personal Comment.* 2004.
[4] "About the Building Code." ABCB.com.au. 2004. Australian Building Codes Board. 16 Feb. 2004 <http://www.abcb.gov.au/content/codes/main.cfm>.

required to show that the alternative still conforms to the BCA. For complex alternative solutions, computer fire models are generally used to validate the design[5].

Computer fire models can take many forms. There are four main categories of models: risk, zone, field, and evacuation/egress[6]. These categories essentially refer to how a room is critically analysed in terms of a fire. Risk models are not commonly used for fire engineering design in Australasia, and are therefore excluded from this study. Zone models analyse the room by breaking it up into two control volumes, an upper and lower, and evaluating the fire by examining conditions in these volumes[7]. Field models, or computational fluid dynamics (CFD) models, examine the room by dividing the room into small volumes, or cells. The size of these cells varies depending upon on how the field model is used[8]. Lastly, evacuation/egress models explore social responses to the fire. In other words, they examine how an individual(s) will react in a room containing fire.

While CFMs can be extremely powerful and helpful tools, there are disadvantages as well. Analysing a fire is a very difficult task, and there are many things that are not understood about fires and how they react. Fires are extremely unpredictable, and a computer model simply looks to simulate this reaction as closely as possible[9]. Due to the very complicated math that goes into modelling a fire, a user must exhibit a fair amount of knowledge on both fire safety engineering and fire models themselves. Often, a user

---

[5] Llewellyn, Rob. *Personal Comment.* Feb. 2004.
[6] Barnett, Jonathan. *Personal Comment.* Feb. 2004.
[7] Society of Fire Protection Engineers. SFPE Handbook for Fire Protection Engineering. 3rd ed. LOCATION: National Fire Protection Association, 2002.
[8] Society of Fire Protection Engineers. SFPE Handbook for Fire Protection Engineering. 3rd ed. LOCATION: National Fire Protection Association, 2002.
[9] Barnett. Jonathan. *Personal Comment.* Oct. 2003

will misuse a model as they attempt to forge the data to support their design[10]. Some do not know the limitations of the model they are using. Improper inputs may yield supportive, yet incorrect outputs. Furthermore, complex interfaces make models hard to use and understand. Yet, even an inexperienced user can use the results obtained from the model to support his or her design. As long as the data illustrates a valid design solution, then there is no desire to verify the results.

This is the embedded problem in using computer fire models to validate a design solution. Without having guidelines or standards to follow, a person can misuse a computer fire model or, as is more often the case, modify the parameters and data of the model to obtain the desired results. This can result in the erection of an unsafe structure. Many fire professionals have recognised this as a dangerous alternative that needs regulation. The focus of this project is to help develop regulations by providing survey data and suggestions for a set of practice guidelines based on the data. These guidelines attempt to standardise fire model use in Australasia and hopefully produce safer alternatives to the DTS.

[10] Llewellyn, Rob. *Personal Comment.* Feb. 2004.

2 Literature Review

2.1 *Key Performance Indicators (KPIs)*

2.1.1 Introduction

2.1.1.1 Reasons for the Use of KPIs in the Computer Fire Models

Why are KPIs needed for computer fire models? This question has been brought up many times. Why do we need them? Well, currently there are no regulations or requirements for a fire practitioner, or anybody for that matter, to use a computer fire model. Basically, anybody can use a computer fire model and have no knowledge on the subject at hand. Professional engineers will not do this, however they are likely to have varying amounts of knowledge on the proper use of computer fire models. There are complex areas within the computational fluid dynamics (CFD) computer fire models that require specialist training in order to know how to use models correctly and efficiently. A fire practitioner may have many years of experience, but no history of formal training in the use of computer fire models. The practitioner may not have an understanding of how to apply computer fire models to their work. Due to the lack of understanding that a practitioner may have, there may be a gap of knowledge between the practitioner and the computer fire model. Computer fire modellers are experts in CFD and mathematical and numerical techniques. Fire modellers can represent the real-life fire situations presented by fire safety practitioners.

All in all, KPIs for computer fire models are needed and provide aid in the usage of computer fire models. They address the knowledge gaps between the computer modeller and fire practitioner. They promote proper use of computer fire models for FSE. They improve the dialogue and approval process between the designers/engineers and enforcers. Lastly they offer a consistent approach to follow that abides by the national and international standards for computer fire model use.

2.1.1.2KPIs

Key Performance Indicators or Key Success Indicators (KSI) help an organization to define and measure progress toward its goals. They are quantifiable measurements (measurable), agreed to beforehand, that reflect the critical success factors of an organization. Furthermore, KPIs must reflect the organization's goals and must be a key to the organization's success. [11]

2.1.1.3Requirements

Requirements are similar to KPIs in that they help an organization to define and measure progress towards organizational goals. Requirements can be either qualitative or quantifiable. A requirement establishes an essential condition that must be met in order to meet an organization's goals. Failing to meet any requirement would result in the failure of the goal.

2.1.2 KPIs or Requirements?

An ongoing issue discussed in the United Kingdom is whether or not the phrase Key Performance Indicator (KPI) is appropriately being applied to fire safety and computer fire modelling guidelines. Even if the phrase is found to be inappropriate, it can only be

---

[11] "Key Performance Indicators (KPIs)" <http://management.about.com/cs/generalmanagement/a/keyperfindic.htm>

replaced if a suitable and more accurate phrase can be used instead. The term "Requirements" has been suggested as an alternative term to use. In order to compare these two terms, it is important to analyse their definitions, and then how they are being or would be used in relation to fire safety and computer fire modelling.

2.1.2.1 Comparison

The main problem with KPIs is that they are quantifiable measurements. However, in relation to fire safety and computer fire modelling, the term KPIs would be used qualitatively. Using the term "Requirements" does not have this problem. Requirements establish essential conditions, they don't provide for a way to measure progress towards the organizational goals, just a way to tell if the goals have been met or not.

2.1.2.2 Conclusions

Both phrases, KPIs and Requirements, are not fully applicable to the fire safety and computer modelling application. Other alternative phrases should be considered, in an effort to find a phrase that is fully applicable. If none can be found, then careful consideration needs to be taken in determining which phrase is "more" applicable.

2.1.3 KPIs – Beneficial or Not?

KPIs are beneficial in many ways. They give confidence in designing and providing a better understanding of FSE. Especially when using a computer fire model, KPIs give guidelines of what is expected of the user of the model. This compels the users to know what they are doing and have a better understanding of how it works. Although there are many benefits, cost, time, complexity, and education are downfalls to the use of KPIs. These four factors can be looked upon as hindrances towards companies and people. The larger, more advance companies can produce more money, and education for the users of the models, than the smaller companies. These factors can sometimes restrain the smaller companies from moving ahead in their studies.

2.2 Summary of BRE's "Development of KPIs for Fire Safety Engineering on the Use of Computer Fire Models"

Fire Safety Engineering has become an important part of our society today. It continues to grow and develop as the years go on. BRE, the leading centre in the United Kingdom of expertise on buildings, construction, energy, and environment fire and risk, has cultivated a project to add to the development of fire safety in our society today by the use of computer fire models.[12] The title of their project is "Development of KPIs for Fire Safety Engineering on the Use of Computer Models."

2.2.1.1 Objectives

In order to produce the most efficient results for the project, BRE has come up with objectives in order to obtain all of the information needed. They plan to produce simple and practical KPIs that can be applied to fire safety engineering and the fire safety engineer and computer fire modelling. KPIs will maintain suitable standards for the entire life of the building in an attempt to minimize the risk of loss of life and property. Clear and valid recommendations for the development of ODPM-approved and widely supported KPIs for fire safety engineering need to be produced.

---

[12] "BRE." <http://www.bre.co.uk/who.jsp>

2.2.1.2 Project Tasks

In order for BRE to carry out all of their objectives for the project, they produced tasks to achieve each part. BRE decided that the following tasks were the best way to approach the objectives of the project.

- Establish Steering Group, Working Parties and brainstorming
- Review professional practices and identify potential KPIs
- Review direct assessment methods and develop a prototype KPI methodology
- Review actual fire-engineered buildings and designs
- Recommendations for development of generic KPIs for FSE
- Benchmarking computer fire models for hazard analysis
- Benchmarking end user for competent use of simulation tools for fire hazard analysis
- Draft KPIs for the use of computer fire models for hazard analysis in support of FSE

2.2.2 Working Party

One project task of the BRE project was to establish working parties. The purpose of these working parties was many-fold. Seemingly, the overall idea of working parties was to set up organized, scheduled sessions to discuss and report on the progress of the overall project. More specific goals of the working parties were developed, and they include the following:

- To review basic concepts and potential criteria
- To debate on main issues and agree way forward

- To inform the development of the project
- To monitor progress of the project
- To review and discuss findings and recommendations of project
- To participate in project workshops

2.2.3 BRE KPIs

The BRE project had three objectives in relation to KPIs. The first objective was to produce simple and practical KPIs that could be applied to fire safety engineering and the fire safety engineer to maintain acceptable standards in the risks to life from fire in buildings over the whole life of the building. Second, was to produce clear and quantified recommendations for the development of ODPM-approved and widely supported KPIs for fire safety engineering in the form of a publishable report. Third, was to propose formal KPIs for the application of computer fire models, from the experience of at least three fire-engineered buildings.

2.2.3.1 KPI Requirements for Computer Fire Models

The first step in developing the KPIs was establishing a list of requirements to adhere to. It was decided that the KPIs needed to be aimed at promoting proper/correct use of computer fire models for (performance-based) fire safety engineering design and assessment and targeted at fire safety practitioners. The KPIs also needed to be consistent and aligned with national and international standards.

Furthermore, each KPI had to be clear, concise, evolving, and qualitative in nature. It is important to note that though KPIs are supposed to be quantitative, that was not a requirement for the Computer Fire Model (CFM) KPIs. It was noted that the KPIs didn't meet this requirement and the BRE report stated that it was not feasible to create quantitative KPIs in regards to CFMs.

Finally, the KPIs would be presented in the form of a check list from interviews of designers/engineers and not done quantitatively in the form of point scoring.

2.2.3.2 Tentative KPIs

Through the Working Party meetings, a list of tentative KPIs was developed. The KPIs developed were classified into two categories: those that were a performance measure of the user, and those that were a performance measure of fire models for FSE design process. The KPIs that were a performance measure of the user were Qualifications and Design team (QDR). The KPIs that were a performance measure of fire models for FSE design process were Design Team (QDR), Methodology, Quality Control, and Reporting and Presentation.

2.2.3.2.1 Qualifications

The Qualifications KPI has five aspects: academic, professional, specialist training, awareness of literature, and experience. A person's qualifications would be analyzed based on whether they had fire specific academic training, worked for a recognized professional body or not, had specialist training, and if that training was adequate and/or appropriate. They were also based on their awareness of fire safety engineering literature, their experience, and whether that experience was relevant.

2.2.3.2.2 Design Team (QDR)

The Design team QDR KPI has several key aspects. First, was defining the fire safety objectives as either life safety or property protection. The second aspect was identifying the fire scenarios. Third, was to agree on the fire model approach, whether it be deterministically through simple calculation method, such as zone or CFD, or probabilistically. The final aspect was to agree on the assessment criteria.

2.2.3.2.3 Methodology

The Methodology KPI is by far the most detailed KPI. Sensitivity to design parameters is a key aspect of the methodology and varies based on the type of model (CFD or zone). Zone models and CFDs also had specific aspects that applied to each them. The following is a list of the methodology in relation to both zone models and CFDs:

- Zone and simple calculation methods
    - Examine/Demonstrate that fire engineered solution is robust by checking sensitivity to:
        - Design parameters
        - Choice of model
    - Sensitivity to design parameters
        - Plume entertainment options
        - Steady versus growing fire-growth rate & peak HRR
        - Boundary heat losses
        - Discharge coefficients for vent openings
        - Ambient & external wind conditions
        - Ventilation system
- CFD Models
    - Sensitivity to design parameters
        - Location of fire(s)
        - Sources & types of fuel
        - Simplification to geometry
        - Steady versus growing fire
        - Grows rate & peak HRR
    - Initial & boundary conditions
        - Ambient air and wall temperatures
        - External wind
        - Space heating
        - Ventilation system
            - Natural versus powered
            - Locations & rates of supplies and extracts
        - Wall thermal characteristics
            - Adiabatic versus isothermal walls
        - Passive fire protection measures
            - Location and size of escape routes
            - Location and size of ceiling smoke screens
            - Location and types of compartmentation walls
        - Active fire-protection measures

            - Location and types of detectors
            - Location and types of sprinklers
            -
        - Sensitivity to numerical parameters
            - Combustion sub-model -volumetric heat source versus combustion source
            - Radiation sub-model – empirical heat transfer coefficient, six flux, discrete transfer method
            - Turbulence – buoyancy modified k-e
            - Numerical grid – coarse versus fine
            - Convergence – residual errors versus relaxation factors, overall heat & mass balance
- Fire Models
    - Pedigree of verification/validation
        - Analytical methods
        - Empirical correlations
        - More advanced methods
        - Experimental data

2.2.3.2.4 Quality Control

Quality control consists of three aspects. The three aspects are documentation; such as geometric input; checking procedure, in-house or third party expert; and archiving, recording or reports, drawings, software documentation, etc.

2.2.3.2.5 Report and Presentation

Report and Presentation consists of the ways in which the results of a CFM are recorded and displayed. Several requirements were proposed for this KPI. The proposed requirements were: description/justification of fire, description/justification of the model and its assumptions, recording of all input data and assessment criteria, description of the grid, convergence (for CFD), description of all relevant hazards and their basis, and conclusions that must support objectives.

2.2.3.3 Checklist

The BRE report went on to develop the actual KPI checklist to use. The checklist is divided into five categories along with specific questions for people in different fields of FPE.

2.2.3.4 Benchmarking Simulation Tools for Fire Hazard Analysis

In benchmarking, the tasks at hand are to technically review the numerical models and methods for smoke and thermal hazard assessment, and to analyse the selection of models for practical applications. The focus is on smoke and thermal hazard analysis within the context of FE solutions. In particular, with reference to the design of smoke management systems and assess the capabilities and limitation of today's numerical models.

There are three main numerical methodologies: engineering calculations, zone models and CFD models. Engineering calculations are fairly "simple" to solve, and refer to formulas that measure flame height and calculate air entrainment. Zone models are generally two-zone models for smoke filling (i.e. CFAST). They have multi-compartment capability and are relatively easy and quick to solve. CFD models are potentially very accurate and use less empirical sub-modelling than do the other two. This makes solving CFDs a fairly difficult and tedious process. Other notable methods include "network" models and probabilistic models.

Important issues to consider when benchmarking simulation tools are geometry, the fire source, chemistry, multi-compartment capability, validity for large and complex enclosures, radiation, solid-fluid coupling, mechanical ventilation and pre-fire conditions. Many models were examined for benchmarks. ASET-B, the CFAST/HAZARD family, and the HARVARD/FIRST family are examples of the zone models examined. CFD fire specific models include JASMINE, SOFIE, SMARTFIRE and FDS. The last grouping of models would be general purpose CFDs, which include CFX4 and CFX5.

In conclusion, fire simulation is still in its infancy. Zone and CFD models have very unique issues; the source terms and boundary conditions are only approximately known and experienced judgment is required in setting up a problem and analysing results. An understanding of the multi-component nature of fire physics is required. Engineering calculations and zone models are still important. They are simpler and useful for general analysis, however there are limitations. CFDs are potentially very useful, even more so than the others. Overall, FSE is still very much in the advancement stage.

2.2.3.5 Benchmarking End Users

2.2.3.5.1 Survey Summary

2.2.3.5.1.1 Overview

One crucial section of BRE's project was to "benchmark end users." Benchmarking implies the acquisition of information on how Computer Fire Models are currently being used by construction industry professionals both in design and in regulatory enforcement. This task was accomplished by way of a mass distributed survey, or questionnaire. The questionnaire was intended to identify the variety of professional backgrounds of the respondents in order to inform future decision-making and how to ensure proper use of fire modelling in practice.

2.2.3.5.1.2 Content

The questionnaire was designed to retrieve information about the use of Computer Fire Models in various fire professions. The beginning of the questionnaire asks the respondent to identify what Fire Safety profession he/she is involved in. The basic categories of the fire safety engineering professions are architects, or building designers; building code officials; and fire fighters. If these workers do not encounter Computer Fire Models in their jobs, then they need not answer the survey. If they do, then survey goes on to ask in what aspect of fire safety the models are used in, and why the models are used. The latter part of the questionnaire determines if the respondent is confident in the validity of the computer fire models, and what references they refer to in the Fire Safety work. The survey is fourteen questions in length.

2.2.3.5.2 Survey Results

The results of the survey are very unclear, and much of the responses do not seem to apply directly to the question at hand. Furthermore, many of the questions that were posed were not answered. Nevertheless, 75% of the designers and 40% of the enforcers interviewed responded that they encountered computer fire models in their work. The dominant reason reported for using certain computer fire models was to check the validity of the design solution. The computer fire models deal with a couple aspects of fire safety, the most common being HVAC and smoke ventilation and the second most common being evacuation. The relevant staff on hand who are chartered fire engineers were involved in about 40% of model applications at the design stage, and about 25% at the enforcer stage. When asked about the specialist training that the staff receives, many responded that there was no specialist training, and if there was, that it was fairly generic. The most popularly consulted reference for fire safety engineering work were standards documents, and the second and third most consulted were the SFPE handbook and the LPC design guide, respectively. Generally, those interviewed who held a design position (Question 1) replied that they were confident that the models were "fit for purpose." On the other hand, those who held the enforcer role were mostly uncertain. Those who commented on the matter said that the model itself was ok, but the data gathered from the model was commonly misused or poor. The most widely used publication on computer fire models was the Fire modelling - BRE Digest 367, November 1991. When asked how the validity of the solutions offered by the fire models is assessed, designers responded that they used "engineering judgment" while enforcers were divided fairly evenly between in-house validation and another consultant. Clearly, responses to the survey are neither conclusive nor complete. In response to this, better questions need to be posed and the responses validating them need to be more pertinent.

2.2.4 Initial Findings for KPIs

2.2.4.1 Qualitative or Quantitative

KPIs are an important factor to FSE computer fire models in our world today. They are standards and guidelines that are beneficial to the work that is produced. They are needed for FSE. BRE found that the terminology of Key Performance Indicators needs much revising though. In most cases, a KPI is something that is quantitative; they are expressed in quantities and numbers. KPIs used in FSE are qualitative rather then quantitative. KPIs for FSE are not intended to limit or restrict anything. They are more like standards and guidelines that are not required, but should not be overlooked.

2.2.4.2 KPI Guidelines

After a lot of research and work on developing KPIs, BRE developed what they believe KPIs should be. BRE believes that KPIs should include guidance, training, effectiveness of design, modelling, design process, life safety, and property protection. KPIs need to be obvious and practical. Creating a KPI that is too advanced and complicated will take away from it only being a "guideline." This may cause a participant to skip over the KPI and proceed to the next one causing important information to be missed. KPIs should be general and not detailed. They should address the primary objectives of the subject matter at hand. Creating a detailed KPI limits the persons involved. Someone involved in FSE may be advancing in an area of study, but might not be able to continue due to a KPI limitation. A KPI should also always allow for continual feedback. The more feedback and information that can be obtained related to KPIs for FSE, the more advanced and essential they will become.

2.2.5 BRE Proposed KPI Methodology

The proposed KPI Methodology consists of four stages. The first stage is the drafting of the KPIs. The drafted KPIs consist of five top-level KPIs for measuring the performance of the design team, fire models, and the various stages of the design and approval process as well as numerous sub-KPIs. The second stage is the validation procedure to evaluate the effectiveness of the draft KPIs developed in the previous stage in the overall fire safety design and approval process. The third stage is the Checklist. The checklist consists of a series of questions related to the KPIs that have been drafted. The checklist helps practitioners ensure that all essential elements of KPIs have been considered. The last stage is the best-practice guidance. It acts as a guideline for facilitating the proper use of computer fire models for fire safety design and assessment.

2.2.5.1 Top Level KPIs

The five top level KPIs are designed to cover all aspects of computer fire modelling. Qualifications of the Design Team and Design methodology (QDR) are a performance measure of the Design team. Modelling methodology, Quality control procedure, and Reporting and presentation are performance measures of fire models and the approval process in support of FSE design.

2.2.5.1.1 Qualifications of the Design Team

Qualifications fall into three categories; academic, professional and specialist training. The fire specific education of the each member of the design team needs to be appropriate as well as any recognized bodies in which members of the design team are active. Any specialist training members have received must also be adequate and appropriate for the purpose they serve in the design team.

2.2.5.1.2 Design and Modelling Methodology

The design and modelling methodology consists of the steps required in designing and modelling a situation. First, the fire safety objectives of the design must be established; this occurs in the client brief, and defines for instance, whether life safety or property protection is the principle objective. Next, the fire scenarios must be identified, specifically, the design parameters for sensitivity analysis. The fire modelling approach, deterministic or probabilistic, must also be agreed. If deterministic is decided, then the calculation method as well as the model type (zone or CFD) must be decided. Finally, the assessment criteria must be agreed upon for the model, this is based on many factors, such as the accuracy required and the sensitivity of the model.

2.2.5.1.3 Quality Control

Documentation is an important aspect of quality control. Details of the design and modelling methodology must be documented as well as all input and output, such as drawings and results. These allow for the validity of the design to be analysed and for others to look up and use the results. Checking procedure is another aspect of quality control. For in-house checking the technical quality is checked by a senior member. In third-party checking, a third party provides independent peer review of the work done. Archiving is the final aspect of quality control, which includes the recording of reports, drawings, results, etc.

2.2.5.1.4 Reporting and Presentation

Reporting and presentation includes the description and justification of the fire, the model and its assumptions, all input data assumptions and assessment criteria, grid, convergence (for CFDs), and all relevant hazards and their basis. Other technical data such as details of sub-models should be in an appendix, and all conclusions must support the objectives.

2.2.5.2 Validation Procedure

A three stage validation procedure is recommended. The first stage is model validation. Model validation ensures that numerical errors are minimized and computed results have been verified against full-scale data. The second stage is user validation. User validation checks that the Design team has appropriate training and experience in using the computer model appropriately. The third stage is case validation. Case validation ensures that computed results have been checked by an expert checker (either in-house or third-party), and against simple and alternative methods.

2.2.6 KPI Checklist Methodology

To effectively fulfil the requirements of the client, the building design process must focus on the end result. Focusing on the final product nearly guarantees that the design objectives have been met to the satisfaction of all those involved. To ensure this, a hierarchical structure has been adopted. This proposed methodology adopts a system of hierarchical levels of KPIs, forming a "logic tree." The user of this methodology can then find the applicable branch.

2.2.6.1 Zero Level – The Building

The building is the subject of the application of KPIs. Users of the KPI methodology should always keep in mind the main goal of the exercise: a building which is safe in the event of a fire, regardless of the when it occurs in the building's lifetime.

2.2.6.2 First Level – The Organizational Users of KPIs

The first level of organizational users of KPIs is comprised of FSE designers, enforcers, management teams, and documentation.

2.2.6.2.1 FSE Designers

The FSE designer group includes the primary design team, along with any allied or sub-contracted organizations including the end client responsible for producing a fire safety strategy.

2.2.6.2.2 Enforcers

Also included in the first level are the enforcers. The enforcers are organizations who assess the design proposals from the FSE designers (above) to ensure that the proposals comply with current requirements for fire safety.

2.2.6.2.3 Management Team

2.2.6.2.3.1 Fire Safety Management

Yet another group is Fire Safety Management. These people are responsible for day-to-day use of the completed and occupied building. Essentially, they make sure that anything that was worked on in the design and construction stage functions as planned.

2.2.6.2.3.2 Construction Managers

There are also Construction Managers. This group is responsible for overseeing, installing, and commissioning fire safety equipment and materials for use in employing the fire safety strategy.

2.2.6.2.4 Documentation

Documentation, as the name implies, is not an actual user. However it is of extreme importance to the real user, so much so that it should still be on the first level of the hierarchy. The documentation simply guarantees a common format and understanding throughout all levels.

2.2.6.3 Second and Third Levels

The second level is comprised of groupings of KPIs. For every first level user, there are many KPIs, and the second level is simply a means of maintaining organization. The third level is comprised of the specific KPIs themselves, each grouped within a second level sub-category.

2.2.6.4 Implications of Methodology

The main goal of the KPI Checklist Methodology is to ensure that the key issues have been addressed, however it doesn't guarantee the validity of the findings (mathematically or otherwise). The KPI methodology does not replace a proper understanding of the engineering involved, but for most users, it will suffice.

2.2.6.5 Conclusion

Fire safety engineering integrates building design, operation and management. Not only that, but FSE is responsible for the entire working life of the building. The public needs to have confidence in FSE and in turn be assured that public buildings are as safe as possible. The methodology of KPIs provides a means of managing, validating, and documenting the process of FSE. However, it is still in the developmental stage.

2.3 Fire Safety Engineering

2.3.1 Introduction

Fire Safety Engineering (FSE) is the application of science and engineering principles to protect people and their environment from destructive fire. It is an extensive field that encompasses the following areas: analysis of fire hazards; lessening of fire damage by proper design, construction and use of structures, materials and transportation systems; the design, installation and maintenance of fire detection and suppression and communication systems; and post-fire investigation and analysis.

Successful fire safety engineers have gained knowledge through education, training, and experience. They are familiar with the nature and characteristics of fire and the resulting products of combustion. Fire safety engineers understand how fires start, how they spread through structures, and how they can be detected, controlled, and hopefully extinguished. Fire safety engineers also should be able to predict how certain materials, structures, machines, etc. will behave during a fire, and how those behaviors relate to the protection of life and property from fire.

Interestingly enough, out of all of the engineering fields, FSE is one of the youngest. Over the past century the following organizations have been established to facilitate the development of this field.

2.3.2 Organisations

2.3.2.1 National Fire Protection Association

Established in 1896, the NFPA is the oldest Fire Protection organization in the world. Therefore most fire safety breakthroughs are less than 100 years old. NFPA's mission is "to reduce the worldwide burden of fire and other hazards on the quality of life by developing and advocating scientifically based consensus codes and standards, research, training, and education."[13] The association currently has upwards of 75,000

---

[13] "NFPA Overview" http://www.nfpa.org/catalog/home/AboutNFPA/NFPAOverview/NFPAOverview.asp

members, representing over 100 nations throughout the world. [14] The NFPA's standards and codes affect basically every structure or building in the United States, as well as many countries overseas. There are currently 300+ codes which the NFPA has produced, making it one of the most influential organizations in the engineering world. [15] Every year, the NFPA holds conferences, seminars, and certification courses to increase knowledge and awareness in the fire protection field.[16]

2.3.2.2 Society of Fire Protection Engineering

Established in 1950, the Society of Fire Protection Engineers (SFPE) attempts to "advance the science and practice of fire protection engineering and its allied fields, and to maintain a high ethical standard among its members and to foster fire protection engineering education."[17] The SFPE provides many benefits to the fire safety community, including educational seminars and short courses, technical symposia and conferences, and books and publications designed to advance the state of the art of fire protection engineering and provide technical information to the fire protection community. The society currently has about 3500 members from all over the world, including chapters in Japan, Italy, and New Zealand. [18]

---

[14] "NFPA Overview" http://www.nfpa.org/catalog/home/AboutNFPA/NFPAOverview/NFPAOverview.asp
[15] "NFPA Overview" http://www.nfpa.org/catalog/home/AboutNFPA/NFPAOverview/NFPAOverview.asp
[16] "NFPA Overview" http://www.nfpa.org/catalog/home/AboutNFPA/NFPAOverview/NFPAOverview.asp
[17] "About SFPE" http://www.sfpe.org/sfpe/about.htm
[18] "About SFPE" http://www.sfpe.org/sfpe/about.htm

2.3.2.3 International Association for Fire Safety Science

The International Association for Fire Safety Science (IAFSS) was founded with a goal of increasing research on the science of preventing the adverse effects of fires. [19] The IAFSS tries to make advancements in unsolved fire problems. The association seeks to cooperate with other organizations that are concerned with the application or with the sciences that are fundamental in fire. The IAFSS "looks to promote high standards, to encourage and stimulate scientists to address fire problems, to provide the necessary scientific foundations and means to facilitate applications aimed at reducing life and property loss."[20] The IAFSS has grown to more than 400 members in Australia, Germany, Hong Kong, Ireland, United Kingdom and the United States of America.[21] Benefits of being a member of the IAFSS include receiving reduced prices for symposia and an IAFSS newsletter along with being able to vote in association affairs.

---

[19] "International Association of Fire Safety Science" http://www.iafss.org/
[20] "International Association of Fire Safety Science" http://www.iafss.org/
[21] "International Association of Fire Safety Science" http://www.iafss.org/

2.4 Computer Fire Models

As computers become more powerful in today's society, so does the use of modelling software in the engineering fields. While still in their infancy, computer fire models are becoming more popular and dependable in the fire protection engineering world. The National Institute of Standards & Technology (NIST) supports two different types of fire models that will be studied intensely in this project.

2.4.1 CFAST

2.4.1.1 Overview

The first, the Consolidated model of Fire growth And Smoke Transport (CFAST) is a computer fire model designed to calculate the evolving distribution of smoke, fire gases, and heat throughout a compartmented facility during a fire. [22] CFAST is the result of the merger of two previous models: FAST and CCFM VENTS. It is based on solving a set of equations that predict state variables (pressure, temperature and so on) based on the enthalpy and mass flux over small increments of time.[23]

CFAST is a zone model, which divides a compartment into an upper and a lower layer and assumes that conditions vary minimally vertically. In other words, temperatures remain homogenous across each layer. The upper layer is a hot gas layer, and the lower layer is a cooler layer, that remains relatively unaffected by the fire.

CFAST is capable of predicting the environment in a multi-compartment structure subjected to a fire. It calculates the time of evolving distribution of smoke and fire gases

---

[22] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.
[23] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.

and the temperature throughout a building during a user-specified fire.[24]

The current version of CFAST includes the ability to independently track multiple fires in one or more rooms of the building. The fires are treated as totally separate entities, i.e. with no interaction of the plumes or radiative exchange between fires in a room.[25]

2.4.1.2 Major Functions Provided

CFAST provides three major functions. The first is calculating plumes, which deals with the production of enthalpy and mass (smoke and gases) by one or more burning objects in one room. The second is calculating vents, the buoyancy-driven as well as forced transport of this energy and mass through a series of specified rooms and connections. The last is calculating the resulting temperatures, smoke optical densities, and gas concentrations after accounting for heat transfer to surfaces and dilution by mixing with clean air. [26]

2.4.1.3 Limitations

The largest limitation of CFAST is the absence of a fire growth model. CFAST, Version 3.1.6, can model up to 30 compartments with duct and fan systems for each compartment. A maximum of 31 fires can be inputted, with multiple plumes, detectors, and sprinklers.[27] CFAST can also model one flame-spread object and the evolution of the ten most important species in the toxicity of fires, including the fatal effective dose.[28]

---

[24] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.
[25] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.
[26] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.
[27] "Computer Models for Fire and Smoke." <http://www.firemodelsurvey.com/pdf/CFAST_FAST_2001.pdf>.
[28] "Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.

2.4.2 FDS

Fire Dynamics Simulator (FDS) is a Large Eddy Simulation-based field model which breaks the entire room up into thousands of blocks, each with their own unique pressure, heat transfer, temperature, and energy.[29]

The FDS model, developed at the National Institute of Justice, is a computational fluid dynamics (CFD) model of fire-driven fluid flow. It solves a form of the Navier-Stokes equations for low-speed flow and highlights smoke and heat transport from fires.[30] The first release, version 1, of FDS was publicly released in February 2000. Nearly two years later, version 2 was released to the public in December 2001. The FDS model that is currently being used is version 3, the results of which can be displayed using the Smokeview visualization program. About half of the applications of this current version have been for the design of smoke handling systems and sprinkler or smoke detector activation studies. The other half is aimed at residential and industrial fire reconstructions. In essence, the FDS fire model is used to solve practical fire problems in fire protection engineering and to provide a tool to study the fundamentals of fire dynamics.

FDS shows scenarios of many types of fires and smoke transports; smoke ventilation, fire detection, fire plumes, and forest fires. The main goal of FDS, which is still under development, is to be able to determine fire patterns. FDS attempts to provide solutions in three primary areas: the reconstruction of fires, the analysis of fires, and the design of fire-safe buildings. Fire engineers want to be able to locate a fire's origin and determine where its path will lead. "The ability to predict and recreate fire burn patterns would

[29] "Computer Models for Fire and Smoke." <http://www.firemodelsurvey.com/pdf/fds_2001.pdf>.
[30] "NIST Fire Dynamics Simulator (FDS) and Smokeview." <http://fire.nist.gov/fds/>.

enable fire investigators to test hypotheses of fire origin and cause, as well as, evaluate possible explanations for deaths attributed to a fire."[31] In the same way that FDS is used to predict fire patterns, it is able to analyse potential fire hazards and the aftermath of such situations. The ability of FDS to explore these two aspects of FSE also gives Fire Safety Engineers a means of appropriately designing fire-safe buildings and structures. In summation, FDS develops fire safety techniques with the ability to preserve property and save lives.

2.5 BRE Survey Analysis

2.5.1 Positive Aspects

There were many positive aspects of the BRE questionnaire. BRE conducted the most common survey, the mail survey. Mail surveys allow more people the opportunity to participate in the questionnaire.

The questions through the survey were fluid, allowing a clear progression from one question to the next. The organization and "flow" of the questions within the survey are important parts of a questionnaire. Presenting the questions out of order can sometimes subconsciously confuse a participant's thinking process, causing skewed answers. BRE worked well with constructing the best order of questions for the questionnaire.

Questions 2, 3, 6, and 13 of BRE's survey also stand out as well-formed questions. These four questions are straight to the point. The detail and clarity of the questions and possible answers contain no ambiguity.

---

[31] "Recreation of Fire Patterns with Computer Simulations." <http://www.ncfs.ucf.edu/22%20Recreation%20Fire%20Patterns.pdf>.

BRE's survey is a great stepping stone for this study. The question progression provides a good model for this project's questionnaire. The survey illustrates the type of information that needs to be obtained for computer fire model KPIs.

2.5.2 Negative Aspects

There were some aspects of the BRE survey that could have been improved. Many of the questions were effective and could have produced valid results if a few minor changes had been made. Some of the survey questions needed clarification as to which direction they were taking. They were slightly vague, yielding results that were not always an accurate measure of the question at hand. Specifically, question 3 should have been redesigned. The participant who did not use computer fire models ends the survey at this point. However, there is important information that could be gathered later in the survey had the participant been allowed to respond to other questions. Specifically, what resources they use and training they have received.

Other questions were either too complex or required too complex an answer. For instance, question 5 asks the participant to make a percentage calculation. This is not a very realistic expectation; it will conceivably lead to incorrect responses and a large variation in results. In contrast to the questions that were too vague, there were also a couple that were too specific. Getting information that is too detailed often involves "write-in" responses, which should try to be avoided when conducting a survey as their results are unquantifiable.

Aside from the questions themselves, the survey could have been improved in a more general manner. The most significant improvement could have been made in regards to the 30% response rate, especially when there is a small target population.

Furthermore, the data gathered by this survey was also heavily skewed due to many more responses from enforcers as compared to designers. The grouping of the questions could have been improved to give the survey better direction. Finally, the survey was performed as simply a “mail survey” and follow-ups were not conducted.

Put simply, the BRE survey forms a very good foundation for finding KPIs in computer fire models. After a few changes in the questions and the manner in which they are posed, the survey would very accurately measure the effectiveness of computer fire models in the fire safety engineering field.

2.5.3 Survey Improvements

Several improvements were made in our survey to overcome the weaknesses of the BRE survey. The improvements fall into two categories, the survey questions and the conducting of the survey. In the survey, changes were made to both the questions and the answers. More answers were added to nearly all the questions to decrease the amount of participant specified answers and to create more defined and less ambiguous results. Several modifications were made to the questions themselves.

Most of the questions were reworded for clarity. For example, question 6 of the BRE survey “If you use computer fire models, what is the main driver for their use?” was reworded to: “When you use computer fire models, what is their main purpose?” In the BRE question in this example, only participants who used computer fire models would have reached the question, so the first part of the question is unneeded. Furthermore, “main driver for their use” was determined to be a confusing term, using the term “main purpose” in our revised question is much clearer.

Several questions were also added to the survey to obtain more information. Most notable is that questions were added for participants who did not use computer fire models. The added questions explore the reasons why participants do not use computer fire models and what references and guidance publications they use for their fire safety engineering work. It is just as important to know why computer fire models are not used as it is to know why they are used.

The questions in our survey have also been arranged under defined sections. This provides for a more clear survey presentation. Also, it allows participants a better understanding of the reasons why certain questions are being asked.

The conducting of the survey is the other major category of improvement. The BRE survey consisted of just a mailed questionnaire. The response rate for the survey was very poor, and statistically, mailed surveys have the poorest response rate. To improve this response rate, our survey will be mailed along with follow-up phone calls and group interviews. Survey phone calls statistically have greater response rates, and coupled with the mailed survey should provide for a vast improvement in the response rate. Furthermore, group interviews statistically have the best response rate. Together, these changes in the conducting of the survey should allow for an improved response rate as well as a more accurate distribution in the primary role's the respondents serve as fire safety practitioners.

Overall, improvements have been made to all the weaknesses identified in the BRE survey. Questions have been clarified, rearranged and added, and more answers have been added to increase the detail in responses. Also, the weaknesses seen in the response rate and the diversity of the respondents are being addressed.

2.6 Conclusion

This background has been written to provide the reader with insight of the important topics of this project. Fire safety engineering is progressing all over the world, and Australasia is no exception. The Australasian Fire Authorities Council was started in 1993, and it continues to look for new and improved ways to provide safety for people and property through fire engineering methods. An example is the recent surge of computer fire models, which can significantly reduce calculation time and provide precise outputs for many different parameters.

Fire safety engineers have used computer fire models to study smoke ventilation, best evacuation routes, structural strength, suppression systems, and fire detection methods among others. While computer fire models have been proven useful, many areas of the world lack guidelines for procurement, training, and proper use of the models. This project goal is to survey Australasia and determine what is being used by whom, and suggest specific guidelines, or Key Performance Indicators, to the Australasian Fire Authorities Council.

BRE has been working on a similar study over the course of the last three years. Since December of 2001, BRE has been striving to produce simple and practical KPIs that can be applied to fire safety engineering, the fire safety engineer and computer fire modelling. To accomplish this, BRE created a questionnaire and surveyed 500 subjects within the fire engineering population. They collected the results and produced preliminary KPIs befit for UK's engineering practices.

We have studied BRE's methods, and decided to work with the basic structure of their questionnaire. We have evaluated the survey, and brainstormed numerous ways to improve upon it according to Australasia's needs. The following methodology will describe in detail the steps our group plans to take in order to develop KPIs for computer fire models in Australasia.

3 Methodology

3.1 Tasks and Sub-tasks

3.1.1 Research

The project in Australasia is similar to one conducted by the Building Research Establishment (BRE) in the UK. The title of the BRE project was the "Development of KPIs for Fire Safety Engineering." The project began by researching relevant topics in the Fire Protection/Safety Engineering field (FPE or FSE).

Investigating computer fire models was the first step that was taken in order to properly evaluate and further the study done by BRE. Many sources were used to examine computer fire models (CFMs), namely the *SFPE Handbook*, the *NFPA Handbook*, and the National Institute of Standards and Technology (NIST) Fire Research website. An FPE graduate class taught by Professor Jonathan Barnett at WPI was also attended to further knowledge of CFMs. CFAST was examined in detail and the most current version was downloaded and explored.[32]

Key Performance Indicators (KPIs) were the basis of the BRE project, and are the basis of the project in Australasia as well. However, after researching the term KPI, it became apparent that a more appropriate term would be "practice guideline". After settling on the term practice guideline, the direction of our project and its goals began to

[32] "Fire Growth and Smoke Transport Modeling with CFAST/FAST." <http://fast.nist.gov/index.html>.

take focus. There were three main goals to this project. The first goal was identified as the comparison of the BRE survey results to those gathered in Australia. The second goal was to assess the gathered results and to justify the need for practice guidelines. Lastly recommendations for possible practice guidelines for the standardization of use of computer fire models were to be developed.

The next step of the project was to develop a survey in order to discover how and why computer fire models are used in Australasia. How to write and conduct a proper survey were two topics closely examined before development of the questionnaire. Preliminary research was also conducted on the Australasian Fire Authority Council (AFAC)[33], the main group in Australasia funding and organizing the study.

Finally, the BRE project itself was examined in-depth. Analysing the BRE project was essentially divided into two tasks: the summary of the project, and the assessment of the survey. The BRE project was read page by page, slide by slide, assuring that main points were clearly defined and all details perused.[34] The BRE survey was then analysed, and by applying current research on proper survey development, it was revised and updated to meet the needs of the Australasia project.

3.1.2 Survey Development

The survey was developed using the BRE survey questionnaire as a base.[35] The overall content and flow, as well as each individual question of the BRE survey, were analysed for all positive aspects and those that needed to be improved upon. A

---

[33] "Australasian Fire Authorities Council." <http://www.afac.com.au/index.html>.

[34] Kumar, Suresh (2003). The Development of Key Performance Indicators for the use of Computer Models in Fire Safety Engineering Information packets that contains power point slides and the results from the study in the UK.

[35] Kumar, Suresh. USE OF COMPUTER MODELS IN FIRE SAFETY ENGINEERING DESIGN QUESTIONNAIRE.

counterpart survey was then developed in which aspects of the BRE questions were improved. Other aspects were flagged to be further researched so that an improvement could be found later.

A list of all the flagged issues in the survey was compiled. The main issues were an overall vagueness both in questions and available answers, the need to find Australasian equivalents to several of the questions, and a poor response rate. The identified issues were researched extensively by all group members.

General background in the fire safety engineering field was developed to allow for improvement in questions related to professional information, model use/purpose, qualifications, and verification. From this research, questions and answers were clarified, further questions were added, and the order of questions was modified to increase the clarity and detail of the survey.

Australasian equivalents have been established through both research and discussions with FSE and FPE professionals. Rob Llewellyn of AFAC in Melbourne, Australia supplied many suggestions to improve the survey and establish Australian equivalents. Richard L. P. Custer from ARUP in Westborough, Massachusetts also supplied many suggestions to improve the survey and establish Australian equivalents. ARUP is a worldwide fire safety consultant agency with offices in Australia and many other countries.[36] Mr. Custer has worked in Australia and has been a long time participant in the FSE field.

A sub goal of the project was to obtain an above average response rate. This objective was addressed through two methods. The first was providing an incentive to fill out the questionnaire. Several important contacts and participants were given the

---

[36] "ARUP." <http://www.arup.com/>.

option to receive the survey results via the internet immediately after they were compiled. Another way the response rate issue was addressed was by making follow-up phone calls and sending follow-up emails. These follow-ups urged those who hadn't yet responded to respond, increasing the overall response rate.

Furthermore, improvements were made to the survey to finalize it before it was sent out. After speaking with Rob Llewellyn of AFAC and Professor Jonathan Barnett of WPI, a final survey was decided upon to be presented to the appropriate people throughout Australasia. Detail was given to some questions, while others were given the appropriate Australasian vernacular. The final draft was then presented to both Rob Llewellyn and Professor Jonathan Barnett for review before it was sent out.

3.1.3 Contact Development

Once in Melbourne the background material was presented to sponsors and key players in the FSE field to spread awareness of the project that will be taking place. Following that one of the first tasks at the AFAC office was to gather contact information of the survey participants. In order to maximize the number of responses, an extensive contact list was developed. A goal in the contact distribution process was to develop a list that was evenly distributed between designers and AHJs. This allowed for the most efficient results. In order to achieve this, a preliminary database of emails was researched through the internet in order to provide an extensive contact list. Rob Llewellyn also provided numerous contacts, along with guidance towards communication with important Fire Safety organisations. Directors and presidents of these organisations were contacted to discuss survey distribution options. The Fire Protection Association of Australia

(FPAA)[37] provided a mailing list of FSE and BS contacts, along with the offer of email distribution throughout all Special Interest Groups and Technical Committees in their organisation. Both options were utilized. The Society of Fire Safety (SFS)[38] could not provide actual contact information, but agreed to distribute the survey throughout their affiliation. Another venue taken was that of the Australian Institute of Building Surveyors (AIBS).[39] The National AIBS office distributed the survey to the executive committees of each state, which then in turn distributed to the AIBS members of their respective regions. The Victorian Municipal Building Surveyors Group Inc.[40] also put out a survey to all their Surveyors.

Paula Beever, the principal Fire Engineer of the New Zealand Fire Service (NZFS) is a key player of the New Zealand Fire Engineering field.[41] Beever distributed the survey to fire engineers in New Zealand, including FSEs and fire service members. After all of the contact information was gathered, it was put into a Microsoft Excel spreadsheet for organizational and analytical purposes. Each contact was monitored to determine who responded and who didn't.

3.1.4 Web Page Development

An online version of the survey was also created to allow participants to submit the survey quickly and effortlessly. This online survey included sections for answers, optional comments, and recommended contacts. Upon submittal, the data gathered from

[37] "Fire Protection Association Australia: National Staff." <http://www.fpaa.com.au/administration/Staff/staff.htm>.
[38] "SOCIETY OF FIRE SAFETY: Contact the Society of Fire Safety." <http://www.sfs.au.com/contactus.shtml>.
[39] "Australian Institute of Building Surveyors: Contacts" <http://www.aibs.com.au/contacts.html>.
[40] "Victorian Municipal Building Surveyors Group: Our Contact Details." <http://www.vmbsg.com.au/cgi-bin/contact.pl>.
[41] "About Us: Paula Beever." New Zealand Fire Service.<http://www.fire.org.nz/about/engineers/paula-beever.htm>.

these three sections was stored in formatted text files to allow it to be easily entered into the database.[42]

The final project report was also put on the web. All survey respondents who had given their email in the personal information section of the survey were sent an email giving them the URL of the final report. This was done as a response to numerous comments expressing interest in seeing the results of the survey.[43]

3.1.5 Distribution Process

Email was the primary tool in sending out the survey, while a smaller percentage was properly posted and mailed out. Portable document format (PDF) files and a website where the survey was located were included in every email. This allowed for the respondent to reply by either data submittal over the internet or by fax of the PDF survey. The questionnaire included the information cover letter, the survey, and the contact information form. After this step, the database development and result compilation processes began.

3.1.6 Follow-up Phone Calls/Email

Approximately two weeks after the questionnaires were initially distributed, follow-up phone calls and emails were placed. Email was the primary means of follow-up, though a few phone calls were placed to some of the executives in order to ensure that the appropriate people were contacted. The emails essentially encouraged the participants to provide feedback on the survey if they had not already done so.

---

[42] Appendix E
[43] Appendix F

3.1.7 Result Compilation

Result compilation played a large role in the project process, and a much more complex role than expected. Data was compiled in Microsoft Access, forming the main database for result analysis. Doing this proved to be a much more arduous task than initially anticipated. To compile our data in Access tables, the first step was to learn the program. The program was much different and had a more complicated user interface than Microsoft Excel. Tutorials and online reading guides were used to get acquainted with the program.[44] After becoming familiar with the program, it was simply a matter of experimentation to get the desired result.

Charts and visuals were then produced from all the data. The resulting data was then compared and contrasted to that of the BRE project. Practice guidelines for computer fire models were developed from this information and all of the research that was done earlier in the project.

Finally, another web page was created to inform visitors that the study had concluded. However, the existing web site was not altered to allow for the possibility of extending the project in the future.

3.1.8 Focus Groups

After the final data was collected and cross-tabulations were completed using Microsoft Access, the task of developing practice guidelines was undertaken. As the students are not professionals in the Australasian FSE field, it would be difficult to create an encompassing set of guidelines that addressed all aspects of CFMs. Therefore, a draft

[44] "Microsft Access Tutorials: *On-line Version.*" <http://fisher.osu.edu/~muhanna_1/837/MSAccess/tutorials.html>.

of guidelines was moulded from the Australasian survey results and BRE's proposed KPIs. With that draft as a starting point, focus groups were scheduled with qualified FSE professionals. The goal of these focus groups was to develop purposeful, pertinent guidelines that would address the necessary aspects of computer fire model use.

The first focus group occurred on 17 February 2004 at the AFAC office. This focus group involved a teleconference involving eight experienced individuals in the fire safety engineering field. Rob Llewellyn of AFAC, Paul England of SFS, Stephen Kip of Warrington Fire Research, and Peter Johnson of ARUP attended the meeting in person.[45] Professor Jonathan Barnett of WPI, Brian Ashe of ABCB, Stephen Wise of Grubits & Associates, and Simon Davis of NZFS participated via telephone.[46] Professor Barnett led the teleconference with an introduction, and Angela Martino chaired the meeting.

The second focus group took place on 18 February, also at the AFAC office. Three individuals participated in this meeting. Jarrod Edwards of the Metropolitan Fire Brigade (MFB), Parkan Behayeddin of MFB, and Peter Phillips of the Country Fire Authority (CFA)[47] all partook in discussing, editing, and modifying the draft guidelines.

3.1.9 Final Project Report

The final project report contains everything that has been completed within this project. The introduction explains the goal and purpose of what was done. The body of

---

[45] Llewellyn, Robert. Focus Group Meeting. *Personal Comment.* 17 February 2004.
England, Paul. Focus Group Meeting. *Personal Comment.* 17 February 2004.
Kip, Stephen. Focus Group Meeting *Personal Comment.* 17 February 2004.
Johnson, Peter. Focus Group Meeting *Personal Comment.* 17 February 2004.

[46] Barnett, Jonathan R. Focus Group Meeting *Personal Comment.* 17 February 2004.
Ashe, Brian. Focus Group Meeting *Personal Comment.* 17 February 2004.
Wise, Stephen. Focus Group Meeting *Personal Comment.* 17 February 2004.
Davis, Simon. Focus Group Meeting *Personal Comment.* 17 February 2004.

[47] Edwards, Jarrod. Focus Group Meeting *Personal Comment.* 18 February 2004
Behayeddin, Parkan. Focus Group Meeting *Personal Comment.* 18 February 2004.
Phillips, Peter. Focus Group Meeting *Personal Comment.* 18 February 2004.

the paper contains all background information that was researched in the project process; this allows readers to understand the basis of what the project is about. The methodology and the summary of results are also presented in this report. The summary of results, along with a comparison of the BRE project with this project, led to the development of practice guidelines for computer fire models in Australasia. Next, the proposed guidelines developed from this project are presented. Lastly, a conclusion of the entire project presented in an attempt to summarize everything that has been completed.

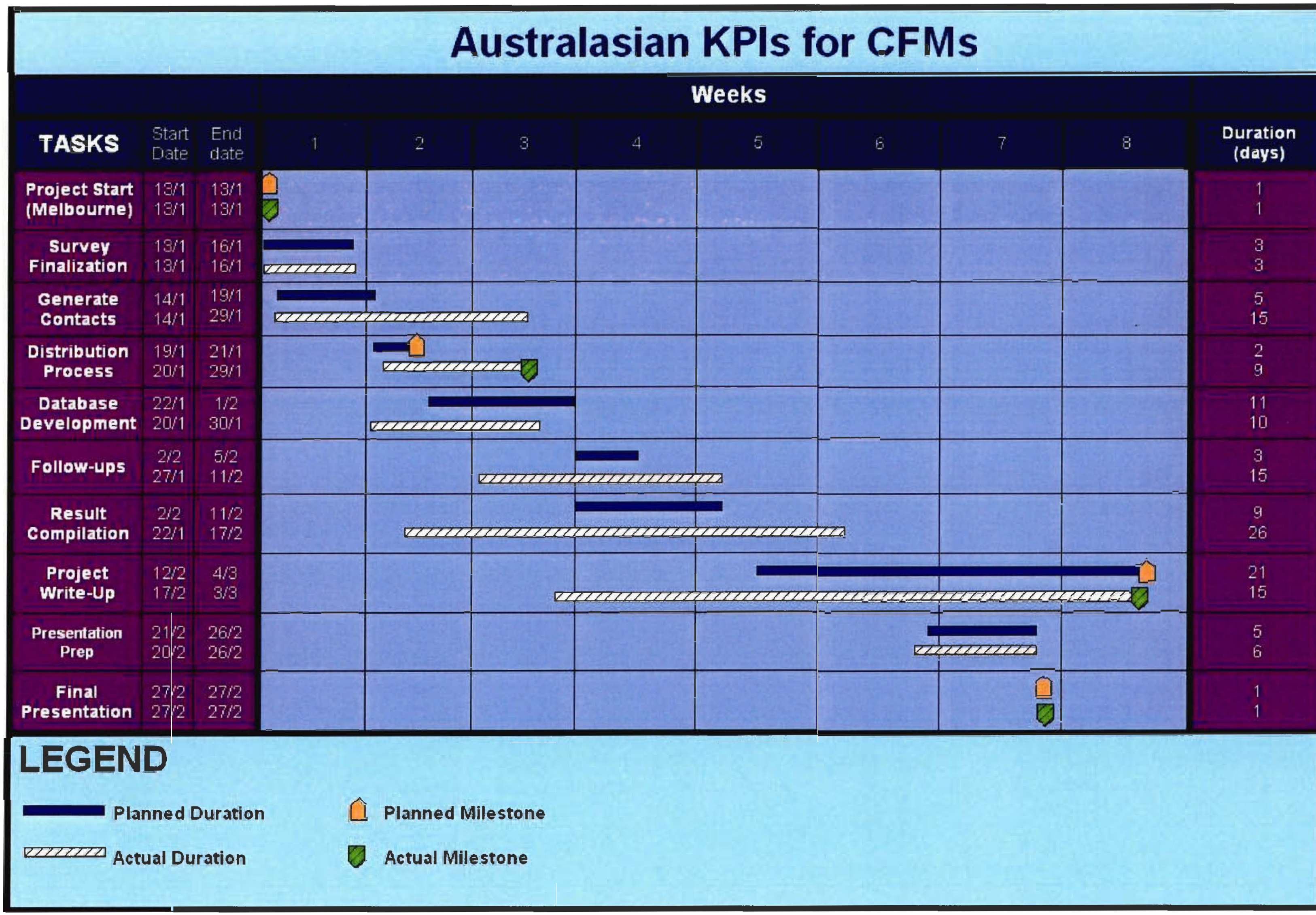
3.1.10 Final Presentation

The final presentation was the last step in the project process, and occurred on Friday, 27 February 2004. The intention of the presentation was to communicate all of the work that was done. All of the information accumulated throughout the entire process was gathered together and summarized. The summary was then presented to our sponsors and other representatives of other FSE organizations. The most important aspects of the project were presented in a PowerPoint presentation.

3.2 Project Time Line

3.2.1 Gantt Chart

The Gantt chart was edited upon completion of the project. This chart was originally created to visually display the proposed timeline of each aspect of the project. After finishing the project, another set of different colour bars was inserted below the originals. These bars indicate the actual timeframe of events that occurred. This chart was included in the final report and can be found in Figure 3-1.



Australasian KPIs for CFMs
Weeks
TASKS
Start Date
End date
1
2
3
4
5
6
7
8
Duration (days)
Project Start (Melbourne) 13/1 13/1 13/1 13/1 1 1
Survey Finalization 13/1 13/1 16/1 16/1 3 3
Generate Contacts 14/1 14/1 19/1 29/1 5 15
Distribution Process 19/1 20/1 21/1 29/1 2 9
Database Development 22/1 20/1 1/2 30/1 11 10
Follow-ups 2/2 27/1 5/2 11/2 3 15
Result Compilation 2/2 22/1 11/2 17/2 9 26
Project Write-Up 12/2 17/2 4/3 3/3 21 15
Presentation Prep 21/2 20/2 26/2 26/2 5 6
Final Presentation 27/2 27/2 27/2 27/2 1 1
LEGEND
Planned Duration
Actual Duration
Planned Milestone
Actual Milestone

Figure 3-1

3.2.2 Time Frame

The project began at WPI in October 2003. For approximately 7 weeks the project group researched relevant background information pertaining to the project. Along with research, contact with the project liaison, Rob Llewellyn of AFAC, had begun in order to obtain more information on the project at hand. Approximately four weeks from the start date, the project group began to create a survey that pertained to computer fire model use in Australasia.

Tuesday 12 January was the start date of work in the AFAC office located in Melbourne, Australia. At this point, the group quickly became acquainted with the office, its surroundings, and the employees within. The first task was to complete the survey. It was to be ensured that all of the survey questions were adapted to Australasian fire engineering terms. This finalisation process was complete by Friday, 16 January. While the survey was being finalized, contact lists of fire practitioners throughout Australasia were being generated. Through many searches and discussions with Rob Llewellyn, as well as other fire practitioners, contact lists of Fire Safety Engineers, Building Surveyors, Fire Brigade Officers, and other fire professionals were created. The majority of contacts were developed by Friday, 20 January.

On the afternoon of 20 January, surveys started to be distributed. Email was the main approach for distribution. As well as emailing the contacts, approximately 70 surveys were sent to FPAA members by post. Approximately 150 surveys were sent out to fire professionals. By the end of the process, approximately 470 surveys were sent out. Survey distribution was completed Friday 24 January.

The following week was mainly devoted to data preparation. The key focus of the data preparation was to become familiar with the Microsoft Access software and develop tables, forms, and queries to enter and store data. The process of creating the table and forms for entering data took approximately one week. However, the process of becoming familiar with Microsoft Access continued as queries and reports were created to calculate and display new complex cross-tabs. Although the surveys had been sent out only the previous week, completed surveys began being collected. Due to this detail, data input had begun once the Access software available for use.

Follow up phone calls and emails had also begun the week of 26 January. These contacts were made to basically remind the participants about the survey. This was also a time for the participants to ask any questions they may have about the project Since the number of timely responses was unpredictable, the respondents were given a due date of Friday 30 January. This only gave them about a week and a half to return the surveys. Although the return date was 30 January, it was extended to 17 February in order to receive the most results possible.

Two focus groups were held in mid-February. The first focus group meeting was held on Tuesday 17 February in the AFAC office. The next focus group meeting was held the following day, also in the AFAC office.

The written portion of the report had begun once all of the survey responses had been collected and inputted into the data software. A draft of recommendations for appropriate CFM practice guidelines was completed by 20 February. Before the recommendations became absolute, a final presentation occurred. The presentation was given to members of the AFAC community on Friday 27 February. At this meeting, feedback on the drafted guidelines was given. The comments given at the presentation were used, and the final recommendations for practice guidelines for the use of computer fire models were complete on Friday 27 February.

That following week the final report was revised and completed by 4 March, where it was then bound and passed into Professor Jonathan R. Barnett.

3.3 Materials Needed

Materials needed for this project were similar to materials found in a typical workplace environment. Specifically, the project required mailing supplies, such as envelopes and postage. The contact information of the participants was required, as well as the participants themselves. To analyse all the responses, the project also required the data analysis tools Microsoft Access and Excel.

3.4 Conclusion

By following the steps presented in this methodology, the Australasia survey attained its goal of providing recommendations for practice guidelines for computer fire model use. After performing research on various aspects of fire engineering and survey development, a contact list was created for those who were to receive the survey. A web page was created for easy data collection, and upon completion, postage mailings and emails were sent out to hopeful participants. While awaiting the responses of the survey participants, follow-up phone calls and emails were sent and results were constantly input into the database. Focus groups were then conducted to receive input and suggestions from representatives of the FSE field. Finally, the comments and suggestions gathered at the focus groups were combined with the results and findings of the survey, and the final report and report presentation were prepared. Through the guidance of the methodology, all requirements of the project were fulfilled.

.

4 Results & Analysis

4.1 Overall Results

The survey results serve as the basis for establishing the goals of this project. Through much contact via email, post, and telephone, approximately 470 surveys were sent out to fire practitioners in Australasia. Of the 470 surveys sent out, 121 were returned, producing a 26% response rate. However, only 120 of the 121 responses were included in the analysis as the last reply was received after the deadline.

Approximately 41% of the participants were in the design area, 35% were approval, 14% were enforcement, and 10% were in a different category i.e. research. For each of the primary roles, the percentage of people who encountered CFMs was calculated. It was found that 93% of designers use CFMs, making them the highest percentage. Approvers followed designers with 84% using CFMs. Enforcers had the lowest percentage of CFM use at 75%. These percentages are shown in Figure 4-1.

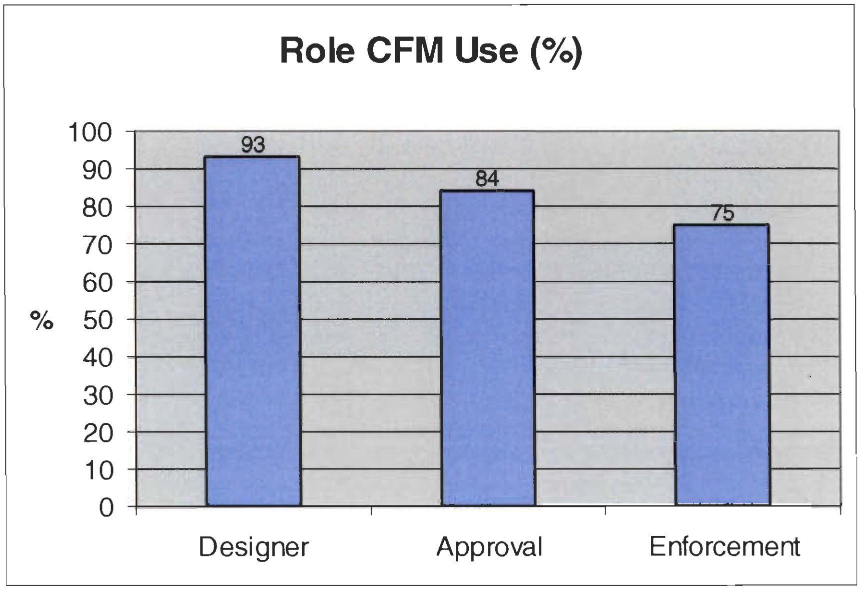


Figure 4-1

For those in each role that encountered CFMs, the following table displays the percentage of projects encountered per year that involved the use of CFMs. Contrary to expected results, enforcement had the highest percentage of projects that involved CFMS at 74%. Approval was second with design falling into a close third.

Percentage of Projects Involving CFMs For Each Role	
Design	48%
Approval	51%
Enforcement	74%
AHJ	52%

Table 4-1

Of the 120 responses, the most common primary role was that of the Fire Safety Engineers who completed 61% of the surveys. Building Surveyors were the second highest response rate at 23% followed by Fire Brigade Officers at 15% and Architects were the lowest with no responses received. Figure 4-2 shows the break down of all the primary roles.

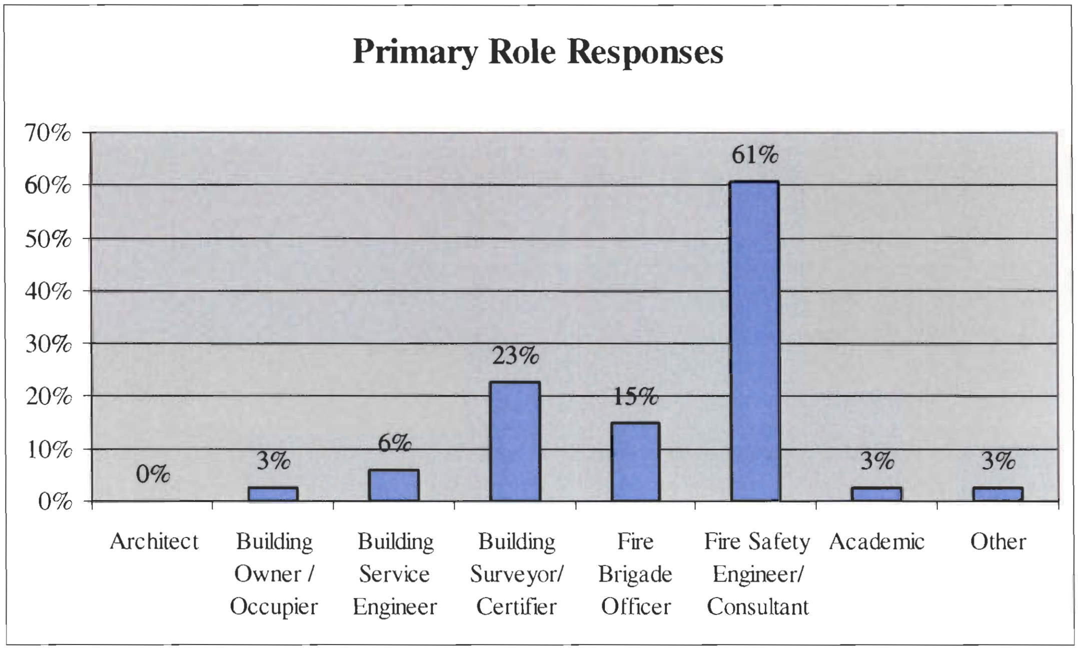


Figure 4-2

The regional distribution of respondents was relatively proportional to the population of the different regions. As shown in Figure 4-3, the majority of the respondents practiced in New South Wales and Victoria. Queensland, South Australia, New Zealand, and Western Australia all had similar response rates, falling between 8 and 12 percent, while the smallest response rate received was from the Northern Territory.

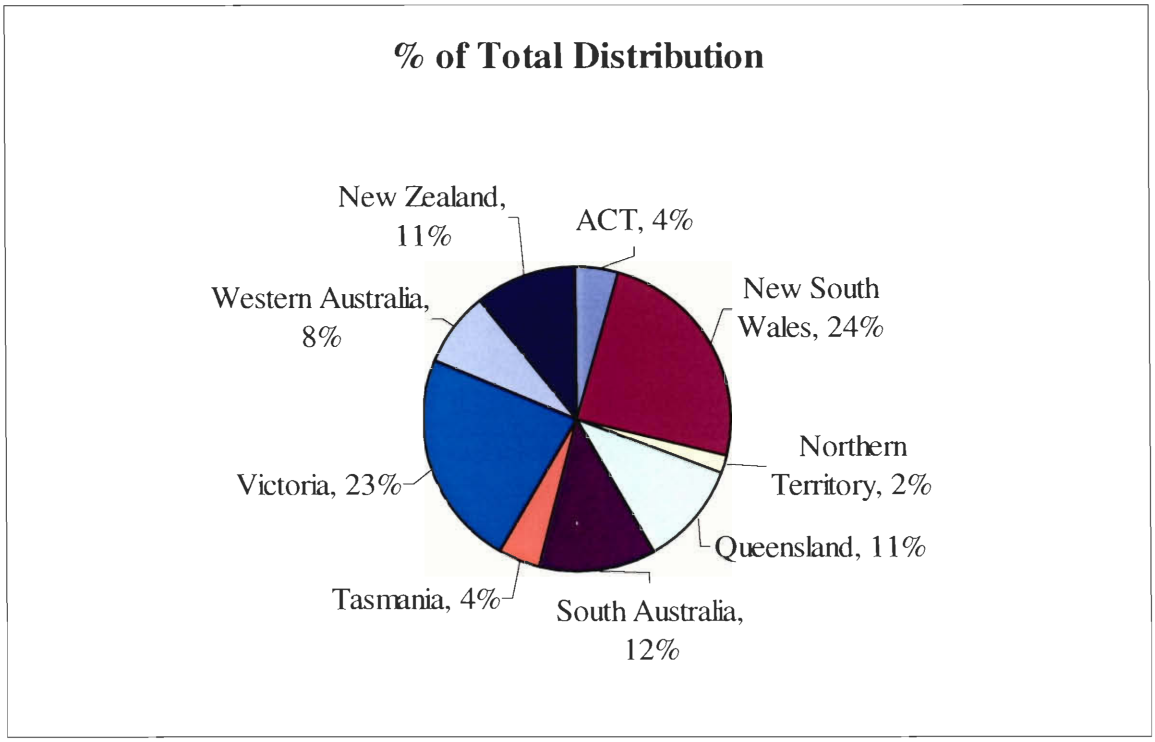


Figure 4-3

Although, there were several participants who were confused about the classification of some models, most classified them correctly. CFAST, FIRECALC, FIREWIND, and FAST were the most commonly used zone models. FDS and PHOENICS were amongst the most common field models. EVACNET and SIMULEX were the most commonly used egress models. The appropriate data is displayed in Table 4-2 and Table 4-3

Zone Models			
CFAST	52	TM19	2
FAST	23	JET	1
FASTLite	10	CESARE	1
ASET-B	3	SIMULEX ZONE	1
BRANZFIRE	21	YARDSTICK	2
FIREWIND	23	DETACT	1
FIRECALC	28	TZAM	1
FPETOOL	18	HAZARD I	5
HOTLAYER	3	FIRST	1
FIRESYS	2	FDS	1
LAVENT	1	ASKFRS	1
CIBSE	1	OWN SPREADSHEET	2

Field Models	
FDS	51
PHOENICS	13
FLUFEMT	1
SMARTFIRE	1
SOFIE	2
FLOD	1
SMOKEVIEW	2
NIST	5
FLUENT	1
JASMINE	1
CFX	1
BRANZFIRE	1

Table 4-2

Evacuation/Egress Models			
EVACNET	41	FAST	1
SIMULEX	16	FIRESYS	1
FIRECALC	7	EFFECTIVE WIDTH	1
FPE TOOL	6	SPREADSHEE	2
HAZARD	1	VACNET	1
PEDROUTE	2	WIC	1
FIREWIND	4	NFPA METHODOLOGY	1
STEPS	4	EXODUS	1
BRANZFIRE	2	EXIT	1
CFAST	1	WAYOUT	11

Table 4-3

Overall, the survey received an adequate response rate. Respondents were reasonably distributed through the role, primary role, and region categories. Furthermore, the survey established a good snapshot of the models being used and provides a strong resource for the justification and design of guidelines for computer fire models.

4.2 BRE Comparison

4.2.1 Introduction

One of the three goals of this project was to compare the BRE survey results from the UK to the results gathered in Australasia. However, before comparisons could be made between the two projects, differences within the survey questions themselves were identified. The Australasia survey was modified to meet the needs of the corresponding fire safety engineering field, yielding different questions and different response options. When appropriate, some responses were combined or separated for better comparison purposes, and some were left out entirely as it was not possible to draw a correlation.

Before comparisons could be made, the two surveys were organized in terms of similarities. Due to alterations of sequence made on the Australasia survey, the two sets of results were compared in order of question number on the BRE survey.[48] Another important point to note is that there is also a difference in terminology between the UK and Australasia, so proper changes were made to the survey to compensate for this. The most significant of these modifications was that the term "enforcer" from the BRE survey was equated with "AHJ" for Australasia. AHJ, or Authority Having Jurisdiction, combines the "enforcer" and "approval" roles in the Australasia survey results. Those holding "other" roles were disregarded for survey comparison, as the numbers were incomparable in each study. This alteration essentially made the comparisons between the two studies possible as it provided ground on which to draw parallels.

The most significant difference between the two studies was the target population for the survey. Though both surveys were aimed at FSE professionals using computer

[48] Appendix D

fire models, the roles of these professionals should be taken into account. In the UK survey, this point seems to have been overlooked. BRE sent out 500 surveys in total, yet only 20 of these were sent to FSE professionals holding a position in the “fire safety engineering” role. There were 147 total responses to the BRE survey, yielding a 30% response rate. However, a low number of these responses were from designers, as there were only 11. Any results obtained and analysed from these numbers are heavily skewed. The survey in Australasia focused on this point, and attempted to obtain approximately 50% of the responses from designers, and 50% from AHJs. In total, there were 120 replies with 61 holding a design role and 71 holding an AHJ role, essentially achieving the desired 50/50 rate. Some respondents held a position as both a designer and as an AHJ which explains why the design and AHJ roles do not add up to 120.

4.2.2 Comparison of Results

The first chart reported in the UK study is derived from the first two questions in the BRE survey. It compares the respondents’ role (design/AHJ) to primary role as a fire safety practitioner (i.e. Building Control Officer, Fire engineer, etc.). Most of the respondents held a position as a Building Code Officer (BCO), followed by those holding Fire officer positions. Few people held roles other than in these two categories, as shown in Table 4-4.

BRE	Design	AHJ
Academic		1
Architect	1	
BCO		83
Building Owner		1
Engineer	4	1
Engineer & Inspector	0.5	0.5
Fire officer		36
Inspector		5
Other	1	
Regulator		
Structural Engineer	1	
System Designer	4	
Trade Association		
Total	11	127

Table 4-4

In the Australasia survey, most designers held a position as a fire safety engineer. Those with a role as an AHJ were divided fairly evenly between Building Surveyor/Certifier, Fire Brigade Officer, and FSE, as shown in Table 4-5 below.

Australasia	Design	AHJ
Architect	0	0
Building Owner/Occupier	0	3
Building Service Engineer	6	3
Building Surveyor/Certifier	4	33
Fire Brigade Officer	0	23
Fire Safety Engineer	56	23
Academic	0	3
Other Category	2	2

Table 4-5

The third question on the BRE survey examined the relationship between each role and the use of computer fire models. The UK study found that 73% of designers use or encounter computer fire models, while 42% of AHJs use or encounter them. Results from the Australasia survey are very different than those gathered in the UK. This survey found that 93% of designers use or encounter computer fire models. Also, 82% of those with an AHJ role use computer fire models, as shown in Figure 4-4.

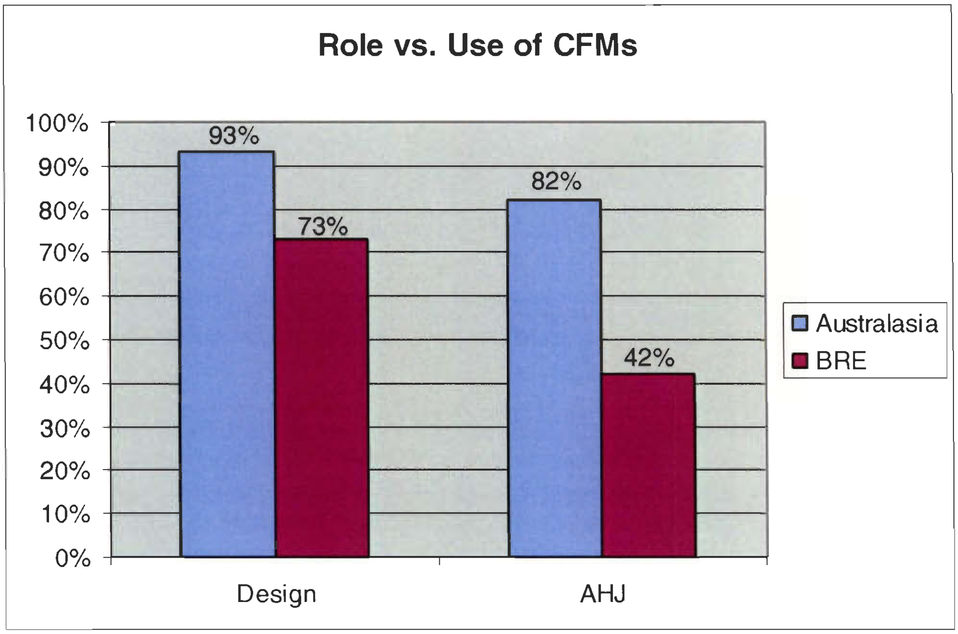


Figure 4-4

The biggest conclusion to draw from these results is that FSE professionals in Australasia, in general, use computer fire models more than those in the UK.

The next comparison combines questions four and five from the BRE survey. The results explore the percentage of projects involving computer fire models for each role. Designers in both the UK and in Australasia use CFMs for about 50% of their projects, as can be seen in Figure 4-5.

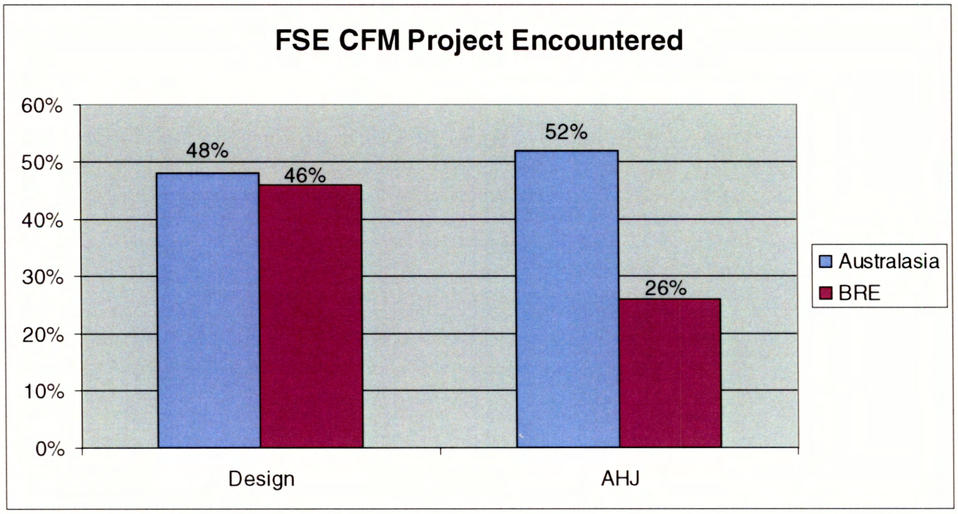


Figure 4-5

On the other hand, AHJs in Australasia use CFMs twice as much as those in the UK, at 52%. Again, it can be concluded that computer fire models are used more often in Australasia than in the UK, especially by AHJs.

Question six of the BRE survey asks FSE professionals their reason for using CFMs. The only issue with making this comparison is that the wording of the response options was different in each survey, so care was taken when examining relationships. In the UK, validity (of the design) is the overwhelming reason for the use of computer fire models by AHJs. Validity is also the biggest reason for designers as well; however, reducing calculation time is a close second. In Australasia, almost 80% of designers responded that they use computer fire models to find a design solution (not to be confused with "validity of the design solution" from the BRE survey). Conversely, almost 50% of AHJs in Australasia use CFMs for validation purposes (Figure 4-6). Furthermore, 40% of AHJs use CFMs to find a design solution.

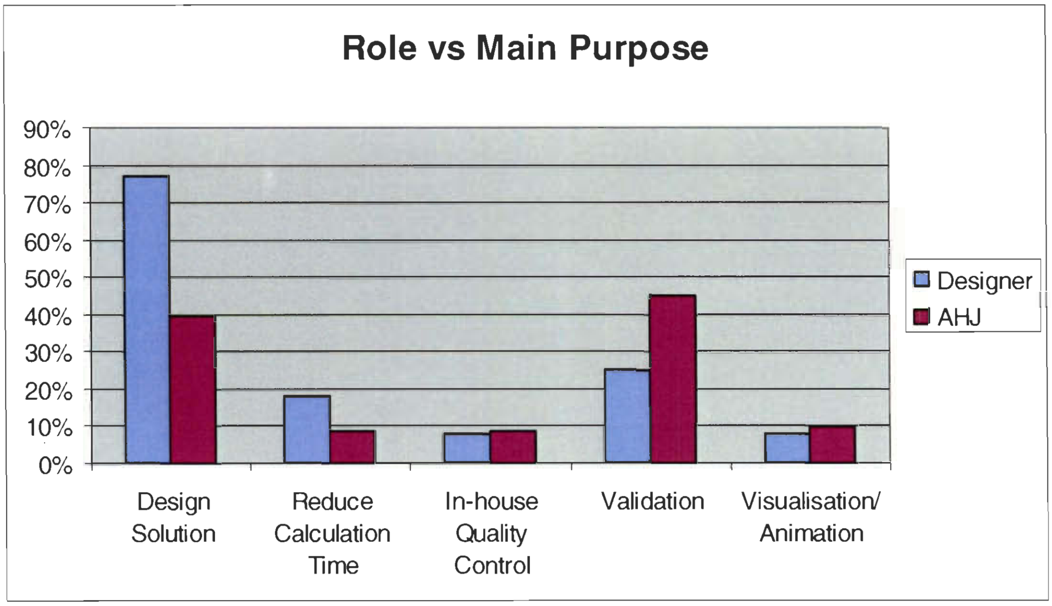


Figure 4-6

Another finding in the results from question seven of the BRE survey is that HVAC and smoke ventilation is the most common application for model use, while evacuation is second. Figure 4-7 shows that detection is the most common application in Australasia, with HVAC and smoke ventilation, and evacuation tied for a close second. HVAC and smoke ventilation, and evacuation, rank very high in both surveys, the only difference being the large number of models being used for detection in Australasia. Therefore, it seems that computer fire models are generally used to address similar aspects of fire safety engineering in both Australasia and the UK.

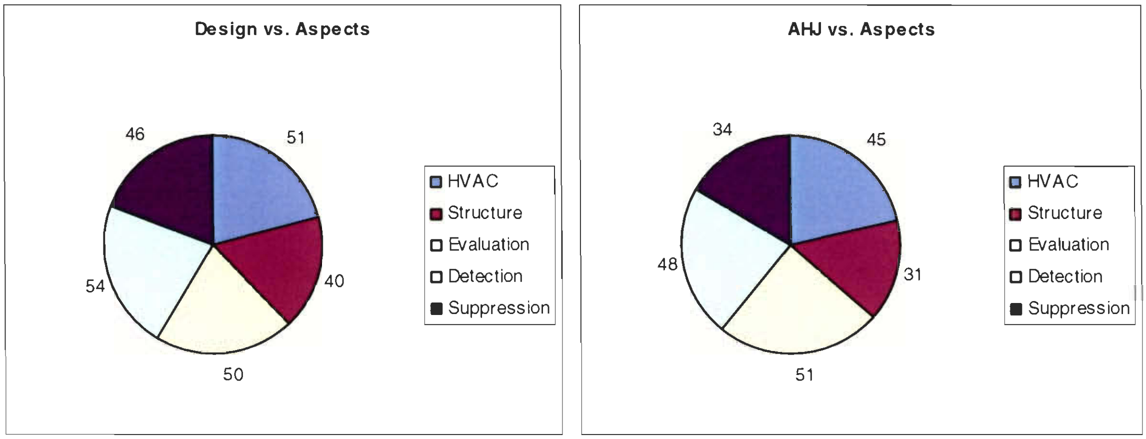


Figure 4-7

Question eight from the BRE survey was not present on the Australasian survey in any variation. There were two main reasons for not including this question. Most importantly, the survey was designed to be taken individually, with responses pertaining only to the individual participant. However, question eight on the BRE survey read "How many of your relevant staff are:", and it was believed that this question undermined the objective of the survey in Australasia. Furthermore, the conclusions made by BRE from this question were invalid. BRE reported that "chartered fire engineers were (potentially) involved in about 40% of model applications at the design stage, and about 25% at the enforcer stage." This result applies not to the participant as an individual, but to those working on his or her staff. The result is therefore unusable in relation to the individual being surveyed, and for the purposes of the study in Australasia, this question was not used.

Comparisons can, however, be drawn between the two surveys in terms of FSE professionals and the specialised training that they have received. BRE reported that "many reported no specialist training in the use of models," as an astounding 80% of enforcers had a lack of training. Less than 20% of designers have had short courses or CPD training. Although it is not displayed in the charts below, the remaining 80% of designers in the UK neglected to reply. This result suggests that they do not have much training in computer fire models. Furthermore, the BRE study states that comments made by those who replied suggested that their training is generally generic as opposed to being specific to any one model. The result in Australasia is far different from that in the UK. Here, the survey reveals that only 14% of respondents have no specialised training. Most participants in the Australasia survey have taken either academic courses, short courses, or are continuing professional development (Figure 4-8, 4-9). In general, FSE professionals in Australasia have had much more specialised training than those in the UK.

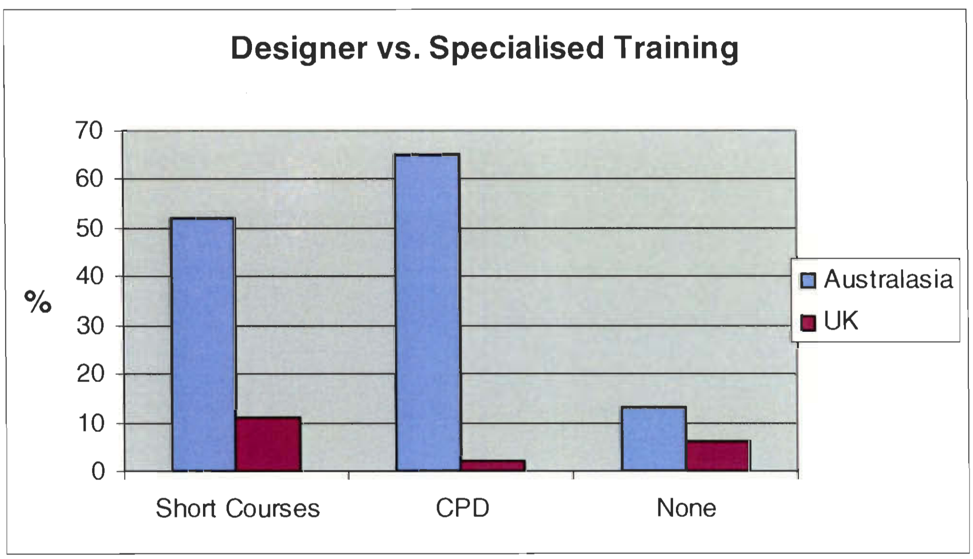


Figure 4-8

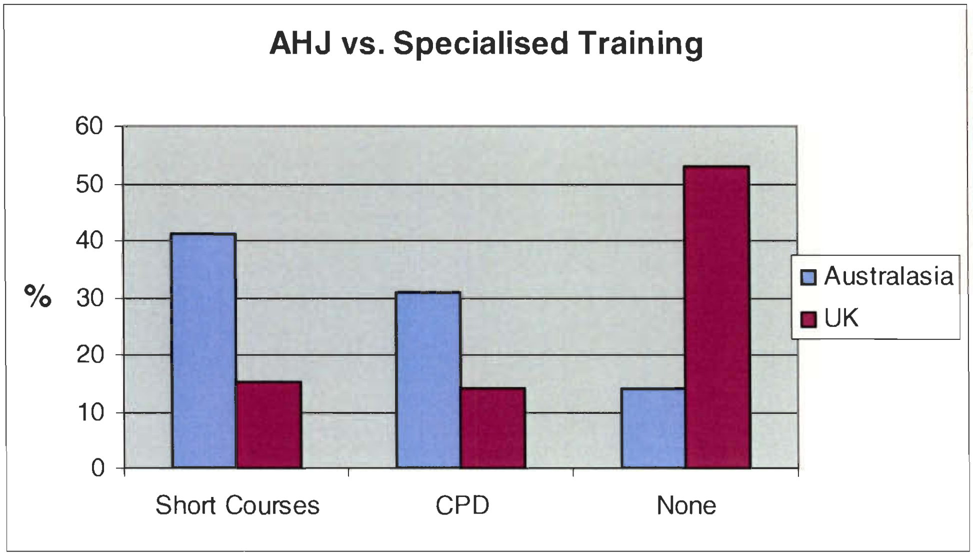


Figure 4-9

For question ten, comparison between the two surveys proved to be a difficult task. This question asks "What references do you regularly consult for your fire safety engineering work?", but aside from standard books published world wide (i.e. SFPE Handbook, NFPA Handbook), there are few likenesses in references used. Nevertheless, it should be noted that over 90% of designers in both the UK and in Australasia use the SFPE Handbook. AHJs seem to predominantly abide by standards documentation or building codes in both studies.

Question eleven, dealing with which computer fire models are used, was also not considered for comparison. BRE results were not available for this question, so there were no statistics to compare.

Question twelve asked "Do you have confidence that the models are 'fit for purpose?'" The only difference between the two surveys was that the Australasia survey included more response options. Instead of "yes", "no" and "uncertain" like the BRE, the survey included options with varying degrees of certainty (i.e. very certain, certain, neutral, etc.). For comparison purposes, "yes" was equated with "confident" and "very confident." Likewise, "no" was equated with "unconfident" and "very unconfident." Finally, "neutral" and "uncertain" were equated as well. As shown in Figure 4-10 below, designers in both studies are mostly confident, though designers in Australasia are a little less confident overall.

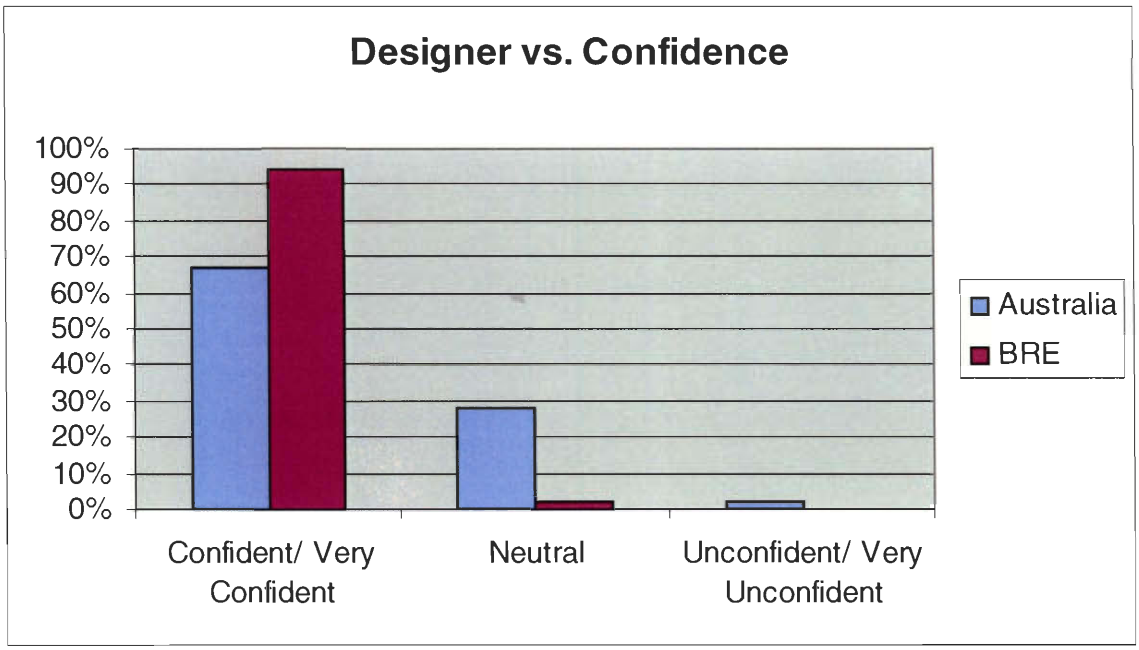


Figure 4-10

AHJs on the other hand, are not nearly as confident overall. Results seemed to indicate neutrality, with both extremes being fairly equal (Figure 4-11).

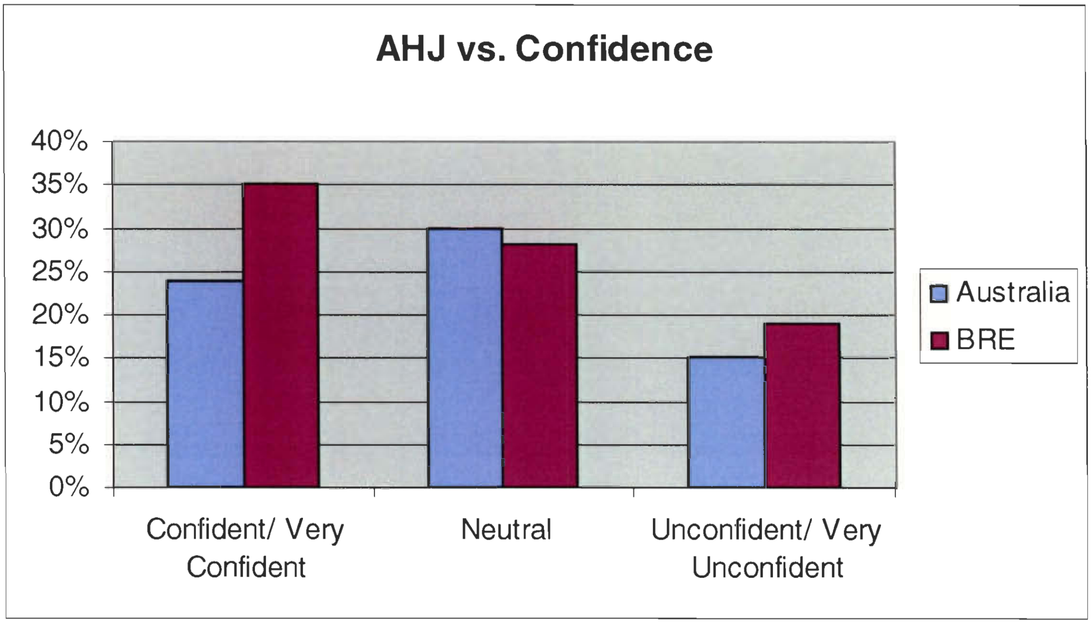


Figure 4-11

A parallel between fire brigade officers and the references used was drawn from question thirteen of the BRE survey. However, like question ten, there are many differences in the references used between the UK and Australasia. BRE findings were not available in writing, so there was only one graph to use for comparison. After perusing the references mentioned, it was recognised that a comparison to Australasia is not possible due to the difference in existing references in the UK.

Finally, question fourteen assessed how FSE professionals verified the design solution proposed by a computer fire model. As can be seen in Figure 4-12 below, engineering analysis is the most dominant method of verification used by designers in both the UK and in Australasia. While not relying as heavily on engineering analysis as those in the UK, designers in Australasia tend to use the other three listed methods of verification about equally, around 20%.

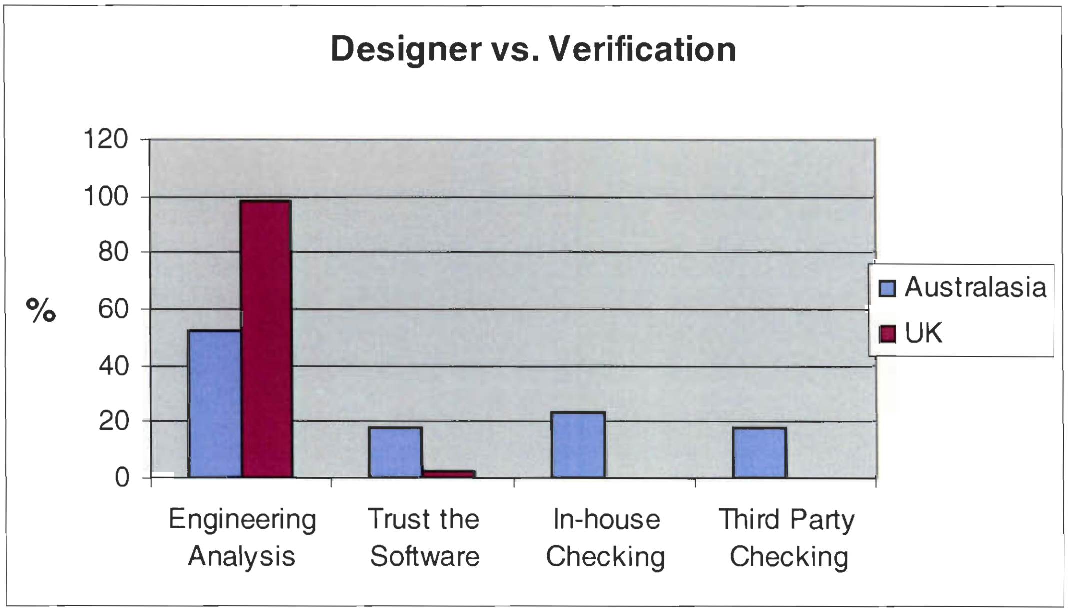


Figure 4-12

On the other hand, approximately 90% of AHJs in the UK use in-house checking as the primary method of verification. Engineering analysis is a distant second at nearly 20%. AHJs in Australasia use any and all methods of verification, however they use engineering analysis the most (Figure 4-13).

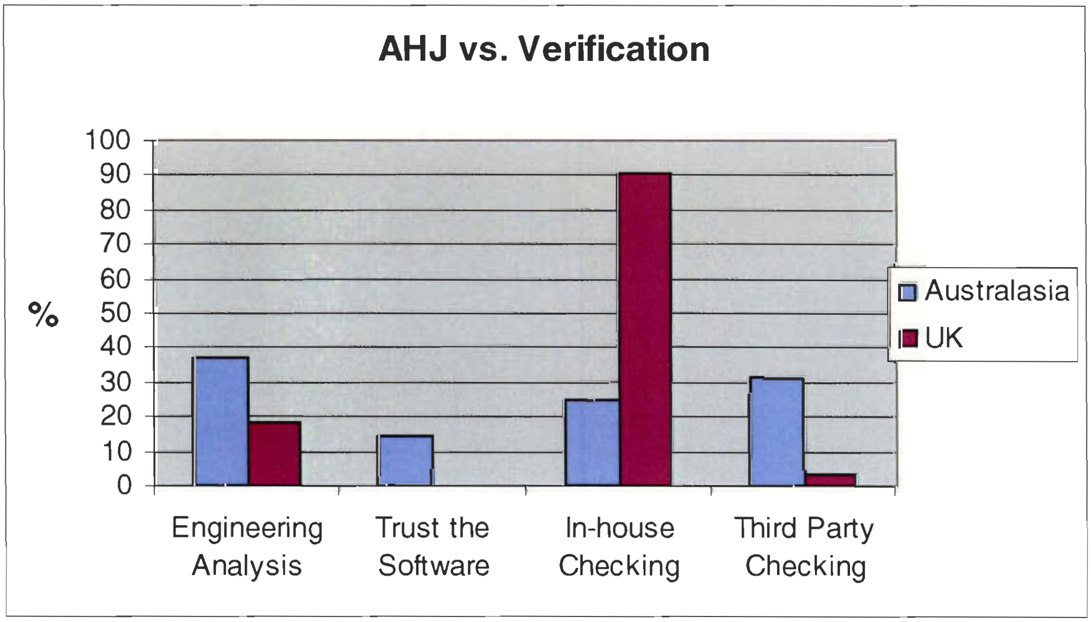


Figure 4-13

4.2.3 Conclusion

In conclusion, there are many differences between the results obtained in the UK and those acquired in Australasia. It is easy to see that conclusions drawn from the BRE study in the UK could not represent fire practitioners in Australasia. Each has different aspects of computer fire modelling that need to be addressed. For these reasons, a separate study in Australasia was necessary and justified.

4.3 Justification of the Need for Guidelines

4.3.1 Need for Guidelines

A guideline is "guidance relative to setting standards or determining a course of action."[49] The proposed practice guidelines for computer fire models are meant to set standards for those who encounter computer fire models in their field. The guidelines increase users' confidence in CFMs. Furthermore, they increase the reliability of CFM outputs and, consequently, decrease the chance of errors in the design. If computer fire models were to be used incorrectly, serious problems could occur; a building structure may not be up to code, causing it to collapse. Currently, there is a widespread belief among those in the FSE field in Australasia that many FSE practitioners are using CFMs incorrectly. As one survey respondent stated:

> "At the moment its open slather for any cowboy to set up as a fire engineer. The Victorian government hands out fire safety engineer tickets like confetti at a wedding. The Institution of Engineers is little better- you have to be a member of the "old boys club" to get your ticket. There is no legislative requirement to have

[49] "Dictionary.com." <http://dictionary.reference.com/search?q=guideline>.

engineers reports vetted by another professional engineer. It's only a matter of time before there is a disaster."[50]

Due to instances such as this, there is a great need for CFM practice guidelines in Australasia. Overall statistics and results that were produced from the survey provide justification as to why guidelines are needed for the use of computer fire models. Qualifications, training and confidence of the participants in CFMs, and references used, are amongst the main survey categories that demonstrate the need for guidelines.

As a primary remark, many survey participants did not correctly classify the models that they commonly use. As shown in Tables 4-6 and 4-7, respondents stated that FDS and SIMULEX were zone models, BRANZFIRE was a field model, as well as an egress model, and that HAZARD, CFAST, and FAST were all egress models. This information illustrates several key points. First, participants do not know the type of model they are using. If the type of model is unknown then its limitations cannot be properly understood nor can it be properly used. Second, it shows that some participants have not had CFM training, such as academic, CPD, short course, etc. Establishing guidelines would help to eliminate both these issues by requiring those involved with CFMs to understand the model and its limitations, and to have specialised training in the use of CFMs. Categorisation of various computer fire models can be found at http://www.firemodelsurvey.com/.[51]

[50] Anonymous Survey Respondent. *Personal Comment.* January 2004.

[51] "International Survey for Computer Models for Fire & Smoke." <http://www.firemodelsurvey.com/>.

Zone Models			
CFAST	52	TM19	2
FAST	23	JET	1
FASTLite	10	CESARE	1
ASET-B	3	SIMULEX	1
BRANZFIRE	21	YARDSTICK	2
FIREWIND	23	DETACT	1
FIRECALC	28	TZAM	1
FPETOOL	18	HAZARD I	5
HOTLAYER	3	FIRST	1
FIRESYS	2	FDS	1
LAVENT	1	ASKFRS	1
CIBSE	1	OWN SPREADSHEET	2

Field Models	
FDS	51
PHOENICS	13
FLUFEMT	1
SMARTFIRE	1
SOFIE	2
FLOD	1
SMOKEVIEW	2
NIST	5
FLUENT	1
JASMINE	1
CFX	1
BRANZFIRE	1

Table 4-6

Evacuation/Egress Models			
EVACNET	41	FAST	1
SIMULEX	16	FIRESYS	1
FIRECALC	7	EFFECTIVE WIDTH	1
FPE TOOL	6	SPREADSHEE	2
HAZARD	1	VACNET	1
PEDROUTE	2	WIC	1
FIREWIND	4	NFPA METHODOLOGY	1
STEPS	4	EXODUS	1
BRANZFIRE	2	EXIT	1
CFAST	1	WAYOUT	11

Table 4-7

The need for guidelines can be further justified through a look at the qualifications of participants. Approximately 30% of the participants are qualified through experience, the second highest qualification, following fire safety graduates. Of those respondents that stated they were qualified through experience, 14% of them stated that they had never received any type of specialised training in the use of computer fire models. This is shown on Figure 4-14. This percentage demonstrates that a relatively high number of fire practitioners use CFMs, with only the knowledge that they have received through their experience at work. Although practice makes perfect, experience with computer fire models does not always signify that the participant knows all of the information that is necessary to produce accurate results. Some type of training is needed for valid model use.

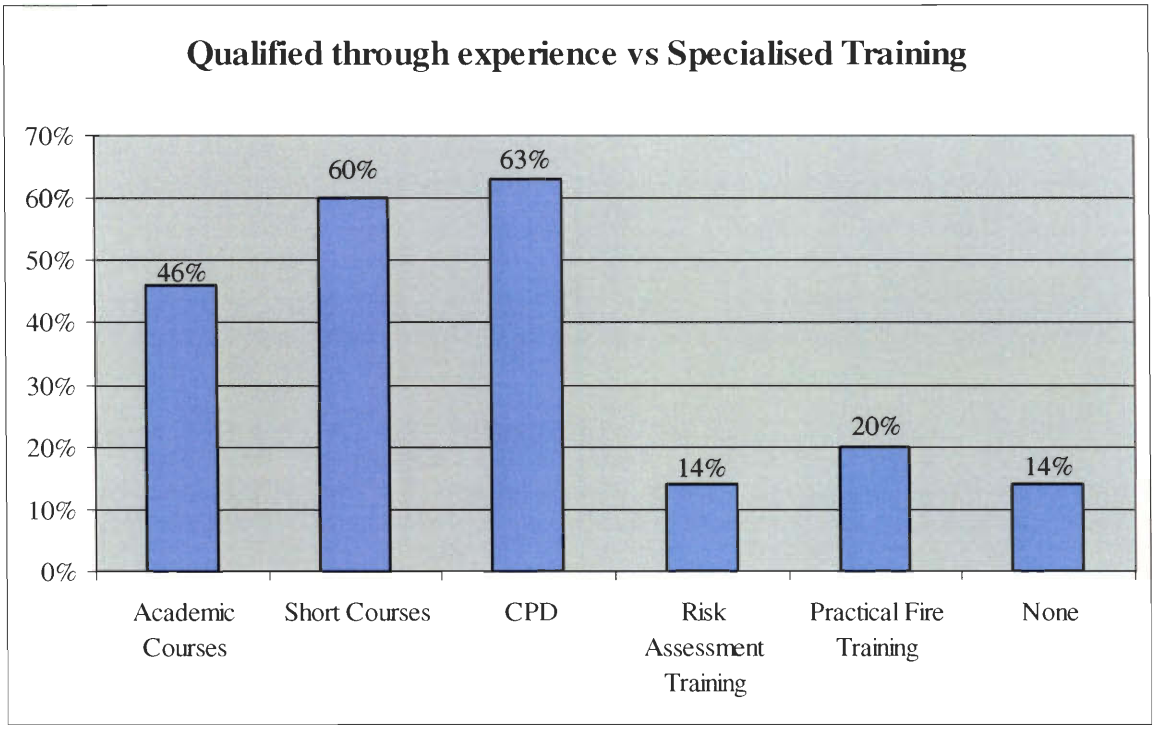


Figure 4-14

Specialised training is an extremely important asset to have when using computer fire models. If not trained properly, the participant may use the model incorrectly, which can create improper designs that could ultimately lead to a disaster.[52] When comparing specialised training to each respective role, most training categories received less than a 50% response. CPD, academic courses, and short courses are only marginally above the 50% mark. These findings can be viewed in Table 4-8.

[52] Barnett, Jonathan. *Personal Comment.* February 2004.

Role vs Specialised Training

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
Designer	55%	52%	65%	12%	13%	13%
Approval	29%	45%	35%	12%	25%	18%
Enforcer	30%	30%	20%	15%	35%	5%

Table 4-8

Confidence is another significant issue that was observed when analysing the results. Of all the respondents, the individuals that are the most confident that computer fire models were "fit for purpose" are those participants who have no specialised training. As shown in Table 4-9, 53% of the non-trained participants are the most confident that the models being used are "fit for purpose."

Specialised Training vs Confidence

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Academic Courses	8%	52%	35%	4%	0%
Short Courses	4%	42%	44%	2%	2%
Continuing Professional Development	7%	46%	37%	2%	2%
Risk Assessment Training	7%	50%	29%	7%	0%
Practical Fire Training	5%	41%	32%	9%	0%
None	6%	53%	18%	12%	6%

Table 4-9

There are many participants, approximately 91%, that are confident to neutral, as to whether the CFMs they used are "fit for purpose." However of this 91%, the most common verification methods that are used are an engineering analysis or simply trust in the software. Although in-house checking, third party checking, and fire/smoke tests are utilized, they are a relatively small percentage of the responses. This demonstrates that those who are confident that models are "fit for purpose" do not use more reliable methods of verification. This comparison can be viewed in Table 4-10.

Verification vs Confidence

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Engineering Analysis	4%	46%	35%	0%	0%
Trust the Software	12%	47%	35%	0%	6%
In-House Validation	11%	33%	33%	7%	0%
Third Party Validation	6%	42%	19%	6%	0%
Fire/Smoke Test	10%	37%	20%	17%	3%

Table 4-10

As previously stated, the highest response for the type of verification method is "engineering analysis." Approximately 38% of participants say that they use engineering analysis to verify their CFM results. However, there are varying degrees of engineering analysis. It is not stated what engineering analysis they are using. One participant could be verifying the results by hand calculations, whereas another could look at the result and feel that it is correct. Requiring documentation of verification methods used is an important guideline that needs to be established in order to address this issue.

References are also efficient tools when using computer fire models. They provide guidance and direction for the user. Table 4-12 on the following page, displays what references are utilized by Australia and New Zealand. Some fire professionals were pleased with the percentages for national standards, building codes, and the current nationally accepted FSE guidelines, while others believed that the percentages should be over 95%.[53]

Lastly, the reasons computer fire models are not being used is another justification for the need of guidelines. Approximately 20% of respondents felt that the CFM software was overly complex. These numbers can be found on Table 4-11. Complexity of the models should not be a determining factor as to whether CFMs are used as part of a design solution. With the incorporation of proper training as a national guideline, this reason could be eliminated.

Role vs Reasons CFMS are not Used

	No Models are 'Fit for Purpose'	Calculations are Simple	Modelling Software Unavailable	Modeling Software Overly Complex	Qualitative Assessment
Designer	38%	73%	12%	18%	17%
Approval	33%	61%	10%	20%	12%
Enforcer	40%	45%	0%	25%	15%

Table 4-11

[53] Fire Professionals. Focus Group Meeting. *Personal Comments.* 17 February 2004.
Fire Professionals. Focus Group Meeting. *Personal Comments.* 17 February 2004.
Fire Professionals. Final Presentation. *Personal Comments.* 27 February 2004.

	Australia (TOTAL)	New Zealand	Australia (TOTAL)	New Zealand (TOTAL)
SFPE Handbook	85	15	69%	100%
NFPA Handbook	63	6	51%	40%
Building Codes of Australia	114	2	92%	13%
Fire Engineering Guidelines, FCRC, 1996	43	2	35%	13%
Fire Safety Engineering Guidelines, 2001	94	4	76%	27%
Australian Standards	110	4	89%	27%
International Standards	49	4	40%	27%
NFPA Codes/Standards	70	6	56%	40%
Textbooks	21	4	17%	27%
Building Codes of New Zealand	2	5	2%	33%
Fire Engineering Design Guide, NZ	5	6	4%	40%
New Zealand Standards	2	4	2%	27%

Table 4-12

In conclusion, the data received from the survey substantiates the need for guidelines for the use of computer fire models. The data demonstrates that there are many people who encounter CFMs that lack the qualifications necessary for their use. Furthermore, the data shows that many designs do not undergo proper methods of verification, therefore potentially lowering the quality of the answers obtained from the model. Establishing guidelines would solve the issues that the survey data demonstrates and it would also increase the confidence in CFM results that this survey has shown is low.

4.4 Guideline Reasoning

While the draft of guidelines was originally titled 'Best Practice Guidelines,' this was modified to simply 'Practice Guidelines.' This change came about for a few reasons. The first reason was that 'Best Practice' implies that a practitioner who follows these guidelines completely would be employing the best practice possible. Whereas fire safety engineering is such a dynamic field, it was decided that no practitioner can ever achieve true best practice. Also, there are various legal implications which brought about the change. If a published document is labelled best practice, this suggests that anyone following the guidelines would yield a perfectly sound design and structure. If the structure is not sound, then the owner of the guidelines would be at fault.[54]

Therefore, it was decided that the guidelines should be broken up into the categories 'Acceptable' and 'Preferred.'[55] The Acceptable category contains guidelines that could be considered as minimal practice. These are guidelines that should already be followed

[54] Appendix G
[55] Appendix G

on a day-to-day basis by practitioners in the FSE field. Preferred guidelines are stricter standards which, when followed, provide for a much higher quality of practice.

Each guideline category was further broken down into three sections: Model Use, Qualifications, and Verification. The Model Use section contains preliminary guidelines regarding whether computer fire models should actually be used, and what models are appropriate. The Qualifications section provides guidance on what qualification the designer and the AHJ should have. The Verification section is split into Methodology and References. Guidelines in the Methodology section concern what sort of checking should be done when computer fire models are used, while the References section provides which references should be consulted. The following sections describe, in detail, the reasoning and justification for each proposed guideline.

4.4.1 Acceptable Guidelines

4.4.1.1 Model Use

1. *Computer fire models are not necessary if simple calculations provide an appropriate answer.*

65% of survey respondents answered that when they don't use computer fire models, one reason is because the calculations are simple enough that models are not required.[56] If simple calculations provide the appropriate answer, then computer fire models are not necessary. The rest of these guidelines would then not pertain to the practitioner.

[56] Appendix F

2. *Computer fire models are not always necessary if qualitative results are desired.*

'Qualitative assessment' was another significant reason that survey respondents gave as to why computer fire models are not used.[57] If the practitioner only needs to make a qualitative decision, then a model is not necessarily needed and the rest of the guidelines do not apply.

3. *The designer should ensure that any proposed models are 'fit for purpose,' and provide justification of the decision.*

All computer fire models exist to simulate certain types of scenarios. While some models can simulate a broad range of scenarios, the practitioner must be sure that the appropriate model is being used for the application. In other words, the model must be fit for purpose. The modeller should also provide appropriate justification as to why the model is appropriate.

4. *The designer should be aware of all limitations of the computer fire models to be used, and the design should not exceed any of these limitations.*

While most computer fire models are capable of simulating a wide range of scenarios, they do have their limitations. To safely and properly utilise a computer fire model, the

[57] Appendix F

user must know what the model is and is not capable of. The user must then ensure that the design does not overstep these boundaries.

5. *A sensitivity analysis should exist for the relevant application.*

A sensitivity analysis is the process of testing a computer fire model repeatedly with slightly incremented inputs. This analysis determines the limits of the model, and resultantly, its capabilities. Only models that have undergone a sensitivity analysis should be employed, since knowledge of the limitations is necessary.

4.4.1.2 Qualifications

6. *The designer/AHJ should have relevant qualifications and experience for computer modelling and fire behaviour; short courses and CPD are essential.*

Fire dynamics is a vast and complex subject. Computer fire models are not a shortcut to understanding how fire behaves. Therefore, a designer or authority having jurisdiction using or verifying computer models must understand the underlying principles of fire safety engineering, as well as all aspects of the model itself. The designer and the AHJ both must have the ability to evaluate the overall design based on knowledge of how the model should work.[58]

---

[58] Appendix G

7. Where the designer/AHJ is qualified through experience or through another discipline, education or training through academic programs, short courses, and CPD is essential.

30% of survey participants said that they were 'qualified through experience' while 25% answered that they were 'qualified through another discipline.'[59] While twenty years of experience in the FSE field might provide sufficient knowledge on the topic of fire dynamics, practitioners should have some sort of training regarding the use of computer fire models. Continuing Professional Development or short courses on computer fire models are valuable programs for practitioners aimed at keeping up-to-date in the FSE field.

4.4.1.3 Verification

4.4.1.3.1 Methodology

8. The version of the model used, along with all input data, assumptions, conditions, parameters, and results should be properly documented.

Documentation provides a history of how a computer fire model was used. This is beneficial for parties looking to obtain similar results, or for those that need to trace a design back to its original calculations for any reason. Documented information acts as hard evidence for the future, and therefore should be consistently practised. Every aspect

[59] Appendix F

of the modelling process, including which version of the model was used, should be documented.

9. *Any engineering analysis used should be properly documented.*

Again, documentation is extremely important. Engineering analysis should be documented so others can understand the process which led to conclusions and results.

10. *Where a zone model has been used, the results should be verified with alternate empirical formulas through spreadsheets, hand calculations, or other zone models.*

While most computer fire models are accurate in their calculations, cross-checks are a heavily supported practise. After a scenario is run in one zone model, this can be verified by running a similar scenario in another zone model that employs different empirical formulas. If drastic differences in results are obtained, then that creates a flag for the user. Verification via spreadsheets and hand calculations should also be employed.

11. *Where a field model has been used, the results should be verified by spreadsheets, hand calculations, a zone model, or an alternate field model.*

Field models can be much more complex than zone models, and often take a good deal longer to compute their results. Even if it is impractical to test similar scenarios on different field models, the results should still be verified by zone models where possible, and by spreadsheets and hand calculations. This cross-checking provides for more valid and trustworthy results.

12. *The computer models used should be deemed appropriate for the application by in-house checking.*
13. *Inputs and results should be verified by in-house checking.*

All parts of the computer fire model process should be validated in-house. The input data is the most determining variable of the computer fire simulation process, and is crucial in successfully modelling a scenario. As such, input data should be reviewed by another party in order to ensure accuracy. Also, a check should be done to ensure that the computer fire model used was indeed fit for purpose, and that the results seem reasonable. In-house checking provides for more reliable designs.

14. *Independent third party checking should be used or considered.*
15. *When independent third party checking has not been used, justification should be provided.*

Third party checking is a further degree of design verification when using computer fire models. Third party checking is similar to in-house checking, but taken to another level. Sending a design out of house to be verified provides the designer with another professional, unbiased opinion. Third party checking may also allow for checking with different computer fire models.

16. *The AHJ should be aware of the limitations of the computer model.*

It is not solely the designer's responsibility to know the limitations of a computer fire model. The authority having jurisdiction should also be cognisant of the model's boundaries as to accurately evaluate and approve designs. The AHJ needs to be able to determine what CFMs can and cannot be used in different situations.[60]

4.4.1.3.2 References

17. *The most relevant FSE references should be consulted for the design.*

References, such as the Building Code of Australia, the Fire Safety Engineering Guidelines, Australian Standards, and others exist to provide guidance and direction for the FSE field. The most current and relevant references should be fully utilized and adhered to.

18. *When available, handbooks and guidelines for computer fire models should be referenced in the design and approval processes.*

[60] Appendix G

Handbooks and guidelines are written to provide insight and assistance when using computer fire models. As such, these guides should be fully utilized.

19. *Stakeholders should be consulted in the case of an alternate solution.*

An example of a stakeholder is the Metropolitan Fire Brigade or the Country Fire Authority. These stakeholders should be consulted because they can provide beneficial insight regarding an alternate solution.[61]

4.4.2 Preferred Guidelines

4.4.2.1 Qualifications

20. *The designer/AHJ should regularly participate in computer fire modelling courses or CPD as appropriate.*

Similar to the guideline in the Acceptable section, this guideline addresses the fact that practitioners encountering CFMs should be well trained. However, this standard is more strict as it directs the practitioner to participate in course or Continuing Professional Development regularly. 'Regularly' is defined as however often a computer fire model has undergone significant development.

21. *The designer should have the following qualifications:*

[61] Appendix G

IEAust certification (FSE)

or

Fire safety engineering post-grad degree and

Appropriate academic or short course participation

This guideline is fairly straightforward; it presents what qualifications are acceptable in order to use computer fire models. This guideline is in the Preferred section because it does not let a modeller be 'qualified through experience' or 'qualified through another discipline.'

4.4.2.2 Verification

22. *Limited fire tests such as hot smoke tests or non-emergency evacuation tests should be used as part of the checking process for CFM use.*

As computer fire models are only fire simulation tools, real world results should be used to verify that the models are appropriate for different scenarios. Hot smoke tests and non-emergency evacuation tests are two examples of limited fire tests that can be used for verification of model scenarios.[62]

[62] Appendix G

5 Conclusions

With the comparison of the survey results with those in the UK and the justification and development of a draft set of guidelines, all goals of this project were accomplished. The final results were successfully compared to the numbers from the UK, with some interesting correlations. These comparisons allow the Australasian fire practitioners to identify which aspects of their field are similar to that in the UK, and which are different. The final results also demonstrate a clear need for practice guidelines for the use of computer fire models.

Overall, based on the results of this study, it is evident that a significant amount of the computer fire model users in Australasia do not have the appropriate training or experience to use CFMs appropriately. This creates concern to the validity and safety of structural designs supported by computer fire model results. The guidelines proposed in this project address this concern, by establishing guidance for all those who encounter computer fire models. The proposed guidelines address issues such as when CFMs should be used, who should use them, and how their results should be verified. The guidelines also encompass the topics of in-house checking, third party checking, and stakeholder consultation.

The final draft of guidelines for this project creates a solid basis for the creation of nationally standardized guidelines for the use of computer fire models in Australasia.

6 Recommendations

Throughout the project, issues arose due to the time of year. The project was conducted during a season when most people take their summer holiday. This made it difficult and slow to reach many of the key people in the FSE field throughout Australasia. It is assumed that this produced a significantly lower response rate to the survey than could have been obtained had the project had been conducted either at a different time or, ideally, over a longer period of time.

The BRE project was conducted over a three year period. A similar approach, in which surveys were distributed and received for six to twelve months, would be an ideal extension to this project. The issue of people being away on summer holiday would be avoided. Furthermore, this would enable the opportunity to distribute the survey at major Australasian fire safety conferences that occur later in the year.

The survey database was developed with extension in mind. It was created so that more results may be received from the target audience in the future. The Access Forms that exist mimic the survey structure to allow for anyone to easily enter new survey responses into the database. When new data is entered into a form, the queries, cross-tabs, and reports in the database automatically update.

Several comments have been made throughout the course of this project about possible future studies. Focus group meetings identified three key survey statistics of this project that required further analysis. The first two statistics involve qualifications and training. During the focus group meetings it was brought up that many people lacked both qualifications and training. Comments received from those filling out the survey expressed similar concerns.

> "One of my biggest concerns is that there appears to be a wide-ranging disregard for the limitations that most models have…"[63]

> "At the moment its open slather for any cowboy to set up as a fire engineer. The Victorian government hands out fire safety engineer tickets like confetti at a wedding. The Institution of Engineers is little better- you have to be a member of the "old boys club" to get your ticket. There is no legislative requirement to have engineer's reports vetted by another professional engineer. It's only a matter of time before there is a disaster."[64]

Many CPD and short courses exist for computer fire models in Australia; it was stated that further studies should be conducted on why these courses are not being taken and what other courses should be provided.[65] The third statistic involved the fire safety references being used. Several members of the focus groups thought that the usage of certain key references was far too low. They expressed interest in discovering the cause of this, and how to remedy it.

Further work is already planned for the development of a set of nationwide practice guidelines that would be derived from the draft set proposed in this project. The Society of Fire Safety (SFS) has tentatively proposed to revise and finalise the draft guidelines and append them to the SFS Code of Practice. The Code of Practice is a nationally published document that provides "guidance to the fire safety community on appropriate procedures to be adopted when designing, certifying, and peer reviewing alternative solutions for compliance with the Building Code of Australia" [66] The publication of a finalised set of guidelines would begin the process of establishing much needed regulation for use of computer fire models in Australasia.

---

[63] Anonymous Survey Respondent. *Personal Comment.* January 2004.
[64] Anonymous Survey Respondent. *Personal Comment.* January 2004.
[65] Fire Professionals. Final Presentation. *Personal Comments.* 27 February 2004.
[66] Society of Fire Safety. <u>CODE OF PRACTICE FOR FIRE SAFETY DESIGN, CERTIFICATION & PEER REVIEW IN ACCORDANCE WITH THE BUILDING CODE OF AUSTRALIA</u>. June 2003.

Glossary

Computer Fire Models - any computer model that simulates scenarios relating to any aspect of the fire safety engineering field (i.e. fire dynamics, heat transfer, fire behaviour, human behaviour, structural design, etc.)

In-house Checking - verification by an independent party within the organisation

Third Party Checking - verification by an unbiased, independent party outside the organisation

Handbooks - computer fire model user's manual

Guidelines - any guidance written for a computer fire model, aside from the user's manual

Preferred Guidelines – guidelines that provide a much higher standard of practice than Acceptable guidelines

Acceptable Guidelines – base guidelines that provide standards for minimal practice

Zone Model - the classification of computer fire models that analyse a room by breaking it up into two control volumes, an upper and lower, and evaluating the fire by examining conditions in these volumes

Field Model - the classification of computer fire models that examine a room by dividing the room into small volumes, or cells; also known as Computational Fluid Dynamics (CFD) models.

Evacuation/egress Model - the classification of computer fire models that explore social responses to a fire; in other words, they examine how an individual(s) will react in a room containing fire.

Key Performance Indicators - Help an organization to define and measure progress toward its goals. They are quantifiable measurements (measurable), agreed to beforehand, that reflect the critical success factors of an organization. Furthermore, KPIs must reflect the organization's goals and must be a key to the organization's success.[67]

Fire Safety - safety against a fire, including fire protection, fire prevention and fire fighting [68]

---

[67] "Key Performance Indicators (KPIs)." <http://management.about.com/cs/generalmanagement/a/keyperfindic.htm>.
[68] AS 2484.2 Sec.1, 1991

Continuing Professional Development (CPD) – "The systematic maintenance, improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life". [69] Such things that are considered CPD are attending conferences and/or seminars, reading relevant essays and journals, producing essays and journals, etc.

Short Courses – Courses, up to two weeks long, administered either by a university or professional organisation

IEAust – Institution of Engineers Australia

Australasia - The islands of the southern Pacific Ocean, including Australia, New Zealand. (*The American Heritage® Dictionary of the English Language, Fourth Edition Copyright © 2000 by Houghton Mifflin Company.*
Published by Houghton Mifflin Company. All rights reserved.)

Authority Having Jurisdiction - the organisation or individual that has the authority to approve equipment, procedures, and activities within certain boundaries

Qualitative Analysis - analysis which merely determines the constituents of a substance without any regards to the quantity of each ingredient; -- contrasted with quantitative analysis. [70]

Fit for purpose – Appropriate for the specified purpose

Sensitivity Analysis - testing how sensitive a model is to changes in the inputs, both actual and relative

Engineering Analysis – Using hand calculations or judgment from the engineer's knowledge in the subject to analyse the design.

IFE – Institution of Fire Engineers

[69] "Marsden Fire Safety." <http://www.marsden-fire-safety.co.uk/cpd.htm>.
[70] "Dictionary.com." <http://dictionary.reference.com/search?q=qualitative>.

References

"About SFPE." <http://www.sfpe.org/sfpe/about.htm>.

"About the Building Code." ABCB.com.au. 2004. Australian Building Codes Board. 16 Feb. 2004 http://www.abcb.gov.au/content/codes/main.cfm.

"About Us: Paula Beever." New Zealand Fire Service.<http://www.fire.org.nz/about/engineers/paula-beever.htm>.

"ARUP." <http://www.arup.com/>.

AS 2484.2 Sec.1, 1991

"Australasian Fire Authorities Council." <http://www.afac.com.au/index.html>.

"Australian Institute of Building Surveyors: Contacts" <http://www.aibs.com.au/contacts.html>.

"BRE." <http://www.bre.co.uk/who.jsp>

"Computer Models for Fire and Smoke." <http://www.firemodelsurvey.com/pdf/fds_2001.pdf>.

"Dictionary.com." <http://dictionary.reference.com/search?q=guideline>.

"Explanation of the CFAST Model." <http://fast.nist.gov/cfast.html>.

"Fire Growth and Smoke Transport Modelling with CFAST/FAST." <http://fast.nist.gov/index.html>.

"Fire Protection Association Australia: National Staff." <http://www.fpaa.com.au/administration/Staff/staff.htm>.

"International Association of Fire Safety Science." <http://www.iafss.org/>.

"International Survey for Computer Models for Fire & Smoke." <http://www.firemodelsurvey.com/>.

"Key Performance Indicators (KPIs)" <http://management.about.com/cs/generalmanagement/a/keyperfindic.htm>

Kumar, Suresh (2003). The Development of Key Performance Indicators for the use of Computer Models in Fire Safety Engineering Information packets that contains power point slides and the results from the study in the UK.

Kumar, Suresh. USE OF COMPUTER MODELS IN FIRE SAFETY ENGINEERING DESIGN QUESTIONNAIRE.

"Marsden Fire Safety." <http://www.marsden-fire-safety.co.uk/cpd.htm>.

"Microsoft Access Tutorials: *On-line Version.*" <http://fisher.osu.edu/~muhanna_1/837/MSAccess/tutorials.html>.

"NFPA Overview." <http://www.nfpa.org/catalog/home/AboutNFPA/NFPAOverview/NFPAOverview.asp>.

"NIST Fire Dynamics Simulator (FDS) and Smokeview." <http://fire.nist.gov/fds/>.

"Recreation of Fire Patterns with Computer Simulations." <http://www.ncfs.ucf.edu/22%20Recreation%20Fire%20Patterns.pdf>.

Society of Fire Protection Engineers. SFPE Handbook for Fire Protection Engineering. 3rd ed. LOCATION: National Fire Protection Association, 2002.

Society of Fire Protection Engineers. SFPE Handbook for Fire Protection Engineering. 3rd ed. LOCATION: National Fire Protection Association, 2002.

Society of Fire Safety. CODE OF PRACTICE FOR FIRE SAFETY DESIGN, CERTIFICATION & PEER REVIEW IN ACCORDANCE WITH THE BUILDING CODE OF AUSTRALIA. June 2003.

"SOCIETY OF FIRE SAFETY: Contact the Society of Fire Safety." <http://www.sfs.au.com/contactus.shtml>.

The American Heritage® Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Company. Published by Houghton Mifflin Company. All rights reserved.

"Victorian Municipal Building Surveyors Group: Our Contact Details." <http://www.vmbsg.com.au/cgi-bin/contact.pl>.

All other citations refer to personal comments made by fire professionals and fire practitioners.

Anonymous Survey Respondent. *Personal Comment.* January 2004.

Ashe, Brian. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Barnett, Jonathan R. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Barnett, Jonathan. *Personal Comment.* Feb. 2004.

Barnett, Jonathan. *Personal Comment.* Oct. 2003

Behayeddin, Parkan. Focus Group Meeting. *Personal Comment.* 18 February 2004.

Davis, Simon. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Edwards, Jarrod. Focus Group Meeting. *Personal Comment.* 18 February 2004

England, Paul. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Fire Professionals. Final Presentation. *Personal Comment.* 27 February 2004.

Fire Professionals. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Johnson, Peter. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Kip, Stephen. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Llewellyn, Rob. *Personal Comment.* Feb. 2004.

Llewellyn, Rob. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Phillips, Peter. Focus Group Meeting. *Personal Comment.* 18 February 2004.

Wise, Stephen. Focus Group Meeting. *Personal Comment.* 17 February 2004.

Appendix A - Australasian Fire Authorities Council

A.1 Who is AFAC?

The Australasian Fire Authorities Council (AFAC) is a large association comprised of many groups and organizations that work with land managements and fire and emergency services in Australia.[71] They work together to provide more safety and knowledge of fire and emergency situations within the areas.

Established in 1993 and located in East Melbourne, AFAC's CEO is Len Foster and it has 23 full members and 14 associate member organizations throughout Australia.[72] The Metropolitan Fire & Emergency Services Boards of Victoria (VIC) and South Australia (SA), the Country Fire Service of VIC and SA, the New South Wales Fire Brigade and the Bushfire Council of Northern Territory are several of the AFAC full members. AFAC is not only comprised of Australian organizations but New Zealand, Papua New Guinea, Singapore, Hong Kong, and East Timor Services are members as well.[73]

The Australasian Fire Authorities Council was once known as the Australia Fire Authorities Council. In 1996, the council branched out of Australia when the New Zealand Fire Service joined the association. In order to accommodate this, the council decided to change the name of the association, so that all surrounding non-Australian areas were welcome to join.[74]

---

[71] "Australasian Fire Authorities Council" http://www.afac.com.au/index.html
[72] "About AFAC" http://www.afac.com.au/about/aboutafac.html
[73] "AFAC Membership" http://www.afac.com.au/about/membership.jsp
[74] "History of AFAC" http://www.afac.com.au/about/history.html

A.2 Organisational Structure

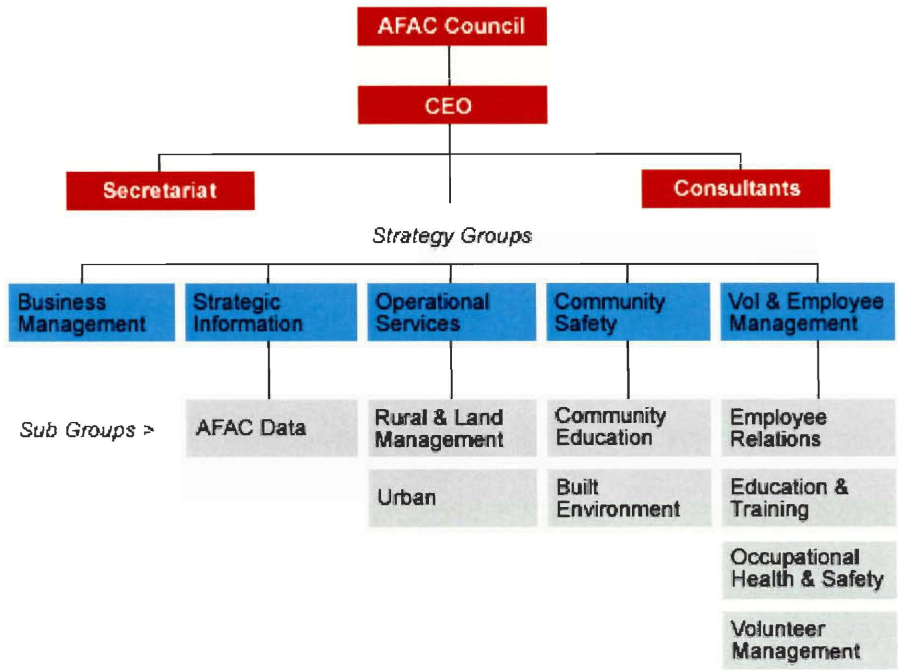


Figure A-1

A.3 Goal

The main goal of AFAC is to add to the development of public safety and progression of the member organizations by providing them with many new services.[75] There are many projects and methods that are currently being worked on and used in order to deliver the best results. Although they do not provide training for the members, they encourage them to study the "National Fire Curriculum," and the "Fire & Emergency Response Training," (FERI).[76] These programs are well developed and allow fire safety engineers to become strong leaders within their area of study. The

[75] "History of AFAC" http://www.afac.com.au/about/history.html
[76] "Products and Services" - Courses http://www.afac.com.au/products/courses.html

VectorCommand and Fire Brigade Intervention Model (FBIM) are two services that are important in the advancement for AFAC. [77]

A.4 Computer Programs

A.4.1 VectorCommand

VectorCommand is a service used within AFAC in order to keep things in control. VectorCommand is a computer simulation, used by all members, that is used as a tool to support training and management. Fire fighters and officers enjoy this way of study. It allows them to make errors in an area without physically hurting anything or anyone.[78]

A.4.2 FBIM

"The FBIM is an event based methodology, used to model the activities and tasks of a Fire Brigade."[79] AFAC uses this program as a specific tool to predict and evaluate how Fire Brigades will need to respond to fires. It was first developed for engineering design purposes. Now it is used to inform the fire brigade of all details of a fire. Knowing all this information allows them to be familiar with all search and rescue tactics, notification warning times, etc. The more information they know, the more lives and land that can be saved.[80]

---

77 "Products and Services" - Courses http://www.afac.com.au/products/courses.html
78 "VectorCommand" http://www.afac.com.au/products/vectorcommand.html
79 "Fire Brigade Intervention Model" http://www.afac.com.au/products/fbim.html
80 "Fire Brigade Intervention Model" http://www.afac.com.au/products/fbim.html

Appendix B - Fire Protection Association Australia

The Fire Protection Industry Association of Australia (FPIAA) and the Australia Fire Protection Association (AFPA) joined together in 1997 and became the Fire Protection Association of Australia (FPAA or FPA Australia).[81] The organization is comprised of 1600 members whom are involved in many aspects of fire protection including government, insurance, research, engineering, architecture, and health.[82] The FPA Australia is the largest organization in Australia that deals with fire safety.[83] They also deal with fire and emergency services and education and training for fire practitioners.[84]

Each year the FPA Australia strives to hold educational conferences and seminars dealing with fire protection.[85] Their main goal is to promote fire safety throughout the country.[86] In order to achieve the goal and stay in contact with members, the FPA Australia sends out newsletters several times a year; "Fire Talk," "TechFire," and "Fire Australia," are the main newsletters sent out. The FPA is also the publisher of a journal called Fire Australia. This journal is considered the fire protection "bible" of Australia. It is the principle journal on fire used by nearly all Australian fire practitioners.

B.1 Board of Directors

The FPA Australia is managed by a board of directors, which contains 8 FPA members.[87] The members of the organization elect the board of directors each year. The

---

[81] "Background & History" http://www.fpaa.com.au/administration/administration.htm
[82] "Background & History" http://www.fpaa.com.au/administration/administration.htm
[83] "National Fire Industry Training" http://training.fpaa.com.au/
[84] "Background & History" http://www.fpaa.com.au/administration/administration.htm
[85] "FPA Australia's Event Schedule" http://www.fpaa.com.au/events/events.htm
[86] "Fire Safety Information" http://www.fpaa.com.au/publications/fire_safety.htm
[87] "Background & History" http://www.fpaa.com.au/administration/administration.htm

board of directors meets "on a 6 weekly basis, predominately in Melbourne or Sydney,"[88] where they discuss current issues within the organization. There is also a national staff working to aid the board.[89]

B.2 Committees

There are many committees within the FPA Australia, each with a different purpose. State Committees and Special Interest Groups (SIGs) are intended for members of FPA Australia "to increase flow of industry specific to members",[90] bring groups of common interest together, and provide important issues relating to the members."[91] They are also a great way to network within the fire related community.

B.2.1 Special Interest Groups

There are 5 Special Interest Groups (SIGs) – Aviation SIG (A/SIG), Marine SIG (M/SIG), Passive SIG (P/SIG), Training SIG (T/SIG), and Workplace Emergency Response SIG (WER-SIG).[92] In order to become a member of a SIG, the recipient must show interest in one of the particular fields or have a professional connection to the work of the group. Each SIG meets regularly throughout the year. They also produce newsletters twice a year explaining what they are currently working on, to see that all members are kept up to date on all issues and events.[93]

---

[88] "Background & History" http://www.fpaa.com.au/administration/administration.htm
[89] "Background & History" http://www.fpaa.com.au/administration/administration.htm
[90] "Special Interest Groups" http://www.fpaa.com.au/committee/committees.htm
[91] "Special Interest Groups" http://www.fpaa.com.au/committee/committees.htm
[92] "Special Interest Groups" http://www.fpaa.com.au/committee/committees.htm
[93] "Special Interest Groups" http://www.fpaa.com.au/committee/committees.htm

B.2.2 Technical Committees

Although the SIGs cover most areas within fire protection, and are a vital part of the organization, the Technical Committees are the "peak body within the FPA Australia."[94] The Technical Committees allow the members of FPA Australia to participate in the development and revisions of Australian Standards, regulations, and technical and regulatory policies. The committees are where members have the ability to change the framework of their businesses. They also discuss the conduct and progress of businesses. There are 6 technical committees within the FPA Australia – National Technical Advisory Committee, Fire Detection and Alarm Systems, Portable Fire Equipment, Fire Sprinkler and Hydrant Systems, Specialized Hazards Protection, and Passive Fire Protection.[95]

B.3 Projects

FPA Australia takes on many fire related projects within their organization. These projects occur on either the national or state level. They also allow members to get involved in their national fire safety standards and documents. The projects are divided into 3 categories – technical issues, regulatory issues, and training issues.

B.3.1 Technical Issues

The technical issue projects are assignments where national documents and standards are researched and revised with changes in order to improve them. Currently FPA Australia is working on the "Maintenance Standards" and "Sprinkler System

[94] "National Technical Committees" http://www.fpaa.com.au/technical/technical_committees.htm
[95] "National Technical Committees" http://www.fpaa.com.au/technical/technical_committees.htm

Standards."[96] These standards are being revised in order to be up to date with the Building Code of Australia (BCA).

B.3.2 Regulatory Issues

Projects within the regulatory issues category are worked upon in order to set requirements and regulations for positions or products. The "Aerosol Extinguisher Regulation"[97] is currently being worked upon to set higher requirements "for the design and performance criteria"[98] on aerosol spray cans. The "Certification of Building Surveyors"[99] was proposed to FPA Australia. The Australian Building Codes Board would like to establish national accreditation for building certification.[100]

B.3.3 Training Issues

Training issued projects are developed in order to acquire accredited fire safety training programs. The "Fire alarm apprenticeship" and "Fire and smoke door inspection and testing" are examples of current projects being worked on. [101]

B.4 National Fire Industry Training

Due to the fact that the FPA Australia is the largest fire safety organization in Australia, they have the ability to create and provide accredited fire safety training programs for those interested. They have many programs currently available and more under production. "Portable fire equipment service technician training," and "workplace

---

[96] "FPA Australia's Technical Projects" http://www.fpaa.com.au/projects/Technical/technical.htm
[97] "FPA Australia's Regulatory Projects" http://www.fpaa.com.au/projects/Regulatory/regulatory.htm
[98] "Aerosol Fire Extinguisher Regulation" http://www.fpaa.com.au/projects/Regulatory/Aerosol_Extinguishers/aerosol_extinguishers.htm
[99] "FPA Australia's Regulatory Projects" http://www.fpaa.com.au/projects/Regulatory/regulatory.htm
[100] "Draft ABCB Proposal for Surveyor Certification" http://www.fpaa.com.au/projects/Regulatory/Surveyor/surveyor.htm
[101] "FPA Australia's Training Projects" http://www.fpaa.com.au/projects/Training/training.htm

assessor and trainer" are two examples of FPA programs that are currently available for members.[102] "ACA Cabling Provider Rules training" and "Fire alarm apprenticeship" are still under production.[103]

[102] FPA's Australia's Training and Accreditation Agenda http://www.fpaa.com.au/member/files/T010165.pdf
[103] FPA's Australia's Training and Accreditation Agenda http://www.fpaa.com.au/member/files/T010165.pdf

Appendix C - How to Write a Survey

A survey is "a gathering of a sample of data or opinions considered to be representative of a whole."[104] After the data is collected, it is then analysed and reported on. Surveys are a tool used to gather necessary information. Most surveys collect information from only a portion of a populated interest. The size of the portion depends on how much information is needed and most importantly, how many people are involved in this interest? Surveys are often used to find the consensus of how popular something is or how much the product is being used. They are also conducted in order to compare and contrast ideas or things. Each participant is given the same questions. The purpose of a survey is not to describe one individual person, but to have an overview consensus of that one group.

Many may believe that giving a survey is an easy task that takes little time and effort. In actuality, surveys take much time and preparation if all the desired information is to be received. Being organized is a huge factor in planning a survey. Knowing exactly what information is needed, how much information is needed, and what approaches the surveyor must use in order to reach his or her goal, is the most important part of a survey.

C.1.1 Procedure

C.1.1.1 Objectives

Defining the objectives for conducting a survey is the most critical part of the procedure. The objectives are the back bone for the entire process. They must be laid

[104] "Dictionary.com" http://dictionary.reference.com/search?r=2&q=survey

out on the table and provide information that is as detailed as possible. The more detailed the information, the better the results. What are the goals for this survey? What needs to be accomplished? What is the best possible way of attacking this situation in order to get the best results? All of these questions should be considered and answered. The surveyor should always be very specific, straightforward, and unambiguous in everything that is done.

Background information is extremely important and vital to the process. Being able to answer all of the factual questions will help the surveyor in the long run. Most importantly, the surveyor needs to know what types of people are being surveyed. All of this information will allow advancement to the next steps of creating a survey.

C.1.1.2 Types of Surveys

Choosing the right type of survey is a procedure that involves many factors. The surveyor must review all of the information and figure out what works best with what they have. Who are they surveying? Are they surveying young children, old adults, teenagers, male, female, etc? The surveyor is the "predator" trying to get their "prey." What tactics are needed in order to reach their goal? How much time is there to complete the surveying? What is the available budget? What resources are needed, and/or provided?

Another important factor to consider is the length of the survey. Long surveys tend to cause fatigue and lack of concentration amongst people that are being surveyed. Incomplete answers start to appear. By keeping the surveys short and to the point, accurate results will be formed, making the information provided more applicable.

Questionnaires and interviews are the two types of surveys that are heavily used today. By assessing all of these factors, a proper survey can be chosen. The type of survey is the basis for the resulting information. Choosing the wrong type of survey can lead to inefficient results if any aspect is overlooked.

C.1.1.2.1 Questionnaires

C.1.1.2.1.1 Mail Survey

Mail surveys are one of three types of questionnaires. They are also the most common. There are many advantages to using a mail survey. Mail surveys allow the surveyors to send the surveys out to unlimited amounts of people. These surveys also allow the respondents to fill them out at their own convenience. However, subjects who forget about the survey or prefer not to participate, produce low response rates. Mail surveys usually do not allow respondents to ask any questions pertaining to the survey, nor can there be detailed written responses; most mail surveys are multiple choice or one-word answers.

C.1.1.2.1.2 Group Administered Questionnaire

The second type of questionnaire is the group administered questionnaire. A group administered questionnaire is a structured questionnaire that is provided for a group of people within a common interest or area. These questionnaires are well researched and are more detailed, with information about the common interest or area that the group has in common. Businesses, occupations, clubs, or organizations could use this method. The surveyor gives each member of the group the questionnaire at a given meeting. This makes it more personal, allowing group members to ask any questions that they may have. This also has a much higher response rate than the mail survey.

C.1.1.2.2 Interviews

C.1.1.2.2.1 Personal Interviews

Personal interviews are one of the two types of interviews. Personal interviews yield an easygoing atmosphere. When delegating an interview, the interviewer knows what type of person is giving the answers. Personal interviews have 100% response rates. They permit the survey to be fully explained in detail. The interviewer can ask follow up questions and ask respondents to elaborate on vague replies. This allows the interviewer to attain all the information needed in detail.

Although there are many advantages to these types of interviews, there are also disadvantages. Personal interviews cause a loss of time and expense for the interviewer. Scheduling between the interviewer and respondent can also be a problem.

C.1.1.2.2.2 Telephone Interviews

A telephone interview is most common method of surveying for large public opinions. It is the easiest and least expensive. Telephone interviews are short and to the point. Long interviews on the phone tend to cause inattentiveness for people, especially when called in their homes. Telephone calls allow for some personal contact between the interviewer and respondent. Vague replies can be asked to be elaborated. The interviewer can also ask any follow-up questions that may be relevant to the questions. Telephone interviews tend not to get the best responses though. Some people hang up when they find out the call is a survey; they would rather not be bothered in their home or work. For a general public survey, there are many unlisted numbers throughout the country, not allowing for the interviewers to have access to all responses.

C.1.1.3 Determining Survey Questions

Determining the proper survey questions is the biggest part of the survey process. These questions directly influence the end results. After choosing what type of survey is needed, a decision needs to be made as to what material goes into the survey.

Before determining the survey questions, the researcher must organize their thoughts thoroughly. Each question must state exactly what is needed in a clear, precise way. The more in depth and to the point the questions are, the more information will be obtained.

Knowing all the background information about the survey subject is extremely important. Each background detail can be looked at as a structure for choosing the best possible question. Wording the questions in a correct manner affects the results in a significant way. For example, asking someone, "Where are you from?" compared to "Where were you born?" the surveyor would most likely get two different answers from the respondent. Depending upon the type of answer that is desired, wording of questions can be significant. Lastly, questions must flow. The order in which someone is asked a question can affect the fate of the results. Switching back and forth from questions about the background of the respondent to questions about the actual subject matter can subconsciously alter the respondents' thinking. This possibility does not allow for the most accurate response.

C.1.1.4 Conducting a Survey

Conducting the survey is the process through which the questionnaire or interview is administered to obtain the best results. The surveys, and how they are given, must be consistent. Presenting surveys in various ways can change end results greatly. In interviews, follow-up questions can always be asked. However, if a question is asked to one person, the same question must be asked to the rest of the group in order to acquire similar results.

One main aspect that must be known for undertaking interviews is that the interviewer must know and be able to answer and react to all questions that may be asked. Being knowledgeable on all background information is extremely important when conducting an interview.

C.1.1.5 Analysing Results

The last step in this survey procedure is the analysis process. After gathering all the information, the results are usually put into a type of presentable form. If the questionnaire was an opinion survey that consisted of longer answers, then the surveyor will record a final summary that summed up all of the answers into one. In most cases, though, a survey is used towards gathering statistical results. The information collected is put into spreadsheet form and analysed. The surveyors and researchers must use the information given to them intelligently, so that they can produce the most efficient outcome.

.

Appendix D - BRE Survey

USE OF COMPUTER MODELS IN FIRE SAFETY ENGINEERING DESIGN

QUESTIONNAIRE

This questionnaire has been prepared for a project entitled "Development of KPIs for fire safety engineering" being conducted by BRE, on behalf of DTLR.

Fire safety engineering, particularly in support of performance-based regulation, offers much greater opportunities than ever before to utilise creative, innovative and cost-effective architectural fire-safety design.

Part of the design process will necessarily involve the use of calculations or computer models to evaluate the consequences of adopting competing design options. There is a wide range of such methods available to the engineer ranging from simple "back-of-envelope" calculations through to more advanced simulation tools.

The objective of this project is to explore the possibility of establishing Key Performance Indicators (KPIs) for the design process and especially for the use of computer simulation tools.

A crucial element of the study is the acquisition of information on how such models are currently being used by construction industry professionals both in design and in regulatory enforcement.

This questionnaire is intended to establish the range of professional backgrounds of the respondents in order to inform future decision-making and how to ensure proper use of fire modelling in practice.

We would therefore be very grateful if you could complete the attached questionnaire to assist us to prepare proposals for appropriate KPIs and to enable us to identify and address the needs of the "end-users". The overall results from the survey, although not the company-specific details, will be made available on the project website in due course.

Thank you in advance for taking the time to help us.

Please complete and return to:

Dr Suresh Kumar
BRE/FRS
Garston
Watford WD25 9XX

If you have any queries you can contact me on (phone) 01923 66 4921, (fax) 01923 66 4910, or email: kumars@bre.co.uk

Fire Simulation Tools Questionnaire

1. What is your primary role in the process?

☐ Design ______________________________

☐ Enforcement ______________________________

☐ Other-say what ______________________________

2. Please select one of following categories, which best describes you as your primary role as a fire safety practitioner?

☐ Architect

☐ Building Owner/occupier

☐ System Designer

☐ Building Control Officer

☐ Approved Inspector

☐ Fire officer

☐ Fire engineer

☐ Academic ______________________________

☐ Other-say what ______________________________

3. Do you use or encounter the use of computer fire models in your work?

☐ Yes

☐ No

If No, the questionnaire is finished; If Yes, please proceed to the next question

4. Roughly how many fire-safety engineered solutions per year do you have contact with?

   Number ________________

5. In what proportion of these projects do you estimate that computer fire models have been used?

   Percentage ________________

6. If you use computer fire models, what is the main driver for their use?

   ☐ Reduce calculation time

   ☐ In-house quality control

   ☐ Validity of the design solution

   ☐ Graphical visualisation/animation of the design solution

   ☐ Other, please specify ____

   ____

7. The models used in question 5 involve which aspects of fire safety (either tick or preferably break down as a proportion of the total)?

   ☐ HVAC and smoke ventilation

   ☐ Structure

   ☐ Evacuation

   ☐ Detection

   ☐ Suppression

   ☐ Other, please specify ____

   ____

8. How many of your relevant staff are:

   ☐ Chartered Fire Engineers

   ☐ Incorporated Fire Engineers/Engineering Technicians

   ☐ Chartered Engineers of a different professional body, say which ____

☐ MIFireE

☐ Fire Safety Engineering graduates ________
-say which course ______________________________

☐ Qualified through another discipline-say which ____________
____

☐ Qualified through experience________
-please quantify ______________________________

☐ None of the above

9. What specialist training do you or your staff receive in the use of models?

☐ Short course-say where and how long______________________
____

☐ CPD-say which course ______________________________
____

☐ Other, please specify ______________________________
____

☐ None

10. Which references do you regularly consult for your fire safety engineering work?

☐ SFPE Handbook

☐ NFPA handbook

☐ LPC design guide

☐ Standards documents

☐ Other, please specify ______________________________
____

11. If you use computer models give details of those used:

Model type and name ______________________________

Supplier ______________________________

12. **Do you have confidence that the models are "fit for purpose"?**

- ☐ Yes
- ☐ No
- ☐ Uncertain

Comment if you wish ______________________________

____

13. **If you are a fire officer, do you have within your brigade guidance publications issued on various computer fire models?**

- ☐ Fire models training, volume 1 Fastlite, FRDG Pub. No. 12/97
- ☐ Fire models training, volume 2 Argos, FRDG Pub. No. 1/98
- ☐ Fire models training, volume 3 Hazard I, FRDG Pub. No. 7/98
- ☐ Fire models – A guide for fire prevention officers, FRDG Pub. No. 6/93
- ☐ Evaluation of Fire models – Summary report, FRDG Pub. No. 52/92
- ☐ Fire modelling – BRE Digest 367, November 1991

Other, please specify ______________________________

____

14. **How do you assess the validity of the solutions offered by the fire models?**

Designers:

- ☐ Engineering judgement
- ☐ Trust the software

Enforcers and Approved Inspectors:

- ☐ In-house validation
- ☐ Another consultant

Regulators:

☐ **What percentage of building design applications, exploiting fire models, is forwarded to a third party for validation?**

Signed..

Date..

Appendix E - Australasia Survey

E.1 Questionnaire Cover Page

Hello,

We are four students of Worcester Polytechnic Institute (Massachusetts, USA), currently in Melbourne working on a project entitled "Key Performance Indicators for Computer Fire Models in Australasia." Our project sponsors are ABCB, AFAC, and FPAA. Our project goal is to determine how Computer Fire Models are being used across Australia and New Zealand, and compare these results to a study being completed in the UK. Our project's report will provide recommendations for best practice for the use of such models in Australasia. One main tool for this project is a survey, which we have attached as a PDF file. We would greatly appreciate it if you could take 5 minutes of your time and complete this questionnaire. Your response can be printed out and faxed to us, or you can visit the website http://users.wpi.edu/~nuke101/survey/survey and complete an identical on-line survey there.

This project will be finalised at the end of February, so a response to this survey by 30 January would be appreciated. If you become aware of other Fire Professionals for whom it would be appropriate to complete this survey, we would appreciate you forwarding this email to them. The number of people you've forwarded this to, or any questions you may have, can be sent to kuhnity@wpi.edu. Thank you for your time, and we look forward to your participation.

Sincerely,

Angela Martino, Brian Kuhn, Mark Moseley, Matthew Souza

Worcester Polytechnic Institute

T +61 (03) 9419 2388

F +61 (03) 9419 2389

E.2 Questionnaire

Fire Simulation Tools Questionnaire

Conducted by Worcester Polytechnic Institute

A joint project with the Australasian Fire Authorities Council, the Australian Building Codes Board and Fire Protection Association of Australia

---

PROFESSIONAL INFORMATION

---

1. In what region do you practice your profession?

   - ☐ Australian Capitol Territory
   - ☐ New South Wales
   - ☐ Northern Territory
   - ☐ Queensland
   - ☐ South Australia
   - ☐ Tasmania
   - ☐ Victoria
   - ☐ Western Australia
   - ☐ New Zealand

2. What is your primary role in the fire safety design process?

   - ☐ Design
   - ☐ Approval
   - ☐ Enforcement
   - ☐ Other – please specify ______________________________

3. Which of the following categories best describes your primary role as a fire safety practitioner?

   - ☐ Architect

☐ Building Owner/occupier

☐ Building Service Engineer (BSE)

☐ Building Surveyor/Certifier

☐ Fire Brigade Officer

☐ Fire Safety Engineer

☐ Academic

☐ Other – please specify ______________________________

4. Please indicate all fire safety engineering activities in which you are professionally involved. Check all that apply.

☐ Fire science (fire chemistry, fire dynamics, etc.)

☐ Interaction between fire and people (Evacuation/Egress)

☐ Fire-ground operations

☐ Fire protection engineering (Active)

☐ Fire protection engineering (Passive)

☐ Fire risk assessment

☐ Fire safety

☐ Smoke control

☐ Fire investigation

☐ Fire engineering design

☐ Fire insurance

☐ Fire safety of consumer items & energy sources

☐ Fire engineering research

☐ Regulation

☐ Alternate Solutions

☐ Other – please specify ______________________________

MODEL USE

---

5. Approximately how many fire safety engineered projects do you encounter per year?

   Number _______________

6. Approximately how many of these projects required the use of computer models?

   Number _______________

7. What are the reasons computer fire models are not used for some projects?

   ☐ No models are "fit for purpose"

   ☐ Calculations are simple

   ☐ Modeling software unavailable

   ☐ Modeling software overly complex

   ☐ Other – please specify ______________________________

If you answered zero for question #6, please skip ahead to question #17. Otherwise proceed to the next question.

MODEL PURPOSE

---

8. Which aspects of fire safety are addressed in the models you use?

   ☐ HVAC and smoke ventilation

   ☐ Structure

   ☐ Evacuation

   ☐ Detection

   ☐ Suppression

   ☐ Other – please specify ______________________________

9. When you use computer fire models, what is their main purpose?

   ☐ Design Solution

   ☐ Reduce calculation time

☐ In-house quality control

☐ Validation

☐ Graphical visualization/animation of the design solution

☐ Other, please specify ______________________________

10. How confident are you that the models you use are "fit for purpose."

☐ Very confident

☐ Confident

☐ Neutral

☐ Unconfident

☐ Very unconfident

STAFF INFORMATION & QUALIFICATION

---

11. What are your qualifications?

☐ IEAust (Fire Safety Engineer)

☐ Registered Building Practitioner (Fire Safety Engineer)

☐ IFE Fire Safety Engineer

☐ Fire Safety Engineering graduates ________

☐ Qualified through another discipline – say which__________________

☐ Qualified through experience – please quantify years________________

☐ Chartered Engineer of a different professional body –
please specify ______________________________

☐ Other – please specify ______________________________

12. What specialized training do you or your staff receive in the use of computer fire models?

☐ Academic Courses (post graduates, university courses, etc.)

☐ Short Courses (conferences, seminars, etc). Estimated total hours: __________

- ☐ Continuing Professional Development (CPD)
- ☐ Risk Assessment Training
- ☐ Practical Fire Training
- ☐ Other – please specify ______________________________
- ☐ None

13. Please list the ZONE computer fire models you use or have used in the past.

____

____

14. Please list the FIELD or CFD computer fire models you use or have used in the past.

____

____

15. Please list the EVACUATION/EGRESS models you use or have used in the past.

____

____

16. Please list any other computer fire models you use or have used in the past.

____

____

VERIFICATION

---

17. How do you verify the results given to you by the fire models?
    - ☐ Engineering analysis
    - ☐ Trust the software
    - ☐ In-house validation
    - ☐ Third party validation

- ☐ Fire/Smoke test
- ☐ Other – please specify ______________________________

18. Which references do you regularly consult for your fire safety engineering work?
    - ☐ SFPE Handbook
    - ☐ NFPA handbook
    - ☐ Building Code of Australia (BCA)
    - ☐ Fire Engineering Guidelines , Fire Code Reform Centre, 1996
    - ☐ Fire Safety Engineering Guidelines, Australian Building Codes Board (2001 edition)
    - ☐ Australian Standards
    - ☐ International Standards
    - ☐ NFPA Codes/Standards
    - ☐ Other – please specify ______________________________

19. Do you have within your library or office, handbooks and guidelines on the computer fire models you use? (Check one for each)

    Handbooks:

    ☐ YES ☐ NO

    Guidelines:

    ☐ YES ☐ NO

Please provide details of any other handbooks or guidelines you have access to on the computer fire models.

____

____

____

____

CONTACT INFORMATION

Thank you for taking the time to complete the survey. Please provide your personal information below for future contact in case we have any questions about your responses. The responses to this survey will not be distributed but will remain CONFIDENTIAL to WPI. Data will be extracted and compiled into a report which will be published as part of this project. If you wish your responses to be anonymous, you may leave the following personal details blank.

Organization Name: ______________________________

Address: ______________________________

____

____

Telephone: ______________ Facsimile: ______________

Email: ______________________________

WWW: ______________________

Name (Last, First, Middle): ______________________________

Title: ______________________________

Department: ______________________________

The goal of the project is to obtain as many individual responses as possible. Therefore, if anyone in your office has not received a copy of this survey, if appropriate, please fill in the information below so that he or she receives a copy.

Name (Last, First, Middle): ______________________________

Department: ______________________________

If you have any questions, or would like to return the survey, please contact us at:

T +61 (03) 9419 2388
F +61 (03) 9419 2389
E kuhnity@wpi.edu

E.3 Online Survey

Key Performance Indicators for Computer Fire Models in Australasia

The time period alotted to receiving responses is now completed.

Thankyou for your participation.

The survey will remain online for viewing and exists in its original format below.

Hello,

We are four students of Worcester Polytechnic Institute (Massachusetts, USA), currently in Melbourne working on a project entitled "Key Performance Indicators for Computer Fire Models in Australasia". Our project sponsors are ABCB, AFAC, and FPAA. Our project goal is to determine how Computer Fire Models are being used across Australia and New Zealand, and compare these results to a study being completed in the UK. Our project's report will provide recommendations for best practice guidelines for the use of such models in Australasia. One main tool for this project is the survey on the following pages. We would greatly appreciate it if you could take 5 minutes of your time and complete this online questionnaire.

This project will be finalised at the end of February, so a response to this survey by as soon as possible would be appreciated. If you become aware of other Fire Professionals for whom it would be appropriate to complete this survey, we would appreciate you forwarding this web address to them. The number of people you've forwarded this to, or any questions you may have, can be sent to kuhnity@wpi.edu. Thank you for your time, and we look forward to your participation.

Sincerely,

Angela Martino, Brian Kuhn, Mark Moseley, Matthew Souza
Worcester Polytechnic Institute

T +61 (03) 9419 2388
F +61 (03) 9419 2389

Start the Survey

Alternatively, a pdf file may be downloaded from here and faxed to us at: +61 (03) 9419 2389

FPA AUSTRALIA

WPI

Fire Simulation Tools Questionnaire

Conducted by Worcester Polytechnic Institute
A joint project with the Australasian Fire Authorities Council, the Australian Building Codes Board and Fire Protection Association of Australia

PROFESSIONAL INFORMATION

1. In what region do you practice your profession?

- Australian Capitol Territory
- New South Wales
- Northern Territory
- Queensland
- South Australia
- Tasmania
- Victoria
- Western Australia
- New Zealand

2. What is your primary role in the fire safety design process?

- Design
- Approval
- Enforcement
- Other . please specify

3. Which of the following categories best describes your primary role as a fire safety practitioner?

- Architect
- Building Owner/Occupier
- Building Service Engineer (BSE)
- Building Surveyor/Certifier

- Fire Brigade Officer
- Fire Safety Engineer/Consultant
- Academic
- Other - please specify

4. Please indicate all fire safety engineering activities in which you are professionally involved. Check all that apply.

- Fire science (fire chemistry, fire dynamics, etc.)
- Interaction between fire and people (Evacuation/Egress)
- Fire-ground operations
- Fire protection engineering (Active)
- Fire protection engineering (Passive)
- Fire risk assessment
- Fire safety
- Smoke control
- Fire investigation
- Fire engineering design
- Fire insurance
- Fire safety of consumer items & energy sources
- Fire engineering research
- Regulation
- Alternate Solutions
- Other - please specify

MODEL USE

---

5. Approximately how many fire safety engineered projects do you encounter per year?

Number

6. Approximately how many of these projects required the use of computer models?

Number

7. What are the reasons computer fire models are not used for some projects? Check all that apply.

- No models are "fit for purpose"
- Calculations are simple
- Modeling software unavailable
- Modeling software overly complex
- Other - please specify

If you answered zero for question #6, please skip ahead to question #17.
Otherwise proceed to the next question.

MODEL PURPOSE

8. Which aspects of fire safety are addressed in the models you use? Check all that apply.

- ☐ HVAC and smoke ventilation
- ☐ Structure
- ☐ Evacuation
- ☐ Detection
- ☐ Suppression
- ☐ Other - please specify

9. When you use computer fire models, what is their main purpose?

- ○ Design Solution
- ○ Reduce calculation time
- ○ In-house quality control
- ○ Validation
- ○ Graphical visualisation/animation of the design solution
- ○ Other - please specify

10. How confident are you that the models you use are "fit for purpose"?

- ○ Very confident
- ○ Confident
- ○ Neutral
- ○ Unconfident
- ○ Very unconfident

PERSONAL INFORMATION & QUALIFICATION

11. What are your qualifications? Check all that apply.

- ☐ IEAust (Fire Safety Engineer)
- ☐ Registered Building Practitioner (Fire Safety Engineer)
- ☐ IFE Fire Safety Engineer

- ☐ Fire Safety Engineering graduates - specify university
- ☐ Qualified through another discipline. say which
- ☐ Qualified through experience. please quantify years
- ☐ Chartered Engineer of a different professional body. please specify
- ☐ Other - please specify

12. What specialised training do you or your staff receive in the use of computer fire models? Check all that apply.

- ☐ Academic Courses (post graduates, university courses, etc.)
- ☐ Short Courses (conferences, seminars, etc). Estimated total hours:
- ☐ Continuing Professional Development (CPD)
- ☐ Risk Assessment Training
- ☐ Practical Fire Training
- ☐ Other - please specify
- ☐ None

13. Please list the ZONE computer fire models you use or have used in the past.

14. Please list the FIELD or CFD computer fire models you use or have used in the past.

15. Please list the EVACUATION/EGRESS models you use or have used in the past.

16. Please list any other computer fire models you use or have used in the past.

VERIFICATION

---

17. How do you verify the results given to you by the fire models?

- ○ Engineering analysis
- ○ Trust the software

- In-house validation
- Third party validation
- Fire/Smoke test
- Other - please specify

18. Which references do you regularly consult for your fire safety engineering work? Check all that apply.

- SFPE Handbook
- NFPA handbook
- Building Code of Australia (BCA)
- Fire Engineering Guidelines , Fire Code Reform Centre, 1996
- Fire Safety Engineering Guidelines, Australian Building Codes Board (2001 edition)
- Australian Standards
- International Standards
- NFPA Codes/Standards
- Other - please specify

19. Do you have within your library or office, handbooks and guidelines on the computer fire models you use? (Check one for each)

Handbooks:
Yes No
Guidelines:
Yes No

20. Please provide details of any other handbooks or guidelines you have access to on the computer fire models.

PERSONAL INFORMATION

Thank you for taking the time to complete the survey.
Please provide your personal information below for future contact in case we have any questions about your responses.
The responses to this survey will not be distributed but will remain CONFIDENTIAL to WPI.
Data will be extracted and compiled into a report which will be published as part of this project.
If you wish your responses to be anonymous, you may leave the following personal details blank.

Organisation Name:
Address:

Telephone: Facsimile:

Email:

WWW:

Name (Last, First, Middle):

Title:

Department:

The goal of the project is to obtain as many individual responses as possible.
Therefore, if anyone in your office has not received a copy of this survey, if appropriate, please fill in the information below so that he or she receives a copy.

Name (Last, First, Middle):
Department:
Email: Telephone:

Finish

AUSTRALASIAN FIRE AUTHORITIES COUNCIL

WPI

Thankyou for participating in this survey.
We appreciate any feedback you may have.

Send comments

Appendix F - Australasia Report

F.1 Website Report

Key Performance Indicators for Computer Fire Models

Page 1 of 1

Report

Key Performance Indicators For Computer Fire Models

Appendices

A AFAC Organisation
B FPAA Organisation
C How To Write a Survey
D BRE Survey
E Australasia Survey
F Statistics & Cross-Tabulations
G Focus Group Minutes
H Draft Guidelines
I Table of Abbreviations
J Glossary

Brian Kuhn · Angela Martino · Mark Moseley · Matt Souza

http://users.wpi.edu/~nuke101/IQP/report.htm

3/3/2004

F.2 Result Reports

Table of Statistics & Cross-tabulations

Overall Survey Statistics

TOTAL RESPONSES 120

PROFESSIONAL INFORMATION

Q1. Regional Distribution		**% of Total**
ACT	6	5%
New South Wales	34	28%
Northern Territory	3	3%
Queensland	15	13%
South Australia	17	14%
Tasmania	6	5%
Victoria	32	27%
Western Australia	11	9%
New Zealand	15	13%

Q3. Primary Role Category		**% of Total**
Architect	0	0%
Building Owner/Occupier	3	3%
Building Service Engineer	7	6%
Building Surveyor/Certifier	27	23%
Fire Brigade Officer	18	15%
Fire Safety Engineer	73	61%
Academic	3	3%
Other Category	3	3%

Q2. Primary Role		**% of Total**
Design	60	41%
Approval	51	35%
Enforcement	20	14%
Other Role	16	11%

Q4. FSE Activities		
Fire science	57	48%
Evacuation/Egress	91	76%
Fire-ground operations	31	26%
FSE (Active)	89	74%
FSE (Passive)	85	71%
Fire risk assessment	76	63%
Fire safety	100	83%
Smoke control	88	73%
Fire investigation	22	18%
Fire engineering design	89	74%
Fire insurance	11	9%
Fire safety of Energy sources	10	8%
Fire engineering research	32	27%
Regulation	63	53%
Alternate solutions	102	85%
Other Activity	4	3%

MODEL USE

Q5. Average FSE projects encountered per year

62.6	

Q6. Projects Requiring CFMs

	% of Total
32.8	52%

Q7. Reasons CFMs are not used

		% of Total
No models are "fit for purpose"	42	35%
Calculations are simple	79	66%
Modeling software unavailable	11	9%
Modeling software too complex	24	20%
Other Reason	37	31%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed		% of Total
HVAC and smoke ventilation	89	74%
Structure	62	52%
Evacuation	89	74%
Detection	90	75%
Suppression	71	59%
Other Aspect	12	10%

Q9. Main Purpose		% of Total
Design Solution	62	52%
Reduce calculation time	14	12%
In-house quality control	6	5%
Validation	41	34%
Visualisation/Animation	8	7%
Other Purpose	6	5%

Q10. Confidence of Models		% of Total
Very confident	6	6%
Confident	49	49%
Neutral	35	35%
Unconfident	7	7%
Very unconfident	2	2%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	29	24%
Registered Building Practitioner	27	23%
IFE Fire Safety Engineer	12	10%
Fire Safety Engineering graduates	51	43%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	32	27%
Qualified through Experience	35	29%
Average Experience (years)	19.3235	
Chartered Engineer of a different body	14	12%
Other Qualification	20	17%

Q12. Specialised Training

		% of Total
Academic Courses	52	43%
Short Courses	55	46%
Average Total Hours:	25.6176	
Continuing Professional Development	57	48%
Risk Assessment Training	14	12%
Practical Fire Training	22	18%
Other Training	13	11%
No Training	17	14%

Computer Fire Models used

Q13. Zone Models

CFAST	52	TM19	2
FAST	23	JET	1
FASTLite	10	CESARE	1
ASET-B	3	SIMULEX ZON	1
BRANZFIRE	21	YARDSTICK	2
FIREWIND	23	DETACT	1
FIRECALC	28	TZAM	1
FPETOOL	18	HAZARD I	5
HOTLAYER	3	FIRST	1
FIRESYS	2	FDS	1
LAVENT	1	ASKFRS	1
CIBSE	1	OWN SPREADSHEET	2

Q14. Field Models

FDS	51
PHOENICS	13
FLUFEMT	1
SMARTFIRE	1
SOFIE	2
FLOD	1
SMOKEVIEW	2
NIST	5
FLUENT	1
JASMINE	1
CFX	1
BRANZFIRE	1

Q15. Evacuation/Egress Models

EVACNET	41	FAST	1
SIMULEX	16	FIRESYS	1
FIRECALC	7	EFFECTIVE WIDTH MODEL	1
FPE TOOL	6	SPREADSHEE	2
HAZARD	1	VACNET	1
PEDROUTE	2	WIC	1
FIREWIND	4	NFPA METHODOLOGY	1
STEPS	4	EXODUS	1
BRANZFIRE	2	EXIT	1
CFAST	1	WAYOUT	11

VERIFICATION

Q17. Verification method		**% of Total**
Engineering analysis	46	38%
Trust the software	17	14%
In-house checking	27	23%
Third party checking	31	26%
Fire/Smoke test	30	25%
Other verification	14	12%

Q18. References regularly consulted

		% of Total
SFPE Handbook	81	68%
NFPA Handbook	51	43%
Building Code of Australia (BCA)	97	81%
Fire Engineering Guidelines, FCRC, 1996	26	22%
Fire Safety Engineering Guidelines, ABCB (2001)	81	68%
Australian Standards	95	79%
International Standards	36	30%
NFPA Codes/Standards	57	25%
Other references	39	33%

Q19. Handbook and Guideline possession

		% of Total
Handbooks	71	59%
Guidelines	69	58%

Designer Statistics

TOTAL DESIGNER RESPONSES 60

PROFESSIONAL INFORMATION

Q1. Regional Distribution

		% of Total
ACT	4	7%
New South Wales	20	33%
Northern Territory	2	3%
Queensland	7	12%
South Australia	4	7%
Tasmania	4	7%
Victoria	16	27%
Western Australia	5	8%
New Zealand	14	23%

Q3. Primary Role Category

		% of Total
Architect	0	0%
Building Owner/Occupier	0	0%
Building Service Engineer	6	10%
Building Surveyor/Certifier	4	7%
Fire Brigade Officer	0	0%
Fire Safety Engineer	56	93%
Academic	0	0%
Other Category	2	3%

Q4. FSE Activities

Fire science	34	57%
Evacuation/Egress	52	87%
Fire-ground operations	10	17%
FSE (Active)	53	88%
FSE (Passive)	47	78%
Fire risk assessment	38	63%
Fire safety	51	85%
Smoke control	51	85%
Fire investigation	6	10%
Fire engineering design	57	95%
Fire insurance	6	10%
Fire safety of Energy sources	3	5%
Fire engineering research	17	28%
Regulation	15	25%
Alternate solutions	51	85%
Other Activity	1	2%

MODEL USE

Q5. Average FSE projects encountered per year

65.1

Q6. Projects Requiring CFMs

		% of Total
	31.2	48%

Q7. Reasons CFMs are not used

		% of Total
No models are "fit for purpose"	23	38%
Calculations are simple	44	73%
Modeling software unavailable	7	12%
Modeling software too complex	11	18%
Other Reason	23	38%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed

		% of Total
HVAC and smoke ventilation	51	85%
Structure	40	67%
Evacuation	50	83%
Detection	54	90%
Suppression	46	77%
Other Aspect	7	12%

Q9. Main Purpose

		% of Total
Design Solution	46	77%
Reduce calculation time	11	18%
In-house quality control	5	8%
Validation	15	25%
Visualisation/Animation	5	8%
Other Purpose	3	5%

Q10. Confidence of Models

		% of Total
Very confident	4	7%
Confident	36	63%
Neutral	16	28%
Unconfident	0	0%
Very unconfident	1	2%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	19	32%
Registered Building Practitioner	21	35%
IFE Fire Safety Engineer	3	5%
Fire Safety Engineering graduates	27	45%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	16	27%
Qualified through Experience	20	33%
Average Experience (years)	15.65	
Chartered Engineer of a different body	7	12%
Other Qualification	12	20%

Q12. Specialised Training

		% of Total
Academic Courses	33	55%
Short Courses	31	52%
Average Total Hours:	30.8823	
Continuing Professional Development	39	65%
Risk Assessment Training	7	12%
Practical Fire Training	8	13%
Other Training	10	17%
No Training	8	13%

Computer Fire Models used

Q13. Zone Models

CFAST	32	TM19	1
FAST	19	JET	1
FASTLite	6	CESARE	0
ASET-B	3	SIMULEX ZON	1
BRANZFIRE	17	YARDSTICK	0
FIREWIND	16	DETACT	1
FIRECALC	20	TZAM	1
FPETOOL	16	HAZARD I	1
HOTLAYER	2	FIRST	1
FIRESYS	2	FDS	0
LAVENT	1	ASKFRS	0
CIBSE	1	OWN SPREADSHEET	0

Q14. Field Models

FDS	37
PHOENICS	11
FLUFEMT	0
SMARTFIRE	0
SOFIE	2
FLOD	0
SMOKEVIEW	1
NIST	4
FLUENT	0
JASMINE	1
CFX	0
BRANZFIRE	1

Q15. Evacuation/Egress Models

EVACNET	31	FAST	0
SIMULEX	14	FIRESYS	1
FIRECALC	2	EFFECTIVE WIDTH MODEL	1
FPE TOOL	5	SPREADSHEE	1
HAZARD	1	VACNET	1
PEDROUTE	1	WIC	0
FIREWIND	2	NFPA METHODOLOGY	0
STEPS	2	EXODUS	0
BRANZFIRE	2	EXIT	1
CFAST	1	WAYOUT	10

VERIFICATION

Q17. Verification method		**% of Total**
Engineering analysis	31	52%
Trust the software	11	18%
In-house checking	14	23%
Third party checking	11	18%
Fire/Smoke test	14	23%
Other verification	9	15%

Q18. References regularly consulted

		% of Total
SFPE Handbook	55	92%
NFPA Handbook	30	50%
Building Code of Australia (BCA)	46	77%
Fire Engineering Guidelines, FCRC, 1996	11	18%
Fire Safety Engineering Guidelines, ABCB (2001)	40	67%
Australian Standards	49	82%
International Standards	22	37%
NFPA Codes/Standards	34	23%
Other references	28	47%

Q19. Handbook and Guideline possession

		% of Total
Handbooks	49	82%
Guidelines	51	85%

Approval Statistics

TOTAL APPROVAL RESPONSES 51

PROFESSIONAL INFORMATION

Q1. Regional Distribution		**% of Total**
ACT	2	4%
New South Wales	10	20%
Northern Territory	3	6%
Queensland	7	14%
South Australia	13	25%
Tasmania	4	8%
Victoria	17	33%
Western Australia	9	18%
New Zealand	3	6%

Q3. Primary Role Category		**% of Total**
Architect	0	0%
Building Owner/Occupier	2	4%
Building Service Engineer	3	6%
Building Surveyor/Certifier	25	49%
Fire Brigade Officer	15	29%
Fire Safety Engineer	15	29%
Academic	2	4%
Other Category	1	2%

Q4. FSE Activities		
Fire science	22	43%
Evacuation/Egress	36	71%
Fire-ground operations	19	37%
FSE (Active)	35	69%
FSE (Passive)	35	69%
Fire risk assessment	31	61%
Fire safety	43	84%
Smoke control	36	71%
Fire investigation	12	24%
Fire engineering design	32	63%
Fire insurance	7	14%
Fire safety of Energy sources	4	8%
Fire engineering research	12	24%
Regulation	42	82%
Alternate solutions	48	94%
Other Activity	2	4%

MODEL USE

Q5. Average FSE projects encountered per year

79.8

Q6. Projects Requiring CFMs

	% of Total
40.7	51%

Q7. Reasons CFMs are not used

		% of Total
No models are "fit for purpose"	17	33%
Calculations are simple	31	61%
Modeling software unavailable	5	10%
Modeling software too complex	10	20%
Other Reason	15	29%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed

		% of Total
HVAC and smoke ventilation	32	63%
Structure	22	43%
Evacuation	36	71%
Detection	35	69%
Suppression	24	47%
Other Aspect	7	14%

Q9. Main Purpose

		% of Total
Design Solution	20	39%
Reduce calculation time	3	6%
In-house quality control	3	6%
Validation	23	45%
Visualisation/Animation	5	10%
Other Purpose	6	12%

Q10. Confidence of Models

		% of Total
Very confident	1	3%
Confident	11	30%
Neutral	17	46%
Unconfident	6	16%
Very unconfident	2	5%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	12	24%
Registered Building Practitioner	10	20%
IFE Fire Safety Engineer	8	16%
Fire Safety Engineering graduates	21	41%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	16	31%
Qualified through Experience	15	29%
Average Experience (years)	23.9285	
Chartered Engineer of a different body	6	12%
Other Qualification	8	16%

Q12. Specialised Training

		% of Total
Academic Courses	15	29%
Short Courses	23	45%
Average Total Hours:	20.13333	
Continuing Professional Development	18	35%
Risk Assessment Training	6	12%
Practical Fire Training	13	25%
Other Training	5	10%
No Training	9	18%

Computer Fire Models used

Q13. Zone Models

CFAST	12	TM19	1
FAST	5	JET	0
FASTLite	3	CESARE	0
ASET-B	0	SIMULEX ZONE	0
BRANZFIRE	3	YARDSTICK	2
FIREWIND	5	DETACT	0
FIRECALC	7	TZAM	0
FPETOOL	3	HAZARD I	1
HOTLAYER	1	FIRST	0
FIRESYS	1	FDS	1
LAVENT	0	ASKFRS	1
CIBSE	0	OWN SPREADSHEET	2

Q14. Field Models

FDS	10
PHOENICS	2
FLUFEMT	0
SMARTFIRE	0
SOFIE	0
FLOD	0
SMOKEVIEW	0
NIST	4
FLUENT	0
JASMINE	0
CFX	0
BRANZFIRE	0

Q15. Evacuation/Egress Models

EVACNET	8	FAST	0
SIMULEX	1	FIRESYS	1
FIRECALC	4	EFFECTIVE WIDTH MODEL	0
FPE TOOL	2	SPREADSHEET	1
HAZARD	0	VACNET	1
PEDROUTE	1	WIC	1
FIREWIND	3	NFPA METHODOLOGY	1
STEPS	0	EXODUS	0
BRANZFIRE	0	EXIT	0
CFAST	1	WAYOUT	1

VERIFICATION

Q17. Verification method		% of Total
Engineering analysis	16	31%
Trust the software	6	12%
In-house checking	12	24%
Third party checking	16	31%
Fire/Smoke test	14	27%
Other verification	8	16%

Q18. References regularly consulted

		% of Total
SFPE Handbook	24	47%
NFPA Handbook	21	41%
Building Code of Australia (BCA)	44	86%
Fire Engineering Guidelines, FCRC, 1996	18	35%
Fire Safety Engineering Guidelines, ABCB (2001)	36	71%
Australian Standards	42	82%
International Standards	11	22%
NFPA Codes/Standards	19	27%
Other references	11	22%

Q19. Handbook and Guideline possession

		% of Total
Handbooks	18	35%
Guidelines	21	41%

Enforcement Statistics

TOTAL ENFORCEMENT RESPONSES 20

PROFESSIONAL INFORMATION

Q1. Regional Distribution		% of Total
ACT	2	10%
New South Wales	8	40%
Northern Territory	2	10%
Queensland	6	30%
South Australia	6	30%
Tasmania	2	10%
Victoria	5	25%
Western Australia	2	10%
New Zealand	3	15%

Q3. Primary Role Category		% of Total
Architect	0	0%
Building Owner/Occupier	1	5%
Building Service Engineer	0	0%
Building Surveyor/Certifier	8	40%
Fire Brigade Officer	8	40%
Fire Safety Engineer	8	40%
Academic	1	5%
Other Category	1	5%

Q4. FSE Activities		
Fire science	8	40%
Evacuation/Egress	13	65%
Fire-ground operations	9	45%
FSE (Active)	9	45%
FSE (Passive)	10	50%
Fire risk assessment	15	75%
Fire safety	15	75%
Smoke control	9	45%
Fire investigation	7	35%
Fire engineering design	7	35%
Fire insurance	3	15%
Fire safety of Energy sources	4	20%
Fire engineering research	8	40%
Regulation	15	75%
Alternate solutions	15	75%
Other Activity	2	10%

MODEL USE

Q5. Average FSE projects encountered per year

50.7	

Q6. Projects Requiring CFMs

	% of Total
37.7	74%

Q7. Reasons CFMs are not used		**% of Total**
No models are "fit for purpose"	8	40%
Calculations are simple	9	45%
Modeling software unavailable	0	0%
Modeling software too complex	5	25%
Other Reason	6	30%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed		**% of Total**
HVAC and smoke ventilation	13	65%
Structure	9	45%
Evacuation	15	75%
Detection	13	65%
Suppression	10	50%
Other Aspect	2	10%

Q9. Main Purpose		**% of Total**
Design Solution	8	40%
Reduce calculation time	3	15%
In-house quality control	3	15%
Validation	9	45%
Visualisation/Animation	2	10%
Other Purpose	3	15%

Q10. Confidence of Models		**% of Total**
Very confident	2	17%
Confident	3	25%
Neutral	4	33%
Unconfident	3	25%
Very unconfident	0	0%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	2	10%
Registered Building Practitioner	3	15%
IFE Fire Safety Engineer	5	25%
Fire Safety Engineering graduates	7	35%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	5	25%
Qualified through Experience	6	30%
Average Experience (years)	21.1666	
Chartered Engineer of a different body	1	5%
Other Qualification	5	25%

Q12. Specialised Training

		% of Total
Academic Courses	6	30%
Short Courses	6	30%
Average Total Hours:	26.5	
Continuing Professional Development	4	20%
Risk Assessment Training	3	15%
Practical Fire Training	7	35%
Other Training	3	15%
No Training	1	5%

Computer Fire Models used

Q13. Zone Models

CFAST	7	TM19	1
FAST	0	JET	0
FASTLite	1	CESARE	0
ASET-B	0	SIMULEX ZON	0
BRANZFIRE	1	YARDSTICK	1
FIREWIND	2	DETACT	0
FIRECALC	4	TZAM	0
FPETOOL	1	HAZARD I	2
HOTLAYER	1	FIRST	0
FIRESYS	0	FDS	0
LAVENT	0	ASKFRS	1
CIBSE	0	OWN SPREADSHEET	2

Q14. Field Models

FDS	5
PHOENICS	0
FLUFEMT	0
SMARTFIRE	0
SOFIE	0
FLOD	0
SMOKEVIEW	1
NIST	2
FLUENT	1
JASMINE	0
CFX	0
BRANZFIRE	0

Q15. Evacuation/Egress Models

EVACNET	3	FAST	0
SIMULEX	0	FIRESYS	0
FIRECALC	1	EFFECTIVE WIDTH MODEL	0
FPE TOOL	1	SPREADSHEE	1
HAZARD	0	VACNET	1
PEDROUTE	0	WIC	0
FIREWIND	0	NFPA METHODOLOGY	0
STEPS	1	EXODUS	0
BRANZFIRE	0	EXIT	0
CFAST	0	WAYOUT	1

VERIFICATION

Q17. Verification method		**% of Total**
Engineering analysis	10	50%
Trust the software	4	20%
In-house checking	6	30%
Third party checking	6	30%
Fire/Smoke test	7	35%
Other verification	2	10%

Q18. References regularly consulted

		% of Total
SFPE Handbook	10	50%
NFPA Handbook	10	50%
Building Code of Australia (BCA)	16	80%
Fire Engineering Guidelines, FCRC, 1996	10	50%
Fire Safety Engineering Guidelines, ABCB (2001)	15	75%
Australian Standards	14	70%
International Standards	4	20%
NFPA Codes/Standards	9	35%
Other references	4	20%

Q19. Handbook and Guideline possession

		% of Total
Handbooks	6	30%
Guidelines	6	30%

Fire Saftey Engineer Statistics

TOTAL FIRE SAFETY ENGINEER RESPONSES 73

PROFESSIONAL INFORMATION

Q1. Regional Distribution

		% of Total
ACT	5	7%
New South Wales	24	33%
Northern Territory	2	3%
Queensland	9	12%
South Australia	5	7%
Tasmania	4	5%
Victoria	21	29%
Western Australia	6	8%
New Zealand	15	21%

Q3. Primary Role Category

		% of Total
Architect	0	0%
Building Owner/Occupier	0	0%
Building Service Engineer	4	27%
Building Surveyor/Certifier	4	5%
Fire Brigade Officer	2	3%
Fire Safety Engineer	73	100%
Academic	1	1%
Other Category	0	0%

Q2. Primary Role

		% of Total
Design	56	77%
Approval	15	21%
Enforcement	8	11%
Other Role	6	8%

Q4. FSE Activities

Fire science	42	58%
Evacuation/Egress	63	86%
Fire-ground operations	17	23%
FSE (Active)	60	82%
FSE (Passive)	55	75%
Fire risk assessment	50	68%
Fire safety	63	86%
Smoke control	59	81%
Fire investigation	13	18%
Fire engineering design	64	88%
Fire insurance	8	11%
Fire safety of Energy sources	6	8%
Fire engineering research	24	33%
Regulation	27	37%
Alternate solutions	63	86%
Other Activity	1	1%

MODEL USE

Q5. Average FSE projects encountered per year

69.1	

Q6. Projects Requiring CFMs

	% of Total
34.2	49%

Q7. Reasons CFMs are not used

		% of Total
No models are "fit for purpose"	26	36%
Calculations are simple	54	74%
Modeling software unavailable	7	10%
Modeling software too complex	14	19%
Other Reason	24	33%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed

		% of Total
HVAC and smoke ventilation	61	84%
Structure	43	59%
Evacuation	61	84%
Detection	63	86%
Suppression	51	70%
Other Aspect	11	15%

Q9. Main Purpose

		% of Total
Design Solution	50	68%
Reduce calculation time	14	19%
In-house quality control	5	7%
Validation	23	32%
Visualisation/Animation	6	8%
Other Purpose	3	4%

Q10. Confidence of Models

		% of Total
Very confident	6	8%
Confident	39	53%
Neutral	20	27%
Unconfident	1	1%
Very unconfident	1	1%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	23	32%
Registered Building Practitioner	21	29%
IFE Fire Safety Engineer	6	8%
Fire Safety Engineering graduates	34	47%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	18	25%
Qualified through Experience	23	32%
Average Experience (years)	16.4347	
Chartered Engineer of a different body	7	10%
Other Qualification	15	21%

Q12. Specialised Training **% of Total**

		% of Total
Academic Courses	41	56%
Short Courses	35	48%
Average Total Hours:	20.1333	
Continuing Professional Development	44	60%
Risk Assessment Training	9	12%
Practical Fire Training	14	19%
Other Training	10	14%
No Training	8	11%

VERIFICATION

Q17. Verification method **% of Total**

		% of Total
Engineering analysis	37	51%
Trust the software	13	18%
In-house checking	18	25%
Third party checking	14	19%
Fire/Smoke test	14	19%
Other verification	10	14%

Q18. References regularly consulted **% of Total**

		% of Total
SFPE Handbook	63	86%
NFPA Handbook	39	53%
Building Code of Australia	58	79%
Fire Engineering Guideline	14	19%
Fire Safety Engineering Gui	51	70%
Australian Standards	59	81%
International Standards	29	40%
NFPA Codes/Standards	41	19%
Other references	34	47%

Q19. Handbook and Guideline possession **% of Total**

		% of Total
Handbooks	58	79%
Guidelines	57	78%

Non-Fire Safety Engineer Statistics

TOTAL NON-FIRE SAFETY ENGINEER RESPONS 47

PROFESSIONAL INFORMATION

Q1. Regional Distribution		% of Total
ACT	1	2%
New South Wales	10	21%
Northern Territory	1	2%
Queensland	6	13%
South Australia	12	26%
Tasmania	2	4%
Victoria	11	23%
Western Australia	5	11%
New Zealand	0	0%

Q3. Primary Role Category		% of Total
Architect	0	0%
Building Owner/Occupier	3	6%
Building Service Engineer	3	8%
Building Surveyor/Certifier	23	49%
Fire Brigade Officer	16	34%
Fire Safety Engineer	0	0%
Academic	2	4%
Other Category	3	6%

Q2. Primary Role		% of Total
Design	4	9%
Approval	36	77%
Enforcement	12	26%
Other Role	10	21%

Q4. FSE Activities		
Fire science	15	32%
Evacuation/Egress	28	60%
Fire-ground operations	14	30%
FSE (Active)	29	62%
FSE (Passive)	30	64%
Fire risk assessment	26	55%
Fire safety	37	79%
Smoke control	29	62%
Fire investigation	9	19%
Fire engineering design	25	53%
Fire insurance	3	6%
Fire safety of Energy sources	4	9%
Fire engineering research	8	17%
Regulation	36	77%
Alternate solutions	39	83%
Other Activity	3	6%

MODEL USE

Q5. Average FSE projects encountered per year

	52.4

Q6. Projects Requiring CFMs

		% of Total
	30.6	58%

Q7. Reasons CFMs are not used

		% of Total
No models are "fit for purpose"	16	34%
Calculations are simple	25	53%
Modeling software unavailable	4	9%
Modeling software too complex	10	21%
Other Reason	13	28%

MODEL PURPOSE

Q8. Aspects of Fire Safety addressed

		% of Total
HVAC and smoke ventilation	28	60%
Structure	19	40%
Evacuation	28	60%
Detection	27	57%
Suppression	20	43%
Other Aspect	1	2%

Q9. Main Purpose

		% of Total
Design Solution	12	26%
Reduce calculation time	0	0%
In-house quality control	1	2%
Validation	18	38%
Visualisation/Animation	2	4%
Other Purpose	3	6%

Q10. Confidence of Models

		% of Total
Very confident	0	0%
Confident	10	27%
Neutral	15	41%
Unconfident	6	16%
Very unconfident	1	3%

QUALIFICATION

Q11. Qualifications

		% of Total
IEAust (Fire Safety Engineer)	6	13%
Registered Building Practitioner	6	13%
IFE Fire Safety Engineer	6	13%
Fire Safety Engineering graduates	17	36%
Most common universities:	University of Canterbury, Victoria University of Technology, University of Western Sydney	
Qualified through another discipline	14	30%
Qualified through Experience	23	49%
Average Experience (years)	16.4347	
Chartered Engineer of a different body	7	15%
Other Qualification	5	11%

Q12. Specialised Training

		% of Total
Academic Courses	11	23%
Short Courses	35	43%
Average Total Hours:	15.0833	
Continuing Professional Development	13	28%
Risk Assessment Training	5	11%
Practical Fire Training	8	17%
Other Training	3	6%
No Training	9	19%

VERIFICATION

Q17. Verification method

		% of Total
Engineering analysis	9	19%
Trust the software	4	9%
In-house checking	9	19%
Third party checking	17	36%
Fire/Smoke test	16	34%
Other verification	4	9%

Q18. References regularly consulted

		% of Total
SFPE Handbook	18	38%
NFPA Handbook	12	26%
Building Code of Australia	39	83%
Fire Engineering Guideline	12	26%
Fire Safety Engineering Gui	30	64%
Australian Standards	36	77%
International Standards	7	15%
NFPA Codes/Standards	16	34%
Other references	5	11%

Q19. Handbook and Guideline possession

		% of Total
Handbooks	13	28%
Guidelines	12	26%

Distribution > Role

	Design	Approval	Enforcement
Australian Capital Territory	4	2	2
New South Wales	20	10	8
Northern Territory	2	3	2
Queensland	7	7	6
South Australia	4	13	6
Tasmania	4	4	2
Victoria	16	17	5
Western Australia	5	9	2
New Zealand	14	3	3
Australia (TOTAL)	62	65	33

	Design	Approval	Enforcement
Australian Capital Territory	67%	33%	33%
New South Wales	59%	29%	24%
Northern Territory	67%	100%	67%
Queensland	47%	47%	40%
South Australia	24%	76%	35%
Tasmania	67%	67%	33%
Victoria	50%	53%	16%
Western Australia	45%	82%	18%
New Zealand	93%	20%	20%
Australia (TOTAL)	50%	52%	27%
New Zealand (TOTAL)	93%	20%	20%

CFM Project % by Role

Design CFM Projects	48%
Approval CFM Projects	51%
Enforcement CFM Projects	74%
AHJ CFM Projects	52%

Role > Main Purpose

	Design Solution	Reduce calculation time	In-house quality control	Validation	Visualisation/ Animation
Designer	46	11	5	15	5
Approval	20	3	3	23	5
Enforcer	8	3	3	9	2

	Design Solution	Reduce calculation time	In-house quality control	Validation	Visualisation/ Animation
Designer	77%	18%	8%	25%	8%
Approval	39%	6%	6%	45%	10%
Enforcer	40%	15%	15%	45%	10%

Role > Aspects

	HVAC and Smoke Ventilation	Structure	Evacuation	Detection	Suppression
Design	51	40	50	54	46
Approval	32	22	36	35	24
Enforcement	13	9	15	13	10

	HVAC and Smoke Ventilation	Structure	Evacuation	Detection	Suppression
Design	85%	67%	83%	90%	77%
Approval	63%	43%	71%	69%	47%
Enforcement	65%	45%	75%	65%	50%

Role > Confidence

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Designer	4	36	16	0	1
Approval	1	11	17	6	2
Enforcer	2	3	4	3	0

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Designer	7%	60%	27%	0%	2%
Approval	2%	22%	33%	12%	4%
Enforcer	10%	15%	20%	15%	0%

Role > Qualifications

	IEAust	Registered Building Practitioner	IFE Fire Safety Engineer	Fire Safety Engineering graduates	Qualified through another discipline	Qualified through experience	Chartered Engineer, diff. prof. body
Design	19	21	3	27	16	20	7
Approval	12	10	8	21	16	15	6
Enforcement	2	3	5	7	5	6	1

	IEAust	Registered Building Practitioner	IFE Fire Safety Engineer	Fire Safety Engineering graduates	Qualified through another discipline	Qualified through experience	Chartered Engineer, diff. prof. body
Design	32%	35%	5%	45%	27%	33%	12%
Approval	24%	20%	16%	41%	31%	29%	12%
Enforcement	10%	15%	25%	35%	25%	30%	5%

Role > Reasons CFMs are not used

	No Models are 'Fit for Purpose'	Calculations are Simple	Modelling Software Unavailable	Modeling Software Overly Complex	Qualitative Assessment
Designer	23	44	7	11	10
Approval	17	31	5	10	6
Enforcer	8	9	0	5	3

	No Models are 'Fit for Purpose'	Calculations are Simple	Modelling Software Unavailable	Modeling Software Overly Complex	Qualitative Assessment
Designer	38%	73%	12%	18%	17%
Approval	33%	61%	10%	20%	12%
Enforcer	40%	45%	0%	25%	15%

Role > Verification

	Engineering Analysis	Trust the Software	In-house Checking	Third Party Checking	Fire/Smoke Test
Designer	31	11	14	11	14
Approval	16	6	12	16	14
Enforcer	10	4	6	6	7

	Engineering Analysis	Trust the Software	In-house Checking	Third Party Checking	Fire/Smoke Test
Designer	52%	18%	23%	18%	23%
Approval	31%	12%	24%	31%	27%
Enforcer	50%	20%	30%	30%	35%

Role > Specialised Training

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
Designer	33	31	39	7	8	8
Approval	15	23	18	6	13	9
Enforcer	6	6	4	3	7	1

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
Designer	55%	52%	65%	12%	13%	13%
Approval	29%	45%	35%	12%	25%	18%
Enforcer	30%	30%	20%	15%	35%	5%

Qualified through experience > Specialised Training

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
Qualified Through Experience	16	21	22	5	7	5

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
Qualified Through Experience	46%	60%	63%	14%	20%	14%

Specialised Training > Confidence

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Academic Courses	4	27	18	2	0
Short Courses	2	23	24	1	1
Continuing Professional Development	4	26	21	1	1
Risk Assessment Training	1	7	4	1	0
Practical Fire Training	1	9	7	2	0
None	1	9	3	2	1

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Academic Courses	8%	52%	35%	4%	0%
Short Courses	4%	42%	44%	2%	2%
Continuing Professional Development	7%	46%	37%	2%	2%
Risk Assessment Training	7%	50%	29%	7%	0%
Practical Fire Training	5%	41%	32%	9%	0%
None	6%	53%	18%	12%	6%

Confidence > Verification

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Engineering Analysis	2	21	16	0	0
Trust the Software	2	8	6	0	1
In-House Checking	3	9	9	2	0
Third Party Checking	2	13	6	2	0
Fire/Smoke Test	3	11	6	5	1

	Very Confident	Confident	Neutral	Unconfident	Very Unconfident
Engineering Analysis	4%	46%	35%	0%	0%
Trust the Software	12%	47%	35%	0%	6%
In-House Checking	11%	33%	33%	7%	0%
Third Party Checking	6%	42%	19%	6%	0%
Fire/Smoke Test	10%	37%	20%	17%	3%

Distribution > References

	ACT	New South Wales	Northern Territory	Queens-land	South Australia	Tasmania	Victoria	Western Australia
SFPE Handbook	5	23	2	12	8	6	22	7
NFPA Handbook	3	15	2	6	8	4	20	5
Building Codes of Australia	6	32	3	14	15	6	28	10
Fire Engineering Guidelines, FCRC, 1996	2	13	2	5	7	3	7	4
Fire Safety Engineering Guidelines, 2001	6	28	3	11	9	6	22	9
Australian Standards	5	30	3	13	15	6	28	10
International Standards	4	17	2	5	2	4	11	4
NFPA Codes/Standards	5	19	2	6	6	3	24	5
Textbooks	1	5	1	1	2	2	7	2
Building Codes of New Zealand	0	1	0	0	0	0	1	0
Fire Engineering Design Guide, NZ	0	1	0	2	0	1	1	0
New Zealand Standards	0	1	0	0	0	0	1	0

	Australian Capital Territory	New South Wales	Northern Territory	Queens-land	South Australia	Tasmania	Victoria	Western Australia	New Zealand
SFPE Handbook	83%	19%	67%	80%	47%	100%	69%	64%	100%
NFPA Handbook	50%	44%	67%	40%	47%	67%	63%	45%	40%
Building Codes of Australia	100%	94%	100%	93%	88%	100%	88%	91%	13%
Fire Engineering Guidelines, FCRC, 1996	33%	38%	67%	33%	41%	50%	22%	36%	13%
Fire Safety Engineering Guidelines, 2001	100%	82%	100%	73%	53%	100%	69%	82%	27%
Australian Standards	83%	88%	100%	87%	88%	100%	88%	91%	27%
International Standards	67%	50%	67%	33%	12%	67%	34%	36%	27%
NFPA Codes/Standards	83%	56%	67%	40%	35%	50%	75%	45%	40%
Textbooks	17%	15%	33%	7%	12%	33%	22%	18%	27%
Building Codes of New Zealand	0%	3%	0%	0%	0%	0%	3%	0%	33%
Fire Engineering Design Guide, NZ	0%	3%	0%	13%	0%	17%	3%	0%	40%
New Zealand Standards	0%	3%	0%	0%	0%	0%	3%	0%	27%

	Australia (TOTAL)	New Zealand	Australia (TOTAL)	New Zealand (TOTAL)
SFPE Handbook	85	15	69%	100%
NFPA Handbook	63	6	51%	40%
Building Codes of Australia	114	2	92%	13%
Fire Engineering Guidelines, FCRC, 1996	43	2	35%	13%
Fire Safety Engineering Guidelines, 2001	94	4	76%	27%
Australian Standards	110	4	89%	27%
International Standards	49	4	40%	27%
NFPA Codes/Standards	70	6	56%	40%
Textbooks	21	4	17%	27%
Building Codes of New Zealand	2	5	2%	33%
Fire Engineering Design Guide, NZ	5	6	4%	40%
New Zealand Standards	2	4	2%	27%

Primary Role vs References

	Architect	Building Owner / occupier	Building Service Engineer	Building Surveyor/ Certifier	Fire Brigade Officer	Fire Safety Engineer/ Consultant	Academic
SFPE Handbook	0	1	6	12	9	63	1
NFPA Handbook	0	2	3	9	5	39	1
Building Codes of Australia	0	3	6	22	14	58	1
Fire Engineering Guidelines, FCRC, 1996	0	1	4	8	6	14	1
Fire Safety Engineering Guidelines, 2001	0	3	4	17	13	51	1
Australian Standards	0	1	7	21	14	59	2
International Standards	0	1	2	6	2	29	1
NFPA Codes/Standards	0	2	5	10	6	41	2
Textbooks	0	0	1	2	1	16	1
Building Code of New Zealand	0	0	0	1	1	6	0
Fire Engineering Design Guide, NZ	0	0	0	1	0	9	0
New Zealand Standards	0	0	0	1	1	5	0

	Architect	Building Owner / occupier	Building Service Engineer	Building Surveyor/ Certifier	Fire Brigade Officer	Fire Safety Engineer/ Consultant	Academic
SFPE Handbook	0	33%	86%	44%	50%	86%	33%
NFPA Handbook	0	67%	43%	33%	28%	53%	33%
Building Code of Australia	0	100%	86%	81%	78%	79%	33%
Fire Engineering Guidelines, FCRC, 1996	0	33%	57%	30%	33%	19%	33%
Fire Safety Engineering Guidelines, 2001	0	100%	57%	63%	72%	70%	33%
Australian Standards	0	33%	100%	78%	78%	81%	67%
International Standards	0	33%	29%	22%	11%	40%	33%
NFPA Codes/Standards	0	67%	71%	37%	33%	56%	67%
Textbooks	0	0%	14%	7%	6%	22%	33%
Building Codes of New Zealand	0	0%	0%	4%	6%	8%	0%
Fire Engineering Design Guide, NZ	0	0%	0%	4%	0%	12%	0%
New Zealand Standards	0	0%	0%	4%	6%	7%	0%

Role vs References

	Design	Approval	Enforcement
SFPE Handbook	55	24	10
NFPA Handbook	30	21	10
Building Code of Australia	46	44	16
Fire Engineering Guidelines, FCRC, 1996	11	18	10
Fire Safety Engineering Guidelines, 2001	40	36	15
Australian Standards	49	42	14
International Standards	22	11	4
NFPA Codes/Standards	34	19	9
Textbooks	14	4	3
Building Codes of New Zealand	6	2	1
Fire Engineering Design Guide, NZ	9	1	0
New Zealand Standards	5	1	1

	Design	Approval	Enforcement
SFPE Handbook	92%	47%	50%
NFPA Handbook	50%	41%	50%
Building Code of Australia	77%	86%	80%
Fire Engineering Guidelines, FCRC, 1996	18%	35%	50%
Fire Safety Engineering Guidelines, 2001	67%	71%	75%
Australian Standards	82%	82%	70%
International Standards	37%	22%	20%
NFPA Codes/Standards	57%	37%	45%
Textbooks	23%	8%	15%
Building Codes of New Zealand	10%	4%	5%
Fire Engineering Design Guide, NZ	15%	2%	0%
New Zealand Standards	8%	2%	5%

FSE - AUS/NZ vs References

	FSE Australia	FSE New Zealand
SFPE Handbook	50	15
NFPA Handbook	35	6
Building Code of Australia	58	2
Fire Engineering Guidelines, FCRC, 1996	14	2
Fire Safety Engineering Guidelines, 2001	49	4
Australian Standards	57	4
International Standards	27	4
NFPA Codes/Standards	37	6
Textbooks	13	4
Building Codes of New Zealand	1	5
Fire Engineering Design Guide, NZ	3	6
New Zealand Standards	1	4

	FSE Australia	FSE New Zealand
SFPE Handbook	83%	100%
NFPA Handbook	58%	40%
Building Code of Australia	97%	13%
Fire Engineering Guidelines, FCRC, 1996	23%	13%
Fire Safety Engineering Guidelines, 2001	82%	27%
Australian Standards	95%	27%
International Standards	45%	27%
NFPA Codes/Standards	62%	40%
Textbooks	22%	27%
Building Codes of New Zealand	2%	33%
Fire Engineering Design Guide, NZ	5%	40%
New Zealand Standards	2%	27%

Models Used > References

	Zone	Field	Egress
SFPE Handbook	219	63	89
NFPA Handbook	116	39	53
Building Codes of Australia	175	63	71
Fire Engineering Guidelines, FCRC, 1996	42	17	18
Fire Safety Engineering Guidelines, 2001	152	55	56
Australian Standards	178	63	71
International Standards	88	28	35
NFPA Codes/Standards	133	40	57
Textbooks	54	16	18
Building Codes of New Zealand	30	1	13
Fire Engineering Design Guide, NZ	42	5	18
New Zealand Standards	27	1	9

References > Zone Models Used

	CFAST	FAST	FASTLite	ASET-B	BRANZFIRE	FIRECALC	FIREWIND	FPETool	HOTLAYER	HAZARD	FDS	
SFPE Handbook	92%	87%	100%	100%	95%	93%	83%	100%	67%	100%	0%	
NFPA Handbook	48%	52%	40%	33%	48%	57%	57%	33%	67%	40%	0%	
Building Codes of Australia	77%	83%	60%	67%	52%	79%	83%	44%	100%	80%	100%	
Fire Engineering Guidelines, FCRC, 1996	19%	22%	20%	0%	5%	29%	13%	6%	33%	20%	0%	
Fire Safety Engineering Guidelines, 2001	67%	78%	60%	67%	48%	61%	74%	28%	100%	60%	100%	
Australian Standards	79%	83%	70%	67%	52%	82%	78%	56%	67%	60%	100%	
International Standards	40%	26%	20%	33%	48%	43%	39%	22%	33%	20%	0%	
NFPA Codes/Standards	58%	43%	60%	33%	52%	71%	52%	39%	100%	60%	0%	
Textbooks	21%	22%	20%	33%	24%	29%	13%	33%	33%	20%	0%	
Building Codes of New Zealand	10%	4%	20%	33%	19%	11%	9%	28%	0%	40%	0%	
Fire Engineering Design Guide, NZ	15%	9%	20%	33%	29%	18%	17%	28%	0%	20%	0%	
New Zealand Standards	10%	4%	20%	33%	14%	11%	4%	22%	0%	40%	0%	

References > Field Models Used

	FDS	PHOENICS	NIST	BRANZFIRE	
SFPE Handbook	94%	77%	80%	100%	
NFPA Handbook	57%	38%	80%	100%	
Building Codes of Australia	88%	92%	100%	100%	
Fire Engineering Guidelines, FCRC, 1996	22%	15%	80%	0%	
Fire Safety Engineering Guidelines, 2001	78%	85%	80%	0%	
Australian Standards	88%	92%	100%	100%	
International Standards	37%	46%	60%	0%	
NFPA Codes/Standards	63%	38%	60%	0%	
Textbooks	25%	8%	40%	0%	
Building Codes of New Zealand	2%	0%	0%	0%	
Fire Engineering Design Guide, NZ	8%	8%	0%	0%	
New Zealand Standards	2%	0%	0%	0%	

References > Egress Models Used

	EVACNET	SIMULEX	WAYOUT	FIRECALC	FPETool	FIREWIND	STEPS	BRANZFIRE	CFAST	FAST	FIRESYS	VACNET
SFPE Handbook	95%	94%	91%	86%	100%	75%	100%	100%	100%	100%	100%	100%
NFPA Handbook	46%	63%	55%	57%	33%	75%	75%	100%	100%	100%	100%	100%
Building Codes of Australia	73%	81%	100%	100%	17%	50%	100%	50%	0%	100%	0%	100%
Fire Engineering Guidelines, FCRC, 1996	24%	6%	18%	43%	0%	0%	0%	0%	0%	100%	0%	100%
Fire Safety Engineering Guidelines, 2001	61%	63%	82%	57%	17%	75%	75%	0%	0%	0%	0%	100%
Australian Standards	76%	75%	82%	100%	33%	50%	100%	100%	0%	100%	0%	100%
International Standards	63%	45%	14%	0%	25%	50%	50%	0%	0%	0%	100%	34%
NFPA Codes/Standards	56%	69%	64%	86%	50%	25%	75%	50%	0%	100%	0%	100%
Textbooks	24%	25%	9%	14%	0%	0%	25%	0%	0%	0%	0%	100%
Building Codes of New Zealand	10%	6%	0%	0%	50%	50%	0%	0%	100%	0%	100%	100%
Fire Engineering Design Guide, NZ	20%	19%	18%	14%	33%	0%	0%	50%	0%	0%	0%	100%
New Zealand Standards	10%	6%	0%	0%	33%	25%	0%	0%	0%	0%	0%	100%

Models Used > Confidence

	Very Confident	Confident	Neutral	Unconfident	Very unconfident
ZONE					
CFAST	8%	56%	29%	4%	2%
FAST	4%	61%	100%	4%	0%
FASTLite	10%	60%	20%	0%	0%
ASET-B	0%	67%	33%	0%	0%
BRANZFIRE	0%	81%	19%	0%	0%
FIRECALC	0%	68%	25%	4%	4%
FIREWIND	9%	78%	17%	0%	0%
FPETool	0%	56%	44%	0%	0%
HOTLAYER	33%	67%	0%	0%	0%
HAZARD	0%	0%	80%	20%	0%
FDS	0%	0%	100%	0%	0%
FIELD					
FDS	6%	61%	25%	2%	4%
PHOENICS	8%	77%	15%	0%	0%
NIST	20%	20%	40%	0%	0%
BRANZFIRE	0%	100%	0%	0%	0%
EGRESS					
EVACNET	7%	63%	29%	0%	0%
SIMULEX	0%	69%	31%	0%	0%
WAYOUT	18%	73%	9%	0%	0%
FIRECALC	0%	71%	14%	0%	0%
FPETool	0%	33%	67%	0%	0%
FIREWIND	0%	75%	25%	0%	0%
STEPS	0%	75%	25%	0%	0%
BRANZFIRE	0%	100%	0%	0%	0%
CFAST	0%	0%	100%	0%	0%
FAST	0%	17%	0%	0%	0%
FIRESYS	0%	0%	100%	0%	0%

Main Purpose > Models Used

	Design Solution	Reduce calculation time	In-house quality control	Validation	Graphical visualisation/ animation
ZONE					
CFAST	63%	19%	8%	35%	8%
FAST	70%	4%	0%	39%	4%
FASTLite	60%	10%	0%	40%	0%
ASET-B	100%	0%	0%	0%	0%
BRANZFIRE	62%	19%	0%	33%	5%
FIRECALC	57%	21%	14%	50%	7%
FIREWIND	57%	22%	0%	35%	9%
FPETool	72%	17%	6%	28%	6%
HOTLAYER	100%	0%	0%	33%	0%
HAZARD	40%	20%	20%	40%	0%
FDS	100%	0%	0%	0%	0%
FIELD					
FDS	67%	14%	6%	35%	8%
PHOENICS	69%	8%	0%	38%	8%
NIST	80%	40%	40%	40%	60%
BRANZFIRE	0%	0%	0%	100%	0%
EGRESS					
EVACNET	71%	22%	7%	32%	5%
SIMULEX	75%	6%	0%	31%	0%
WAYOUT	91%	18%	0%	18%	0%
FIRECALC	14%	14%	0%	100%	14%
FPETool	50%	33%	0%	33%	0%
FIREWIND	25%	25%	0%	75%	0%
STEPS	100%	0%	0%	25%	0%
BRANZFIRE	50%	0%	0%	50%	0%
CFAST	100%	100%	0%	0%	0%
FAST	0%	100%	0%	100%	100%
FIRESYS	100%	100%	0%	0%	0%

Reasons CFMs are not used > Models Used

	No models are "fit for purpose"	Calculations are simple	Modeling software unavailable	Modeling software overly complex	Qualitative Assessment
ZONE					
CFAST	37%	79%	12%	23%	12%
FAST	30%	61%	9%	13%	22%
FASTLite	10%	40%	10%	10%	10%
ASET-B	0%	100%	0%	33%	33%
BRANZFIRE	24%	86%	14%	24%	10%
FIRECALC	46%	68%	7%	18%	18%
FIREWIND	39%	83%	4%	22%	26%
FPETool	17%	83%	6%	22%	11%
HOTLAYER	67%	33%	33%	33%	0%
HAZARD	20%	80%	20%	60%	0%
FDS	0%	100%	0%	100%	0%
FIELD					
FDS	39%	73%	8%	18%	20%
PHOENICS	46%	69%	15%	15%	23%
NIST	0%	60%	20%	0%	60%
BRANZFIRE	0%	0%	100%	100%	0%
EGRESS					
EVACNET	46%	80%	12%	20%	12%
SIMULEX	38%	100%	13%	25%	6%
WAYOUT	45%	64%	9%	27%	18%
FIRECALC	14%	43%	0%	29%	29%
FPETool	17%	67%	0%	67%	17%
FIREWIND	25%	100%	25%	50%	0%
STEPS	50%	100%	0%	25%	0%
BRANZFIRE	50%	50%	50%	50%	0%
CFAST	0%	100%	0%	100%	0%
FAST	0%	0%	0%	0%	100%
FIRESYS	0%	100%	0%	100%	0%

Role > Models Used

	Design	Approval	Enforcement
ZONE			
CFAST	62%	23%	13%
FAST	83%	22%	0%
FASTLite	60%	30%	10%
ASET-B	100%	0%	0%
BRANZFIRE	81%	14%	5%
FIRECALC	71%	25%	14%
FIREWIND	70%	22%	9%
FPETool	89%	17%	6%
HOTLAYER	67%	33%	33%
HAZARD	20%	20%	40%
FDS	0%	100%	0%
FIELD			
FDS	73%	20%	10%
PHOENICS	85%	15%	0%
NIST	80%	80%	40%
BRANZFIRE	100%	0%	0%
EGRESS			
EVACNET	76%	20%	7%
SIMULEX	88%	6%	0%
WAYOUT	91%	9%	9%
FIRECALC	29%	57%	14%
FPETool	83%	33%	17%
FIREWIND	50%	75%	0%
STEPS	50%	0%	25%
BRANZFIRE	100%	0%	0%
CFAST	100%	100%	0%
FAST	0%	0%	0%
FIRESYS	100%	100%	0%

Specialised Training > Models Used

	Academic Courses	Short Courses	Continuing Professional Development	Risk Assessment Training	Practical Fire Training	None
ZONE						
CFAST	62%	60%	58%	15%	25%	8%
FAST	61%	39%	65%	4%	9%	13%
FASTLite	70%	70%	40%	0%	10%	20%
ASET-B	67%	33%	67%	0%	0%	67%
BRANZFIRE	57%	67%	76%	10%	14%	14%
FIRECALC	71%	64%	57%	14%	18%	7%
FIREWIND	52%	48%	70%	17%	22%	22%
FPETool	61%	61%	67%	0%	6%	11%
HOTLAYER	100%	33%	67%	33%	33%	0%
HAZARD	60%	100%	80%	0%	40%	0%
FDS	0%	100%	0%	0%	0%	0%
FIELD						
FDS	63%	55%	61%	18%	22%	10%
PHOENICS	54%	46%	85%	15%	15%	8%
NIST	60%	60%	80%	20%	20%	0%
BRANZFIRE	0%	0%	0%	0%	0%	100%
EGRESS						
EVACNET	71%	56%	66%	17%	20%	2%
SIMULEX	75%	69%	88%	6%	31%	6%
WAYOUT	73%	45%	82%	27%	9%	18%
FIRECALC	71%	71%	43%	0%	29%	14%
FPETool	67%	83%	50%	17%	17%	0%
FIREWIND	25%	50%	50%	25%	25%	50%
STEPS	75%	50%	50%	50%	75%	25%
BRANZFIRE	0%	50%	50%	0%	50%	50%
CFAST	100%	100%	100%	0%	0%	0%
FAST	0%	0%	100%	0%	100%	0%
FIRESYS	100%	100%	100%	0%	0%	0%

Verification > Models Used

	Engineering Analysis	Trust the Software	In-house Checking	Third Party Checking	Fire/Smoke Test
ZONE					
CFAST	44%	17%	25%	23%	21%
FAST	52%	17%	9%	22%	26%
FASTLite	40%	30%	0%	0%	40%
ASET-B	67%	33%	0%	0%	0%
BRANZFIRE	57%	5%	10%	14%	19%
FIRECALC	54%	21%	21%	25%	21%
FIREWIND	43%	13%	13%	13%	30%
FPETool	67%	28%	11%	6%	6%
HOTLAYER	100%	33%	33%	100%	100%
HAZARD	60%	0%	60%	20%	40%
FDS	0%	0%	100%	0%	0%
FIELD					
FDS	51%	16%	24%	22%	24%
PHOENICS	46%	15%	8%	23%	46%
NIST	80%	20%	40%	0%	0%
BRANZFIRE	0%	0%	0%	0%	100%
EGRESS					
EVACNET	56%	24%	29%	29%	15%
SIMULEX	56%	6%	19%	31%	25%
WAYOUT	64%	18%	9%	27%	55%
FIRECALC	14%	29%	14%	0%	43%
FPETool	50%	33%	0%	0%	17%
FIREWIND	50%	25%	0%	0%	25%
STEPS	50%	0%	25%	50%	25%
BRANZFIRE	0%	0%	50%	0%	50%
CFAST	100%	0%	0%	0%	100%
FAST	0%	0%	100%	0%	0%
FIRESYS	100%	0%	0%	0%	100%

Appendix G - Focus Group Summary

G.1 Summary of Focus Group – 17 February 2004

In order to develop purposeful, pertinent guidelines, a focus group was held at the AFAC office with members participating in person and via teleconference. Peter Johnson of ARUP, Paul England of SFS, and Stephen Kip of Warrington Fire Research attended in person, while Professor Jonathan Barnett of WPI, Brian Ashe of ABCB, Stephen Wise of Grubits & Associates, and Simon Davis of the New Zealand Fire Service participated via telephone. This combination of fire practitioners was intended to represent a broad range of fire practitioners in Australasia. The focus group's purpose was to discuss the results of the survey, and to use the results to further develop guidelines regarding computer fire model use. The agenda followed the sections of the questionnaire, with the three main categories being Model Use, Qualification, and Verification.

The first item addressed was that of the target guideline audience. It was decided that these guidelines will apply to all FSE practitioners who encounter computer fire models. As a starting point, the first guideline pertains to the question of whether or not computer fire models are necessary. Next, the comment was made that models should be used as only one of many tools in the design process. Fire models should not be relied on as the sole method of deriving results. One participant remarked that people taking results from the models need a healthy scepticism and knowledge of the uncertainty of the models. Another note was made regarding which CFMs are most commonly used. It was suggested that training be aimed at the most frequently used models. It was also determined that in order to develop guidelines regarding which models to use, extensive research would need to be performed on CFMs. This would include an input analysis and sensitivity analysis, among other tasks.

The next section focused on the topic of qualifications. It was agreed that the engineer and the Authority Having Jurisdiction (AHJ) using a fire model need significant, but not equal, qualifications. The idea was brought up that all professionals using CFMs should receive Continuing Professional Development (CPD) training on a regular basis, and that qualification by experience was not sufficient enough. Another point was raised regarding the difference between the engineer of the design and the actual body that inputs the data into the fire model. It was decided that regardless of who actually inputs the data, the engineer needs to evaluate and understand the entire process. Similar to the BRE KPIs, it was also agreed upon that in-house and third party checkers should be required to have sufficient qualification and experience, as they are the ones who review the work and make the final decision for approval.

Discussion on the Verification section went into the most detail. The primary concern was the documentation during the CFM process. Specifically, items that need documentation are inputs, results, and any engineering analysis performed. This is necessary to provide evidence in any future inquiries about a design. Another topic discussed was that of model verification via alternative methods. For example, other fire models or actual fire tests should be used to verify any model-based results. Although further verification was suggested in terms of referencing the Building Code of Australia, Fire Safety Engineering Guidelines, and Australian Standards, it was decided that these references relate to FSE design as a whole, and are not specific to CFMs. These references, however, should exist nationally in all offices where computer fire models are being utilized.

The final discussion concentrated on the actual title of the guideline document. The issue was raised that the title “Best Practice Guidelines” should be changed to “Reasonable Practice Guidelines” or “Minimal Practice Guidelines.” This was recommended due to the legal obligations of a document entitled “Best Practice.” Upon further discussion, the title “Practice Guidelines” was agreed upon, with ‘Accepted’ and ‘Preferred’ sections. ‘Acceptable’ guidelines would be those which are the bare minimum, while ‘Preferred’ guidelines would suggest a higher level of practice. The meeting then adjourned with the understanding that this project will provide recommendations for guidelines, but will hopefully be expanded upon in the near future by those in the FSE field.

G.2 Summary of Focus Group – 18 February 2004

The second focus group met on 18 February in the AFAC office. This focus group occurred because it coincided with another meeting at the AFAC office. Jarrod Edwards and Parkan Behayeddin of MFB and Peter Phillips of CFA were present. The meeting began with an overview of the current progress of the project, followed by a brief explanation of how the meeting would be conducted. The guidelines were studied individually for possible suggestions and modifications. Many important issues were discussed, resulting in some alterations and additions to the drafted guidelines. The first point discussed was the terminology concerning the ‘approver’ and the ‘enforcer.’ It was decided that the term Authority Having Jurisdiction (AHJ), would encompass both terms. An addition to the Verification section was proposed by Peter, reading “Stakeholders should be consulted in the case of an alternate solution." This guideline was agreed upon and adopted. Another suggestion for the Verification section had to do with verifying field and zone model results. It was decided that the guideline should direct practitioners to check zone models with hand calculations, spreadsheets, or other zone models with different assumptions. Field models should be checked with hand calculations, spreadsheets, zone models, or other field models, where applicable. One of the final topics discussed was third party checking. Third party checking was stressed as an important part of the design process. As such, a guideline was added to ensure justification where third party checking was not utilized. The meeting then adjourned with a similar understanding to the first focus group.

Appendix H - Final Draft of Guidelines

Practice Guidelines
for Computer Fire Model Use in Australasia

These guidelines were developed through a study performed in Australasia by four WPI undergraduate students during the time period of January through March, 2004. They are based on survey results and the input gathered through multiple focus groups involving key fire professionals. In complying with these guidelines, it is important to note that the following definitions are assumed:

Computer Fire Model – any computer model that simulates scenarios relating to any aspect of the fire safety engineering field (i.e. fire dynamics, heat transfer, fire behaviour, human behaviour, structural design, etc.)

In-house Checking – verification by an independent party within the organisation

Third Party Checking – verification by an unbiased, independent party outside the organisation

Handbook – computer fire model user's manual

Guidelines – any guidance written for a computer fire model, aside from the user's manual

Continuing Professional Development (CPD) - "The systematic maintenance, improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life".[105] Such things that are considered CPD are attending conferences and/or seminars, reading relevant essays and journals, producing essays and journals, etc.

[105] "Marsden Fire Safety." <http://www.marsden-fire-safety.co.uk/cpd.htm>.

Acceptable Guidelines

Model Use

1. Computer fire models are not necessary if simple calculations provide an appropriate answer.
2. Computer fire models are not always necessary if qualitative results are desired.
3. The designer should ensure that any proposed models are 'fit for purpose,' and provide justification of the decision
4. The designer should be aware of all limitations of the computer fire models to be used, and the design should not exceed any of these limitations.
5. A sensitivity analysis should exist for the relevant application.

Qualifications

6. The designer/AHJ should have relevant qualifications and experience for computer fire modelling and fire behaviour; short courses and CPD relevant to CFMs are essential.
7. Where the designer/AHJ is qualified through experience or through another discipline, education or training through academic programs, short courses, and CPD relevant to CFMs are essential.

Verification

Methodology

8. All input data, assumptions, conditions, parameters, and results should be properly documented.
9. Any engineering analysis used should be properly documented.
10. Where a zone model has been used, the results should be verified with alternate empirical formulas through spreadsheets, hand calculations, or other zone models.
11. Where a field model has been used, the results should be verified by spreadsheets, hand calculations, a zone model, or an alternate field model.

12. The computer models used should be deemed appropriate for the application by in-house checking.
13. Inputs and results should be verified by in-house checking.
14. Independent third party checking should be used or considered.
15. When third party checking has not been used, justification should be provided.
16. The AHJ should be aware of the limitations of the computer model.

References

17. The most relevant FSE references should be consulted for the design.
18. When available, handbooks and guidelines for computer fire models should be referenced in the design and approval processes.
19. Stakeholders should be consulted in the case of an alternate solution.

Preferred Guidelines

Qualifications

20. The designer/AHJ should regularly participate in computer fire modelling CPD courses as appropriate.
21. The designer should have the following qualifications:
    - IEAust certification (FSE)

      or
    - Fire safety engineering post-graduate degree *and*
    - Academic or short course experience

Verification

22. Limited fire tests such as hot smoke tests or non-emergency evacuation tests should be used as part of the checking process for CFM use.

Appendix I - Table of Abbreviations

Table of Abbreviations

Abbreviation	Meaning
ABCB	Australian Building Codes Board
AFAC	Australasian Fire Authorities Council
AFPA	Australian Fire Protection Association
AHJ	Authority Having Jurisdiction
AIBS	Australian Institute of Building Surveyors
BCA	Building Code of Australia
BRE	Building Research Establishment
CFA	Country Fire Authority
CFAST	Consolidated model of Fire growth And Smoke Transport
CFD	Computational Fluid Dynamics
CFM	Computer Fire Model
CPD	Continuing Professional Development
DTS	Deemed To Satisfy
FBIM	Fire Brigade Intervention Model
FDS	Fire Dynamics Simulator
FE	Fire Engineer
FERT	Fire and Emergency Response Training
FPAA	Fire Protection Association of Australia
FPE	Fire Prevention Engineering
FPIAA	Fire Protection Industry Association of Australia
FSE	Fire Safety Engineering
FSE	Fire Safety Engineering
IAFSS	International Association of Fire Safety Science
KPI	Key Performance Indicator
KSI	Key Success Indicator
MFB	Metropolitan Fire Brigade
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NZFS	New Zealand Fire Service
PDF	Portable Document Format
QDR	Quality Design Review
SFPE	Society of Fire Protection Engineers
SFS	Society of Fire Safety
SIG	Special Interest Group