How fire risks should be managed
In enclosed Australian shopping centres

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Abstract

The purpose of this research is to study fire risk management in enclosed shopping centres. Enclosed shopping centres are commercial buildings and as such are regulated as commercial buildings. Over the past decades, there have been a large number of enclosed shopping centres built across the world. In turn, there has been an increase in major fires and loss of life. Enclosed shopping centres are perceived to have lower fire risks than other commercial buildings in Australia. However, evidence has shown that this is not always the case, in particular, the fire in September 2006 at the Myer store in Hobart. The purpose of this research is to find out how the fire risks are managed and to provide a model to guide that management. Enclosed shopping centres have large numbers of people passing through, especially at weekends and other times such as during festive seasons. There are the people who work for the tenants that could be in the hundreds depending on the size of the centre. There are also the service providers such as cleaning and security contractors who are also part of the centre workforce. Centre management has the responsibility of fire risk management and to make sure this risk is minimised.

Firstly, the research looks at risk in relation to probability, external and internal controls. The following chapter deals with the fire risks in commercial buildings and the current systems and processes in place. Next, the knowledge of commercial buildings, the shopping centre industry in Australia and its owners and managers are studied. The conceptual framework is centred on the theory of fire risk and the interaction of the various stakeholders. The conceptual framework comprises fire risk management in enclosed shopping centres and how the various parties interact. The research methodology involves questionnaires and interviews of the many parties involved in the management of fire risks in enclosed shopping centres. The secondary data includes studying the various Australian Standards including AS 3745:2002, AS/NZ 4360 2004:, AS 4655:2005, AS5387.8 and ISO 31000:2009, all are involved with fire risk management and fire regulations in place. The final secondary study discusses the fire in the Myer store in Hobart, Tasmania. This concludes with a clear path to the fire risk management model. The data shows that while there are systems in place there is a need for a model.

The major output of the study is a generic model that can be used at the operational risk management level to map the fire risk management processes. The model is presented with the aid of Operational Risk Management process flow charts and descriptive information including reasons why each area is important to the fire risk management. The result will aid the management of fire risks at the centre management level.

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Doctor of Business Administration Declaration

"I, Malcolm Freeman, declare that the DBA thesis entitled "How fire risks should be managed in enclosed shopping centres" is no more than 65,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work".

Signature Date

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Glossary of Terms

Word or Phase	Meaning/Definition	Source
Australian Standards	Standards Australia is the nation's peak non-government Standards organisation. It is charged by the Commonwealth Government to meet Australia's need for contemporary, internationally aligned Standards and related services	website www.standards.org.au
COSO	The Committee of Sponsoring Organisations of the Treadway Commission. This group issued the landmark document 'Internal Control – Integrated Framework'. This set out the first widely accepted structure for well controlled organisations	Australian Standards AS/NZS 4360, Risk Management
Enclosed Shopping Centre	Shopping centre in which there are free movements between tenancies. Limited entry and exit points	International Council of Shopping Centres
Fire Evacuation and Training Providers	Service providers engaged by the owners/managers to control the fire training and instigate trial evacuations using fire wardens	First Five Minutes
Fire and Emergency Services	Service provided by the various States and Territories for the provision of fire services	State/Territory Government websites
Food Court	Central eating area which is supported by various takeaway food suppliers. This can also include selling of fresh food	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties
Insurance	Coverage provided by a recognised insurance provider	Insurance Council of Australia
Internal Control	Internal control is a process, effected by an entity's board of directors, management and other personnel, designed to provide reasonable assurance regarding the achievements of objectives in the following categories: • Effectiveness and efficiency of operations • Reliability of financial reports • Compliance with applicable laws and regulations	Australian Standards AS/NZS 4360, Risk Management
International Council of Shopping Centres	ICSC the global trade association of the shopping centre industry. Its 75,000 members in the US, Canada and more than 80 other countries include shopping centre owners, developers, managers, marketing specialists, investors, lenders, retailers and other professionals as well as academics and public officials	Website www.icsc.org
Majors (Tenants)	Tenants such as supermarkets, department stores (Myer & David Jones) K Mart, Big W, Target	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties

Glossary of Terms

Word or Phase	Meaning/Definition	Source
Mini Majors (Tenants)	Mini majors are tenants such as Dick Smith, Priceline	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties
Property Manager	The entity given the task of managing the centre on behalf of the owner for fees	CB Ellis
Property Owner	The owner of the property under law. The owner may be a passive investor or investors such as managed funds	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties
Probability	The likelihood of an event or occurrence that can be measured by mathematical formula	Oxford dictionary
Risk	A situation that could be dangerous or have an undesirable outcome	Oxford dictionary
Service Tenants	Post office, optometrists, government providers such as Medicare	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties
Specialty Tenants	Fashion and other apparel. Others include jewellery, travel agents, bakeries, etc.	Centro Colonial First State Westfield, Stocklands, Mirvac, Pacific Properties
Square Metre	Australian enclosed shopping centres are measure by total square metres. This will include tenancy area, common area but not including car parking spaces	International Council of Shopping Centres

Acronyms

Acronym	Meaning
EXODUS	Evacuation Software developed by University of Greenwich London Registered Name
W.W.W.	World Wide Web – Internet

Chapter 1 Introduction – How fire risks should be managed in enclosed shopping centres

1.1 Background – fire risks in enclosed shopping centres

Fire risks, especially in commercial buildings, will continue to be a safety issue. The tragic events of 11 September 2001 in New York clearly show how fire can quickly destroy a major building (www.theage.com). The general consensus is that the higher the building, the higher the risk. The majority of casualties were from the fires that engulfed the twin towers after the planes hit. If the occupants of the twin towers had been able to exit the buildings in a more orderly manner, there was every possibility that there would have been lower casualties. Although these terrorist attacks were an exceptional occurrence, they do show what damage a major fire can cause. Enclosed shopping centres have vast numbers of people visiting each day and also large numbers of staff who work for the tenants. The entry/exit points are restricted due to various factors that will be discussed in this thesis. The general consensus is that fire risks in enclosed shopping centres may be low. However, there are many hundreds of enclosed shopping centres around the world, visited by many people, and this alone increases the risk of fire. Even low-level buildings constitute some level of risk. There are more enclosed shopping centres being built in all countries as the general affluence of their populations increase. However, the support services may not be able to cope as in the Bashundhara City shopping centre fire as discussed in the following section. While fire services have improved over the years with better equipment and resources, they are still at a disadvantage when it comes to major fires. Lives continue to be lost due to fires getting out of hand despite fire services doing as best they can in the circumstances.

How can we manage fire risks in a more productive manner? Is there a better system and process so as to reduce the risk? Is there a model that can be used by managers of enclosed shopping centres? These are the questions that this research will endeavour to answer. During the initial research of my candidature, and following from general discussions with various stakeholders, it was found that there were systems and processes in place to manage fire risks. There appeared to be no best practice model. The initial literature research found that there were only a limited number of papers dealing with fire risks in enclosed shopping centres. From this, the idea of a best practice model became the basis of my research. The research included a conceptual model showing the components of fire risk management in enclosed shopping centres. The research identifies what the major issues are when dealing with the management of fire risks in enclosed shopping centres. (Refer appendix 1 the glossary of terms used in this thesis).

Recent enclosed shopping centre fires

Over the past number of years there have been many cases of fires in enclosed shopping centres. There are case studies to refer to, such as the fire in the Elizabeth St shopping centre in Hobart. According to newspaper reports, the Myer store was completely gutted and resulted in losses of over 54 million dollars (Webster 2009). This fire was the result of an electrical fault within the store that took hold in a short period of time. There were issues with the age of the building and how it was affected by the spread of the fire. Since this fire there have been other major incidents including one in central Sydney at the Broadway centre, again with major fire damage.

There are a number of recent overseas incidents involving enclosed shopping centre fires. There was a major fire in Dhaka, capital of Bangladesh. The Bashundhara City shopping centre – a modern centre – was damaged by fire in March 2009. Seven people were killed while in an elevator and it took six hours to control the fire and 10 hours to finally extinguish it. The blame for the fire was laid on a lack of fire equipment. While Bangladesh can be seen as a Third World country, this centre is located in the central business district of Dhaka. There was also a major fire in 1996 at the Kebon Kembang Shopping centre in Indonesia that claimed 77 lives. There have been other recent fires in shopping centres in the US. They include at least three where a number of fire fighters lost their lives when a shopping centre roof collapsed. A minor smell of burning at the Lakeside Shopping Centre (www.lakeside.uk.com) in early 2001, caused by Littlewoods Retail Ltd, almost resulted in a major fire (Rogers 2003). The company was fined £75,000 ($A125,000) costs for breaches to the *Fire Precautions Act 1971*. The breached condition of their fire certificate included obstruction of fire doors, fire alarms and extinguishers. It was noted that fire precaution log books were not completed and fire evacuation exercises not carried out. Enclosed shopping centres face similar fire risks in all locations. It is only a matter of time until the same issues surface in Australia. There are lessons for tenants of Australian shopping centres as many of the issues arise in much the same way. It is imperative that tenants are involved in all aspects of the reduction of fire risks, including fire evacuation training. Tenants are required to meet their obligations to reduce fire risks inside the tenancy. The tenants hold various types of goods that could include flammable items. Due to the close proximity of the tenancies, fires can move quickly and engulf others in a short space of time. There is an Australian Standard governing fire prevention and control (AS-3745). The majority of shopping centres are privately owned and have various levels of internal controls to identify risk. Many smaller enclosed shopping centres do not have full-time centre staff stationed at the centre. In such cases it is left to the individual tenants to control fire risks. The centre owners/managers outsource the fire prevention systems by engaging specialised service providers. The training providers carry out fire evacuation testing and training of fire

wardens and other staff. This takes place on a six-month rotation. However, fire evacuation is on a pre-determined date and time. Therefore, they are not spontaneous in the testing and this is discussed further in section 3.2.1.

Major Enclosed Shopping Centre Fires

The flowing table shows a number of recent major shopping centre fires. There are many smaller fires that are too numerous to include in this table. However it gives some indication to reason, where and how the fires have started. There are fires that originated in adjoining buildings including railway stations or department stores such as Sennichids and Taiyo in Japan which claimed over 222 lives are not included. The majority of the fires were caused by electrical faults.

Table 1.1 Number of recent major enclosed shopping centre fires

Country	Name of Shopping Centre	Year	Damage In Value if known	Cause (If Known)
Australia	Myer Centre (Hobart)	2007	A$55M	Electrical Fault
Bangladesh	Bashundhara City (Dhaka)	2009	A$75M	Electrical Fault
China	Jilin Shopping Centre	2010	Unknown	Electrical Fault (19 Deaths)
China	Luoyang SC (Night Club)	2000	Unknown	Electrical Fault (309 Deaths)
Indonesia	Kebon Kembang Shopping Centre	1994		Electrical Fault (77 Deaths)
Thailand	Centre World Bangkok	2009	$150m	Riots
Thailand	Santika Club in Shopping Centre	2009	Unknown	Electrical Fault (60 Deaths)
Peru	Mesa Redonda SC(Lima)	2001	Unknown	Electrical Fault (291 Deaths)
UK	Bath Shopping Centre	2008	A$50	Under Construction

1.2 Research problem and contribution

1.2.1 Aims of the research

The aim of this study is to ascertain the risk management at enclosed shopping centres or malls, concentrating on the management of fire risk. Shopping centres are private buildings with unfettered public access (www.icsc.org). Purpose-built shopping centres now form an important element of the urban environment. They service not only retailing but also a host of other services including banks, medical centres and entertainment venues. They draw large crowds at peak times. An enclosed shopping centre is a building or set of buildings that contain a variety of retail or other types of tenants with interconnecting walkways enabling visitors to move from tenant to tenant. A modern centre can be on one level or ranging to vertical centres such as in New York and Hong Kong. The first enclosed

shopping centres appeared in the US in the 1920s (www.icsc.org) and they have spread to most other countries of the world. The enclosed shopping centre in Australia had its beginnings in the early 1950s with centres in Sydney and Melbourne. It is said that many airports are now shopping malls with airports attached – such is the influence of the modern shopping mall. The ownership and management of the modern shopping centre may be in different hands and this has led to the professional shopping centre manager. The modern shopping centre is perceived to have minimal risk due to the configuration of the building. Major incidents at shopping centres in Australia have, until now, been limited to a small number of fires. However, there have been major incidents at shopping centres overseas, including fires and terrorist attacks.

The study concentrates on fire risk, as this is by far the greatest risk in Australia. The risk to Australian centres from events such as cyclones is minimal (Barton and Hardogree 1995). Enclosed shopping centres are commercial buildings and come under this classification in both state and federal laws in respect of fire safety. Each state has its own set of fire regulations including evacuation systems, equipment, and building regulations. The study looks at fire risks and how they are applied to enclosed shopping centres. Each owner/manager is required by law to have a fire plan and evacuation procedures for each shopping centre. The fire services carry out regular testing of fire equipment. However, many owners/managers engage private training providers such as 'First Five Minutes' to support evacuation procedures. The typical enclosed shopping centre has a variety of tenants. They will include a range from low-risk tenants such as fashion clothing shops to high-risk areas such as food courts.

1.2. 2 Research questions

The initial research questions address the risk of fire and how the risks are managed in relation to enclosed shopping centres. The purpose of the research questions is firstly to see what the current process and systems are and secondly to what extent fire services, insurance, government agencies and centre tenants are involved in the fire prevention process. This includes evacuation training and systems. Once this information is known, a model can be constructed. The research questions in the study are the following:

Question		Question	
1.	How is the management of the fire risk analysed and implemented?	**1. (a)**	How are the risks assessed for each building and how are they graded?
1. (b)	Does the owner/manager have a detailed plan available to the tenants and is the public aware of the plan in light of an emergency?	**1. (c)**	Has the owner/manager completed a Fire Safety Audit under the Australian Standard 4655-2005?
1. (d)	Is there a clear legal responsibility for managers and tenants to minimise the fire risk and is this enforced?	**1. (e)**	What is the relationship between the owners and managers in relation to fire safety in the centres?
2.	What relationship does the owner/manager have with the fire and emergency services?	**3.**	What is the best process of fire control and evacuation procedures?

1.2.3 Research contributions

Body of Knowledge

The research is contributing to knowledge in a number of ways. The study will look at all aspects of fire risk management and how each component interacts both internally and externally. The research includes older enclosed shopping centre buildings and what is being undertaken to reduce fire hazards. I believe this is an important area of study due to issues of fire safety. The key contribution of this research is to build an effective model of operational risk management, specifically in the area of fire risk that could be used in Australia and other countries.

Contribution to the Industry/Practioners/Government

Fire risk is considered the major catastrophic risk for any commercial building. Enclosed shopping centres and malls are particularly vulnerable due to a number of factors. The movement of people, especially at peak times and weekends, is a major potential risk. There are limited entry and exits points that are static and not related to the movement of people. This is evident during store sales when many customers are trying to enter a store at the same time and have caused major problems resulting in customers being injured or seriously hurt. The proposed fire risk response model will incorporate all that is required to promote best practice. The objective is to have a model template that can be used by

owners/managers of enclosed shopping centres to provide the highest possible fire safety system. The model can be used in all enclosed shopping centres with a minimal adjustment.

1.2.4 The need for a model

The review of prior knowledge shows that there is no clear understanding from all stakeholders on the fire risks in enclosed shopping centres. There are rules and regulations, training providers, tenants, managers and owners all part of the total picture, but nothing to bring all stakeholders together in one document. The review supports the theory that a model is required to show how fire risks in enclosed shopping centres should be managed. The literature is concentrated on fire risks in general commercial buildings and not specifically enclosed shopping centres. Such centres have unique attributes such as large numbers of tenants and other specific risks that other commercial buildings may not have. The model built gives a detailed breakdown of all the major components that the operational personnel in the enclosed shopping centre should be aware of. The model is being user-friendly and precise.

1.3 Literature

1.3.1 Risk theory

The literature is divided into two distinct areas. Firstly, there is the literature on the theory of risk and, secondly, there is literature on fire risks in commercial buildings. There are numerous research papers covering the theory of risk. This study is confined to major papers covering the theory and calculation of risk. The first part of the literature review looks at the philosophy of risk and the paper by Hansson (2007). This is an important concept and details the five areas that are important to risk. The analysing of risks is discussed with the paper by Emblemsvag and Kjolsad (2006). The paper by White (1995), classifying the concepts of risk is also discussed, including the Poisson theory. The role of Monte Carlo simulation and modelling is discussed and how important it has become in the calculation of risk. Next, the theory of probability and the paper by Andrews (1982) is analysed detailing the history of probability and its relationship to modern risk theory. Risk management is now practised in all countries and the major breakthrough came with the establishment of the Treadway Commission in the USA that set benchmarks in the area of internal control for risk management and is known as COSO. The International Risk Governance Council has also issued a risk governance framework dealing with risk on an international level (www.irgc.org).

Enterprise Risk Management (ERM) in most large organisations has become the standard process to mitigate risk. The theory of moral hazard is discussed, and its implications with risk management and the relationship with insurance. Risk management in Australia is governed by Australian Standards AS 4360:2004 and is now superseded by AS/NZS 31000:2009. The Australian Standards is a generic risk management system for all organisations. The Australian Standards aim to give a basic template for risk management that can be used by all organisations. However, it is up to the individual organisations to adjust the systems for its own needs and risk. Corporate governance has increased in Australia due to a number of corporate failures. However, this is not confined to purely financial risks but now includes operational risks. This will include fire risks that can be detrimental to all organisations and the social, cultural and political impact of risks and how they are perceived by the public in the paper by Kletz (1996).

1.3.2 Commercial buildings

There are also numerous papers in respect to commercial buildings. However, this study is centred on fire risks in enclosed shopping centres. The literature firstly looks at the work by the Warren Centre project in 1989. This involved fire safety in Australia, specifically in the area of risk assessment models and building design. The Australian Standard 3745:200 governs the risks in commercial buildings. However, as with all standards this is generic in nature and is intended to cover all commercial buildings. However, it does serve as a basis for the control of fire and other incidents in commercial buildings. Building regulations in Australia are under the control of the state and territory governments and as such may have different regulations. The literature review looks at the Victorian regulations and how they impact on the fire services in that state. There was a major change in the regulations in Queensland as a result of a fire at a backpackers' hostel in 2000. Those changes to commercial building fire regulations have not been taken up by other states at this point in time. The literature review looks at the paper by Zhao, Yang, Li, Zhu and Zou (2006) that discusses the commercial building exits and pedestrian flow so critical to the safe movement of people. Finally, the literature reviews the Australian shopping centre industry and the impact it has on the economy. This includes the major owners and managers, all of which are public companies. The literature review discusses a paper by Smith (2008) on the fire risks in enclosed shopping centres from the Philadelphia Fire Department's perspective and what can be done to limit the risks.

1.4 Methodology of research

Operational research

The approach to the research is in three phases. The first is the selection of the type of enclosed shopping centre, followed by a questionnaire to the owners and managers. Secondly, interviews were undertaken with other stakeholders including service providers in the area of training, buildings and fire authorities. Interviews were undertaken with stakeholders involved with the buildings. Research will also include how insurance has affected the fire risks in enclosed shopping centres. Thirdly, the research studied the Australian Standards and regulations and a fire at Myer in Hobart, Tasmania.

Selection of enclosed shopping centres to research

The research is confined to the regional and sub-regional enclosed shopping centres as discussed in section 3.6. The regional and sub-regional centres tend to be in the 30,000 to 85,000 sq m tenanted area. The number of permanent tenants ranges from 50 to over 150. There are approximately 271 centres of this size in Australia and they are of a sufficient size to have a higher risk. The smaller supermarket or neighbourhood centres do not pose such a high risk due to their limited tenancies. A selection of regional and sub-regional enclosed shopping centres across all states is part of the research. The centres targeted for the research are managed or owned by different organisations to give a wide sample. This is important as the managers may have differing systems in place to reduce the fire risk. The research required the cooperation of the managers to share their knowledge and be part of the research. There is a need for a comprehensive best practice model that can be referred to as a benchmark in the area of fire risks.

Questionnaire

The questionnaire gathered information on the centres' risk management. The questionnaire has 42 questions covering general centre statistics, fire prevention and fire training. This involved a sample of 50 enclosed shopping centres across Australia. The results of the questionnaire were analysed for any correlation between the centres.

Analysis of questionnaire

The analysis of the questionnaire is in the form of an Excel spreadsheet due to the limited quantitative complexity of the research. There are 42 questions in the questionnaire sent to owners and managers of shopping centres, firstly of a statistical nature in relation to the centre, followed by general questions and finally, opinions required of the management.

Other parties involved with the operational issues

The research included interviews with other parties that are involved with the operations including training providers and major tenants. They also include service providers such as cleaners, security and maintenance contractors.

Building research

The organisations involved with the buildings include architects, project managers, building surveyors and speciality engineering consultants. The secondary areas of the research include Australian standards relating to fires. The commercial building codes and state fire regulations are also important to the research.

External research

The external research is centred on the external influences to enclosed shopping centres. They are the fire services, regulations, insurance and professional associations. These organisations do not have a direct influence; however, the shopping centre management should be mindful of what is required from the external bodies.

Building of the model

The model is generated from the information gained in the questionnaires, interviews and other data. The model was sent to various stakeholders to review and add comments. It is understood that the

model is based on theory and that a full simulation of a fire emergency at an enclosed shopping centre was not possible. However, it is believed to provide all the required components to manage fire risks in enclosed shopping centres.

Outline of the thesis

The report is a reflection of best practice in the control of fire risks at enclosed shopping centres. The research highlights what is needed to reduce the risk of fire in enclosed shopping centres, together with what controls are required including fire evacuation training and other control measures. Risk theory is analysed in Chapter 2. In Chapter 3 the research is centred on the fire risks in commercial buildings and reviews the Australian shopping centre industry and the major owners/managers. Following on in Chapter 4 we have the conceptual framework of the research. In Chapter 5 we look at the methodology of the research and in Chapter 6 the analysis of the data. Chapter 7 builds the model and the components. The conclusions are in Chapter 8.

1.5 Scope and key assumptions

The research is confined to enclosed shopping centres that are located in the suburbs and regional centres in each state. There are enclosed shopping centres that are connected to airports and resorts that have specific fire risks. However, to include this type of centre would expand the research and include specific risks not associated with normal enclosed shopping centres.

1.6 Summary

The introduction of this research highlights the issues that fire risk poses for the enclosed shopping centre. The literature studied showed that while fire risks in general commercial buildings are well documented, there is limited literature on fire risks in enclosed shopping centres. Enclosed shopping centres are treated like any other commercial building in respect to fire risks. However, they have specific characteristics that place them apart from other commercial buildings. This research found the most effective model that could be used as a basis to manage the fire risks. Because this sector of commercial property is perceived to have a low risk, there is less of a requirement for effective controls.

However, even with this perceived low risk it still requires strong fire risk controls. The model shows how that fire risk should be managed.

The following flow chart shows how the research flows from the literature review to the conceptual framework and to the methodology of the research. This is followed with the analysis of the data bring together in model. The final chapter concludes the research with findings and implications.

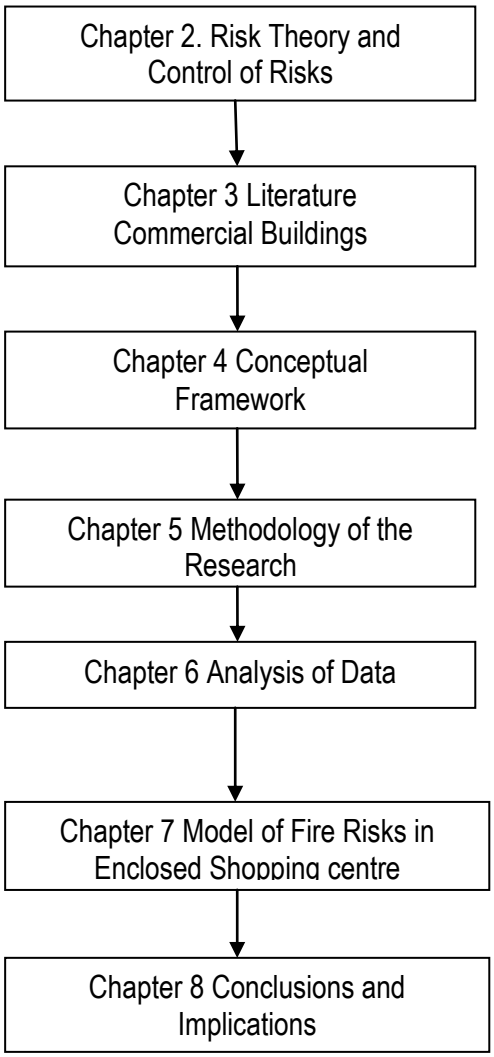


Figure 1.1 Flow Chart of the research

Chapter 2 Risk Theory, Assessment and Control

2.1 Introduction

The first part of this literature review discusses risk theory and its components. The first two sections discuss the risk concepts, followed by the philosophy of risk. The following section deals with calculating and analysing risks. Probability and its related components are discussed in this section. The research moves on to risk assessment and related topics in section 2.3. This is followed by risk control concepts, the importance of the Treadway Commission in the USA (www.coso.org), and the importance of Enterprise Risk Management (ERM) in risk control. This section concludes with related control concepts including risk appetite, Acts of God and non-quantifiable risks such as reputation. Section 2.4.7 deals with the concept of moral hazard and the relationship it has with risk. Section 2.5 studies the Australian Standards AS/NZS 4360:2004, ISO 31000:2009 and how they relate to risk management in Australia (www.standards.com.au). The final sections deal with corporate governance and related concepts. The chapter concludes with the areas discussed and sets the scene for Chapter 3 that deals with commercial property. The study of risk covers a wide spectrum. It is not possible to investigate all risk theory, including financial and economic, as this is not necessary for the research.

2.2 Risk theory

2.2.1 Risk concepts

What is risk? The Oxford dictionary (Waite 2007) defines risk as 'A situation that could be dangerous or have an undesirable outcome'. All human activity has some level of risk. The issue is how we measure that risk and how it is controlled and even reduced. The philosophy of risk is discussed to set the scene in this part of the study. The issues in calculating and analysing risk follow this. Probability is central to the theory of risk and is covered in this part of the literature. The next section deals with the philosophy of risk and how it is perceived and analysed.

2.2.2 The philosophy of risk

The paper by Hansson (2007) looks at the philosophy of risk and the various types. The word *risk* often refers to events that are possible but not certain. Technically, there are five areas that are important in risk as follows:

1. An *unwanted event*, which may or may not occur.
2. The *cause* of an unwanted event that may or may not occur.
3. The *probability* of an unwanted event that may or may not occur.
4. The statistical expectations *value* of an unwanted event that may or may not occur.
5. The fact that a decision is made under conditions of *known probabilities* (decisions under risk as opposed to decisions under uncertainty).

Each of the five areas has some relationship to the probability of an action or event happening. This is fundamental in the theory of risk. In other words, what are the chances of this happening?

Theory of knowledge

Following on from the philosophy of risk the discussion moves to the theory of knowledge. The paper by Gettier (1963) discusses the belief in a situation may be true, but it fails to count as knowledge. Management may believe fire risks are low, but do they have the knowledge to support that theory? The exact knowledge dealt with is critical to the theory of risk. It is interesting to note that the difference between uncertainty and risk is important. Risk is a strongly objective component, whereas uncertainty is very subjective. Uncertainty is an important concept in the area of risk and has a critical influence in the area of risk theory and its application. For example, we may be certain a risk is present; however, if we are uncertain about its form, this makes the calculation of the risk that much more difficult. To put this theory into practical terms we could look at the following scenario. There may have been a belief the building is safe but the truth may be somewhat different. Therefore, the difference between the two is the knowledge that the building is safe. The only way this theory can be completely tested is for a major incident to happen to a building. This may be a fire or other major incident. This is why testing as close to the real thing as possible is of the upmost importance. This includes fire evacuation testing at a time when the tenants do not expect it.

2.2.3 Calculating and analysing risks

The knowledge of risks is fundamental in the next section dealing with calculating and analysing risks. There are a number of ways of calculating and analysing risk and the following methods are used according to the circumstances.

Analytical method

The concept of the analytical method of calculating risk is usually understood to be a three-stage process (Emblemsvag and Kjolsad 2006). The first stage is to take the risk apart and to break it down into subsections. How far it is broken down depends on the risk. The second part is to understand how the behaviour of the parts act separately, and finally, how all the parts come together to make up the total risk profile. This requires highly detailed analysis of the sections or parts. There are issues with the type of analysis as it could become a situation of 'what comes first?' as many risks are closely linked to another. Risks do not occur in isolation. There are interconnecting actions that cause a risk to be evident. One way is to take the components apart, trying to understand the behaviour of the parts and then assemble them into the whole risk. This course of action requires meticulous analysis of all the parts. This can be time-consuming and requires a software application to do the calculations.

Systems thinking method

The systems thinking approach is based on the idea of the emergence of the risk and how the system approach fits into the hierarchy, and finally, the control of those risks. This holistic approach tackles problems by examining the total environment in which they occur (Emblemsvag and Kjolsad 2006).
The researchers propose four types of analysis, as follows:

1. A risk analysis, 2. A sensitivity analysis of the risk analysis, 3.An uncertainty analysis of the risk analysis, and 4. A sensitivity analysis of the uncertainty analysis.

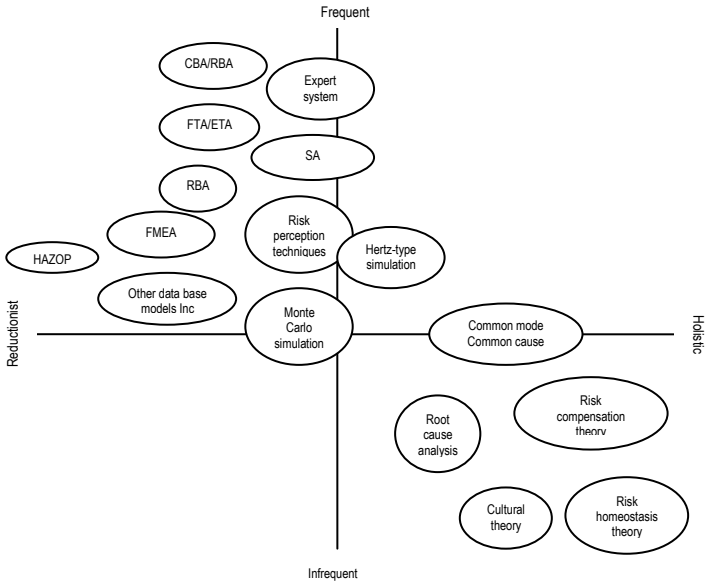
This is a highly complex way of assessing the risk and requires detailed systems analysis that can only take place with advanced computer software. This requires risks to be assessed in a measured way including how the risks are interconnected and how sensitive the risks are to other actions or results. There are many risk assessment techniques and the map in Figure 2.1 shows how they interact with each other. The risk assessment techniques are based on the reductionist and holistic axis and the frequent and infrequent on the other axis. For example, cost benefit analysis is skewed towards the reductionist. If a risk is to be reduced, what are the costs involved? An example would be having permanent staff at each entry/exit point in the enclosed shopping centre in case of an incident. The costs would not equate to the risk. The models that interact with each other include human reliability analysis, event tree analysis, cost/risk benefit analysis, and expert systems database. Risk estimation, risk identification and risk perception techniques are all connected through the above models. There is no one model that is universally accepted.

Mont Carlo Simulation

A third type of model is the Monte Carlo simulation in which logic at sample form distribution are used to reflect real life simulations (White 1995) as shown in figure 2.1

Other risk theoretical models as they compare on the frequent/infrequent and reductionist/holistic axis

The following chart shows how assessment techniques fit into other theories in reductionist and holistic theories. This theoretical model shows that the various risk management models tend to be in the reductionist and frequent area. This supports the theory of reduction and not elimination of the risk.



Key to above chart

HAZOP =	Hazard and operability study	ETA =	Event tree analysis
FTA =	Fault tree analysis	CBA/RBA =	Cost benefit analysis/risk benefit analysis
FMEA =	Failure mode and effect analysis	SA =	Sensibility analysis
HRA =	Human reliability analysis		

Figure 2.1 Classification of concepts relating to risk (White 1995)

The above conceptual map is a possible tool to use in the calculation of the fire risks in enclosed shopping centres. The hazard and operability study theory is a tool to use as a basis to reduce hazard risks including areas such as flammable liquid storage. Another theoretical model is the cost benefit analysis/risk benefit analysis and directly relates to the risk and costs. The Monte Carlo simulation is another tool that sits directly on the reductionist/holistic axis, and is widely used in risk assessment. There are risks that are not easily quantified and as such there are probability models used such as in natural disasters or events beyond human control.

2.2.4 Notion of probability

Probability is fundamental to the theory of risk. Probability refers to the analysis of random phenomena that are events or measured quantities that may either be a single occurrence or evolve over time. The probability theory had its origins in the correspondence between Blaise Pascal and Pierre Fermat in the fortunes and misfortunes at dice of the Chevalier de Mere in 1713 (Andrews 1982). Early probability was concerned with the playing of dice and cards. A defined program was conducted according to fixed rules. Later developments led to the beta and gamma functions and to the whole armoury of probability theory. Probabilities are part of the statistical area of mathematical theory. The statistical distribution that is used to estimate the independent variable is the Poisson distribution. The Poisson distribution is a discrete probability distribution that expresses the probability of the number of events occurring in a fixed period. These events occur with a known average rate and are independent of the time since the last event. The Poisson distribution can also be used for the number of events in other specified intervals such as distance, area or volume. The probability of outcome *n* events when the expectation is *x* and the variable is considered to be distributed according to the Poisson distribution is stated below:

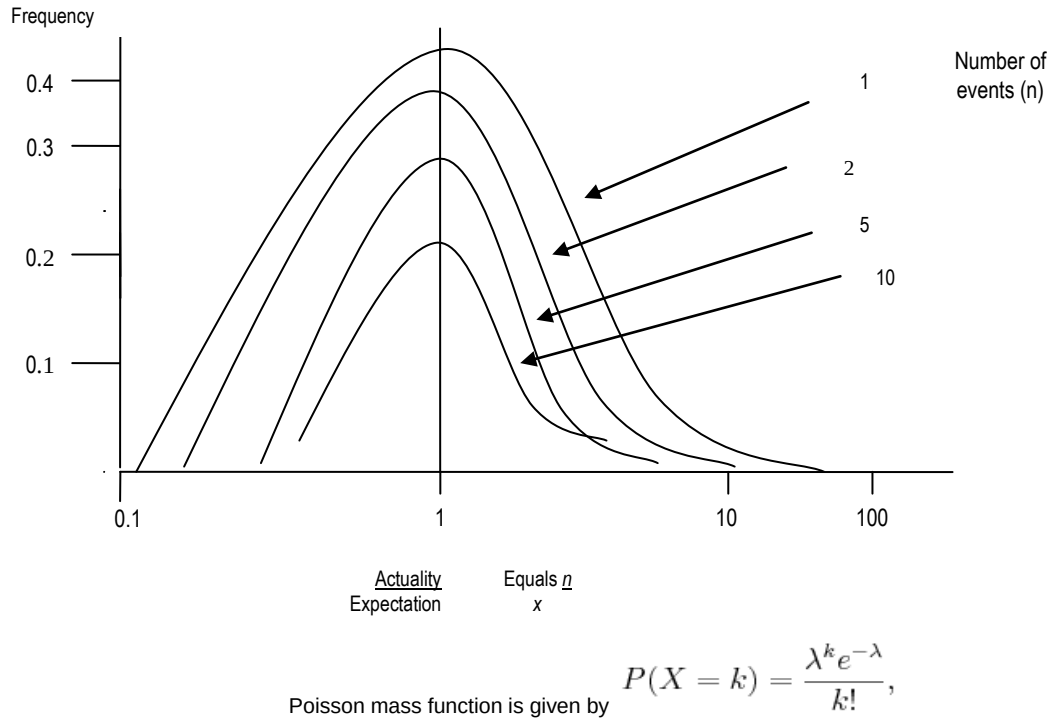


Figure 2.2 Poisson theory

The notion of probability of occurrence is central to all risk assessment techniques. The interpretation of probability depends on whether risk is viewed in an objective or subjective way (White 1995).

Estimation of risk still requires an impartial review. For example: 'What is the probability of a meteor striking the Earth within a given time span?' The chart in Figure 2.3 is an alternative way of showing how probability and consequence interconnect in the calculation of outcomes. The area between problem and catastrophe is the area of credible outcomes. This is the area of highest risk.

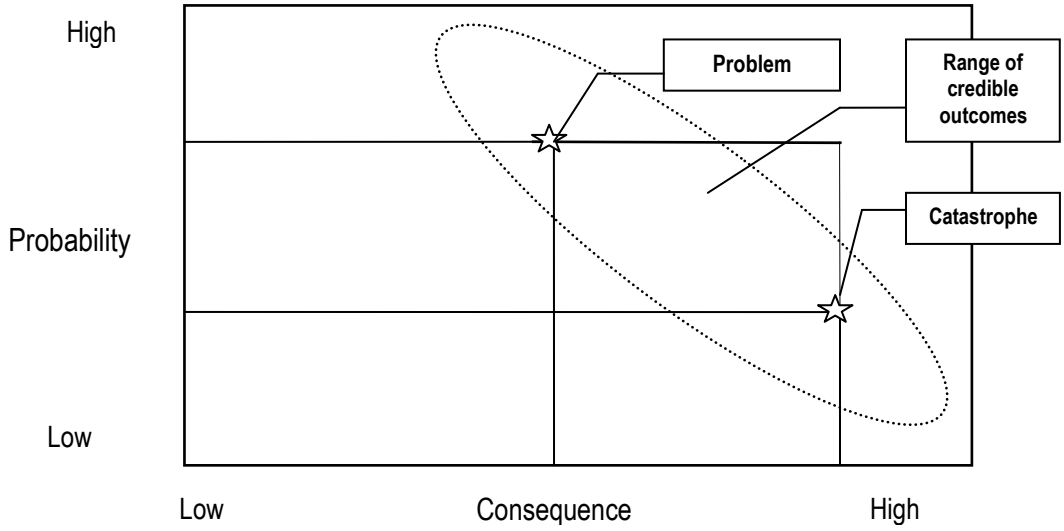


Figure 2.3 Risk with a range of outcomes – source AS/NZS 4360: 2004

Probability and sampling theory

The theory of probability and sampling is an important concept in the area of social research (Babble 2007). This is important when undertaking large-scale research into social questions. It is impossible to question all participants but it is feasible to use an adequate sample that can be small depending on the variables. The probability of an incident occurring is, of course, one of the factors that the public takes into account when risks are involved. However, it is not the only one and the knowledge of the risk and the different size of the risk are often far removed from the actual size (Kletz 1996). The discussion on probability shows that is a major part of risk theory and interlocks with other areas so far discussed.

The theory of probability is important to risk management as it underpins the basis of when an event could or will happen. Because the probability of an event taking place e.g. fire in an enclosed shopping may be low. This does mean that adequate processes and systems to reduce the risk should not be in place. The actual probability of an event taking place is difficult to calculate without the use of computer simulations. The alternative is to have the management practices in place to reduce those risks

The 2.3 Risk assessment

The study moves on from the risk theory including probability and looks at related areas such as risk assessment. This section deals with risk assessment literature and the components that support this part of the research. The two major areas of literature that the study looks at are the literature issued by the Committee of Sponsoring Organisation of the Treadway Commission in the USA (www.coso.org) and the Australian Standards AS/NZS 4360: 2004 (www.standards.com.au) The first part deals with risk identification, estimation and evaluation. This is followed by risk controls and then moves on to risk appetite, Acts of God, transfers, acceptance and avoidance. The next section deals with discussion on non-quantifiable risks such as reputation. The final part of the section deals with moral hazard and the relationship to risk.

Risk identification

The Australian Standards AS/NZS 4360: 2004 in Figure 2.4 state the three distinct areas of risk identification, risk estimation and risk evaluation. This is the first part of the assessment process and involves identifying the risk. This normally involves analysing the situation and breaking down the components. Risks many not be instantly identifiable and they take a period of time to fully comprehend. Part of the process will be to build a risk matrix. The risk matrix is to identify the required controls to reduce those risks.

Risk estimation

Risk estimating requires the use of statistical analysis including the use of probabilities theory that is discussed in 2.2.4. It also includes describing the risk in detail so that as much as possible is known about the risk. This is included in the risk matrix.

Risk evaluation

The final part is the risk evaluation by using the probability of the event happening. It may be acceptable that the risk is low and no action needs to take place. However, risks are not static and regular review is required. This should be monitored on a continuing basis depending on the risk. The objective must always be to concentrate on the core risks. The risk evaluation for commercial buildings

including enclosed shopping centres will take into account various parts. They will include the age and position of the building. The risk evaluation will also include how the building was constructed and state of repair and what are the exit points are in relation to public areas.

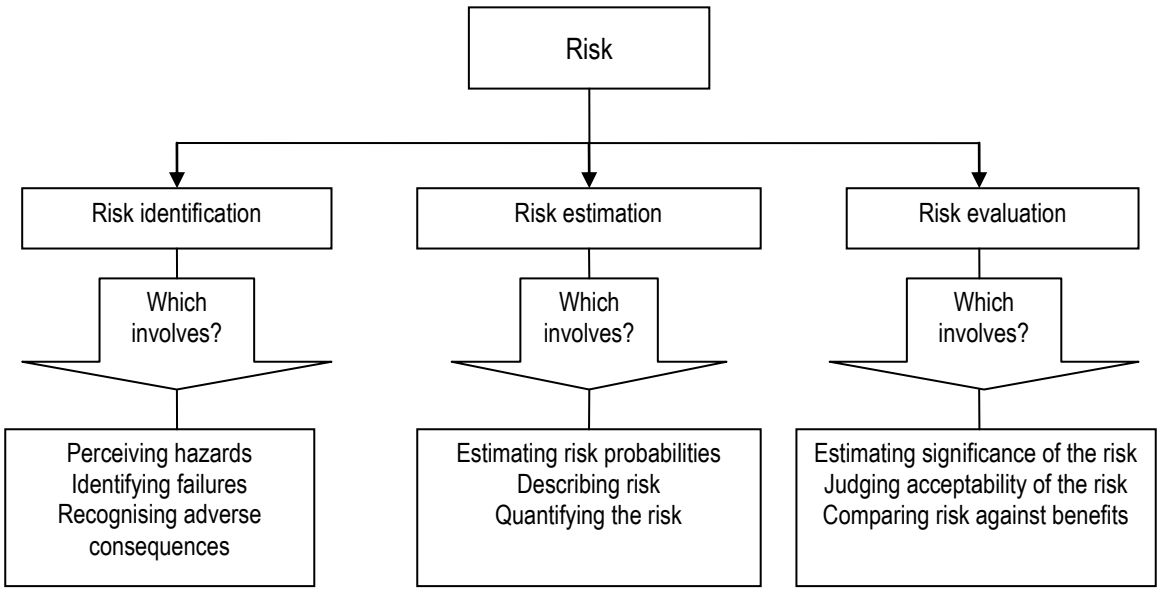


Figure 2.4 Risk identification, estimation and evaluation AS 4360:2004

It is important that each area is assessed individually so as not to confuse the process. The risk areas are then marked according to the level of risk. However, this can be subjective in analysis as perceptions form part of the risk analysis. The above flow chart takes a somewhat different view of how the process takes place compared with the Australian Standards Figure 2.6 (see section 2.5). The following section discusses the theory and practice of risk control and the components that make up an integral part of risk management.

2. 4 Risk control

2.4.1 External control

The control of risk is divided between external and internal controls (www.standards.com.au). External controls are, by their definition, external in nature and are, in general terms, unable to be controlled by the organisation's management. They are controls undertaken by government agencies, regulations and long-standing conventions. However, internal controls are easier for management to change and review. This is especially true with fire risks. In the previous section dealing with risk assessment, there

were external issues such as 'Act of God that includes lightning, earthquakes and cyclones and other non-manmade actions' and consideration of 'Force Majeure' in respect to Acts of God and other acts such as an invasion, act of foreign enemies, hostilities (regardless of whether war is declared), civil war, rebellion, revolution, insurrection, military or usurped power or confiscation, terrorist activities, nationalisation, government sanction, blockage, embargo, labour dispute, strike, lockout or interruption or failure of electricity or telephone service. The types of risks that would be considered external but that organisations have control over would be as follows:

- Insurance is with a reputable company. Coverage is adequate for the chosen risks.
- Emergency services are aware of the requirements of the business. That the emergency services can be called upon at any time to provide a complete service.

There are instances when controls pass from internal to external. They include economic, social and other environmental issues. The enclosed shopping centre has no control over changes to the management of the tenancies for example.

2.4.2 Internal control

Strong internal controls have a direct effect on reduction in fire risks. This has become an integral part of the total internal control function of all organisations. Strong internal controls lead to a reduction in costs and improved efficiencies. The issues with internal controls first surfaced with the establishment of the Treadway Commission in the USA (www.coso.org). This commission set the scene for increased internal controls and is now used as a benchmark in all major countries. Internal control is not just confined to financial controls but other internal controls including operational areas that could affect the organisation. The issues with internal controls are that the level of control does not necessarily reflect the risk. In many organisations more controls are put on minor areas because it is easier, while more high-risk areas have low controls. A case in point was the sub-prime lending in the US when the risk of 'Low Doc' loans was overlooked while genuine borrowers were treated as higher risk.

The Committee of Sponsoring Organisation of the Treadway Commission (COSO) USA

In the US, the management of risk and, in particular, the use of internal controls has been a major issue for lawmakers. The National Commission on Fraudulent Financial Reporting (commonly known as the Treadway Commission after its sponsor in the US Congress) was formed in October 1985

(www.coso.org) Out of this commission a committee was formed to look into the issues of internal control. The Committee of Sponsoring Organisation of the Treadway Commission, or COSO, is a US private-sector initiative formed in late 1985. Its major objective is to identify the factors that cause fraudulent financial reporting and to make recommendations to reduce its incidence. COSO has established a common definition of internal controls, standards and criteria against which companies and organisations can assess their control systems. The committee consists of major US professional bodies and is instrumental in the benchmarking of internal controls. The Committee of Sponsoring Organisation of the Treadway Commission (COSO) (www.coso.org) defines Enterprise Risk Management (ERM) as follows:

Enterprise Risk Management (ERM) is a process, affected by an entity's board of directors, management, and other personnel, applied in a strategy setting and across the enterprise, designed to identify potential events that may affect the entity and to manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.

The objectives of this committee have now extended from purely financial control to incorporate operational issues. The purpose of this change was that operational risks could have a direct relationship to the financial risks. Having strong internal controls enables organisations to reduce or control the risks better. Internal control is fundamental to the management of fire risk. This is included in regular evacuation testing at an appropriate time and regular testing of fire alarms, smoke detectors and fire hydrants in a real-life situation. The theory of internal control is summarised as follows:

2.4.3 Compliance with applicable laws and regulations

The owners/managers are required to have full knowledge of the laws and regulations in the area of fire safety. This includes fire safety equipment including fire doors, hoses, pumps and extinguishers. Internal control is a process and is seen as a means to an end. Employees affect internal control and it relates to every level in an organisation. Internal control can be expected to provide reasonable assurance but will not give absolute assurance to the organisation's management and board. Internal control has become fundamental in the good governance of many organisations. However, recent events have shown that many organisations should do more to improve internal control.

Components of internal control

As part of the risk assessment, the Committee of Sponsoring Organisation (COSO) www.coso.org published the Guidance on Monitoring Internal Control Systems. The guidance states that there are five components of internal control that are interconnected and rely on each other. They require the complete commitment of the organisation and all stakeholders should understand that internal controls affect all levels and positions. The guidance states the following five points that all organisations should adhere to.

Control environment – 1

The centre of any organisation is its people, their individual attributes including integrity, ethical values and competences. They are the engine that drives the organisation and the foundation on which everything rests. Fire evacuation training is centred on the needs of the enclosed shopping centre.

Risk assessment – 2

The organisation must be aware of the risks it faces. It must set objectives in all areas including operations, finance, sales, etc. This is a continuous process and requires constant review and assessment. This should be done on a regular basis with the full cooperation of all people in the organisation. The enclosed shopping centre needs to know all the fire risks and how it will control those risks. This requires a detailed analysis of those risks. Risk assessment is an ongoing process and should be undertaken on regular basis. Risks are constantly changing due to many factors, including changes in government regulations, environmental issues and other areas which will require updated assessments.

Control activities – 3

Policies and procedures must be established and executed to ensure that actions by management address risks to achieve the organisation's objectives. The enclosed shopping centre needs to have a detailed policy and procedure on all aspects of fire control. The policy and procedure require the input of managers, owners and tenants.

Information and communications – 4

The COSO guide states there needs to be a comprehensive information and communications system to enable the organisation to conduct, manage and control the operations. The enclosed shopping centre management needs to have good lines of information and communication between all stakeholders, including tenants and employees of the tenants.

Monitoring – 5

The internal control processes require constant monitoring and modification so that the system can react dynamically and change as conditions warrant it. This may require the management of the enclosed shopping centre needs to monitor the control process on a daily basis to see if there are any changes to the risk profile according to training consultants.

2.4.4 Risk appetite

The Enterprise Risk Management (ERM) integrated framework discusses risk appetite www.coso.org. There are levels of risk that will be accepted in any given situation. For example, the higher the risk, the higher the rate of interest received on a deposit. At what point in time does the risk outweigh any perceived return? This is a fundamental issue in the control of risk. Risk appetite can only be calculated if all the facts are known about a perceived risk. The level of risk appetite can rise and fall depending on the perceived risk at any given time. It is not a static situation. It requires constant monitoring of the risks and the control of those risks. In the current financial climate many financial institutions are risk adverse, and as such, their risk appetite has decreased. However, this may change over time as other factors change. The threat of a terrorist attack may have abated but the threat from the danger of fire is always with us. It is, therefore, necessary to keep this in mind with risk assessment. The level of fire risk may look on the surface to be low. This does not mean that the risks are to be treated in a manner that is detrimental to the control of such risk.

2.4.5 Treatment of risk – 'Acts of God'

Risk can be split into two major components. First, there is the Act of God that includes lightning, earthquakes and cyclones. However, there are risks that while they appear to be Acts of God are, in fact, man-made. For example, a flood could be caused by disruption to the water storage systems. There are only a few risks that can truly be called Acts of God. Most risks are a result of man-made endeavours. There is a mistaken belief that Acts of God are beyond human control. However, incidents such as floods and droughts can be due to mismanagement rather than too much or too little rain (Kletz 1996). The bush fires in Victoria, Australia in early 2009 are also a case in point. All the signs were that high temperatures, severe drought and very dry conditions caused it. It may be possible that inaction to clear vegetation increased the fire risk.

Treatment of risks – transfer, acceptance and avoidance

Transfer of risk requires another party to take the risk (www.standards.com.au). This is normally in the form of insurance. However, other instances of risk transfer include warranties and guarantees that transfer risk. For example guarantees that a building will be built according to regulations. Risk may be accepted if the risk can be controlled and be managed. Risk avoidance is doing nothing to bring on such a risk. Risks such as these are normally within the control of management. The components of risk are interconnected in the risk profile in Figure 2.5. The more likelihood there is of the risk, there is the need to treat it with controls or avoid the risk. There are many risks that cannot be avoided. In such cases, the only way to reduce the risk is by having strong controls. This may take many forms including operational controls. This is further examined in section 2.5 Australian Standards.

Consequence

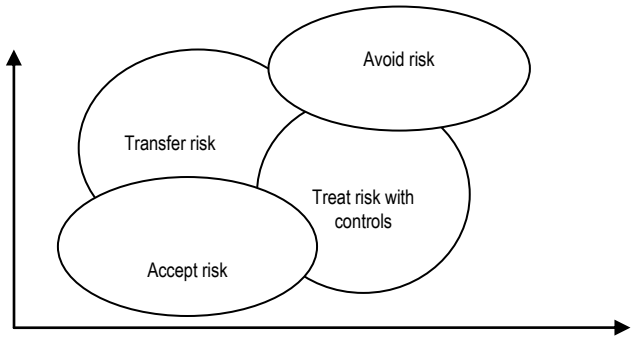


Figure 2.5 Risk treatments

2.4.6 Non-quantifiable risk – reputation

It is said that reputation is the greatest risk facing business today (Murray 2003). Reputation is one such area that is difficult to quantify and measure. A good reputation is an intangible asset that is never shown in a balance sheet but can be destroyed in an instant by fire. There are many instances when reputations have been harmed by not taking risks seriously. For example, Toyota vehicles had a high reputation for having safe vehicles. However, this reputation is under scrutiny due to safety issues (www.theage.com.au).

Management of risk

Risk management has become a major issue for many organisations. The risks may be financial, operational or other types. The management of risk is the final part of the risk literature review. Risk theory moves from the concept stage through to the treatment of the risks. In Australia, organisations use the Australian Standards' Enterprise Risk Management (ERM) matrix that allows organisations to profile their own risks and controls (www.standards.org au). However, the use of ERM is only generic and requires further analysis and profiling of the risks.

2.4.7 Moral hazard

This section deals with moral hazard that has become a major theoretical issue as business becomes reliant on professional managers. The theory of moral hazard dates back to the 17th century and was used by English insurance companies as a term to express negative connotations in the area of fraud and immoral behaviour. It was not until the 1960s that it became more widespread as an economic term. The basis of the theory is that parties will act differently when insulated from the risk (www.economist.com). There are numerous cases of this in the recent financial crisis when banks did not act as responsible lenders. The issues relate to the principal-agent theory when the agent does not act correctly for the principal. The agent has more information than the principal and therefore should have a higher level of control. This can lead the agent to not exercise the level of control required to protect the interests of the principal. All care and no responsibility is the catchphrase. The issue in this study is the relationship between moral hazard and insurance. Since the insured party does not bear the costs of the behaviour, it is able to pass the risk to the insurance company. This allows the insured to be less diligent with the risks. This issue is especially true with fire prevention and control. The case of the owners at a Bangkok nightclub at which 60 people died indicated that there was more concern

with patrons entering the nightclub rather than with evacuating the premises (www.abc.net.au). There are other major incidents where profits have been put in front of patrons' safety. There are many aspects to insufficient control and they impact all areas of risk management. The next section studies the Australian Standards, specifically risk management and how they are used by all organisations across Australia to manage risk.

2.5 Australian Standards – risk management - AS/NZS 4360

This section of the literature review deals with the Australian Standard in respect to risk management. In Australia, the Australian Standard AS/NZS 4360:2004 define risk management processes and systems and was the standard until 2009. The new Australian Standard AS/NZS ISO 31000:2009 comes into operation in 2010. The new standard is based on AS/NZS 4360 and is used in conjunction with the previous standard. There are no federal or state regulations defining risk management and how it is to be conducted. However, there are various Acts that are involved with risk management such as the Health and Occupational Safety Acts. The joint Standards Australia/Standards New Zealand Committee OB-007 was responsible for the standard. It provides a generic framework for establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk. There is also the *Risk Management Guidelines Companion* used as guidance on the implementation of the standard (www.standards.com.au). The objectives of the standard are detailed in Appendix 1.8. The following figure is how the standard shows the risk management process.

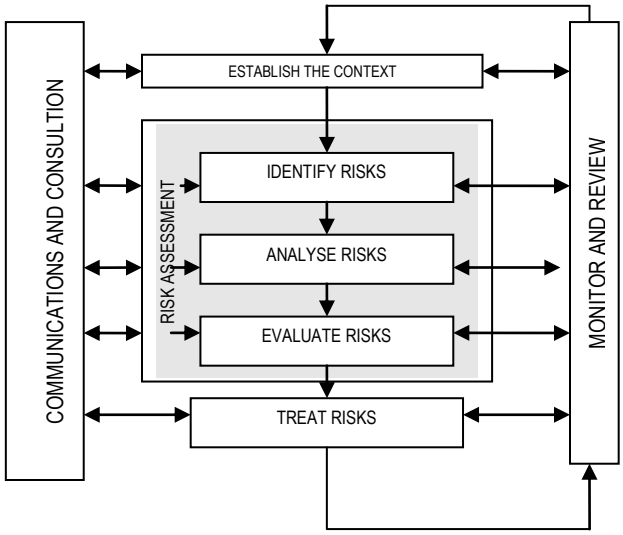


Figure 2.6 Risk management process – overview AS 4360:2004

Consequences scale

One of the major tools in the area of management of risk is to construct a c*onsequences scale* as in Table 2.1 from Australian Standard AS/NZS 4360:2004. This grades the severity into five levels – the highest being five. The risk is also allocated to various risk areas such as health and safety and its possible impact. However, this type of table is limited as it is generic and does not take into account the types of risk that may be specific to the organisation. This scale is important, as it should relate to risks across the whole spectrum.

Table 2.1 Consequences scale – AS/NZS 4360: 2004

	Consequences types					
Severity Level	**Profit Reduction**	**Health & Safety**	**Natural Environment**	**Social/Cultural Heritage**	**Community/Government /Reputation/Media**	**Legal**
5	$US 10m to 100m	Multiple fatalities or significant irreversible effects to 50 plus persons	Very serious long-term environmental impairment of ecosystem functions			Significant prosecution and fines and very serious litigation including class action
4	$US 1m to 10m	Single fatality and/or server irreversible disability to 30% to one or more persons		Ongoing serious social issues. Significant damage to structural/items of cultural significance	Serious public or media outcry (international coverage)	Major breach of regulation major litigation
3	$US 100,000 to 1m	Moderate irreversible disability or impairment to 30% to one or more persons	Serious medium-term environmental effects		Significant adverse national media/public/ NGO attention	Serious breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible
2	$US 10,000 to 100,000	Objective but reversible disability requiring hospitalisation	Moderate short-term effects but not affecting ecosystem functions	Ongoing social issues. Permanent damage to items of cultural significance	Attention from media and/or heightened concern by local community. Criticism by NGOs	Minor legal issues, non-compliance and breaches of regulation
1	Less $US 10,000	No medical treatment required	Minor effects on biological physical environment	Minor medium-term social impact on local population. Mostly repairable	Minor, adverse local public or medical attention or complaints	

Table 2.2 is a likelihood scale showing the levels from A to G from an almost certain to almost incredible occurrence. However, this table would require major use of the probability theory before an event would be classed as happening once a year, for example. The once-a-year occurrence could be classed a catastrophe if it were a widely affecting incident.

Table 2.2 Example of likelihood scale – AS/NZS 4360: 2004

Example likelihood scale			
Level	**Descriptor**	**Description**	**Indicative frequency (expected to occur)**
A	Almost certain	The event will occur on an annual basis	Once a year or more frequently
B	Likely	The event has occurred several times or more in your career	Once every three years
C	Possible	The event might occur once in your career	Once every ten years
D	Unlikely	The event does occur somewhere from time to time	Once every thirty years
E	Rare	Heard of something similar occurring elsewhere	Once every 100 years
F	Very rare	Have never heard of this happening	Once every 1000 years
G	Almost incredible	Theoretically possible but not expected to occur	Once every 10,000 years

Theoretical model consequence and likelihood table showing risk ratings

The consequence and likelihood table is built to show both the likelihood of an incident and what would be the consequence of that incident. Figure 2.7 below should be analysed in relation to the risk assessment chart in Table 2.2. The following table is from Australian Standards AS 4360 (www.standards.org.au) and is used in Enterprise Risk Management (ERM). The purpose is to produce a risk rating which will involve a decision regarding whether a particular risk is acceptable or not. This will take into account existing controls, cost consequences and risks borne by other stakeholders.

Table 2.3 Enterprise Risk Management likelihood table

Likelihood		**Consequence**				
		Insignificant	***Minor***	***Moderate***	***Major***	***Catastrophic***
	Almost certain	medium	medium	high	high	extreme
	Likely	medium	medium	medium	high	extreme
	Possible	low	medium	medium	high	high
	Unlikely	low	low	medium	medium	high
	Rare	low	low	medium	medium	medium

It is possible to incorporate the above chart into a risk matrix. The above table can be applied to the fire risks in enclosed shopping centres. The insignificant risk is a small fire in a tenancy that is under control in a short space of time. The other side of the table is when a catastrophic incident takes place. This would involve high casualties including major loss of life and may severely damage or destroy the building. This matrix looks at incidents in isolation and does not show the interconnecting flow of risk as a consequence from other risks. Other risk models, as previously discussed, could provide a more in-depth analysis for specific risks. The Enterprise Risk Management (ERM) is subjective in its application and does not take into account any statistical modelling. In the commercial environment it relies on

judgements that may not be completely clear. The model is a top-down model and is only used for high-risk areas. However, it is the standard process for assessing risks. The literature does not point to any model that is far superior to any other. All models require assumptions to be made on statistical or other information that may be inaccurate. Risk analysis is in fact difficult and time consuming and it is difficult to quantify in the real world. The difficulty of risk assessment was highlighted on 11 September 2001 in New York and Washington when airliners were used as bombs. How would such risk be assessed and calculated? The incidents would be classed as catastrophic and rare. The following section deals with corporate governance and the relationship to risk management. Corporate governance has become a major part of risk management via Corporate Social Responsibility (CSR) that is discussed in the following section.

2.6 Corporate governance – risk

2.6.1 Australian Stock Exchange – Corporate Social Responsibility (CSR)

The corporate sector has moved to a increased regulation regime in the last decade due to corporation failures in the early part of the 21st century. For example, the high-profile collapses such as HIH in Australia and Enron and Worldcom in the USA. This has resulted in an increased focus on corporate governance. While the emphasis has centred on the financial risks, operational issues are now considered part of the total risk strategy (www.asx.com.au). The corporations that own and manage the enclosed shopping centres in Australia are listed on the Australian Stock Exchange and as such are required to abide by the corporate governance listing requirements. They are also required to abide by state and territory occupational health and safety regulations as discussed in section 2.6.2. There is now a greater awareness of the requirements of corporate governance with such professional bodies as Chartered Secretaries Australia that are involved with corporate governance training (www.csaust.com). This not only includes financial governance but other areas such as environmental and operational reporting. Good corporate social responsibility policies can help the bottom line of corporations. The reduction of risks and being socially responsible go hand in hand with the prevention of fire including strong evacuation policies and strong controls over the risk of fire. Good governance makes enclosed shopping centres as safe as possible. All companies with shares listed on the ASX are required to have a risk management strategy. This strategy includes both financial and operational risks. Recognise and Manage Risk – Principle 7 states that companies should establish a sound system of risk oversight and management and internal control.

Recommendation 7.1 Companies should establish policies for the oversight and management of material business risk and disclosure of those policies.

Given that a large number of major enclosed shopping centres are owned or managed by publicly listed companies such as Westfield, Stockland, Mirvac and Centro, the above recommendations would apply and include all operational risks including fire risks.

2.6.2 Occupational health & safety – fire safety

The regional and sub-regional enclosed shopping centres have large numbers of tenant employees, service provider employees and customers. There is a greater risk to the employees than to the public due to the time spent in the centres. The tenants may have individual fire testing and evacuation plans, however, they are not normally connected to the owners/managers systems. There are requirements of the Occupational Health and Safety Acts that require workplaces to have a certain level of safety. The occupational health and safety requirements, for example, come under the *Occupational Health & Safety Act (2004)* (www.worksafe.vic.gov.au) that states the following:

The workplace must be maintained in a safe condition ensuring fire exits are not blocked and emergency equipment is serviceable and that other people are not endangered by the conduct of your business.

There are penalties for breaches of the *Occupational Health & Safety Act (2004).* Those penalties can be a maximum of $943,290 for companies and $188,658 for individuals. Occupational health and safety are affected by fire risks and should be taken into account when framing a model. This will include all tenants, centre management and service provider employees.

2.7 Social, cultural and political impact of risk

Risks – public view

In this study we have looked at the theoretical or technical aspects of risk. However, the public idea of risk may be entirely different. Kletz (1996) discusses the differences between risk perceptions and the consequence of the risks. The public accepts less risk if the possible outcomes are known. The perceptions of risk in the public eye are different according to the activity. The public are in more danger on the roads than flying in an airliner. However, flying is perceived as more risky. The public

sees fire risks in enclosed shopping centres as low risk. However, if there were to be some major fires in Australia this would undoubtedly change the perceptions that enclosed shopping centres are safe. Reputations are gained over many years and can be destroyed in an instant. It only takes a minor emergency and the issue of safety is quickly raised. The process for the public view of risk by Smallman (1996) is summarised in Figure 2.8 below. Many perceptions of risk are filtered through prejudices. For example, risks with older buildings may not conform to reality. Would an old enclosed shopping centre be any more in danger of a fire than a recently built centre? Information is carried via word of mouth and observation. This is why evacuations and testings should be conducted at a time when the public can see how they are conducted and give a feeling of certainty.

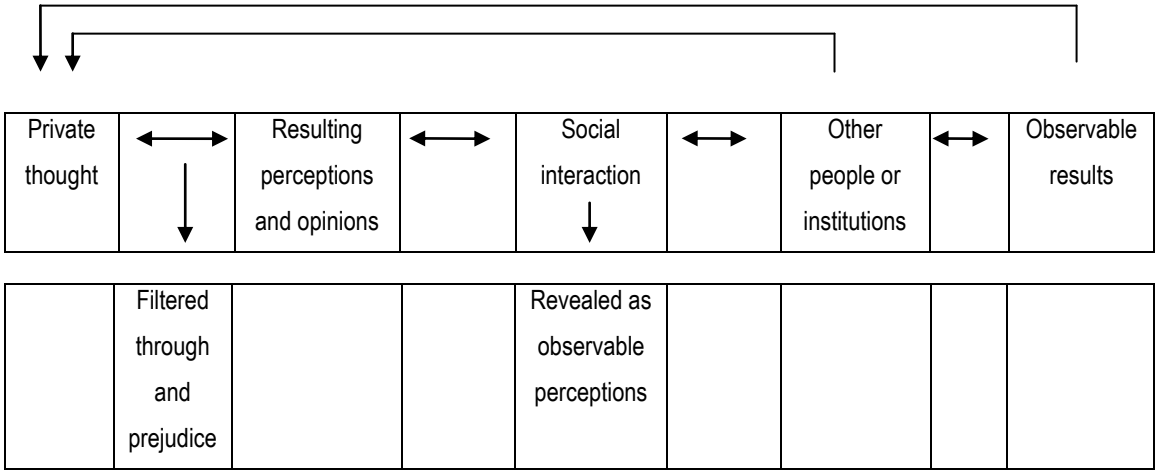


Figure 2.7 Formation of risk perceptions – public

Cultural and political risks

The cultural view of risk depends on where in the world the risk is located. There are societies that look at risk in a more adverse way. The developing world is not as risk adverse as the developed world. This is supported by the fire in the Bangkok nightclub as discussed in section 2.4.7. However, the risk depends on the type. The developed world has seen major risk issues in the financial systems but in areas of fire and other incidents the risk visibility is lower. In the developing world the fire risks are higher due to lack of advanced fire services and regulations. Politics plays an important role in the risk as political systems have a high degree of influence on risk outcomes, for example, the risk of fire from oil installations in Nigeria due to substandard installations (www.globalissues.org).

2.8 Summary - Risk theory, assessment and control

This chapter takes the research from the risk concepts to describing what risk is. The philosophy of risk and what this concept means. This is followed by the known and unknown risks, which is an important part of the concept of risk. Section 2.2.3 discusses the calculating and analysing of risks, and the analytical and system method of risk calculation. Those methods of risk calculation require detailed analysis and could be difficult for managers of enclosed shopping centres to master. The concept of probability is discussed in section 2.2.4 including the Poisson distribution. The problem with the concept of probability is to relate this to real world situations. The chances of an event happening can be calculated, however when an event does take place it is generally referred to a "Once in a hundred year event" The event can have a range of outcomes as shown in figure 2.3. In the following section 2.3 the theory moves to risk assessment. This again is difficult and time consuming for the practitioner to implement. It is am three part process with identification, estimation and evaluation.

The following section 2.4 discusses risk controls. If an organisation is to function there will be risks that are deemed necessary. The question is at what level the controls should be implemented so that the organisation can function at its optimum. This can only be answered with a detailed analysis of the risk. In section 2.4.5 there is discussion on the risks that are classed as "Acts of God", however, as discussed those are rare and many are caused by man. It describes the Victorian Bush Fires in early 2009. It should be noted that there is now a model or manual for those people in bush fire areas to prepare for the evacuation in event of a fire. The following section 2.4.6 deals with non quantifiable risks such as reputation. There are many instances when reputation has been destroyed in one act. There are many instances in recent history described in the section. This is an area that all organisations should be fully aware of the reifications of loss of reputation.

In section 2.4.7 discussion is centred on the theory of moral hazard. During the recent global financial crisis the theory and practice of moral hazard came to the fore. All care and no responsibility is an important concept. The insurance may cover losses, however there are some losses that are difficult to insure or will be expensive. The model's aim is to underpin the issue of moral hazard so all parties have a complete understanding of the fire risk management. The section 2.5 deals with the Australian Standard for risk management. The Standard is a generic document and is a guide only. All organisations need to implement their own risk management systems. However it is good starting point. The section 2.6 deals with corporate governance including the influence of the Australian Stock Exchange and what corporations are expected to implement in the area of social responsibility.The final

section discusses the social, cultural and political impact of risk. It is known that the perception and consequence is something the public takes for granted. That activity has no relation to risk as comparing danger on the roads to flying in an aircraft.

Chapter 3 Literature – Fire Risks in Commercial Buildings

3.1 Introduction

Chapter 2 focused on the theory of risk and the related components. Chapter 3 looks specifically at the issue of fire risks in commercial buildings and the components that make up the management of those risks. Commercial building comprise of offices, warehousing, hotels, shopping centres and airports. Companies and individuals own commercial buildings. Which come under a number of laws and regulations including zoning rules. Commercial buildings are subject to strict environmental regulations including usage. The chapter firstly discusses the knowledge available regarding fire risks for various types of buildings.. The implications of Australian Standards is analysed in the next section. Discussion on how the states administer the fire regulations is next, including the role of fire services in the fire risk management of commercial buildings. The next section deals with emergency planning, training and safety aids. Finally, this chapter studies the influence of the enclosed shopping centre on the Australian retail industry.

The state regulations are discussed and how the fire services are organised in Victoria and the recent changes in Queensland. The following section discusses emergency planning and training and the role of training providers in fire risk management. Evacuation planning by use of computer simulation follows on from this. The next part of this section discusses the use of safety aids including closed circuit television (CCTV). Building exits and pedestrian flows are discussed by highlighting the work done by Zhao, Yang, Li, Zhu, and Zou (2006). The final section discusses the use of sprinklered shopping centres in the management of fire risks. Section 3.6 discusses the importance of enclosed shopping centres in the economy and how they are central to the retail shopping industry

3.1.1 Current literature – commercial buildings fire risks

The risk of fire in commercial buildings is well known and documented. However, the risks in the literature tend to apply to commercial buildings in general. There are different types of commercial buildings including offices, general shopping centres, warehouses, hotels and airports. Enclosed shopping centres are a relatively recent addition to the commercial building landscape in their size and complexity. They are now located in all urban areas including central business districts. Enclosed shopping centres also form integral parts of major airports. The risks that set enclosed shopping centres apart from other commercial buildings are the movement of large numbers of people at any given time. The other related commercial buildings with the same characteristics are buildings with major people movements such as hotels and airports. However, enclosed shopping centres have

variations in how they are managed. The risks that set them apart from other commercial buildings include having large numbers of people passing each day. Other types of commercial buildings do not have the level of tenancies that in large regional centres can be in excess of 200. The paper by Hassanain (2009) discusses the fire risks in hotels. They are commercial buildings that have some similar attributes as enclosed shopping centres. They deal with large people movements; have catering facilities much like food courts and have restricted entry and exit points. The paper describes hotels as high-risk facilities and this theory is supported by the number of hotel fires across the world. Hotels have banquet halls and restaurants that function much the same way as food courts, having the same risks with escape and exit points. The role of hotel manager is much the same as the centre manager in an enclosed shopping centre and serves as the coordinating role in the fire risk management. In the paper the writer discusses the role of the warden and how important it is. This is reflected in the Australian Standards. However, this leads into the reason why a model of fire risk management is an important step forward. Many enclosed shopping centres now include large cinema complexes. This increases risks due to large movements of people in narrow entry and exit points. This is in addition to the movement of people from general tenancies in enclosed shopping centres. Hassanain (2008) discusses the issues that multiplex cinema complexes bring to the movement of people in fire risk situations. From the above papers it is clear that the main area of concern with any commercial building is the safe evacuation of the people. There can never be enough entry and exit points that allow all people within a building sufficient time to evacuate at the same time. This comes back to the issue of reducing the risk of fire in the first instance. The following section deals with earlier research into fire risks in commercial buildings, specifically the Warren Centre Project in 1989.

The Warren Centre Project

The work of Beck (1989) in relation to 'The Warren Centre Project' in 1989 investigated rational design methods for buildings. The project was to develop recommendations on the most appropriate philosophy for the implementation of a systematic design approach to enhance fire safety. The project recommended that:

(a) the current level of fire safety in Australia should be maintained
(b) the design for fire safety be treated as a *design engineering* responsibility rather than a matter for detailed regulatory control
(c) that the risk assessment models and the associated sub-models and input data be further developed to improve their reliability before they are used for design purposes

(d) adequate financial resources be provided to enable this development to be progressed in the short term
(e) risk assessment models are used as a basis for identifying cost-effective combinations of fire safety sub-systems for building design
(f) appropriate statistical information on actual fires be collated and form input data to the risk assessment models (Beck 1989).

The report recommended other changes to engineering techniques and training in fire engineering design. The question arising from this work by Beck is whether there has been any major progress in fire risk identification. Safety is a major issue with any public building, especially buildings such as shopping centres with high public access. Due to public access, there is a risk that fires can be deliberately started and hence involve innocent people being injured or killed. The research by Ramachandran (1999) covers the risk, quantitative modelling, and probability in fire safety. The literature discusses the mathematical models in the quantitative assessments of the extent of the spread of fire and smoke in a building of given characteristics. However, every building has its own characteristics. It is therefore difficult to apply the models to every situation. The paper by Barton and Hardogree (1995) includes the possible incidence of fire, bomb threats, floods, hurricanes (cyclones), hostage taking, robbery, chemical leak or spill and others. They are the types of incidents that have occurred in shopping centres in Australia and overseas. It is therefore necessary to relate those risks to enclosed shopping centres. Proulx (1999) investigates the issue of initiating evacuations of public buildings when research and experience shows that occupants tend to ignore fire alarm signals and continue their activities. This has been observed in enclosed shopping centres in Australia. The writer also concludes that training should be given to all employees and that the use of CCTV is recommended. The use of CCTV systems is not compulsory in enclosed shopping centres. However, it is now standard practice to have them. The majority of the centres now have CCTV systems. In the paper by Wong and Fong (2005), the writers have endeavoured to calculate the required exit widths of commercial buildings in Hong Kong. This issue is not confined to Hong Kong but could relate to any commercial building with limited exit points, including enclosed shopping centres. The following section 3.2 discusses the Australian Standards in respect to fire and other emergencies in commercial buildings. Australia does not have national fire regulations and as a result the Australian Standards have become the basis for fire and emergency control.

3.2 Australian Standards – commercial buildings

The Australian Standards (www.standards.com.au) serve as the basis for the control of emergencies in commercial buildings. There are a number of reasons for this including the lack of national regulations on how emergencies are to be contained in commercial buildings. There are constitutional issues with having federal fire regulations as this area has traditionally been the domain of the states and territories. This has resulted in the Australian Standards being used as a substitute for regulations by training companies and commercial building owners. However, Queensland has recently introduced reforms to the fire regulations that include increased controls and processes. This change came about because of the Childers backpackers' hostel fire in 2000. This is discussed in state regulations (section 3.3). The Australian Standards are the basis for all states and territories with respect to commercial buildings. This chapter reviews a number of the standards and highlights the major issue in each standard. With the major changes to fire regulations in Queensland, there is the possibility that there be a move to a more regulatory system of fire control. If this is the case then this should be part of future research in this area as discussed in the conclusions in 8.4.

3.2.1 Australian Standard – emergency control organisation and procedures for buildings, structures and workplaces AS 3745: 2002

The Australian Standard AS 3745:2002 (www.standards.com.au) is the standard for the control of emergencies in buildings, structures and workplaces. This standard is used by owners/managers, training organisations and others as the basis for the control of emergencies in the above. The following organisations on the Australian Standards Committee FP-017 were the major sponsors. They all have a vested interest in risk management. Australian Standards are not the result of one body making a decision, but many coming together to give as much insight as possible into the issues. Both government and non-government bodies are involved. This includes such bodies as the Australian Retail Association that serve as an important voice regarding fire risks in commercial buildings including enclosed shopping centres.

Australasian Fire Authorities Council
Australia Post
Australian Bomb Data Centre
Australian Retail Association
Communication Interest (Australia)
Department of Defence
Department of Human Services (Victoria)
Fire Protection Association Australia
Fire Trainers Association of Australia
Institute of Fire Engineers
National Fire Industry Association
Property Council of Australia
Safety Institute of Australia Inc

The Fire Protection of Australia is the industrial body for all types of fire protection. This includes both government and non government sectors. The Property Council of Australia looks after the interests of all property ownership in Australia.

The standard makes the following statements:

*The objective of this standard is to provide procedures for the safety of people in buildings, structures, and workplaces during emergencies. The standard is written in general terms to make it applicable to all types of occupiable buildings, structures, and workplaces***.**

The purpose of the standard is generic in nature. It does not take into consideration the individual needs of the owner/manager of the enclosed shopping centre. This research will argue that each enclosed shopping centre should have its own detailed plan for risk management.

Indemnity

The standard makes the following statement on indemnity for those involved in both the Emergency Planning Committee and Emergency Control Organisation (ECO).

Both EPC and ECO personnel shall be indemnified by their employer against civil liability resulting from workplace emergency response assessment, education, training sessions, periodic exercise or emergency evacuation of a building where the personnel act in good faith and in the course of their emergency control duties.

The above statement is important to the risk and control of fires in commercial buildings and workplaces. It goes to the heart of the issue of moral hazard as discussed in the section on risks.

Emergency planning committee (AS section 2.1) and clause number 2.14

The standard recommends that building owners, managers and agents arrange for the establishment of an Emergency Planning Committee. This committee should control the implementation of matters addressed by Australian Standard 3745-2002. The duties of the EPC will be as follows:

(a) Meet regularly to establish emergency plans and emergency procedures.

(b) Determine the number of ECO personnel consistent with the nature and risk of the buildings, structures and workplaces.

(c) *Ensure that the personnel are appointed to all positions on the ECO but particularly the chief warden group.*

(d) *Arrange for the training of ECO personnel.*

(e) *Arrange for the conduct of evacuation exercises.*

(f) *Review the effectiveness of evacuation exercises and arrange for procedure improvements.*

(g) *Determine who will implement emergency procedures.*

The above recommendations are generic and allow the individual organisation to interpret the standard as they see fit.

Developing emergency procedures (AS section 2.2)

This section of the standard deals with developing emergency procedures in some detail. However, it is again generic in its application as there are wide variations in how the procedures are to be applied. The standard states it is up to the individual organisation to develop emergency procedures. The danger with this is the supervision of the emergency procedures and to make the system work. The full details are in Appendix 1.5.

Emergency control organisation (AS section 2.4)

The Emergency Control Organisation (ECO) should be appropriate for the building, structure or workplace. It should have the following:
Chief Warden and deputy chief wardens
Floor or area wardens, general wardens
Other persons as required (security staff)
Warden registry – includes all details of the wardens.

The ECO should give directions and shall issue directions to all persons on the premises. It has the overriding responsibility for the safe evacuation of the building. The emergency services should be coordinating their efforts with the emergency control organisation. The status of the emergency control organisation is not a regulatory body and as such does not have the force of the law.

Education and training – general (AS section 3)

The Emergency Planning Committee is responsible for the delivery of education and training sessions and *periodic* exercises. Emergency control organisation personnel are required to be familiar with a number of areas in building, structure and workplace. They include the following:

(a) Floor details
(b) Evacuation routes
(c) Communication equipment
(d) People with disabilities
(e) Fire detection and suppression systems
(f) Any special procedures on the floor area
(g) Dangerous goods attention
(h) Operation of portable fire extinguishers, fire hose reels and fire blankets.

The above states that ECO personnel are required to have the above knowledge. There are no formal requirements that training in those areas has to take place to make sure they do in fact have the knowledge.

Training programs (section AS 3.2)

The section on training relies on the organisation having relevant training programs and systems. The standard is non-specific on what type of training is required. However, the following is noted as part of the training:

(a) Alarms
(b) Evacuation procedures
(c) Assembly area locations
(d) Evacuation modifications
(e) Identification of personnel
(f) Emergency personnel authorities
(g) Emergency team and roles of members
(h) Methods of raising alarms.

The standard makes the following statement: *All employees should undertake emergency training according to their positions* since the training is normally undertaken within a group of tenants, centre

staff and service personnel. There may be instances when the team members do not receive the correct training according to their position.

Evacuation exercise (AS section 3.5)

The standard states that an evacuation exercise program should be established for 12 months in advance. There are objectives that all evacuation practices should include as follows:

(a) Roles of wardens
(b) Calls to emergency services
(c) Evacuation times
(d) Disabilities assistance
(e) Vehicle movements.

This section, like all other sections, is general in nature and requires all organisations to prepare their own evacuation testing systems and not just rely on the standards.

Other sections of the Australian Standard 3745:2002

The two other sections refer to bomb and disorder threats. They are beyond the area of this research.

3.2.2 Australian Standards – fire safety audits AS 4655-2005

The Australian Standards Committee (FP-021) approved the standard in March 2005 as a result of previous research in this area. The following organisations made up the committee.

Australasian Fire Authorities Council	Fire Protection Association Australia
Australian Chamber of Commerce and Industry	Engineers Australia – Society of Fire Safety
Australian Institute of Building	Institute of Security Executives
Australian Institute of Building Surveyors	Insurance Council of Australia
Communication Interest (Australia)	Joint Accreditation System of Australia & NZ
Department of Human Services (Victoria)	Property Council of Australia

All the participants have a role in fire safety audits and are representative of the organisations involved in fire risks. It is important that no one organisation has the sole responsibility so all inputs are taken

into account. The parties represent a wide range of interests. However, there are no consumer organisations represented.

The object of the standard is to set out the structured process of auditing fire safety against audit criteria to enable stakeholders to adequately gauge the differing levels of confidence, the efficacy and suitability of fire safety measures in facilities and to ensure that adequate fire safety records are generated and retained. Stakeholders include facility owners, occupiers, managers, the authority having jurisdiction and other interested parties (AS 4655-2005).

The standard is in three sections as follows:

(a) Scope and general

The standard follows the general principles of auditing including ethical conduct, fair presentation, due professional care and independence. The audit recommends a review of documentation, safety measures and interviewing personnel. The standard is not compulsory and has no legal ramifications if not carried out.

(b) Managing an audit program

The management of the audit program follows the general principles in auditing and includes areas of responsibility, competence, responsibility and objectives. This section also includes the resource issues followed by procedures and implementation.

(c) Audit activities

The audit activities follow the normal course of events in an audit environment. The standard has all the details for a fire risk audit. In Appendices A, B, C and D of the standard further information and detail are given on how the audit should be undertaken.

3.2.3 Australian Standards – fire safety engineering AS 5387.8

The Australian Standard's objective is to be an informative technical publication in the area of fire safety engineering. The standard is in eight parts as follows:

Part 1. Application of fire performance concepts to design objectives

Part 2. Design fire scenarios and design fires

Part 3. Assessment and verification of mathematical fire models

Part 4. Initiation and development of fire and generation of fire effluents (e.g. smoke)

Part 5. Movement of fire effluents

Part 6. Structural response and fire spread beyond the enclosure of origin

Part 7. Detection, activation and suppression

Part 8. Life safety – occupants' behaviour, location and condition.

This standard is confined to the issues of fire safety engineering. It relates to the technical issue areas such as fire models, performance, suppression and behaviour. The standard would be of interest to fire engineering consultants. Section 3.3 discusses the state regulations for commercial buildings. Each state and territory has its own regulation and until recently they had a high level of uniformity. As a result of an incident in 2000, the Queensland government introduced more complex regulations that are discussed in section 3.3.2.

3.3 State regulations – commercial buildings

This section follows on from the previous study into the Australian Standards and looks at the state and territory regulations applicable to emergencies. Each state and territory has its own system of emergency management. In Australia, the provision for emergency and fire services rests with the state and territory governments. There is no overriding federal organisation in this area. The majority of the states have one major fire service together with a specific fire service for bush fires. The states have their own fire regulations. However, the regulations are similar and are in line with bodies such as Standards Australia. The states enforce the fire regulations such as the fire services within the states. The federal government does not have any direct influence over fire regulations. The state fire regulations have, until recently, been in unison to a large degree. However, due to recent changes, the fire regulations in Queensland are now more stringent than other states (www.qld.gov.au). The state government changed the regulations following the Childers Palace backpacker' hostel fire in 2005 that resulted in the loss of 15 lives.

3.3.1 State regulations – Victoria

The two states that are used for the study are Victoria and Queensland. Victoria is used as it is where the research is conducted from, including the interviews. Queensland is also used in the study as it has recently made changes to the fire regulations as discussed in section 3.3.2. In Victoria, there are the Melbourne Fire Brigade (www.mfb.gov.au) and the Country Fire Authority (www.cfa.gov.au), which are

parts of the state department of emergency services. They both have responsibilities in respect to commercial and residential buildings in Victoria. Both organisations are involved with the *Building Regulations Act 2006*. The Chief Fire Officer of the Melbourne Fire Brigade has the power to inspect and report on safety matters in commercial buildings.

The major matters that the fire services are involved with are:

- fire water mains
- hydrants, hose reels
- control valves
- booster assemblies to increase the flow of water
- emergency vehicle access
- fire indicator panels
- location and content of fire control centres.

The provision of a first-class fire service is critical in any community. How the fire service operates and how the service is managed is of the upmost importance to the community. Fire services are an integral part of fire risk management. Many functions and attributes of the fire service are critical to fire management such as response time, function of equipment and trained personnel. The fire services function in much the same way throughout Australia as discussed in (section 6.6.1); however, there may be differences in how they are administered. The systems that are in place are a result of historical conventions and precedents. This is especially true in Victoria. In the paper by Kloot (2008), the writer discusses the role of the Melbourne Fire Brigade (MFB) and the Country Fire Authority (CFA). Both authorities are involved in fire emergencies in the greater Melbourne area. This was the result of outer areas once being rural and now being part of the urban environment but still coming under the CFA service umbrella. This may be unusual in fire service delivery. However, it shows how fire services can be organised and that commercial building managers should be aware of how the fire services are managed. This is critical in areas such as response times.

3.3.2 State regulations - Queensland (building fire safety regulations 2008 part 4)

The regulations in place prior to 2008 were on the same level as those in other states (www.qld.gov.au). Australian Standards were the basis of the administration of fire evacuation and training in Queensland. Due to the backpacker hostel fire in Childers in 2000 that resulted in 15 deaths, the Queensland government decided to change the regulations to improve the process in fire risk. The

major changes to the Queensland fire safety regulations came into being in January 2009 (www.qld.gov.au). The new regulations involve the evacuation planning instructions and practice of commercial buildings including shopping centres. The regulations include evacuation diagrams for the public. There is a new regulation with the appointment of a fire safety officer in high-occupancy buildings. Those regulations are specifically for Queensland. However, it does not follow that the regulations be taken up by other states. The normal course of action would be that other states and territories would follow the Queensland regulations if the new regulations work as expected. However, it does show how inconsistent the regulations are becoming in Australia.

3.3.3 State regulations – other states and territories

The other states and two mainland territories have their own fire regulations and Acts as discussed in section 6.6.1. The fire regulations are generally the same. They follow the Australian Standards as in Victoria. However, due to changes in Queensland there is the possibility that other states and territories will follow suit and enact the same rules. No jurisdiction has been seen as the pacemaker in this area until the changes in Queensland. In all regulations of this type the states and territories tend to be in unison, otherwise it tends to make the administration more difficult in areas such as building ownership and training.

Australasian Fire and Emergency Service Authorities Council

There is no overriding authority in fire risk management in Australia. The Australasian Fire and Emergency Service Authorities Council (AFAC) is the peak industry body for fire, land management, and emergency service organisations in Australia and New Zealand (www.afac.com.au). The committee membership which includes both Australian and New Zealand fire services and was established in 1993 to collaborate on matters of international, national and regional importance. By sharing each other's extensive capabilities, experience and knowledge AFAC members expect communities to benefit from the economies of scale, reduction in the duplication of effort and the strengthening of industry capability. However, the AFAC does not have any regulatory powers and is only to support and advise the various fire and emergency services. It is to this end that the influence of the AFAC is limited in the wider fire risk regulation. The fact that the AFAC has limited powers is critical to the total fire risk picture in Australia, as it demonstrates the need to have close ties between fire and emergency authorities. The study now moves on to the concept of emergency planning in commercial buildings. This section deals with administration of the emergency planning and includes fire safety aids including exits and pedestrian flows.

3.3.4 Building Design – Sprinkler Systems

The paper by Bennetts, Poh and Thomas (2000) and the Fire Research Report number 6 by Bennett, Poh and Thomas and others (1998) and studied the cost of sprinkler systems in low-rise shopping centres, which could also relate to commercial buildings. The writers argue that the risk to shopping centres up to four levels is low and that building regulations are too harsh. The building codes require changes to improve the cost effectiveness of the buildings. They argue that there are strong economic motives to avoid significant fires and this is managed by strong management practices. It cites the following:

- Housekeeping audits
- Audit of electrical cabinets
- Residual current protection
- Regular replacement of old electrical (light) installations
- Maintenance of electrical equipment.

Minimise fire size by the use of the following:

- Camera surveillance
- Fire awareness and fire-fighting training for all staff
- Sprinkler management policies.

Training may be variable in incidence as there are no mandatory training regulations at enclosed shopping centres, apart from recent changes in Queensland. The fire departments do not review fire evacuation training and camera surveillance is not mandatory in shopping centres.

3.4 Commercial buildings – emergency planning

3.4.1 Introduction

This section follows on from the study into the state and territory regulations and the prior Australian Standards. This section deals with emergency planning in a commercial building. The emergency can take various forms. There may be a power outage, chemical leak, fire and even a bomb threat. Each type of incident has different levels of risk. There are also different risks according to the building and the number of levels. However, with any emergency the overriding objective is the safe evacuation of the people within the building Bennett I, Poh K (2000). There are various aids that support emergency

planning including training and computer simulation (Filippidis L, Galea E, Gwynne S and Lawrence P 2006).

3.4.2 Emergency management and training

Alexander (2003) discusses the possible future role of standards in ensuring the quality and content of programs for the education and training of people in the fields of emergency planning and management. There will always be the issue of training and education in respect of fire safety. While there appears to be separate literature covering risk management and commercial property, there is no specific literature covering the training for fire risk management at enclosed shopping centres. Enclosed shopping centres are related to other commercial property. However, there are certain characteristics that set them apart. They include high public access and tenants with different levels of risk. The enclosed shopping centre may have food court tenants who use cooking appliances that have a high fire risk according to anecdotal evidence. It is also at the food court where there is normally a large concentration of people. The entry and exits to food courts are restricted and are close to other tenants. The evacuation training of tenants in food courts is difficult for a number of factors that may include culture, language and equipment. There is also the issue as to how the public reacts to such incidents in food courts.

3.4.3 Fire and emergency training providers in Australia

There are many fire and emergency training providers in Australia. They include companies such as First Five Minutes (www.first5minutes.com.au) and Red Rebel (www.redrebal.com.au). The providers are normally part of quality management systems under AS/NZ ISO 9001-2000 (www.standards.com.au). They are engaged to provide fire training to employees, tenants and other stakeholders. The normal services provided include evacuation exercises, warden and fire equipment training. The training involves simulating an emergency involving fire, bomb threat or other evacuation testing. The providers produce emergency response manuals for commercial property. They control and keep the warden register and assistance register. They provide an annual program of fire risk training and evacuation testing. The training is part of the employers' obligations in meeting occupational health and safety Acts in force across Australia. The training providers are required to be registered training providers under state and federal laws. They are required to be up to date on the regulations in each state and territory.

State fire services – training for business

The fire services in each location provide emergency management and training. This is to help business prepare fire risk training and manage emergencies. However, this is not compulsory. The fire services are not equipped to carry out training and advisory services to commercial building owners. If training is completed it is done on a fee-for-service basis.

Certificate of Compliance

The training providers engaged by the operations management issue a Certificate of Compliance that states that the client has completed training according to Australian Standard AS-3745 in 'Emergency Control Organisation and Procedures for Buildings, Structures and Workplaces'. However, there is no system to oversee the issue of the Certificate of Compliance and it relies on the service provider to do the right thing. Inspectors under WorkSafe legislation in force in all states can visit workplaces at any time.

3.4.4 Evacuation planning – computer simulation

The evacuation of people from commercial buildings is a concern as long as there are emergencies of all kinds. In many countries, including Australia, performance-based fire safety engineering models are built to allow a flexible approach to building design. However, the problem is finding the quickest way of evacuating people from a commercial building be it a hotel, airport or shopping centre. There are computer-based models. In research undertaken by Owen M, Galea E, and Lawrence P (1996), the EXODUS model simulates escape patterns of occupants and provides valuable information for the design of circulation paths and exits. Lo, Huang, and Yuen (2007) look at the mathematical methodology of the evacuation process. The model that is discussed is confined to simply one level exit or entry. Difficulties arise when there are multi-entries and exits on a number of levels. This can relate to enclosed shopping centres that are located in central business districts and high-density areas such as Hong Kong. However, many enclosed shopping centres are being built in major Australian cities that are multi-storey or close to other commercial buildings.

Building exits and pedestrian flow

The issue of building exits and the flow of pedestrians from a commercial building is raised in the paper by Zhao, Yang, Li, Zhu, and Zou (2006). The issue is that when the evacuation of a building is required, what is the relationship between pedestrian flow and the exit structure? The writers put forward the

theory that the movement of pedestrians is not unlike the behaviour of granular material that can exhibit both solid-like and fluid-like behaviour. These peculiar properties give rise to at least three important 'states' in granular flows; namely, dilute flow, dense flow, and the jammed state. The phenomenon of crowding can be considered as a transition from dilute to dense flows and that of jamming is a transition from dense flow to a jammed state. Movement during an occupant evacuation can also be considered as a kind of discrete flow. Especially when the density of occupants is high, people in the pedestrian flow can do nothing but go with the crowd. Their walking speed is constrained by the other people in the flow; individual ability and psychology play a reduced role in their movements and the occupants act just like granular material. The state of the pedestrian flows can be dilute, dense, and jammed. In dilute flow, occupants can walk at their expected speed, and their individual ability and psychology make individual behaviour different from each other. In dense flow, occupants act more like granular material and their walking speeds are restricted by the other occupants. Of greatest interest is the dilute-to-dense transition in pedestrian flow and the relation between the exit design and this state of transition.

The pedestrian flow in evacuation has essential differences from the flows of inanimate granular material according to Zhao, Yang, Li, Zhu, and Zou (2006). The walking speed of occupants is confined to a relatively small range while particle velocity can be increased endlessly in gravity or some other fields. The forces in granular flow are gravity, friction, etc., while pedestrian flow may be more complex because of various 'social forces' which can be simulated by physical attributes such as position attraction, attraction and repulsive force caused by nearby occupants, attraction of movement direction, and repulsive force caused by fire. The interactions among the occupants in pedestrian flow are more complex than that among inanimate particles. In the case of granular flow, there are only collision, extrusion and so on, complying with the deterministic physical rules. On the contrary, different psychologies of occupants will arouse different behaviour: on the one hand, all occupants try to avoid colliding with each other; on the other hand, occasionally they want to gather together with their relatives.

Behaviour is also different at a bottleneck. Grains can pile up around the bottleneck. When they pile up to a certain degree, phenomena similar to 'avalanches' occur; namely, a large quantity of grains flows through the exits suddenly. If the occupants pile around the bottleneck there can be potentially dangerous phenomena such as crushing and trampling. But sometimes occupants queue for evacuation at the bottleneck or move up and down uneasily, especially in an evacuation with the intervention of staff, the avalanche phenomenon will seldom happen. Gwynne, Kuligowski, Kratchman, Milke (2008) discuss exit width in their article. The size of the exits can have a profound effect on the number of people passing both into and out of a commercial building. The ideal situation is to get the maximum size exit without having undue influence on the buildings' services such as the air

conditioning systems. If they are too narrow, they hinder the movement of people. Figure 3.1 is used in computer simulation models to ascertain the movement of people out of a building. It is assumed that in an emergency, inward movement would be confined to emergency personnel only and that other people movement will be restricted.

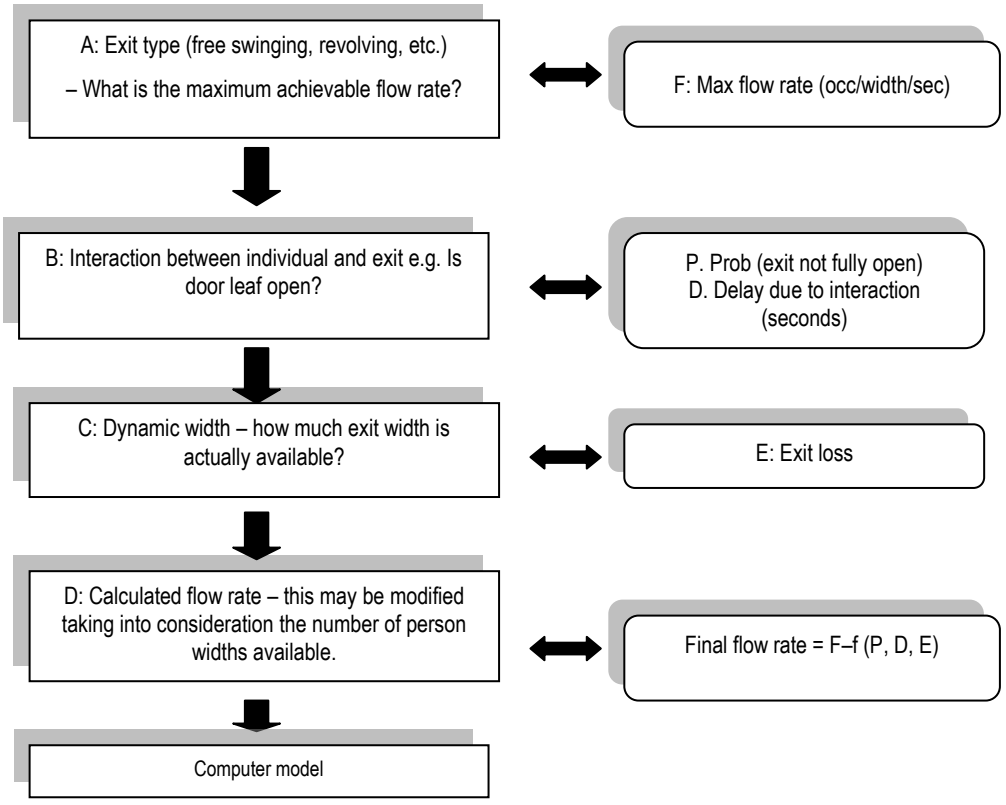


Figure 3.1 Computer simulation flow chart

The computer model should show the most efficient way to move the people from the building in an emergency. This is conditional of the variables as stated above in Figure 3.1 being correct and as close as possible to reality. However, with all computer simulations, various scenarios are undertaken simultaneously according to Owen M, Galea E, and Lawrence P (1996).

3.4.5 Fire risk safety aids

There are a number of safety aids that are used in commercial buildings. Signage is required in all commercial buildings. This is followed by closed circuit television systems. Those systems should support the safe evacuation of people from any commercial building. However, they are only part of the total picture and are not the total solution.

Signage and other pedestrian issues – visibility catchment area

Signage can provide the occupants with suggestions and the opportunity to decide the best possible route for evacuation of an enclosed shopping centre. The paper by Filippidis, Galea, Gwynne, and Lawrence (2006) looks at the issue of occupants with signage in large buildings such as enclosed shopping centres. This is in conjunction with a prototype behaviour model that seeks to find the most efficient way of evacuation from large buildings. Physical and psychological factors may influence the effectiveness of the signage. The visibility of the signs is important. This study used EXODUS software tools designed to simulate the evacuation of a large number of people from complex enclosures.

Closed circuit television systems

The use of closed circuit television systems has become important in the emergency planning in all commercial buildings. It allows surveillance of a large area by a limited number of personnel. As stated in section 3.1.1, close circuit television is not compulsory in enclosed shopping centres; however, it is standard practice for the system to be installed. How the CCTV system is integrated with the emergency planning is an important aspect of the total evacuation training system. In the enclosed shopping centre it is normal practice for the security personnel to manage the CCTV system on behalf of the managers. If there is an incident it is the responsibility of security to convey the details of the incident to the operations management. There may be CCTV systems operated by a major tenant that are not normally accessible by the operations management. This can be cause for concern to the operations management as it reduces the level of control within parts of the enclosed shopping centre.

3.6 Australian and overseas shopping centres

3.6.1 Introduction

This section studies the importance of the enclosed shopping centre in Australia as part of the commercial building sector. The enclosed shopping centres had their start in Australia in the 1950s with the opening of the Roseland shopping centre in Sydney and it was quickly followed by other developments. The first centre in Melbourne was at Chadstone that started as a small 'barrel' site (www.chadstoneshopping.com.au). It has since become a super regional shopping centre. Enclosed shopping centres were being developed in Queensland and Western Australia at this time. The new centres tended to be in growth areas. The size and influence of the shopping centre industry has been increasing as new centres are built in growing residential areas. Over the past decades there have been large-scale redevelopments of central business districts and provincial towns. The later developments included airports with large shopping centres attached. This development has resulted in a large number of enclosed shopping centres across Australia. There are a number of surveys and investigations into the shopping centres. The report by Jebb, Holland and Dimasi, (www.scca.org.au) is the last major report completed into Australian shopping centres.

3.6.2 Statistical information on Australian shopping centres including ownership, size, and contribution to the Australian economy

The report by Jebb, Holland and Dimasi (2001) to the Shopping Centre Council of Australia (www.scca.org.au) includes the following statistics and retail information. The Australian shopping centre industry is one of the major sectoral contributors to the Australian economy and had a direct GDP of 2.8% in 2000. The Australian retail sector currently records total sales of $132.8 billion, which represents an average annual spending of $6,961 per person. Retail sales growth has averaged 5.1% per annum since 1992. There are 918 shopping centres in Australia comprising 64 regional centres, 225 discount department stores (DDS), and 625 supermarket-based centres. The 918 shopping centres contain 11.1 million square metres of retail floor space, equivalent to 29% of total retail floor space in Australia. Enclosed shopping centres in Australia recorded a total turnover in 1999/2000 of $57.9 billion. That is 44% of all retail turnover recorded in Australia. Enclosed shopping centres currently achieve an average trading level of $5,208 per square metre. Sales per square metre levels in shopping centres have increased at an average 2.5% per annum compared with 3.1% per annum for all retail. Australia currently has some 167,500 retail shops of which 45,300 (or 27%) are situated in

enclosed shopping centres. The average rate of visits to shopping centres in Australia equates to around two visits per week per person to a regional or sub-regional centre.

The average provision of retail space is 2.0 square metres per person in Australia of which 0.58 square metres per capita is provided by shopping centres, while in the US it is 3.3 square metres per capita of which 1.95 square metres is that provided by shopping centres. The information in Appendix 1.5 is the latest information available. However, the number and ownership in Australia have not increased substantially in the past decade. (www.propertyoz.com.au) The demand for new regional and sub-regional centres has remained static due to the lack of available land to construct new enclosed shopping centres. This has led to the expansion of existing centres by the increasing size and number of tenants. This is especially true at Chadstone in Melbourne that has seen the centre more than double in size over a 15-year span. Enclosed shopping centres in Australia are ranked according to size and major tenancies. They range from a small number of super regionals such as Chadstone shopping centre in Melbourne down to the neighbourhood centre that has a supermarket plus a small number of specialty stores. The following is a summary of the different types of centres in Australia.

Regional shopping centres

A regional shopping centre is defined as a major retail facility provided within one integrated building structure. Regional shopping centres incorporate at least one full-scale department store as well as a wide range of other facilities. Regional shopping centres can be found in all states and territories of Australia. The Property Council of Australia (www.propertyoz.com.au) defines three categories of regional shopping centre, namely:

1. **Super regional (e.g. Chadstone, Melbourne) in excess of 85,000 square metres**

This centre attracts a high number of visitors most days of the week and is especially patronised at weekends, during late night trading and prior to major holiday times. Chadstone shopping centre has grown in size over the years (www.chadstoneshopping.com.au). The centre now includes large entertainment zones that capture a large number of patrons, especially at weekends and in the evenings. It has a number of food courts to cater for the large number of patrons. The sizeable centre has at least two major tenants including a major department store, supermarkets, a number of 'mini majors' and bulk stores.

2. **Regional centres (e.g. Centro the Glen, Westfield Southland, Westfield Eastland) between 50,000 and 85,000 square metres**

Regional centres, while not being as large as the super regional centres, attract patrons at the weekends and during late night trading and prior to major holidays. Many have large food courts that are used extensively during the middle of the day. They have a diverse tenant mix of service providers such as banks, post offices and government agencies. They include a number of fashion stores and 'mini majors'.

3. **Sub-regional (e.g. Centro Brandon Park, Mirvac Waverley Gardens) between 30,000 to 50,000 square metres**

The sub-regional centres tend to have less patronage than the major regional centres. However, during certain times of the week they can attract large numbers of patrons. Many have large food courts that are used extensively during the middle of the day. Like the regionals, they include a diverse tenant mix from service providers such as banks, post offices and other agencies and mini majors. There are other types of enclosed shopping centres that are excluded from the research as they are not regional or sub-regional enclosed shopping centres. The types of shopping centre excluded from the research include discount department stores and supermarket/neighbourhood centres.

Discount department stores (DDS) e.g. K Mart stores to 20,000 square metres

These centres are smaller, typically sub-regional facilities built around a department store and one or more supermarkets. They are typically around 20,000 square metres in size. They may have specialty shops and a 'junior' department store. They may have a small number of service providers including banks. However, they were excluded from this research as they are not enclosed to the level of regional and sub-regional centres.

Supermarket/neighbourhood centres

Supermarket/neighbourhood centres are less than 10,000 square metres with one or two major supermarkets. They have a minimum 1,000 square metres of common area of floor space with a number of food and non-food specialty shops and services. They can also include a small food court as seen in the larger centres. They include more services such as banks, post offices and medical practices. The supermarket neighbourhood centres are excluded from this research as they are not enclosed to the level of regional and sub-regional centres.

Other types of enclosed shopping centres

There are enclosed shopping centres in a variety of public buildings including airports, train stations and other public buildings. The ownership and management of these types of centres are more complex than this research.

3.6.3 Owners and managers of enclosed shopping centres

The management of enclosed shopping centres in Australia comes under the provisions of the Real Estate Acts of the states and territories. They are required to keep trust accounts for the receipt of tenants' rents and there are other statutory requirements (www.vic.gov.au). Operational issues are covered by management agreements (www.cbre.com.au). Managers are paid a percentage of the rents and may be entitled to other income. It is in their interests that the centre is well patronised and is pleasant for the customers to visit.

The larger centres have on-site personnel including a centre manager, marketing manager and an operations manager. The operations manager has the day-to-day responsibility for such areas as security, fire protection, and training. The issues of principle and agent come into play. As stated previously in the study there is always the issue of moral hazard. Do the managers always act in the best interests of the owner, for example? This can be a major issue when decisions have to be made that may not be in the best interests of both parties. The structure of the commercial property industry ownership/management contains many variations including direct ownership, joint ventures and syndicates. Enclosed shopping centres may have passive owners or investors who contract professional managers to oversee the property. However, the majority of the major enclosed shopping centres in Australia are now both owned and managed by the same group. There are smaller centres that are under private ownership and managed by professional managers such as Richard Ellis (www.cbre.com.au).

The major owners in Australia are listed in Appendix 1.5. The owners are household names, especially Westfield. This company is now the largest shopping centre owner and manager in the world. Westfield centres are located in Australia, US and Europe with the latest being at White City London, which is the largest centre in Europe. There are other large groups including AMP, Lend Lease and Centro. Each group has interests in various sizes of centres and may include major regional to neighbourhood or local centres.

Branding of centres

Westfield was the first to brand their centres. They are known as Westfield, followed by the location, such as Westfield Southlands. However, other owners have followed suit including Centro, Stocklands, and Mirvac. This has had the effect of increasing the owner's name in the public domain. This could be detrimental to the owner if there was to be a major incident at one of their centres. The branding of centres does bring its risk. It is the downside of branding.

3.6.4 Tenants in enclosed shopping centres

According to the websites of enclosed shopping centres, they have a wide variety of tenants. They range from department stores such as Myer and David Jones on two or more levels, down to the small kiosks that are occupied by services such as communication suppliers. There are the food court tenants who provide a variety of food to customers. Each tenant has rights and obligations according to the lease that all tenants sign. The opportunity to be part of the success or otherwise of the centre is the main criteria. There are tenants such as government agencies that are there as a convenience to the public. They include post offices and Medicare offices. New types of tenants are being tested to expand the variety of services available. This in turn increases the fire risk as products such as flammable chemicals are being sold.

Permanent tenants – lease agreements

There are two major types of tenants in the shopping centres. The first are the permanent tenants that lease a specific area. This lease may be for a term of up to 20 years. However, the majority of leases are for an average of five years with the option of further periods. The lease governs the basic conditions being rent, variable outgoings, and other issues. This may include obligations in respect to fire safety, including having a plan. However, it is not obligatory to include a fire safety plan. They come under the Real Estate Acts in force for the particular state or territory. The lease may also include protection from competition and other restrictions from other tenants.

Non-permanent tenants

The centre may also allow non-permanent tenants and others to trade in the centre and they are known as casual mall tenants. These tenants are required to sign temporary lease agreements to cover costs,

etc. They are required to observe various safety requirements including the use of power. Due to the transient nature of the casual mall lease they are not required to participate in evacuation training or any other safety issues. Therefore, they are under the complete control of the centre management.

Other types of tenants

Enclosed shopping centres are now used by communication companies if the building is multilevel or in a strategic position. The centre houses communication masts and transmittal facilities. If the centre were to have a major fire, the communication facility could sustain damage. The communication companies pay for the use of the facilities. All enclosed shopping centres have automatic teller machines (ATMs) and game machines that require power.

3.7 Current practices in fire prevention in enclosed shopping centres

The bases for fire prevention in enclosed shopping centres are centred on the guidelines set out in the Australian Standard AS 3745. This governs all commercial property including enclosed shopping centres. The study aims to ascertain whether the owners/managers refer to this standard and whether they include it in the centres' policy and procedures. The majority of enclosed shopping centres are privately owned and have various levels of internal controls to identify the risk. Many enclosed shopping centres do not have full-time centre staff stationed at the centre. In such cases, it is left to the tenants individually to control fires.

3.7.1 Fire regulations

Commercial buildings follow existing fire regulations from the time they are constructed. However, enclosed shopping centres, unlike other commercial buildings, are subject to upgrades at any time. The larger the centre, the more likely there are changes in the tenant mix. This brings added risks that could be overlooked. The fire regulations are subject to changes over a long period of time. Whether those changes can be incorporated into older-style enclosed shopping centres is an issue. Research of this aspect is difficult as it requires detailed analysis of the age and modifications to the building.

3.7.2 Fire risks during construction, alterations and maintenance

Commercial buildings require regular changes to make them both pleasing and safe for customers and staff. This requires periodic maintenance and upgrades. This may require completely new facilities including air conditioning systems. It is normal for commercial buildings to be used while the work is being carried out. This includes offices, shopping centres and hotels. It is unusual for commercial buildings to be completely closed down during renovations and upgrades. Fires in commercial buildings can take place during construction, whilst having alterations, and during routine maintenance. Fire risk during construction can have devastating effects and could put a project in jeopardy (www.theage.com.au) Commercial buildings require constant maintenance and refurbishment. This requires the use of equipment such as welders and other fire risk equipment. This equipment could be used while the building is being occupied. Hinks and Puybaraud (1999) discuss the issue of fires on commercial building sites in the UK. The writers believe there are risks that have not been fully explored due to insufficient data into the causes and outcomes of fires. There are many reasons for the fires including the misuse of equipment such as welders and cutters. Enclosed shopping centres are being constructed, having alterations, and being maintained at any given time. They may be undergoing major renovations or single tenancy upgrades. Maintenance of equipment such as air conditioning systems and lighting systems are carried out on a regular basis. This poses a major fire risk as many of those actions are carried out while the centre is occupied. There was a major fire during the renovation of the Myer Burke Street store in Melbourne. This caused many millions of dollars damage and set back the project some weeks but there was no injury to any person (www.theage.com.au).

3.8 International shopping centres

3.8.1 Introduction

There are enclosed shopping centres in all countries and the expansion of these centres has taken place in the developing countries of Africa, Middle East, and Asia. Enclosed shopping centres are expanding in places where the climate is conducive to shopping in enclosed areas such as countries of the Middle East. However, with the increase in wealth, there are moves to improve the quality of services and this includes the expansion of enclosed shopping centres in all countries. The issue is whether the infrastructure, including good fire and emergency services, can cope with this level of expansion.

3.8.2 Fire risks in enclosed shopping centres in USA and other countries

The United States of America has a long history of malls and enclosed shopping centres going back to the 1920s. The growth in the USA malls has been unsurpassed and the US has more retail space than any other country. The USA has an advanced system of fire regulations and control. Fire risks are still a major issue in the USA where there have been a number of large fires involving loss of life (www.icsc.org.). Many of the enclosed shopping centres or malls in the USA were built some years ago when the fire regulations were not as stringent and they are now a fire risk.

Enclosed shopping centre – Philadelphia Fire Department

The paper by Smith (2008) discusses the enclosed shopping mall from the fire department's perspective in Philadelphia, USA. It is interesting that many of the problems highlighted in this paper can also be attributed to Australia. This was highlighted in the UK case at Lakeside shopping centre section 1.1.3, when the tenant was fined for having breaches of the UK Fire Protection Act due to a small fire in a store room. The tenancies are close to each other and share the same dividing walls that increase the risk of fire. The paper highlighted the problems with containers with rubbish that are common in enclosed shopping centres both in the USA and Australia. The suburban enclosed shopping centre in the USA has much in common with the suburban centre in Australia, including large car parking facilities. When the car parks are full of cars, this can cause problems when large numbers of people are attempting to leave at the same time as the fire service is trying to enter. Appendix 1.6 lists the important considerations in fire risks in enclosed shopping centres for the fire services as discussed by Smith (2008). They include:

Water

The need to have adequate hose lines to get to the fire source. This was highlighted in the example of the Myer Hobart fire (Webster 2009). Water pressure can be a problem in enclosed shopping centres. The higher the building and further from the mains water system, the greater the risk of water pressure problems. This can come about for a number of reasons including fire equipment and piping being used.

Tenancies

Tenants may store highly inflammable products without the knowledge of the centre management. It is only when a fire takes place the centre management is aware of the situation. It is therefore important, that the storing of flammable products is closely controlled (Smith 2008). Tenants should be aware of the dangers and be diligent with what is required. Centre management should always be aware of this.

Life hazards

There are many hazards that are overlooked and the centre management may be unaware of the fire risks. They include the food establishments operating outside normal centre hours. They include fast food establishments that are part of the centre, but open to the outside. This may also include retailers such as dry cleaners that while opening to the outside have connecting walls with other internal tenants (Smith 2008)

Construction

The there are problems with older buildings and the lack of newer fire protection equipment. This is especially true for the centre business districts of major cities (Smith 2008). The United States of America shares the same type of central business districts as Australia. The paper discusses the strategic considerations for fires in enclosed shopping centres as follows:

Strategic goals

The enclosed shopping centre needs to have controls in place in the event of a fire. This includes having the required plan in place by the fire service (Smith 2008)

Incident management

The fire service has adequate incident management processes that include having personnel in charge with the knowledge required to fight the fire. This may not appear to be a problem. However, as with the Myer Hobart fire (Webster 2009), there was inadequate equipment and this caused the damage to be higher than it should have been.

Fire at Bath shopping centre during construction

The Southgate project is to rejuvenate an area in the central business district of Bath city in the UK. The project includes shops, restaurants, leisure centre, apartments and an underground car park for 800 cars. The Southgate shopping centre in Bath UK was under construction during September 2008 when three gas cylinders exploded (www.thisisbristol.co.uk). The damage was extensive and required people evacuation from local streets. The local media stated that there was 'chaos' as people attempted to flee as the shopping centre was close to other occupied buildings. There were hundreds of building workers on site at the time of the explosion and they were also evacuated from the site. This shows that fire or emergency evacuation is an ever-present problem and can happen at any time and in any country.

Fires at Chinese and Indonesia shopping centres

A fire at a shopping centre in the city of Jilin in North East China killed at least 53 people and injured another 71 in February 2004 (www.chinadaily.com.cn). The fire started in a storeroom near a boiler room on the second floor. The shopping centre was home to shops and other facilities including an entertainment complex. The fire was on a Sunday and many people were in the building. The power went off and the centre was in darkness. This resulted in people being unable to leave the centre. Many of the people jumped from windows and this resulted in many injuries. The major cause of death was by carbon monoxide poisoning and only a few were burnt to death. This highlights the problem with not having adequate evacuation training systems in place. There was another major fire in 1994 at Kebon Kembang shopping centre near Jakarta Indonesia (www.latimes.com). This was caused by an electrical short circuit and resulted in the deaths of 77 employees of a department store, who were undertaking inventory reviews.

From the three above cases it shows that there are risks both at the time of construction and during occupancy. There are many similar attributes in all enclosed shopping centres. They include a large number of tenants with different fire risks. The continual movement of people, both entering and exiting the centre can place stress on the entry and exit points. Those risks alone provide the reasons why fire risks in enclosed shopping centres need to be closely monitored.

3.9 Summary of fire risks in commercial buildings and enclosed shopping centres

This chapter reviewed the Australian Standards and fire regulations in Victoria and Queensland. This was followed by commercial building emergency planning including training and computer simulation. The literature studied in this research shows that there are many investigations into fire safety in commercial buildings. The Warren Centre Project was an important study and found there were needs to improve designs and enhance safety. The Australian Standards are an important part of the fire risk management in commercial buildings and give a generic basis to control those risks. The final part of this chapter reviewed the Australian shopping centre industry and the major owners/managers of the regional and sub-regional centres. The statistics of the industry are discussed and analysed including the types of tenants and risks each brings to the centres, the fire risk management in USA enclosed shopping centres from the fire services angle. The section on shopping centres concluded with the problems that other countries have had with fires in enclosed shopping centres that resulted in death and injury. Enclosed shopping centres, like all commercial buildings, are subject to fire risks.

Chapter 4 discusses the conceptual framework of the research including concerns about presently managed fire risks. Chapter 5 studies the methodology of the research including the primary and secondary data. The primary data includes both the use of questionnaires and interviews in the research process, the selection of the enclosed shopping centre that was used for the questionnaires and the interviews were conducted and with whom. Chapter 6 analyses the data from the questionnaires, interviews and an example of a fire incident. From this analysis the model is then conceptualised in Chapter 7. The concluding chapter summarises all the findings from the research.

Chapter 4 Conceptual framework

4.1 Introduction

The conceptual framework is the building block of the research, erected on top of prior knowledge. It shows how the research is dissected into the various components for fire risks, specifically in enclosed shopping centres. This research argues that enclosed shopping centres are different in many ways to ordinary commercial buildings. The closest related commercial building to an enclosed shopping centre is a hotel or other building with a large number of people movements. However, the conceptual framework shows in Figure 4.1 that there are major differences including tenant numbers, types of tenants and large people movements (www.propertyoz.com.au). The conceptual mapping described in this chapter was the result of prior research, general observation and discussions with various stakeholders. The research questions are part of the conceptual framework in each of the sections. Firstly, there are the basic concepts that relate to all fire risks and the meaning of each concept. This is followed by components of the operational systems in place at an enclosed shopping centre. The building of the enclosed shopping centre is the following concept, including the various parties involved. Finally, there are the external parties that have some level of influence over the fire risks. Table 4.1 shows the basic concepts involved with the management of fire risks in enclosed shopping centres. The table shows the concept such as risk followed by the definition and the operationalisation, as follows:

Table 4.1 Concept, definitions and operationalisation

Concept	Definition	Operationalisation
Risk	The chances of an event happening and what are the consequences of the risk.	The method of measuring risk involves use of a matrix of the various levels of risk according to the situation. (Security guards on all entrances)
Management	The art of management and the theory of management control. In this instance, the role of management in risk control.	What is the How, Why and What of management in relation to those risks?
Enclosed shopping centres	Shopping centre that is enclosed with specific number of entry/exit points.	The controls in place in respect to the fire risks in the specific property.
Fire risk parties	The fire risk parties are the centre management, tenants, service providers and the public. They all have a specific role to play in the area of fire risks.	How are the parties defined in the risk matrix? What role does each party play and what are their responsibilities?
Preparedness	Is the enclosed shopping centre prepared for a fire and how will it cope with the emergency?	How far will the centre management go to prepare for a fire? Do they undertake training on fire risks and undertake regular evacuation testing?
Events causing fire	What are the types of events that could cause a fire including electrical faults, flammable material being stored in tenancies without centre management knowledge?	What systems are in place to reduce the risks? There are regular reviews of any fire hazards. Are the tenants aware of their responsibilities in the control of fire risks?
Reaction by management	What was the reaction by management to the event? Did management get to the root cause of the fire or did centre management continue in the same way?	Does management react in a positive way to how the fire risk was handled? Do they play the blame game and try to make others responsible?

4.1.2 Fire risks in enclosed shopping centres

Fire risks in enclosed shopping centres is an ongoing issue for centre management. The conceptual framework is in four sections. The first is the conceptual framework in the basic form. The second part shows how centre management interacts in the operational environment including tenants, service providers and the public. The third part deals with the building. The building fire risk problems can comprise those due to both initial construction and also to renovations (www.theage.com.au). The fourth part deals with the external questions including the emergency services, insurance companies and occupational health and safety. Fire risk management in enclosed shopping centres brings together a number of stakeholders involved in the enclosed shopping centre. There are the owners/managers who have the responsibility to protect the shopping centre customers, tenants, management employees and the service providers working in the centre. There are the external stakeholders such as fire services, government regulators and insurance companies. They all have a role to ensure the risk of fire is as low as possible. However, the stakeholders do not work in isolation and they require a high level of interaction. The owners/managers require a high degree of cooperation with all the tenants and external parties to make the system work. There are pressures from competing interests that may not see the risk of fire as a major problem in enclosed shopping centres. This normally changes because of a major incident such as the fire in Myer, Hobart (Webster 2009). There is always the need to balance the requirements of the tenants and those of the owner that at times can cause conflict.

It could be argued that the needs of the enclosed shopping centre customers and employees must always come first; however, this is sometimes difficult due to conflicting needs. It could be argued that due to the large number of tenants who have different fire safety practices it is the centre management's responsibility to control the threat of fire. The main fire risks are in the individual tenancies that have major control over their own systems and processes. It is not generally the centre management's responsibility to manage the tenants' fire risk. The conceptual models in this chapter show the stakeholders involved in the fire risks in an enclosed shopping centre. The enclosed shopping centre has major differences to other commercial buildings in that:

1. Tenants have their own fire risk strategy, especially the major tenants.
2. The possibility that large people movements occur during hours when the risk is greatest, that is, at weekends and late night shopping. At that time the centre management, including operational personnel, may not be at full strength.

3. Enclosed shopping centres have pre-determined entry and exit points that cater for a pre-determined level of movement. There is always the risk of an emergency that will take place near an entry/exit point that was unable to evacuate a large number of people safely.
4. Tenants may have highly flammable goods and equipment, for example, food courts, unknown to centre management. Management are unable to police all tenants in respect to flammable goods and equipment.
5. Constant changes in the tenant mix at enclosed shopping centres that may increase the risk of fires.
6. Renovations and extensions taking place while the enclosed shopping centre is being used.

The conceptual framework has various inputs that include the current fire regulations for commercial buildings (www.vic.gov.au). This includes the maintenance of fire equipment and the regular testing of such equipment. The state governments set the regulations and the fire services are required to implement them. The fire services carry out the testing of the equipment and are able to enter any commercial building (www.mfb.vic.gov.au) Enclosed shopping centres can have large numbers of tenancies and the cooperation with the owners/managers in all areas of fire safety is paramount. This includes fire evacuation training and fire control within the tenancies. Enclosed shopping centres are classified as commercial buildings and as such are treated in the same manner as any other commercial building. However, they do have a number of specific characteristics including the volume of people passing through at various times and the types and number of tenants in regional and sub-regional centres. The owners and managers are aware of the fire risks at enclosed shopping centres and make provisions for the control of those risks. The question posed is how the risks are mitigated and this forms part of the research that will seek to find the answers. Enclosed shopping centres are commercial buildings and are included with general commercial building statistics. In recent times there have been some high profile shopping centre fires including the Myer store in Hobart (Webster 2009). The damage caused was in excess of 55 million dollars. The Myer store has been demolished and is ready for redevelopment. There have been other fires in Melbourne and Sydney resulting in substantial damage and requiring centres to be closed for short periods. The conceptual framework in Figure 4.2 discusses the components of how the basic fire risks are controlled. However, with enclosed shopping centres, other interacting parts as described in Figure 4.3 make the management of fire risk more complex.

4.2 Basic conceptual framework

The conceptual framework in Figure 4.1 shows how the basic processes for fire risks in enclosed shopping centres are undertaken (www.first5minutes.com.au). Firstly, there is the centre preparing for the fire risk. This includes having the appropriate systems and processes in place and appropriate evacuation testing, and all parties understand their obligations and responsibilities. There are the events that caused the fire, were they an electrical fault or a flammable substance in a tenancy that the centre management were unaware was being stored. What was the management reaction to the fire, and were they caught off guard and did not have the appropriate systems in place? The final part involves how management dealt with the aftermath of the fire. Did they have a complete review of the processes and systems in place for future fire risks? The following is a flow chart of the above concepts.

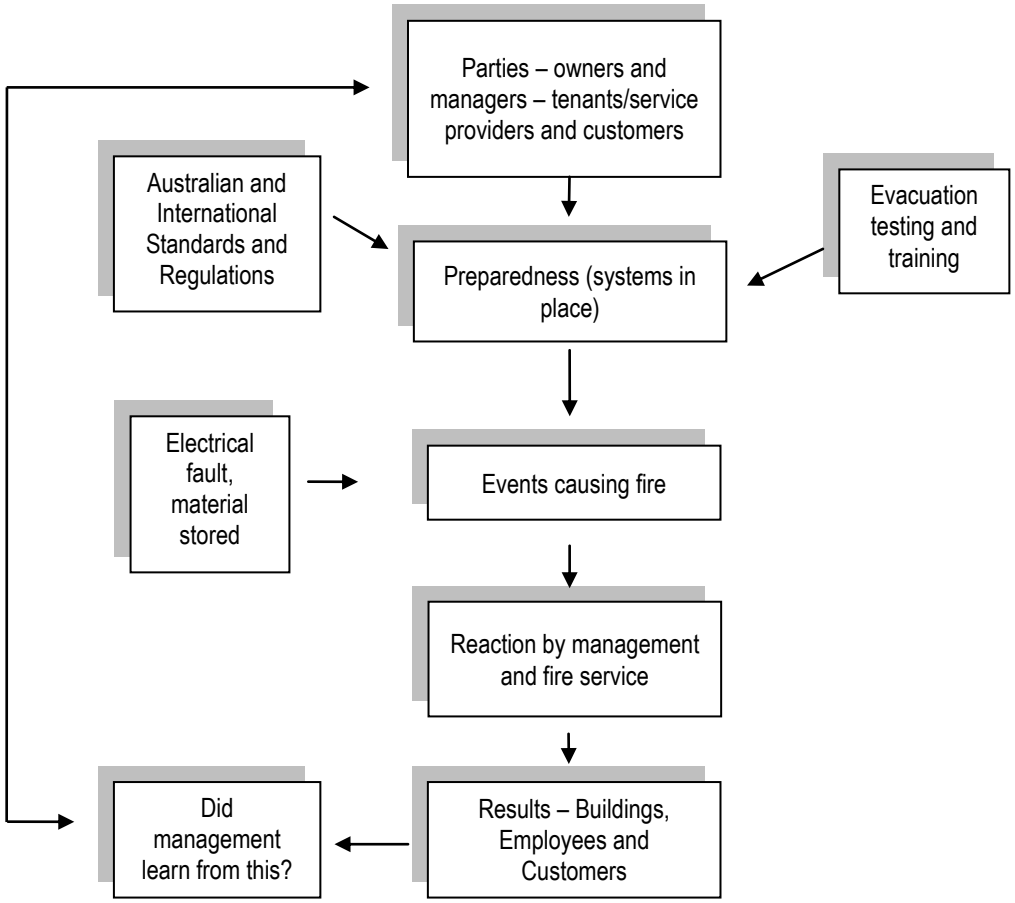


Figure 4.1 A Conceptual framework – flow chart

This conceptual framework is fundamental to many situations. If the fire risk were to be in a hotel, for example, the parties involved with the fire risk would be the hotel management and the guests. The

movement of guests would be much less than that of an enclosed shopping centre. The number of people in a hotel at any given time would directly correlate to the number of rooms and eating facilities. Offices are the other major commercial buildings that have similar fire risks to that of hotels. Offices have a high static population who work in the building, plus a few visitors. The enclosed shopping centre is unique in the commercial building sector because of the factors outlined in section 4.1. The following sections show how the various stakeholders interact with the centre management.

Conceptual framework – centre management

Centre management has the pivotal role in the management of fire risk and it receives all information pertaining to fire risk management. Conceptually, the centre management is in complete control of the fire risks in the enclosed shopping centre. The owners of the centre may not have direct day-to-day influence and control at the centre. The owners rely on the capabilities of the operations management to manage the fire risks at the optimum level. This goes to the centre of the theory of moral hazard and that of principal and agent. Figure 4.2 shows how the centre management has the pivotal role in fire risk management.

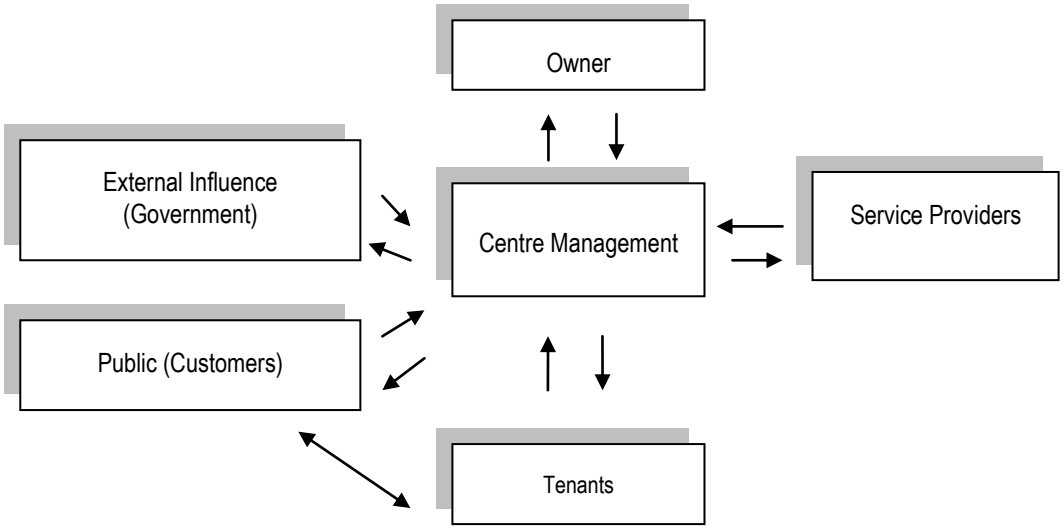


Figure 4.2 Centre management influence

4.3 Operational interacting Parties

This part of the conceptual framework is broken down into three sections. The first is in Figure 4.3. The managers undertake many functions like other commercial property managers. However, there are a number of major differences with enclosed shopping centres compared to other commercial buildings.

The differences include the number of tenants, both permanent and casual. The enclosed shopping centre managers deal with large numbers of customers moving through the centre at any given time. The managers are responsible to keep the centre in a good state of repair on behalf of the owners.

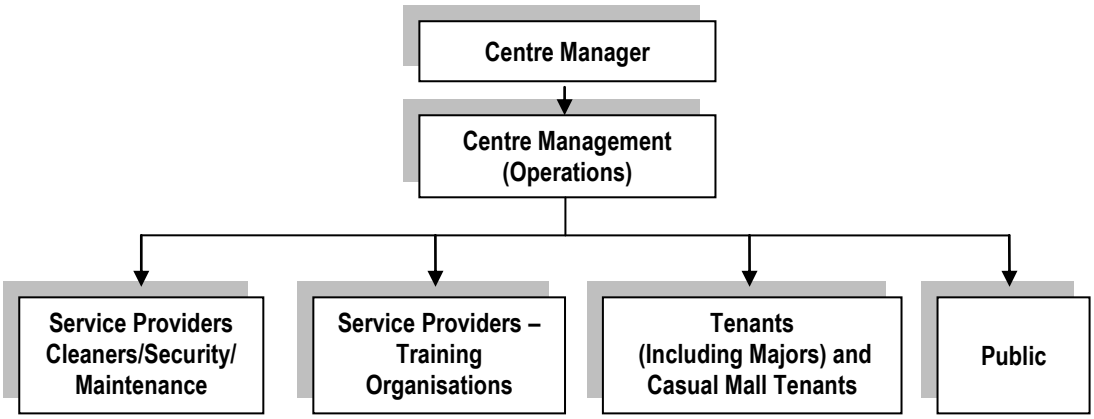


Figure 4.3 – Operational interaction

Service providers (cleaners, security and maintenance)

Conceptually commercial buildings have two ways of organising the services to keep the building clean, provide security and maintain the building. They can directly employ the personnel to complete the tasks or sub-contract the work to a service provider. If they employ the staff directly they are part of the staff and follow instructions in the normal manner. However, if they are employed by the service provider they will take instructions from the supervisors and managers of the service organisations who in turn liaise with the centre management.

The service providers, including the cleaners, security, and maintenance, have specific functions to complete. The cleaners are there for a specific function and are not involved in the fire risk process. However, it is expected if they were to discover a fire, they would contact the centre management being either directly employed or by a service provider. The security personnel have the specific function of the keeping the centre safe and they would be expected to contact centre management in the same way as the cleaners. They are required to advise the centre management of any incidents in the common areas. The security function of the centre management does not extend to the tenancies. The maintenance staff are employed for specific functions that do not include the reporting of any incidents. However, it is expected that they will advise centre management of any fire risks while undertaking maintenance work.

Training organisations

The training organisations are independent service providers engaged to carry out specific functions for the centre management (www.first5minutes.com.au). The training involves all aspects of incidents and includes evacuation testing. The extent of participation will normally include centre management staff, cleaning, security, and representatives from the tenants. Training is normally carried out as required by the training organisations. However, the centre management has the responsibility to advise the tenants when and where the training will take place. The training organisation such as First Five Minutes will fit into the centre management requirements and they in turn liaise with the tenants. The training is undertaken at an acceptable time to all parties.

Tenants

The tenants in both regional and sub-regional centres are varied in both size and structure (www.propertyoz.com.au). The smaller specialty stores that employee one or two people may not have any fire risk management in place and may rely on the centre management for guidance. The centre management will be proactive in the area of fire risk management to cover for the smaller tenants. This is especially true for the tenants in the food courts that have a higher fire risk. There are also temporary tenants, normally referred to as casual mall tenants. They are invited into an enclosed shopping centre for a short-term to market various types of goods and services in the common areas.

Major tenants

The major tenants such as the supermarkets, that are in turn part of large groups, have fire risk management processes in place. However, they are still close to other tenancies and as such fire can easily spread to adjoining tenancies. There is also a risk that the major tenancies may be storing materials that could be highly flammable. The centre management may not be aware of the goods that have a fire risk. However, the lease may have restrictions on the type of goods stored. The fire risk is therefore entirely in the hands of the major tenant in respect to flammable material in their premises.

Public

The public are mainly dependent on the centre management for the safety of the centre and the fire risk management. The centre has fire risk controls in place. However, no system is completely without some level of risk and it is up to the centre management and tenants to reduce the risks. The way that

the centre management is able to assist the public is by reducing the known risks and having strong evacuation processes and good signage. The centre management has complete control over the evacuation process and in this there is less likelihood of a major incident.

4.4 Building interaction parties

The chart in Figure 4.4 shows the interaction with the various parties in the construction and renovation of enclosed shopping centres according to the project managers. This involves the original building and subsequent renovations and extensions. The enclosed shopping centre ownership may be in different hands to that of the centre management. The owners may have a slightly different outlook on the building to that of the managers. However, both parties wish to protect the assets and obtain the highest return. The managers are paid according to the management agreement. The owners and managers have agreements in place to specify what they are responsible for in respect to fire risk management. However, the manager should always undertake any maintenance to keep the building fire safe. This part of the conceptual framework should not be underestimated. There are major fire risks in many buildings due to age, material used and access (Webster 2009). This is especially true for enclosed shopping centres that are located in the central business districts of cities. This makes them vulnerable to fire risks due to age and access. The following flow chart was the result of the interviews with the building surveyors and architects.

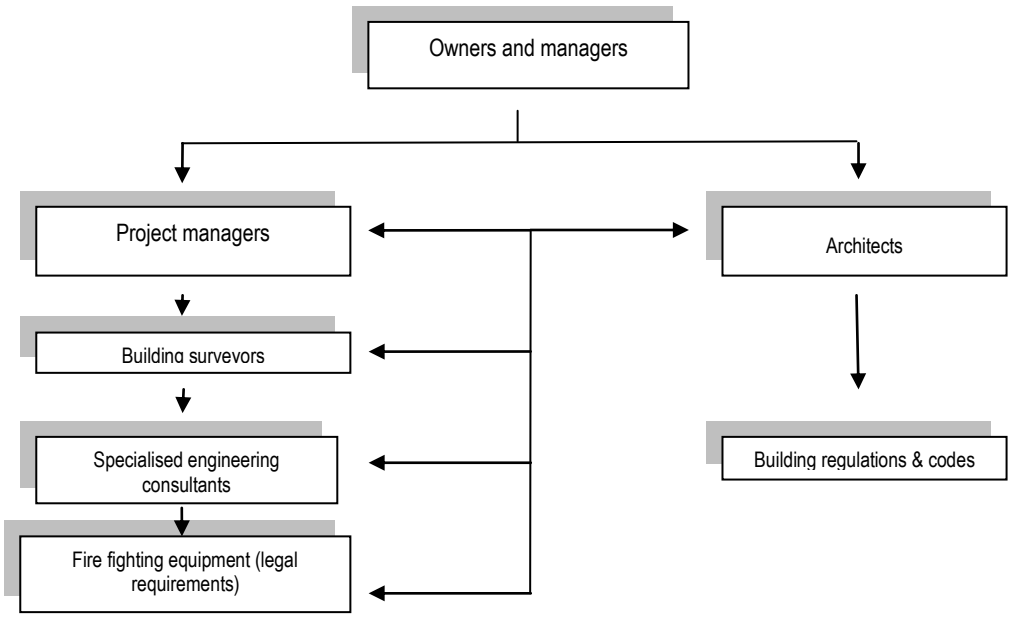


Figure 4.4 – Building interaction

Renovations and extensions

Enclosed shopping centres undergo renovations and extensions from time to time which are normally undertaken while the centre is open for business. The area for the renovations and extensions is sectioned off with limited public access. However, the renovations can be close to existing tenancies and they can be a fire risk due to machinery and material being used. There are a number of cases when fires have started during renovations (www.theage.com.au) and this has led to a high level of damage and risks to customers, contractors and tenants.

Project managers

The project manager has an important function in respect to the building during the initial construction and later if it is renovated. Such managers are the central point of the coordination during the renovations. The project manager's liaison with the owner and managers during the renovations and extensions are required to control the fire risks with the contractors. Therefore, they play an important role during this time.

Architects

The architects have the responsibility to make sure the building will be fire safe at the design stage. The architects must consider, for example, whether there are adequate entry and exit points. The building may conform to the highest design standards, but it does not allow safe passage of people. This can only be achieved with detailed simulation as discussed in section 3.4.4.

Building surveyors

The building surveyor has a close working relationship with the architects. The objective of both parties is to enable a structurally safe and pleasing building to be constructed. The building surveyors have an important function in commercial building construction. They certify that the building is complete according to the regulations. They are the conduit between the project managers and the consulting engineers, for example. They have an important role to play in the area of fire risk management during the construction phase. They are also responsible for the fire fighting equipment and to ensure that the

building has adequate resources including hoses, extinguishers and other equipment. This is part of the building regulations (www.vic.gov.au).

Specialised engineering consultants

The specialised engineering consultants are engaged to review the engineering aspects of the building. This involves the movement of people, including the number of entry and exit points. This is important information, especially for commercial buildings such as enclosed shopping centres that have large movements of people. They are required to get the best outcome for the building.

4.5 External parties

The third part of the conceptual framework involves the owner and manager with external parties. This includes the fire and emergency services, insurance companies and occupational health and safety regulations that are administered by the state and territory government.

Insurance

Insurance companies do not have a direct role in the management of fire risks in enclosed shopping centres. However, they have an important role in the area of reducing risks to protect their interests. They will advise the managers and owners if there are any fire risks that require attention. Insurance has an important connection to moral hazard as discussed in the area of risk in 2.4.7. This forms part of an important aspect of the conceptual framework.

Fire services

The objective of the fire service is to protect the people and building and contents from the risk of damage by fire (www.mfb.vic.gov.au) The fire service has to serve various types of customers in the geographical area in which it operates. The type of users of the service varies from single houses, apartment blocks, warehouses, offices, and enclosed shopping centres. Do the fire services have adequate equipment to service all the possible users in the area it operates? If the local fire service does not have the equipment, where will the equipment come from? It could be argued that it is only in an emergency that those types of questions are asked as happened in the Myer Hobart fire (Webster 2009). The fire services that cover the specific area in which the enclosed shopping centre is located

are of the upmost importance to the centre management. Centre management should have a good understanding of how the local fire service operates and how fires would be managed.

Occupational health and safety (O H & S)

The occupational health and safety regulations are an important consideration in all enclosed shopping centres. There are employees at all levels including centre management, tenants, service providers, and building personnel. They are all subject to the occupational health and safety laws in force under state government acts (www.vic.gov.au). The employees, including the centre management, tenants, and service providers are responsible for providing a safe workplace environment. This includes the fire risks in all areas. The following Figure 4.5 shows the interaction between the centre operations and the external stakeholders. The external parties can be any organisation with whom the operations do not have a direct interaction with the centre operations. The insurance company, for example, will interact with both the owner and the manager.

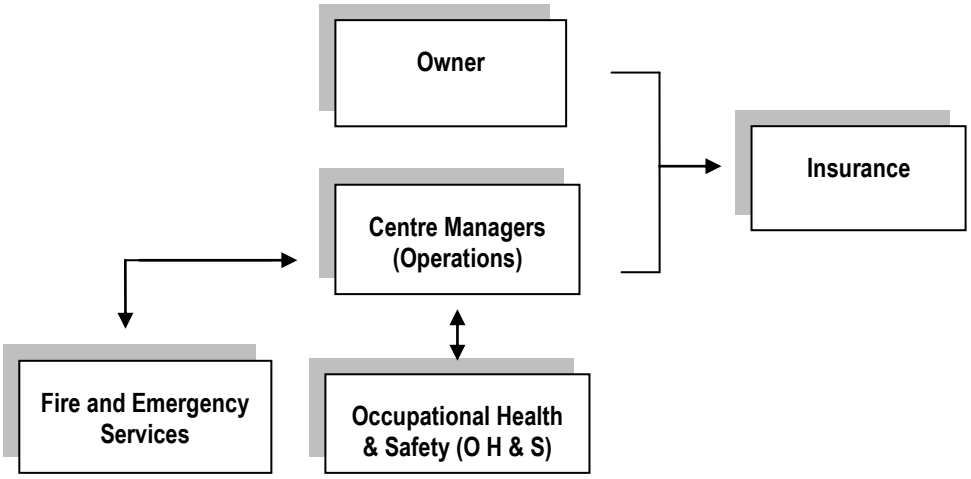


Figure 4.5 External interactions

4.6 Final propositions

The final propositions as detailed in Table 4.2 in relation to the orginal research questions in 1.2.2 in the following way. The research Questions 1, 1(a), 1(b), 1 (c), 1(d) and 1(e) relate to the proposition 1 to 3. Research Question 2 only discussed the relationship with the fire services; however, proposition 4 expanded this to include areas such as occupational health and safety. Research Question 3 was the precursor to proposition 5 for a model. The following propositions are stated below in this conceptual framework.

Table 4.2 Final propositions

Propositions	Comments on propositions
1. What are the current systems in place for the control of fire risks in enclosed shopping centres?	This is important to give an insight to the fire risks that confront the management of the enclosed shopping centre. Are the systems and processes fully documented and is there a detailed plan for all stakeholders to review?
2. What is the responsibility of the various stakeholders to reduce fire risk in enclosed shopping centres?	Following on from the first question, are the various parties fulfilling their role in the management of fire risks? Do all the stakeholders know their responsibilities and are they aware of them?
3. What systems and processes are in place to make sure the enclosed shopping centre adheres to all Australian Standards in respect to fire safety?	The commercial building sectors that include enclosed shopping centres rely on Australian Standards when mapping their fire risk systems and processes. It is important that there are some checks and balances to make sure this is undertaken by way of fire safety audits in AS 4655-2005.
4. Do external parties such as the local fire service, insurance companies and regulatory bodies such as WorkCare fully understand the enclosed shopping centre?	It is important that all external parties fully understand the workings of the centre. This is especially important for the bodies noted above. It is important that the local fire service has complete knowledge of how the centre fire risk management systems and processes work.
5. What is the best way of showing how fire risks are to be managed in Australian enclosed shopping centres?	This is the result of the research and study to produce a model in best practice fire risk management in enclosed shopping centres.

4.7 Summary

Information in the conceptual framework shows that fire risk management in enclosed shopping centres is complex. The interacting parties and their obligations make the control of the risks difficult. It is only when there is a major emergency that the evacuation systems can be fully tested to understand any problems. The enclosed shopping centre management undertakes evacuation testing in a controlled environment. However, the only real test is in a genuine emergency, when it said that people may tend to act in a vastly different way to how they normally do as discussed by Owen M, Galea E, and Lawrence P (1996). However, the situation is dependent on other stakeholders to do their part. The major tenants have an important role in fire risk control as this conceptual framework shows. The study at the conceptual framework stage has highlighted the complex interaction involving all stakeholders with fire risk management in enclosed shopping centres. The conceptual framework forms the basis in the research methodology in Chapter 5. The process is to take the information and design the

appropriate forms of research. This includes major research at the operational level by way of questionnaires and interviews to gain an insight into the processes in place. This also includes interviews with other stakeholders. This includes the construction and external stakeholders such as insurance companies and fire services. The data from the research is analysed in Chapter 6 and, from that, the model is built in Chapter 7. The final Chapter 8 discusses the research findings and conclusions from the model.

Chapter 5 Methodology of the research

5.1 Aims of the research and research questions

The aim of the research is to take the research questions and apply them to the current practices in fire risk management in enclosed shopping centres. This chapter builds on Chapter 2 that studied the theory of risk, and how it is calculated, together with related theories. Following on from this in Chapter 2, the influence of the Australian Standards AS/NZS 4360:2004 in risk management and how it guides Australian organisations. Chapter 3 discussed the fire risks in commercial buildings and the importance of enclosed shopping centres in Australia. The literature available is both in-depth and comprehensive in both risk and commercial buildings. However, there is limited literature on the management of fire risks in enclosed shopping centres. Chapter 4 discussed and analysed the conceptual framework of fire risks in commercial buildings and enclosed shopping centres. This chapter will build on the previous chapters by discussing the methodology of the research. The research questions as discussed in this chapter are as follows and are the basis of this study.

	Question		Question
1	How is the management of the fire risk analysed and implemented?	**1. (d)**	Is there a clear legal responsibility for managers and tenants to minimise the fire risk and is this enforced?
1.(a)	How are the risks assessed for each building and how are they graded?	**1. (e)**	What is the relationship between the owners and managers in relation to fire safety in the centres?
1. (b)	Does the owner/manager have a detailed plan available to the tenants and is the public aware of the plan in light of an emergency?	**2.**	What relationship does the owner/manager have with the fire and emergency services?
1. (c)	Has the owner/manager completed a Fire Safety Audit under the Australian Standard 4655-2005?	**3.**	What is the best process of fire control and evacuation procedures?

The methodology of the empirical research involves the following major areas. The research required primary data collection by both questionnaires and interviews. The questionnaires were targeted at operational management at enclosed shopping centres. The questionnaires look at individual enclosed shopping centres and how each centre managed fire risks. (Refer Appendix 2).The interviews were conducted with a number of stakeholders in the management of fire risks. The interviews are in three areas of operations, building and external stakeholders. The operational issues include interviews with major tenants and training organisations. The building interviews are directly related to fire risks in

enclosed shopping centres including how the building stakeholders interact with each other. The final interviews are with the external stakeholders including the fire services, occupational health and safety, and insurance. Direct observational research was undertaken at a low level due to various privacy issues. The aim of this research is to study and produce a model of fire risk management practices in enclosed shopping centres.

Previous research

There has been previous research into fire risks in enclosed shopping centres. However they have centred on specific aspects of the fire risks such as buildings and fire equipment (Bennetts I, Poh K and Thomas I 1998). This research takes the study to another level and includes owners, managers, tenants and external stakeholders such as training organisations and fire services. All of which have a specific role to play in the management of fire risks in enclosed shopping centres. The aim of the research is to produce a model that can be used by various stakeholders for fire risk management in enclosed shopping centres.

5.2 Research methods – justification

There are a number of ways to collect the research data. This includes questionnaires, case studies, and focus groups (Veal 2005). Research involves either quantitative or qualitative data. The nature of this study will not lend itself to large amounts of quantitative research such as numerical data. As a result, the data is will be more qualitative. The research has included literature both in risk, commercial buildings, and enclosed shopping centres. The primary data collection could have included both group interviews and focus groups. The group interviews were rejected, as the participants would not have been forthcoming with opinions due to the sensitive nature of the study. Focus groups usually consist of between five and twelve participants according to Veal (2005). The primary data collection does not lend itself to focus groups as the study is not seeking information from individual opinions, but that of organisations. The merits of questionnaires according to Veal (2005) are:

Quantified data for decision-making
Transparency
Succinct presentation
Comparability
Capturing complexity

Questionnaires are the most appropriate form of data collection for this research, together with interviews.

5.2.1 Questionnaires

The primary data is a combination of questionnaires, interviews and observation. The questionnaires and interviews were conducted with the various stakeholders involved with fire risk management in enclosed shopping centres. The observations part of the research was only a minor aspect of the research due to privacy concerns. The major part of the primary research will involve a questionnaire to the owners/managers of major regional and sub-regional enclosed shopping centres around Australia. The questionnaire was not distributed to any overseas owners/managers as it was beyond the scope of this research. The methodology of this study is in two parts. There is the fire risk management and how the owners/managers of enclosed shopping centres perceive it. The other is how owners/managers understand and respond to the fire risks in enclosed shopping centres. The owners/managers of enclosed shopping centres understand the threat of fire; however, the level of those risks may be underestimated. It is therefore imperative to gain the required knowledge to take this study to the next level. This can only take place with primary data. Surveys are a very old research technique (Babble 2007). In the *Old Testament*, for example, we find the following:

After the plague, the Lord said to Moses and to Eleazar the son of Aaron, the priest 'Take a census of all the congregation of the people of Israel, from twenty old upwards'.

According to Veal (2005), there are a number of research methodologies that capture the data required. They include the use of both primary and secondary data. This part of the research uses a qualitative approach in the form of questionnaires to managers of enclosed shopping centres. Questionnaires are a major form of soliciting information that may not be available by other means and have been used to determine many questions going back for hundreds of years. The questionnaires will specifically involve the enclosed shopping centre and will not involve external parties such as the fire services. The information is not readily available via company reports, the internet, or Australian Bureau of Statistics. This information is normally for internal purposes and not for public discussion. If the fire risk information was made public, it could attract criticism for not having the customers' and tenants' interests at heart.

The questionnaire aimed to obtain appropriate information without any form of criticism of the owners/managers. The purpose of the questionnaire is to help build the best practice model. There are 42 questions all relating to fire protection, training and evacuations. The questionnaire is then analysed and the results used for the model. The questionnaire is targeted at the organisation or persons most able to answer in an unbiased way. The recipient of the questionnaire must have some knowledge of the research, especially if the questions are of a technical nature. The questions are all closed to reduce the risk of ambiguity. The questionnaires were sent to 50 owners/managers of Australian enclosed shopping centres. The centres were chosen for size, location and ownership. This was to give as wide a sample as possible. The size of the centre is important, as the regional and sub-regional enclosed shopping centres are the size chosen for the research, whereas the other enclosed shopping centres (super regional and supermarket/neighbourhood shopping centres) were excluded for reasons discussed in section 3.6.2. The questionnaires relate to fire risks and control within the enclosed shopping centre. The operations or facilities managers were requested to complete the questionnaires. The first part included basic statistical information followed by a number of 'yes' or 'no' answers in part 2. The final part 3 of the questionnaire required the use of grading by use of Likert Scales. This form of questionnaire is a common approach when attitudes to issues are required.

5.2.2 Interviews

Interviews were conducted with the various stakeholders. This included those involved in emergency evacuation training and associated services. The other primary information is from the connections to the actual buildings including the project managers, surveyors and specialised engineering consultants involved in the building code requirements. Interviews were conducted with the fire services in Melbourne to obtain their input into the fire risks in enclosed shopping centres. Interviews with other stakeholders such as insurance consultants and their input to fire risks in enclosed shopping centres were obtained. The primary data was analysed and a model was produced from the answers. The information from the interviews was collated and analysed to see if any issues or trends could be gained from the information. The use of qualitative information, such as interviews, is important in this type of research. Interviews are a proven method of data collection for research (Veal, 2005). The interviews can be face to face or by telephone/email. The method is important for gaining personal experiences in this study. The objective is to build a 'story' of how the respondents see the issues in the management of fire risks. As shown in the conceptual framework section 4.2, there are various stakeholders involved with the management of fire risks in enclosed shopping centres. The interviews were in the form of pre-determined questions. The answers were obtained in writing so that analysing

can be completed without further contact. The interviews include stakeholders in the operations area, the building sector and external bodies. Interviews were conducted with various stakeholders in the operations area including training providers and major tenants. In the building area, interviews were undertaken with project managers, building surveyors and consulting engineers. External bodies include fire services and insurance. Personnel from the professional bodies such as Fire Protection Association of Australia were not interviewed, as they not considered likely to add to the study. However, information from websites and publications was used in the research.

Interview with major tenants/retailers

Two groups of tenants dominate Australian enclosed shopping centres. They are the Coles Group now owned by Wesfarmers and Woolworths Limited. Both groups trade under various names including Coles Supermarkets, Woolworths Supermarkets, Target, K Mart and Big W. All regional and sub-regional enclosed shopping centres have at least one of these retailers. The retailers have risk management policies which are detailed in Appendix 1.5. However, the day-to-day risk management is in the hands of the store management.

5.2.3 Observation

There is also the use of observation to collect data**.** Observations are referred to as the 'unobtrusive method of research' (Kellehear 1993). This type of research involves gathering information without people's knowledge. This could be used to observe situations at enclosed shopping centres for the purpose of fire risk controls. In this study there could be privacy concerns with the managers. Permission is needed to carry out such observations. The elements of observational research, according to Zikmund (1991), are in Figure 5.1. It is important, therefore, to relate the elements back to the study. With the above in mind the observations were confined to fire risk issues found without the need to observe the movement of people within the enclosed shopping centre. It is not within this study to determine the social behaviour of the people within the enclosed shopping centre. However, the general observation of the buildings without involving customers can be undertaken.

Table 5.1 Key elements for observation

The participants	Who are they? What are their interrelationships? How many are there?
The setting	Appearance? Behaviours that the setting might encourage, discourage or permit.
The purpose	What has brought the participants together? What is the official purpose? Are the goals of all the participants compatible?
The social behaviour	What do the participants actually do? How do they go about it? Stimulus for the behaviour What is the behaviour directed towards? Qualities of behaviour (intensity, appropriateness, etc.) Effects of behaviour (others, responses, etc.)
Frequency and duration	When did the event occur? How long did it last? Does it recur? How frequently does it recur?

5.3 Primary data collection

5.3.1 Questionnaires

Introduction

The formulation of the questions was informed by prior research in different types of commercial buildings (Hassanain 2008, Proulx 2009). The specific questions for enclosed shopping centres was undertaken with the assistance of enclosed shopping centre senior operations personnel. The operations personnel had a large number of enclosed shopping centres under their control. Prior to the questionnaires being distributed to the enclosed shopping centre manager's, pilot testing of the questionnaires were carried out with a number of managers. They gave feedback on the questions and recommend changes that would enhance the questionnaires. (Veal 2005) states the purpose of pilot testing is wording, sequence, and layout .The concept of questionnaires is that they seek to open new ideas and issues, and as such they tend to be new formulations.

Major owners and managers of regional and sub-regional enclosed shopping centres

There are a number of public companies owning and managing regional and sub-regional shopping centres in Australia. The following companies were chosen due to their high profile and geographical spread in all states. There are a number of the companies, such as Stocklands, involved in land development and other commercial buildings. However, this research is solely in respect of their interests in regional and sub-regional enclosed shopping centres. The following seven companies are involved in the research: AMP Capital, Centro Properties Group, Colonial First State (CFS), Lend Lease, Mirvac, Stockland and Westfield and the information was

obtained from each website (for example www.westfield.com.au). The centres each group owns/manages is as follows:

Table 5.2 of enclosed shopping centres by ownership and geographical location

Owner/manager	Total	NSW	Vic	Qld	WA	SA	Tas
AMP Capital	29	17	4	5	3	-	-
Centro Properties Group	119	25	28	27	20	12	7
Colonial First State (CFS)	25	3	11	6	1	3	1
Lend Lease	9	3	2	4	-	-	-
Mirvac	26	15	5	5	1	-	-
Stockland	29	15	4	7	3	-	-
Westfield	34	16	6	6	3	3	-
Total	**271**	**94**	**60**	**60**	**31**	**18**	**8**

Table 5.2 shows that there is no consistency with ownership across the geographical areas. AMP Capital is centred in NSW, for example. Centro Properties has the largest number of centres. However, Westfield enclosed shopping centres and others are individually larger in total square metres. The study includes enclosed shopping centres in all states so as to give as wide a review as possible. The population and total number of centres in each state are taken into account. The Northern Territory and Australian Capital Territory enclosed shopping centres are not part of this study because coverage in the states is deemed adequate. It is important that the centres selected are from a number of managers/owners to give a wide sample of the structures in place. The information is to be gathered by questionnaire. This is the basis of the research as it is centred on information generated from each centre. There are state legal requirements that could affect fire and emergency evacuation training. This has been taken into consideration when the sample was chosen. The above information, current at June 2009, was obtained from the companies' websites. The ownership and management tend to be conducted by different sections of the same company. This allows the senior management to use Key Performance Indicators in the various sections of the company such as funds management for the ownership issues, while the centre operations is by property management.

Research sample of major owners and managers of regional and sub-regional enclosed shopping centres

There are a large number of both regional and sub-regional centres. They are owned and managed by a diverse number of public companies. The purpose is to get as wide a sample as possible in both geographical terms and management. It is more common for ownership and management to be part of the same company in the larger centres. The research is targeted at enclosed shopping centres owned by the companies in Table 5.2. There are a large number of enclosed shopping centres as shown in Appendice 1.5. The total targeted enclosed shopping centres and locations are as in Figure 5.3. There were states in which no samples were taken (NST).

Table 5.3 Samples for research of enclosed shopping centres by ownership and geographical location

Owner/manager	Total	NSW	Vic	Qld	WA	SA	Tas
AMP Capital	6	3	1	1	1	NST	NST
Centro Properties Group	22	6	5	4	4	2	1
Colonial First State (CFS)	4	1	1	1	NST	1	NST
Lend Lease	2	1	1	NST	NST	NST	NST
Mirvac	5	3	1	1	NST	NST	NST
Stockland	5	3	1	1	NST	NST	NST
Westfield	6	3	1	1	1	NST	NST
Total	**50**	**20**	**11**	**9**	**6**	**3**	**1**

The above figure 5.3 represents 18% of the 271 centres in Table 5.2 and varies between 15 and 21% over the six geographical areas. The aim of the research is to target a sample of regional and sub-regional shopping centres across the major geographical locations in Australia. This is then to be related back to the owner/management of the centres as listed in Figure 5.2.

Questionnaire to owners/managers

The purpose of the questionnaire is to gain insight into how the enclosed shopping centres deal with the risk of fire. (Refer to Appendix 1.2 with details of the questions). This is important as it provide an indication of what the model should include. The questionnaire includes 10 questions that can be analysed and from which statistical information can be drawn. This involves a sample of 50 enclosed shopping centres across Australia to gauge the current processes and procedures in risk management. The data collection involved all areas stated in the conceptual model. There are in excess of 1,338 enclosed shopping centres in Australia that include supermarket/neighbourhood centres (www.scca.org.au). The research is centred on regional and sub-regional centres due to their size and

location. Permission was required before any data was collected. It required some level of statistics in analysing the data such as the number of fires, damage, type of building, etc. It involved statistical analysis of risk management and how it has been applied. The actual analysis of the data varies on the information available and what can be extracted. The questionnaires were sent to owners/managers of enclosed shopping centres as in Appendix 1.2.

The questionnaires are in three parts. The first deals with centre statistical information that relates directly to the fire risks in each centre including number of entry and exit points. The second part of the questionnaire deals with areas such as emergency control organisations and appointment of wardens. The second section requires a yes or no answer. The third section deals with the further opinions regarding the manager's attitude to fire risk issues. The questionnaires were sent to 50 owners/managers of enclosed shopping centres across Australia. The criteria in the choice of owner/manager were as follows:

1. Number of centres in Australia owned or managed in proportion to the total in the sample.
2. The spread across all states.
3. The enclosed shopping centres represent both regional and sub-regional centres.

The operations/facilities managers are responsible for the fire evacuation and training. They were invited to complete a questionnaire on behalf of the owners/managers. The persons holding such a position have a detailed knowledge of the centre, including entry and exit points. The person has direct access to the service providers. They are the first point of contact. The above information can be analysed and a rating for each section obtained. This was analysed by use of Excel spreadsheets. From this information, any trends or outcomes in the data were obtained. There is a need for a confidential analysis so that no individual enclosed shopping centre can be identified. The sole purpose of the analysis is to see what the majority of the selected centres are doing. The above information is not in the public domain and permission was required and it was subsequently obtained. Also, this was not an issue because individual centres are not identifiable in this thesis. From the above information it is expected that a majority result will emerge on how the fire risks are treated and whether there are any common elements to fire risk management in enclosed shopping centres.

Primary data – questionnaires

The formulation of the questionnaires and the research process was completed in the following manner. The questionnaires were tested on a number of managers in the enclosed shopping centre industry and a number of changes were recommended. The following flow chart shows how the research questionnaire was completed.

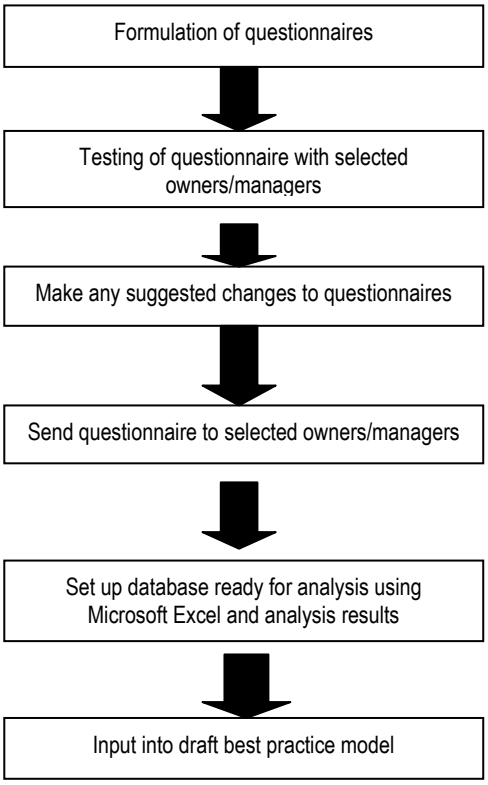


Figure 5.1 Questionnaire process

Process of questionnaire distribution

The first action was to set up a database of the enclosed shopping centres from the various websites of the owners/managers and select a sample from the organisations' websites. From this information, 50 centres were chosen at random from information available on the organisations' websites. The next action was to decide in which states the sample centres were to come from. The majority of the centres are based in the three major states of New South Wales, Victoria and Queensland. Thus, the majority of the samples came from those three states. The next question involved the ownership and management of the centres. There are owners and managers that have larger centres, but smaller in total numbers. Conversely, there are owners and managers owning large numbers of smaller centres

such as Centro Properties Group. The objective of the sample was to have bias in the selection process.

The operations management of the shopping centres tends to be at the centre level for a number of reasons including being at the 'coal face' with day-to-day operating issues. Contact was made with the centre management to ascertain the head of operations in each centre. The questionnaire was sent with a covering letter requesting involvement with the research. The letter included the clause that all information is kept confidential. Permission was also given by senior management to conduct the research. The questionnaires were distributed to the 50 centres chosen via the above process. The recipients were asked whether they wanted to be part of the research and if not to return the questionnaires direct to the Victoria University.

5.3.2 Primary data – interviews

Introduction

The interview process started with pilot questions being formulated with the assistance of the senior operations management at the owners of enclosed shopping centres. The questions were deemed to be part of internal risk management processes. The interview process is described in the figure 5.5 below. However before conducting any interview the questions were tested on various stakeholders. This was undertaken by sending the questions to third parties to ascertain whether the questions were reverent and to the point. It is important that before any interview is undertaken the questions are fully researched as this can influence the outcome of the interview.

Process of interviews

The process used to gain the research interviews was to contact the various stakeholders by telephone, website and email. The communications depended on the stakeholder and the person who was to be interviewed. The organisation's website is an excellent place to start as they are now more than ever full of detail. They normally provide some contact points. However, they do not normally have specific names of persons. When contact has been made an email detailing the study and the expected outcome – in this case the model – is advised. The most important aspect of the interview is for the person being interviewed to have the correct knowledge so that answers are accurate and credible. This is of prime importance in the interview process.

Interviews

The interview process was completed in a formal manner with a number of set questions. The targets were senior managers in the various organisations who had a deep understanding of the issues and how the systems operate.

The process of the interview is as follows:

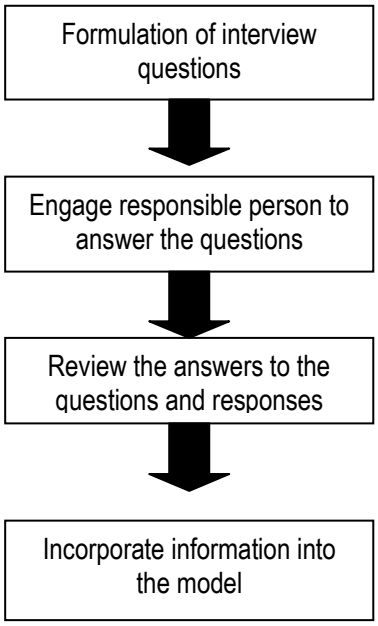


Figure 5.2 Interview process

Interviews with training providers

The enclosed shopping centre owners/managers engage service providers to organise all aspects of the emergency evacuation training. This includes the training of the fire wardens in the area of evacuation control. The service providers organise trial evacuations in conjunction with the managers and tenants. They are responsible to the management of the centre to provide such training to the required standard. The research involved information from providers of fire evacuation training. The service is highly competitive and the organisations have requested that the research is kept confidential. The target companies did not have any indication of the other service providers being involved in the research. It is not mandatory for commercial building managers and owners to use such services. It does give an independent review of the training. It allows management to concentrate on

the management aspects of the building. Currently, there are no independent reviews of the training service providers. They rely upon the reactions from the owners and managers to know how well they are doing the job.

Major retailers/tenants

Enclosed shopping centres in Australia have a small number of major tenants. They are concentrated in two major groups – Coles Group (part of Wesfarmers) and Woolworths Limited. There are other major tenants, these being David Jones and the Myer Group. However, they are restricted to the super regional and regional centres. The major retailers/tenants have an important role to play in the area of fire risk. This was highlighted at Lakeside Shopping Centre UK, Littlewoods department store discussed in section 1.1.2 Rogers (2003), when flammable material was being stored incorrectly and resulted in large fines to the retailer Littlewoods. The tenants may have their own fire risk processes that are not integrated with those of the centre management. The tenants may have their own direct entry/exit points that bypass the other tenants. Thus, the general evacuation risks are likely to be less. However, there are also entry/exit points directly into the shopping centre, in which case they are part of the general evacuation strategy. There may be movement of customers through the tenancy, even if the customers were not directly involved in the tenancy at the time of the incident. Tenants may be reluctant to divulge information due to commercial considerations. However, they constitute an important area of the research due to their influence in enclosed shopping centres. The major retailers are themselves major public companies and are required to implement strong fire risk controls according to corporate governance requirements of the Australian Stock Exchange (www.asx.com.au).

Interview completion

When the interviews were completed, they were summarised and analysed. The interviews were of a general nature due to commercial confidentiality. There was consensus from the interviews on what are the fire risks in enclosed shopping centres. Where possible, the interviews were conducted with a minimum of two in each part of the research, including two training providers. Other external parties including the fire services and insurance was conducted with one interview each. The interview process included following up with the participants if there was need of clarification.

Service providers – cleaners, security, and maintenance contractors

As discussed in the conceptual framework section 4.2, the cleaners, security and maintenance contractors are engaged to undertake specific functions. Cleaners, security and maintenance contractors do not have direct fire risk management responsibilities. They do have a duty of care and they are required to advise the centre management of any fire risk problems. This is an important concept in the theory of moral hazard discussed in section 2.4.7. No interviews were requested from cleaners, security and maintenance personnel due to privacy issues. The service providers relating to cleaners, security and maintenance are discussed in section 6.3.3.

5.3.3 Buildings

The management of the fire risk starts at the time the building is constructed or refurbished. There are many stakeholders including architects, project managers, building surveyors and engineering consultants. They all play their part in making the building safe for the public, tenants, and centre staff. The building must be compliant with the building codes and be as safe as possible. However, this is not to say that there have not been issues after the completion when the building is occupied and is in full use.

Building project managers

Issues relating to developing new enclosed shopping centres

Enclosed shopping centres are completed to the required building regulations and the building code in force at the time of construction. The owners or developers engage project managers to oversee the project from the design to the opening of the centre. The configuration of the centre depends upon the needs of the tenants, especially the major tenants, and this has a major impact on the evacuation process. The number of entry/exit points is determined according to the expected number of people passing through the centre. The buildings are required to conform to environmental rules, especially in the area of energy conservation. Major tenants tend to have areas close to entry/exit points and close to car parks.

Refurbishment of enclosed shopping centres

Enclosed shopping centres need to be kept up to date and be attractive to the customer. This requires constant upgrades in the form of new tenants and upgrades to existing tenants. The refurbishments can also involve completely new sections including new food courts and other areas that attract customers. The refurbishments can bring new fire risks and may not be compatible with the older parts of the centre. The refurbishments are normally conducted while the main shopping centre is open. This can cause higher fire risks due to equipment being used close to occupied tenancies. The area being refurbished is normally closed off to the public; however, there are dangers as construction workers move around the site and use equipment. There was a major fire during the refurbishment of the Myer Burke Street store in Melbourne in 2008 (www.theage.com.au).

Building surveyors

The Australian Institute of Building Surveyors is the governing body representing building surveyors in Australia. This body is the peak body both in Australia and overseas. The Australian Institute of Building Surveyors (www.aibs.com.au) website defines the building surveyor as follows:

Building surveyors are responsible for making sure buildings are safe, energy efficient, accessible and meet all legal requirements. They evaluate and access plans, conduct inspections, and issue building permits, such as occupancy permits.

The project managers on behalf of the owners/managers appoint building surveyors. They take their instructions from the owner/manager via the project manager. The building surveyor has an important role to play in the building process. The objective of the building surveyor is to work with the project manager and advise on any building issues that may conflict with the building code. The building surveyor has the responsibility to issue the occupancy permits for all commercial buildings including enclosed shopping centres. They are required to follow all the required building codes and ascertain that the building follows the building codes in full. This includes all fire prevention and safety requirements. The building surveyor is still subject to the needs of the enclosed shopping centre owner/manager and must be commercially astute to know what those needs are. There will always be issues that may conflict with the building codes or other regulations. It is the role of the building surveyor to make sure the building is not compromised by the needs of the owner/manager**.** The use of surveyors in the construction industry is important due to risks and potential litigation. They are involved

in all types of buildings from office complexes, warehouses, hotels and shopping centres. The other services that building surveyors are involved with include property legislation advice, handling of planning applications and building inspections. The major objective of the building surveyor is to ensure the building conforms to the building code. The building code consultations are undertaken with all the stakeholders involved with the enclosed shopping centres. This includes the architects, project managers, surveyors and engineers. Surveyors advise the project managers of issues arising from the proposed development or refurbishment. This is relayed to the owners/managers for further consideration. Surveyors are able to issue occupancy certificates and they are responsible for ensuring the building conforms to the building codes. Only one interview was required as they all follow the same professional guidelines and professional competency.

Consulting engineers in fire safety

The objective of engaging the consulting engineers is to advise the stakeholders of the current fire regulations (www.scifire.com.au) and how they apply to commercial buildings. Fire regulations are state-based and therefore the building is required to conform to those regulations. Such engineers advise the building surveyor if any changes are required to meet the regulations. They are an important part of the process in the early stages of the building construction or alterations. The consulting engineers work with both the architects and building surveyors to obtain the best outcome for the owner or client. The consulting engineers build simulations of people movements. This is to make sure that the entry/exit points are sufficient to allow safe passage of people. However, this is undertaken before the construction of the building. There is a potential problem when the commercial building undergoes major changes to the tenancies. The changes may bring more people movement and, therefore, increase pressure on the entry/exit points.

5.4 Secondary data

There is a wealth of secondary data in the area of fire risk relating to commercial buildings. This includes information from Australian Standards, professional associations, fire services and other government bodies involved in occupational health and safety. The purpose of this data is to support the model and the assumptions. Other information that supports the model includes company and government reports, including those on risk and fire. This information has been used where possible in this research. The result of the secondary data is included in Chapter 6.

However, the information from the secondary data does not give a detailed picture of what is happening at enclosed shopping centres and there is primary data required in the form of questionnaires and interviews.

5.5 Model theory

Introduction

The main purpose of the research is to produce a model that can be used as a 'best practice' guide for all enclosed shopping centres. The model can be used as a template on how to manage fire risks in enclosed shopping centres. While not all enclosed shopping centres are the same, many have the same characteristics and basic configurations. These include specific entry and exit points, minimum number of tenants and possible food court or central eating area. The centres may also be multilevel and have transport access such as a railway station or bus terminal. They may also be part of an airport terminal. The fire risks may have various characteristics specifically relating to that centre. No enclosed shopping centre has the same number of entry/exits points or is the same size. The paper by Gwynne S, Kuligowski E, Kratchman J, Milke J. (2008) highlighted the issues with entry and exit points. There is no major alternative to a model as any other report or summary does not address the whole picture. Fire risks at enclosed shopping centres are a complex process and have a large number of interactions between the various parties. Fire risk management is not under the control of one body, but under the control of many hundreds of organisations in the form of tenants.

Model definitions and types – theoretical

There are a number of definitions for a model. The Oxford dictionary (Waite 2007) defines one model as a simplified mathematical description of a system or process used to assist calculations and predictions. The model should be easy to understand and have clarity in the way the processes of the various components come together. What should operations management do to make the processes as transparent as possible so that management has maximum control over the fire management risk? There are a number of models that could be used, including data flow diagrams, control flow diagrams, flow charts, Gant charts, PERT diagrams and Integration Definition (IDEF). They are all part of the business process modelling used in business today.

Practical model

The model developed in this research is the type of model that is a flow of actions and embodies both theory and practice. The model does not require detailed statistical analysis and is more likely to depend on processes and basic systems. It is intended that the model be used by the operations management of enclosed shopping centres and therefore it needs to be user-friendly. The data collected to this point in the research shows that a high level of integration is required of the known issues to construct the model. The model takes various forms including a series of flow charts or a written manual. The result is a 'best practice' model to use as a template for the owner/manager in the area of fire risks in enclosed shopping centres. The data collected, analysed and discussed in Chapter 6 will be the basis of the model components. From the information, the model is built to show how fire risks should be managed in enclosed shopping centres. The model is fundamental in its form and is intended to bring all the known information together.

5.6 Ethical considerations

The questionnaires and interviews do not involve any personal information of any kind. They relate solely to the enclosed shopping centre and general systems and processes. However, the ethical consideration of this study involves the possible confidential details of the various owners/managers' operation systems. The study has only referred to the enclosed shopping centre by means of a code, which does not relate to ownership, location or size. It is imperative that this information remains confidential otherwise it could be interpreted as a weakness or detrimental to the owners/managers of the enclosed shopping centre. The purpose of this study is not to find any weakness in the current systems or processes. The aim of this research is to improve the efficiency of the systems and processes now in place by way of a model. This will, in turn, reduce the risk of fire and the consequences. The interviews were agreed upon on the understanding that no confidential information was to be available to the public or to other service providers.

Limitations of study

The research will endeavour to be as wide and detailed as possible. However, the study involves a number of high-profile organisations in a highly competitive environment. The research is confined to Australian enclosed shopping centres located in all states. Information from owners/managers is given

'in confidence' and that no information is given that will affect any privacy policy. Such information includes details of attendance at incident training.

5.7 Summary

In this chapter we look at the methodology of the research including the primary questionnaire, secondary data and interviews with the various stakeholders. There are other areas of the research that include external stakeholders such as the fire services, insurance and professional bodies. This follows on from the conceptual model in Chapter 4. In Chapter 2, firstly the theory of risk was discussed and analysed followed by the specific issues of fire risks in commercial buildings and the role of enclosed shopping centres and their impact on Australian retail industry. This chapter applies the conceptual framework and maps the methodology of the research. The primary data is in the form of questionnaires and interviews with various stakeholders in the management of fire risks in enclosed shopping centres. The secondary data includes the Australian Standards, fire regulations and other information. There are a number of inputs into the management of fire risks in enclosed shopping centres. There are the operational issues such as owners/managers input and training of staff and tenants. There are the external influences including the fire services and building codes. Chapter 6 shows the analysis of the data collected and what assumptions can be made. Chapter 7 sets out the template model and the areas of fire risk management research that need to be incorporated into the model. The final Chapter 8 summarises the conclusion of the research and the path forward.

Chapter 6 Analysis of data

6.1 Introduction

The purpose of this chapter is to analyse the information gained from the research. The chapter follows on from the conceptual framework and the research methodology. Data is analysed by means of Likert scales and arrangement of qualitative scales. The research is qualitative in nature and lends itself to questionnaires, interviews and a case study. There were 50 questionnaires sent to the managers and owners of the shopping centres and 30 replies that constitute a 60% response. It was agreed with supervisors that this adequate for analysis. The use of quantitative data analysis in this study has been limited to the 30 enclosed shopping centres used in the sample. However, there are also limited levels of statistics used in the building section. The research deals with the experience of the management at the centre and those closely connected to the management. They are the service providers that deal with the centre management on a regular basis and have an important role in fire risk management. The tenants have an important role in the area of fire risk management including the 'majors'. The primary data is in the areas of operations management, building data, and external influences. They all have their place in the management of fire risks and each has their own methods for reducing the risk for all the stakeholders. Operations management is responsible to the owners, tenants and the general public. The major building stakeholders are the owners and building code regulators. There are other external parties such as the fire services and insurance companies that are expected to contribute to fire risk management. They have their role to play; however, they are not involved in the day-to-day running of the centre.

Primary operational data

The first area of data collection involves the questionnaires that were completed by owners/managers of the enclosed shopping centres (Refer appendix 2). The shopping centres are in a highly competitive industry and information on individual shopping centres is highly confidential. As a result, the interviews were conducted with the agreement that details of the individual centres would remain confidential. Following on, there are interviews with major tenants and training providers. The information from both the questionnaires and the interviews are analysed in this chapter. The interviews were conducted with the complete support of the target organisations. The consensus is that while the fire systems worked as well as possible there is always room for improvement.

Primary building data

Extensive interviews were conducted with the bodies related to the construction and building part of the research including project managers, building surveyors and engineering consultants (Refer Appendix 4). They are the second tier of influence in the fire risk management in enclosed shopping centres. The organisations interviewed were all directly related to the enclosed shopping centre industry, being involved with some high-profile centres. The purpose of the interviews was to understand the issues relate to areas such as building codes and simulation of people movements.

Primary external data

The final part of the primary data involves interviews with external stakeholders including insurance consultants and fire services. The interviews were carried out to obtain an in-depth knowledge of how the stakeholders interact in the conceptual framework and how they interact with management. They both constitute an important part of the risk management framework and have detailed knowledge of commercial buildings including enclosed shopping centres. The interviews were confined to the insurance and fire services. The interview process did not include the professional associations as they were considered unlikely give any extra information to the research.

The following is a summary of the primary data collected:

Table 6.1 Details of Collected Primary Data

Type of data	Number	Respondent	Operation/Building/ External	Section
Questionnaire	30	Enclosed shopping centre owners/managers	Operational	6.2
Interview	4	Training providers	Operational	6.3.1
Interview	2	Major tenant	Operational	6.3.2
Interview	Nil	Cleaning, security and contractors (Interviews with those service providers did not take place. See 6.3.3)	Operational	6.3.3
Interview	1	Project managers	Buildings	6.4.1
Interview	1	Building surveyors	Buildings	6.4.2
Interview	1	Engineering consultants	Buildings	6.4.3
Interview	1	Fire services	External	6.5.1
Interview	1	Insurance consultants	External	6.5.2
Observation	2	2 enclosed shopping centres	Operational	6.5.3

6.2 Primary data analysis – operational issues

6.2.1 Questionnaires to owners/managers

Introduction

There were 50 questionnaires sent to managers/owners of enclosed shopping centres. The questionnaires distributed covered all regional and sub regional shopping centres in Australia, that is 50 in figure 5.2

Table 6.2 Questionnaires sent to Managers/Owners

Owner/Manager	Total	NSW	Vic	Qld	WA	SA	Tas
AMP Capital	6	3	1	1	1	-	-
Centro Properties Group	22	6	5	4	4	2	1
Colonial First State (CFS)	4	1	1	1	-	1	-
Lend Lease	2	1	1	-	-	-	-
Mirvac	5	3	1	1	-	-	-
Stockland	5	3	1	1	-	-	-
Westfield	6	3	1	1	1	-	-
Total	50	20	11	9	6	3	1

The data from the questionnaires, obtained from 30 owners/managers of enclosed shopping centres around Australia, is analysed using statistical tools within Microsoft Excel (Refer Appendix 2). The data was analysed to ascertain, quantify and correlate the answers in the questionnaire and what is presently known in the area of fire risk. The rate of responses of 60% of the sample is considered acceptable for this type of questionnaire. A minor number of the owners/managers declined to answer the questionnaire due to company policy. The centres that declined were from the same ownership group that gave other responses to the questionnaire. This could indicate that the decision to complete the questionnaire was left in the hands of the various centres. In this age of the highly competitive environment, the owners/managers would be reluctant to divulge this level of information.

The interviews will be analysed and summarised into a format that highlights the general consensus about fire risk management in enclosed shopping centres. Enclosed shopping centres vary in size as explained in Chapter 3 (i.e. super regional, regional, sub-regional, supermarket, and neighbourhood centres). The research is centred on the regional and sub-regional centres. There are a limited number of super regional shopping centres in Australia. The supermarket/neighbourhood centres tend to be a

supermarket with a small number of specialty tenants. Supermarkets traditionally have direct access to the outside so they can trade outside normal hours, and other tenants may also have direct access to the outside. As a result, the number of tenants who do not have direct outside access in supermarket/neighbourhood centres is small and hence the risk of evacuation problems is much smaller.

The questionnaire is in three sections, with the first section dealing with questions that relate to type i.e. regional or sub-regional. The following questions relate to the size in square metres of both tenancies and common areas. The final part of section 1 relates to entry/exits points. The information in this section forms part of the statistical information known to the owners/managers. The second section deals with the basic fire risk questions that require yes or no answers. The third section requires rating the answers in the scale 1 to 5. This area is the most important as it relates to what the managers/owners think about fire risks. The questionnaires were sent to fifty owners/managers of enclosed shopping centres around Australia.

The number of questionnaires returned was as follows:

Table 6.3 Results from questionnaires returned by owners/managers and state

Owner/Manager	Total	NSW	Vic	Qld	WA	SA	Tas
AMP Capital	3	1	1	1	0	NSS	NSS
Centro Properties Group	16	5	2	2	4	2	1
Colonial First State (CFS)	2	0	0	1	1	NSS	NSS
Lend Lease	1	1	0	NSS	NSS	NSS	NSS
Mirvac	3	2	1	0	NSS	NSS	NSS
Stockland	2	1	0	1	NSS	NSS	NSS
Westfield	3	1	1	1	0	NSS	NSS
Total	30	11	5	6	5	2	1

NSS – No Shopping Centre Sample
0 – No questionnaire returned

The number of questionnaires returned equalled to 60% response rate. This is considered acceptable in the light of the confidentiality as discussed below. All states were represented in the completed questionnaires. The decision to participate was made at the level of operational management. The total level of responses is considered adequate for the information requested. A number of the managers'

representatives declined to be part of the research due to confidentiality issues, while others in the same group participated in the research.

6.2.2 Questionnaires to owners/managers – analysis

The questionnaires were sent to the centre management at the enclosed shopping centres. (Refer appendix 2) This section analyses the three sections of the questionnaires. The first part deals with the statistical analysis, followed in section 2 with general yes and no questions that only required that level of answer and finally, in section 3, with likert graded questions.

Part 1 Analysis of general statistics

This section refers to general statistics for the 30 questionnaires returned (Refer Appendix 3). This includes type, area in square metres, common areas, permanent tenancies, and entry and exit points. The important information is the total area and the entry and exit points in the statistics. The following figure 6.2 shows that the tenanted areas of the centre do not have any correlation with the entry/exit points in the centre. The issue is that with a lower ratio of entry/exit points to both total area and total excluding common areas, it could be argued that some centres have higher risks due to more people movement. This analysis assumes that all entry/exit points are about the same size. This could have a bearing on the number of people able to pass at any given time. The common areas in enclosed shopping centres do vary from centre to centre. The common areas are included to calculate the total trading area of the centre.

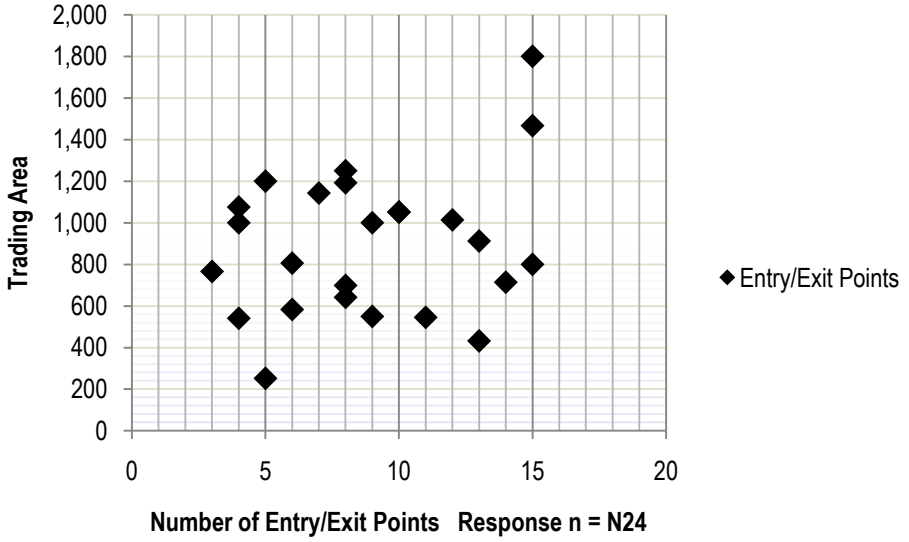


Figure 6.1 Entry/Exit points at target shopping centres

The above figure shows there no clear relationship between the size of the centre and the number of entry/exit points. There may be specific reasons why an enclosed shopping centre has the number of entry and exit points. The scale is between 4 and 15 entry and exit points and trading area square meters in total area. It is therefore difficult to make any conclusions on whether this is a factor in fire risk management.

Questionnaire – section 1 conclusion

The information in figure 6.2 shows that there is no relationship between size in square metres and number of entry/exit points, it does not conclusively point to a strong relationship. This is important to the safe movement of customers, centre tenants and centre staff. There could be good reasons why there are such results, including the size of the entry/exit points and where they are situated. However, the only way that a true indication is reached of the average movements is by accessing the door counters at each entry/exit point. Centre management uses this information to calculate people traffic movement to and from the centre. Centre management would not divulge this information as it is confidential.

6.2.3 Questionnaires – owners/managers part 2

Introduction

The second part of the questionnaires involved 19 general questions relating to fire risk management in the enclosed shopping centre (Refer Appendix 2). The questions required a yes or no answer, as it was considered that a rating would not give a precise response. The questionnaires were completed by the management of enclosed shopping centres. They all managed the centres on behalf of the owners. The owners of the centre are not part of the study as the day-to-day fire risk management is under the control of centre management. (Refer appendix 2)

Fire risk management at centre level

Questions

2. 1 Do you manage the Centre on behalf of an owner?	**2.3 Do you conduct regular fire evacuation training?**
2.2 Do you have a detailed fire risk plan?	**2.4 Is the fire evacuation training undertaken at times agreed with all the tenants?**

All respondents confirmed they managed the centre on behalf of the owner. A large majority of 93% answered that they had a detailed fire risk plan in Question 2. However, the remaining 7% stated they had no fire risk plan. There are over 271 enclosed shopping centres owned by the target companies. If the level of 7% is replicated across all enclosed shopping centres, it is estimated that about 19 centres have no detailed fire plan according to the questionnaire.

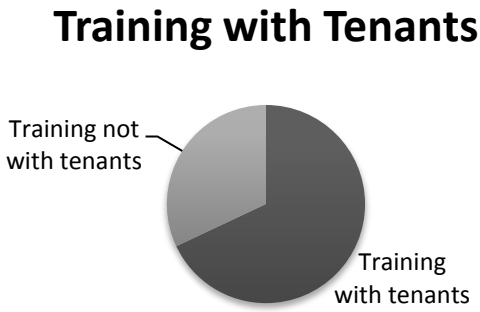


Figure 6.2 Training with Tenants

The question is whether the fire risk training is at an acceptable standard to satisfy the requirements of the fire risk plan. The majority 68% agreed to times for evacuation training with the tenants. However, the remaining 32% did not. It is important that both centre management and tenants work together in fire evacuation training. The outcome will be high controls and better management.

The overwhelming response to this was that 92% agreed that centre management liaised with the tenants regarding their fire plans. However, a small minority did not. There are various management styles and the tenant management may believe that fire risks are totally a centre management issue and the tenants need not be involved. However, information from other managers indicates that they believe that all should be involved. In regional and sub-regional shopping centres there are regular changes in tenancies. This may occur for a variety of reasons including changes in franchisees at branded stores. It is imperative that all tenants are aware of the fire or incident management processes in place. The majority of 69% stated that they agreed with the requirement. However, 31% did not agree with the requirement. This may not be an important issue but it shows that there are communications between the service provider and the manager that need to be addressed. This question has a direct relationship to Question 2.6. A small minority of 4% said they did not give briefings on the fire evacuation plans. The centre management gave briefings but tenants were not required to attend. In other words, centre management will organise the briefing but the tenants may not attend. There needs to be some internal control over the attendance at the training seminars. It is

important that the majority of the tenants, or their representatives, undertake some evacuation and incident training.

The majority of the centre management stated that they conducted fire safety audits according to the Australian Standard AS 4665. There was no indication of what systems they used in place of the Australian Standards. Compliance is not compulsory and similar regulations to those in Queensland may need to be introduced in all other states and territories. One of the main ways that centre management is able to manage fire risks effectively is by having regular training. This is important for both management and tenants. The questionnaire highlighted the communication breakdown when less than 46% followed up with tenants on fire evacuation training. The majority of 54% did not. It is important that all tenants are exposed to the fire evacuation training.

The operations centre management has the responsibility for choosing the fire wardens in consultation with the general centre management and have the responsibility for choosing the right person. Centre management chose 88% of the fire wardens according to the questionnaires and this level of reply is constant with general industry practice according to discussions with training organisations. The service provider or other management-nominated persons could appoint the remaining 12%. However, the main objective is that a system of accountability is in place so that there are strong internal controls. The Emergency Control Organisation (ECO) is the organisation that coordinates and controls emergencies in all commercial buildings. This is discussed in section 3.2.1 and is part of the Australian Standard. It is an integral part of the fire risk management at all commercial buildings. The Emergency Control Organisation should be staffed with appropriately qualified personnel to cope with an emergency. However, it assumes that all enclosed shopping centres have the appropriate staff. This was not the case: 8% answered in the negative.

Evacuation and assembly areas

Question 2.5 Do you liaise with tenants in respect to their fire plans? and 2.6 Are *new* tenants required to attend fire safety briefings?

Questions 2.5 and 2.6 relate to evacuation and assembly of people to safe areas. The importance of people moving from danger to a safe assembly point was made. In the event of a fire or other emergency, it is standard practice to have designated assembly areas for customers, employees and others. The assembly areas are away from the building and may be in a car park, school or other buildings. The facilities being used may in time be sold or changed to other uses and therefore become

unavailable for the intended use. It is therefore important that regular reviews are made so that the intended assembly area is still available in the event of an emergency. The majority of 96% said no to question 2.5 and implied that no action had taken place. However, it is an area that needs to be regularly reviewed at least annually or when an evacuation testing is planned.

Storage of chemicals or other hazardous materials

The tenancies undergo regular changes as stated on the enclosed shopping centre websites. This can include complete change to a tenancy or changes within the use of tenancies. For example, the storage and use of flammable chemicals are constantly changing. This includes such service providers as dry cleaners. A retailer supplying highly combustible swimming pool products for the first time could pose a fire risk. Those types of changes are not conveyed or known to the centre management and can affect tenancies close by. Centre management needs to be advised of any major changes to the internal workings of the tenancies so that the fire risk management can be reviewed. The majority of the questionnaires, (93% in 3.3), support this and management were aware of the reasons for such reviews.

Service provider to conduct fire evacuations and training

It is current practice for centre management to use a recognised service provider for fire and incident training. As discussed in section 5.2 they have a pivotal role to play in effective fire risk management. All the centres in this study use the services of professional fire and incident evacuation training experts. The question was asked in order to see whether any of the centres conducted their own training and none of the enclosed shopping centres do. Until the recent changes in Queensland, there were no rules or conditions in the regulations to make the owners/managers use professional training experts.

Part 2 of questionnaire – conclusions

Questions 2.7 to 2.16 are as follows:

2.7 Are *new* tenants given a briefing on the Centre fire evacuation plans?	2.12 Are personnel appointed to all positions on the ECO, particularly the Chief Warden group?
2.8 Do you conduct fire safety audits according to Australian Standards AS 4665 - 2002?	2.13 Has there been a change in use or change to the layout of the Centre since the last Emergency Response Procedure (ERP) was produced?
2.9 Does your staff follow up with tenants who have not attended fire evacuation training on a regular basis?	2.14 Has there been any change in the number of tenants/occupants at the Centre that may affect emergency response procedures and the evacuation of the Centre?
2.10 Does the Centre Management choose	2.15 Are evacuation routes from the Centre

the fire wardens?	safe and without structural or other hindrance
2.11 Is the Emergency Control Organisation (ECO) adequately staffed to cope with an emergency at the Centre?	2.16 Has there been a change in the location or the use of the primary evacuation assembly area(s)?

The second part of the questionnaire relates to emergency control organisations, fire evacuation training, and fire plans. The answers were, in general, positive. The level of response was encouraging as the research does support the need for a fire risk management model. The operations managers appear not to have a defined system or process that can be followed. The Australian Standard is generic in its application and therefore does not show a detailed process to which fire risk management in enclosed shopping centres can be applied.

6.2.4 Questionnaires to owners/managers part 3

The third part of the questionnaire used a Likert scale and was graded into the five points (Refer Appendix 3). The research indicates that the 5-point analysis does not produce major differences to a 7- or 10-point scale (Dawes 2008). The data analysis does show that there is general satisfaction with the present system. However, the present system appears to be vague and inconsistent. The process of fire risk management is left to the operations management.

Question 3.1 Are fire risks the greatest threat at your centre?

It is interesting that 46% agreed that fire risks were the greatest threat. However, 36% were neutral and could not agree that fire risk was the greatest threat. It should be noted that one centre concluded their greater threat was from flooding due to the location of the centre. There is evidence to show that fire is the greatest operational threat to any commercial building, however, there were no respondents who strongly disagreed with the question (N = 30 and the mode value of M 3 and the mean $\bar{x}$ 2.6).

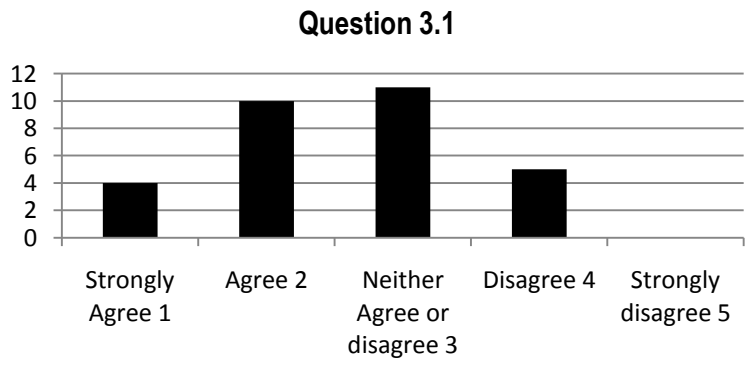


Figure 6.3 Is fire risk the greatest threat at your centre?

Question 3.2 Are all centre tenants likely to cooperate on fire risk issues?

This is a positive sign that the majority 67% of the centre management have a good relationship with the tenants on fire risks. However, whether this is actually reflected in areas such as fire evacuation training may be questioned. There were no respondents who strongly disagreed with the question (N = 30 and the mode value of 2 and mean $\bar{x}$ 2.4).

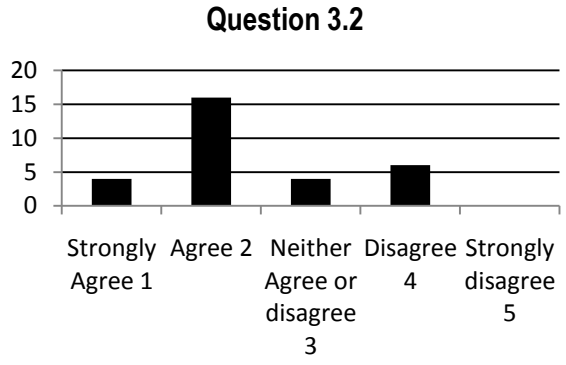


Figure 6.4 Are all centre tenants likely to cooperate on fire risk issues?

Question 3.3 Is an annual independent assessment of the centre fire risks important to your company?

The majority of the respondents agreed that annual independent fire risk assessments were important. The issue is the process that will be undertaken in the annual assessment. However, there is no set method for this to be undertaken. Should they rely on the training providers, insurance companies or other professional support? The assessment requires independent investigation to assess the risks and report on them (N = 30 and the mode value of M 1 and the mean $\bar{x}$ 1.5).

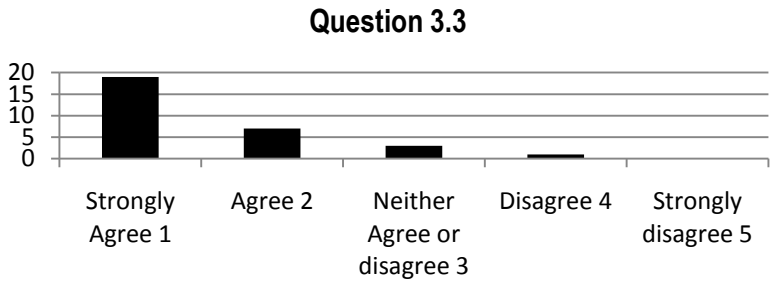


Figure 6.5 Is an annual independent assessment of the centre fire risks important to your company?

Question 3.4 Are independent service providers such as 'First 5 Minutes' important in the training and prevention of fire risks?

The reliance on the training providers is overwhelming and reliance on their expertise is important. However, the responsibility for the management of fire risks still resides with the centre management. Centre management is still required to keep close control over all aspects of fire risk management. They can delegate the training, but not the responsibility. It is interesting that one respondent disagreed due to local issues with a service provider (N = 30 and the mode value of M 1 and mean $\bar{x}$ 1.5).

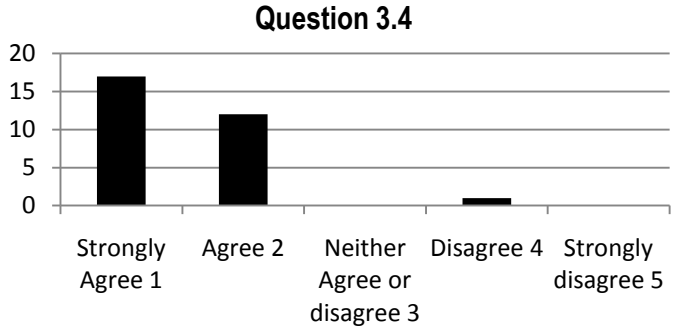


Figure 6.6 Are independent service providers such as 'First 5 Minutes' important in the training and prevention of the fire risks?

Question 3.5 Do you agree that fire evacuation training should be undertaken at the busiest time to maximise the learning?

The fire evacuation training is normally undertaken at a time that is most convenient to the tenants. Fire evacuation training is normally undertaken early in the day. The concern with undertaking fire evacuation early in the day is that the centre will not have a sufficient number of customers to provide an adequate testing environment. Since the majority of the respondents gave a neutral position, this indicates lack of detailed policy in this area (N =30 and the mode value M 3 and mean $\bar{x}$ 2.7).

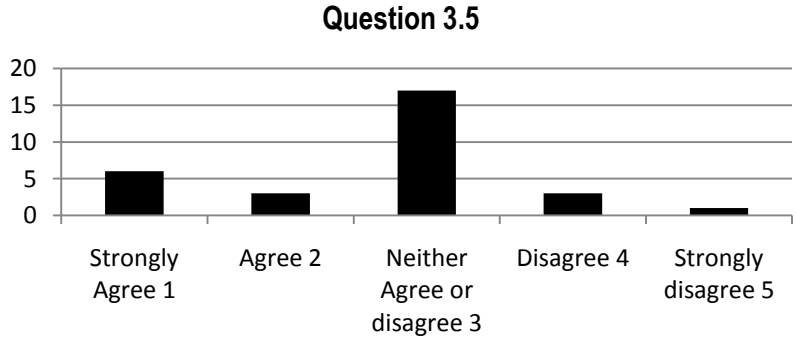


Figure 6.7 Do you agree that fire evacuation training should be undertaken at the busiest time to maximise the learning?

Question 3.6 Do you agree that fire evacuation training can take place to suit the tenants?

This question is directly related to the previous question and appears to contradict the answers given. Opinion is evenly divided that fire evacuation training should take place to suit the tenants. Again, this is another sign that the management is not sure about how to handle fire evacuation training. In many cases the needs of the tenants come first and effective training comes second (N = 30 and the mode value M 2 and mean $\bar{x}$ = 3.6).

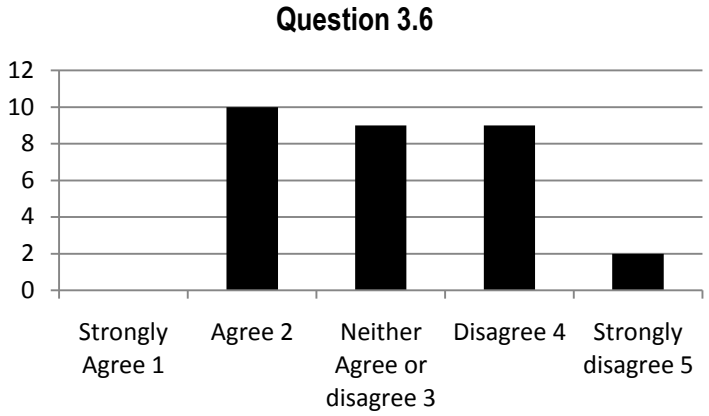


Figure 6.8 Do you agree that fire evacuation training can take place to suit the tenants?

Question 3.7 Should the public be involved with fire evacuation training?

There is considerable support for the public to be involved with fire evacuation training. How this will be achieved is open to debate. There are instances where the public is involved. (N = 30 and the mode value of M 2 and the mean $\bar{x}$ 2.3).

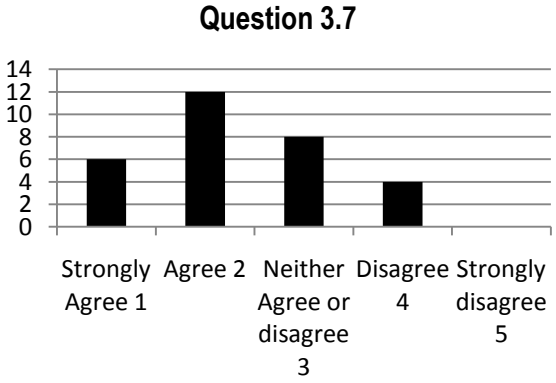


Figure 6.9 Should the public be involved with fire evacuation training?

Question 3.8 Is it important that owners of the tenancies are advised of the participation of staff in fire evacuation training?

The response indicates that communications between centre management were important and refers to the major tenancies that employee a large number of people. It is important that in the event of an emergency they are the employees that are on call. The training providers are advised by centre management about who is attending the training. However, due to regular changes in major tenant employees, there is always the risk that a major tenant will not have a trained person on staff. This also gives a good indication of the participation level with the major tenants (N = 30 and the mode value of M 1 and the mean $\bar{x}$ 2.0).

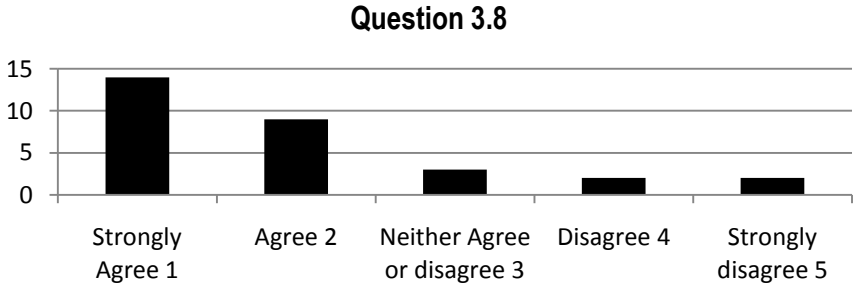


Figure 6.10 Is it important that owners of the tenancies are advised of the participation of staff in fire evacuation training?

Question 3.9 Is it important that all staff working for owners/managers participate in fire evacuation training?

The response to this question was highly positive and shows that management consider fire evacuation training important. The participation of staff at centre management level is important be they administrative, operational or maintenance personnel. It is imperative that all employees know how evacuations are undertaken and that all employees understand what is required when there is an emergency situation. (N = 30 and the mode value of M 1 mean $\bar{x}$ 1.3).

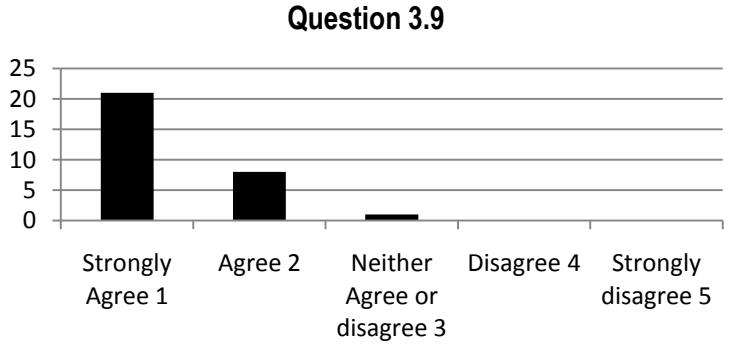


Figure 6.11 Is it important that all staff working for owners/managers participate in fire evacuation training?

Question 3.10 Is it important that staff working for service providers (cleaners, security) participate in fire evacuation training?

The response for this question was highly positive. The training is to overcome any lack of knowledge with the service providers. The service provider employees are an integral part of the emergency response team in any enclosed shopping centre. They are able to quickly advise the centre management of an emergency. Therefore, they all need to be part of the emergency response team. It is imperative that all cleaners and security staff have a detailed knowledge of the centre's evacuation processes and this is confirmed by this response. (N = 30 and the mode value of M 1 and the mean $\bar{x}$ 1.4).

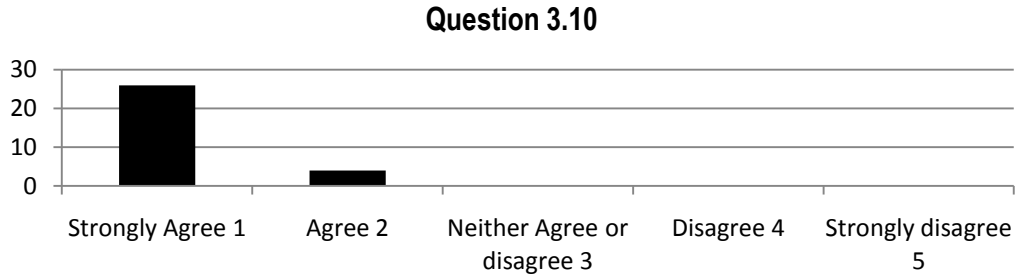


Figure 6.12 Is it important that staff working for service providers (cleaners, security) participate in fire evacuation training?

Question 3.11 Is it important that the managers/owners have some connection with the local fire service?

The response to this question was highly positive and shows that connection to the local fire service is important. In normal circumstances, the local fire service will be the first emergency service to be in attendance. As discussed in section 7.2.3, there was a problem with the Hobart fire service being unable to use the required hoses. It is important that the local fire service understands the configuration of the centre before there is an emergency. It is understood, from the interview with the Metropolitan Fire Brigade, it is not the practice for the fire service to attend the local shopping centre, unless in an emergency. The process of the local fire service visiting the shopping centre and reviewing the centres fire risks will be part of the proposed model in section 7.5.3 (N = 30 and the mode value M 1 and mean $\bar{x}$ = 1.3).

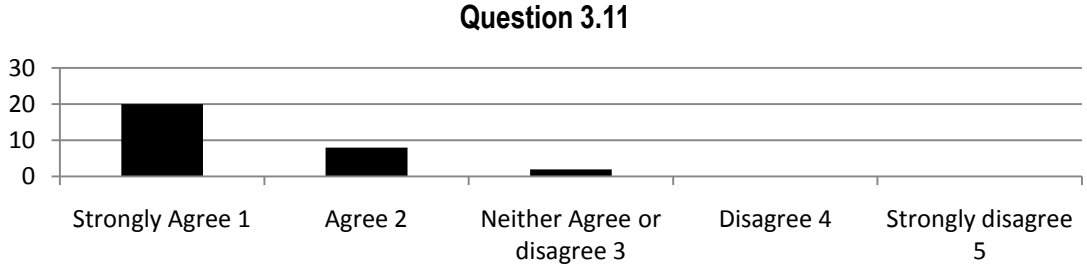


Figure 6.13 Is it important that the managers/owners have some connection with the local fire service?

Question 3.14 Should the local fire service visit the centre regularly to prepare itself for possible fires?

The response from this question was highly positive and shows there is a need for the fire service to visit the centre. This question related directly to Question 3.11. It is not part of the fire service requirements according to the interview conducted with the fire service. However, this can be undertaken at the request of the centre management. It could save time and therefore damage when an emergency occurs as demonstrated in the Hobart fire (N = 30 and the mode value M1 mean $\bar{x}$ 1.2).

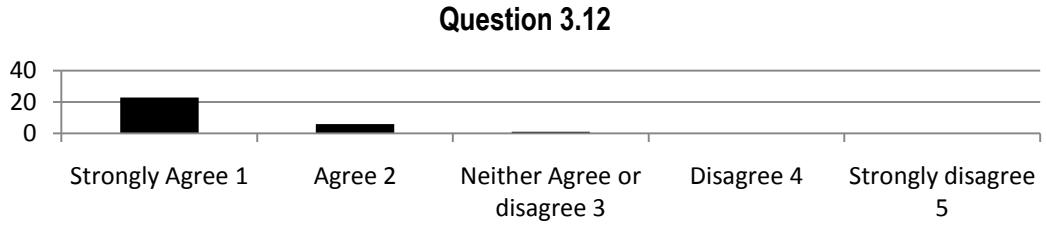


Figure 6.14 Should the local fire service visit the centre regularly to prepare itself for possible fires?

Question 3.13 Is close cooperation between owners and managers an important aspect of running a successful centre?

The response from the questionnaire was highly positive and shows that good communication is paramount between the owner and management of the centre. The owners of enclosed shopping centres may not have direct involvement with the centre management on a day-to-day basis. It is imperative that good communications are maintained between the two. The management has an obligation to advise the owners of any fire threat or other risks facing the centre (N = 30 and the mode value of M 1 $\bar{x}$ = mean 1.2).

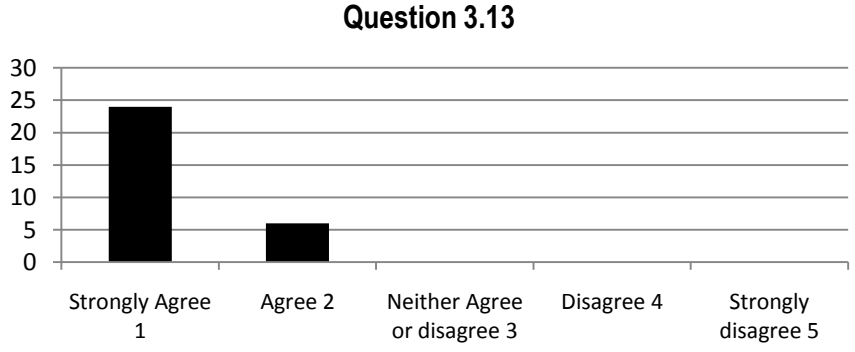


Figure 6.15 Is close cooperation between owners and managers an important aspect of running a successful centre?

6.2.5 Questionnaires to owners/managers - Conclusion

The results from the questionnaires were generally positive. There are processes and systems questions that need to be addressed. While the majority of the completed questionnaires agreed that fire risk was the greatest threat. The tenant's cooperation with fire risk was paramount. Question 3.6 that highlighted the issue of fire evacuation being held to suit the tenants. In other words while the tenants cooperated, it was possibly on their terms. This is an area that needs close cooperation between manager and tenant. The managers agreed that the public should be involved with fire evacuation testing, however the public do not like to be inconvenience during shopping time. This could pose a problem with both the tenants and public. However, in practice the systems and processes may not result in the same outcomes. These are important questions relating to fire risks in enclosed shopping centres that a model will support. This includes improvements in systems and processes so that fire management is better controlled. It is easy to become complacent when there are no emergencies. History has shown this is when risks are at their highest and need to be controlled. As in the case of the Myer store fire in Hobart, problems can easily enter into the system. It is only when there is an emergency, or a major incident, that processes and systems change.

6.3 Primary data analysis : operations interviews

Introduction

Research into the centre operations management was undertaken via the questionnaire discussed and analysed in the previous section (Refer appendix 4). This part of the review involved interviews with selected stakeholders at the operations level. They included the emergency training providers and a major tenant. Smaller tenants were not interviewed due to a number of factors including doubts whether they would be able to add anything to the research. Smaller tenants tend to rely on centre management for fire evacuation training according to the training providers. The management of fire risk is centred on a small team at centre management and the training providers. The major tenants have their own fire risk processes and systems that are discussed in this section.

6.3.1 Interviews with training providers

As part of the research, interviews with training providers were undertaken. It was agreed with the organisations interviewed that all information would remain confidential. The service providers are used in a large number of shopping centres to do incident and fire evacuation training. They take their instructions from the centre management – specifically the operations management. There are several

organisations specialising in this service. They may be Australia-wide organisations such as First Five Minutes and Chubb or local companies such as Red Rebel working in each state. The interviews gave important information about evacuation training. The four training organisations interviewed were given six questions (Refer Appendix 4). The interviews started with a general discussion on the background to the research. All four organisations were willing participants. They felt that while the systems and processes were working according to the client's needs, communications could be improved. They all believed the systems and processes could be improved. The idea of a model was met with positive comments and ideas. Each of the organisations had different methods for conducting the training and how it was organised. Two of the organisations did not employ trainers directly but used contract staff, while the other two organisations employed the training staff. It was stated that there was a high level of movement of operations staff at the centres and this made communication difficult and time-consuming. There were also regular changes in the management structure that also made communications difficult. The contract for the service could be regularly moved and this made the retention of staff for the service provider difficult. Most of all, there was a consensus with those interviewed that many of the contracts were based on price and so the training had to respond to this. The consensus was that a high proportion of the managers wanted to do the minimal requirements to satisfy the Australian Standards. The needs of the tenants were of paramount importance. It is an ongoing problem, weighing up the needs of the tenants against the need to have meaningful evacuation and fire risk training.

Model – training

The training companies have a pivotal role in the incident training. The following model is how the training process should take place. This model was developed with the assistance of the training providers.

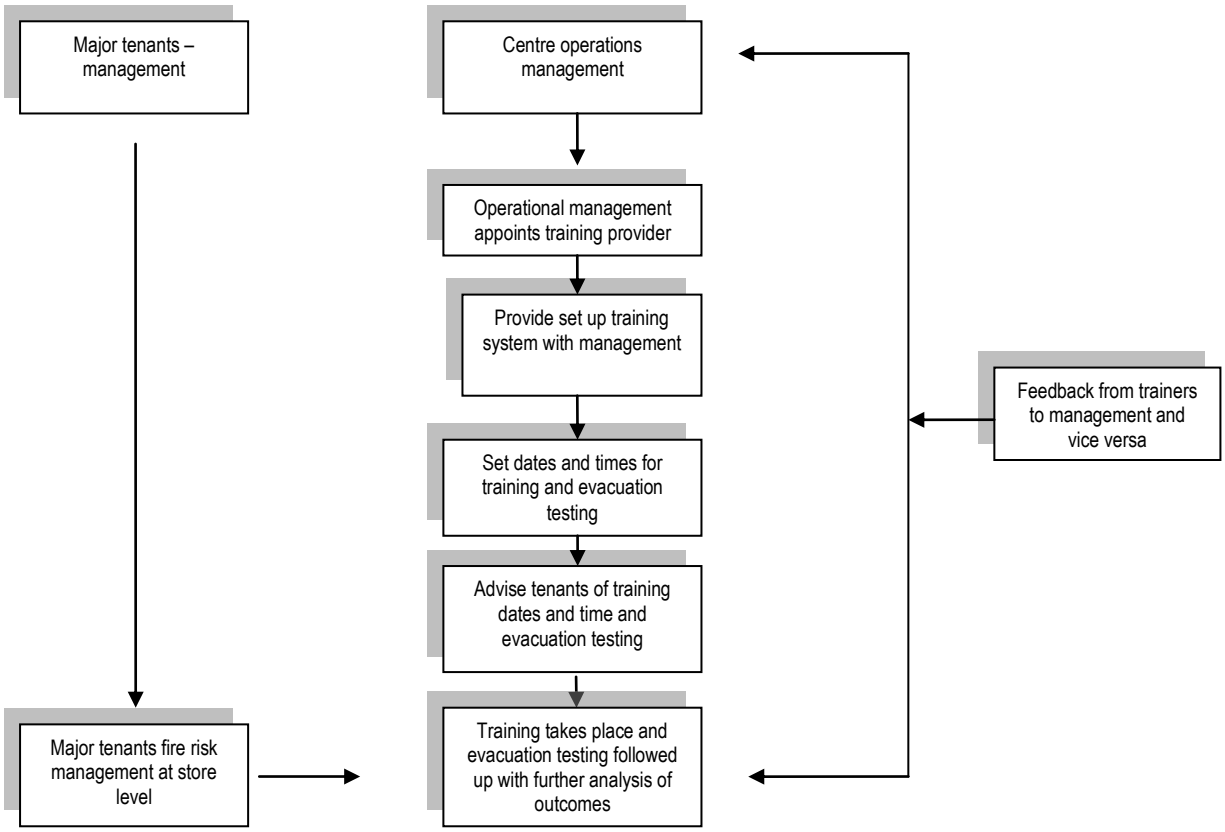


Figure 6.16 Model – training providers

Standard and training qualifications

The training organisations employ trainers with both experience and workplace training qualifications. In Victoria, the training providers are required to be registered under the Training Act (www.worksafe.vic gov.au) and are required to hold Certificate IV in Assessment and Workplace Training. This qualification is undertaken at a TAFE college (www.vic.gov.au). All other states have the same level of qualification requirements. All the training providers use the various Australian Standards including AS3745-2002 as the basis of the training. The training has to be compliant with Australian Standard 3745–2002 as discussed in section 3.2.1. Training providers write their own training manuals and training processes. The level of training depends on the training company since there are no external reviews of the training. This includes quality or best practice assessment. The training is subject to regular assessment by the centre management. This can cause conflicts if there are incidents that take place when blame is a problem. The training needs to have the cooperation of the tenants and other stakeholders to complete the training successfully.

Attendance at training sessions

This area, according to the training organisations, is completely under the control of the operations management. The dates of the training are agreed with the operations management of the centre. The operations management advise the tenants as to the time and date of the training. The only time the training organisation has direct communication with the tenants is during the training. The training organisation has no individual contact details, and as a result, the operations management has sole responsibility for attendance at the training sessions. According to the training organisations, this can cause some concern as there are times when not enough of the tenants attend the training sessions. However, one of the organisations did state that a minimum of 10% of the tenants is required to have a training session. It was also stated that minimum numbers were not an issue for the trainers as they were dealing the cost of training with time and not student numbers.

Evacuation testing

There are no regulations in Victoria that require evacuation testing in commercial buildings at the present time. However test evacuations are normally carried out. In Victoria, the fire brigade has the final sign-off responsibility for all building emergency plans. The Queensland rules relating to evacuation training have changed. This is discussed later in this chapter in (Section 6.6.1). All the training organisations undertook evacuation training whenever the management required it. However, the management did seek input from the training organisation on the appropriate time that would satisfy both the tenants and honour the intent of the training exercise. There appears to be general consensus that over time, the requirements will change with respect to evacuation training and there will be more precise rules on how and when it is performed and by whom. The need to reduce risk and make the system more transparent is propelling this.

Other influences

It was stated by one of the training organisations that the influence of the WorkSafe legislation is more important than fire regulations and Australian Standards. This required businesses to have Emergency Management Plans (EMP) in place for occupational health and safety. The legislation allows inspection of premises by them in the way that the fire regulations do not.

6.3.2 Interviews – major retailers/tenants

There are two major supermarket chains in Australia. They are the Coles Group that is now owned by Wesfarmers, based in Western Australia (www.wesfamers.com.au), and Woolworths Limited, based in Sydney (www.woolworths.com.au). They both trade under various brand names including Coles Supermarkets, Target, and K Mart for Wesfarmers. Woolworths trade under Woolworths Supermarkets, Safeway Supermarkets, and Big W. All those brands are represented in enclosed shopping centres. Both groups were approached for information on their fire risk management. However, one of the groups declined to be part of the research on the grounds that information on such an important matter was confidential. The company representative advised that the group had a comprehensive fire risk strategy and referred to the company website for further information. However, the other groups were willing to be part of the research and the following are the answers and information given. A senior manager in safety, health, and environment gave the information in an interview and with written answers. The information correlates with information from centre operations management. The major tenants have their own fire wardens. The Emergency Control Organisation of each shopping centre appoints its own fire wardens as discussed in section 3.2.1. The issue is how the major tenants' fire wardens relate to the fire wardens appointed by the Emergency Control Organisation (ECO). However, when an emergency takes place, the authority to undertake the evacuation should always reside with the ECO. This chain of command is not generally understood. Interviews were carried out with one of the major tenants and the results of the questions were as follows (Refer Appendix 5):

Q1. Do you depend on the enclosed shopping centre management to control the fire/incident risk management?

Reply: 'We control indicants of sure nature within our stores and cooperate with centre management if the risk is in the shopping centre and they have control of these situations'. This reply was understood to mean that the major tenants control the internal to their premises fire risks and cooperate on external fire risks.

Q2. Do your stores in enclosed shopping centres have their own fire risk management systems including evacuation training and testing?

Reply: 'Our wardens are trained in-house and we have our fire equipment tested as required monthly, 6-monthly or yearly'.

Q3. Do you encourage store management be part of the fire/incident training at the enclosed shopping centres?

Reply: 'Yes, we do. In most cases it is part of our lease agreement that we do participate in the training'.

Q4. Do you request centre management to pass on the details of the fire/incident training so as to make sure the centre is complying with best practice?

Reply: 'In most cases we do not request this: it is passed on voluntarily to store management'.

Conclusion

In Question 1, the reply appears to say that the major tenant believes they have control over the internal risks to the supermarket premises, but they expect the centre management to handle the external risk. However, the tenant's area is not isolated from the rest of the centre. Fire can travel at a fast rate and therefore other tenancies could be involved at short notice. This research argues that there needs close cooperation between the major tenant(s) and the centre management on the management of risks. In Question 2, the answer does not indicate they use outside service providers for the training of fire wardens. The same personnel could also attend the centre training. It could be said that this is a duplication of resources. The issue is that the major tenant's area is not a risk in isolation, but is an integral part of the centre. As such, it needs to be part of the total risk picture. The other issue is what controls are in place to make sure the fire equipment is tested. There is always the risk that the equipment may not be tested and when an emergency does happen there could be a problem. This issue was raised in section 1.1.3 when a tenant was fined for not having the required fire equipment in place. This was also highlighted in the Hobart Myers store fire. In Question 3 it is accepted that the fire training is part of the lease conditions. However, it is the responsibility of the tenant to have personnel available for the training. The centre management communicates the fire risk strategy to all levels within the major tenancy. This gives all levels at the majors the minimum numbers of the tenancy staff that are aware of the centre's fire risk plans. The details of the fire/incident training will be part of the model. There needs to be close cooperation between the centre management and the major tenants in all areas. The information should flow both ways and the majors should have a complete understanding of how the training is undertaken. There appears to be some reluctance from the majors to discuss the fire risk management in some detail. There are many reasons for this including the issue of confidentiality and competitive advantage. The fact that even one was prepared to give some insight into how they manage fire risks is, I believe, a positive response.

6.3.3 Service providers – cleaners, security, and contractors

The service providers do not have a direct involvement with fire risk management as this information was included in the questionnaire to operation centre management (Refer Appendix 4). The personnel are not employed directly by the managers of the centre but are subject to the directions of the centre management. However, in most cases the personnel are provided under a contract to the management. The contract lasts a minimum of twelve months through to three years. The service provided includes various conditions that may include involvement with fire risk management. The cleaners and security tend to have onsite supervision. The supervisor reports to the centre operations management. They are normally included with any incident training. However, their responsibility is limited to the positions they hold. In regional and sub-regional shopping centres it is the practice for both cleaning and security staff to be full-time. The security staff are involved in after-hours surveillance of the centre. If there were to be an emergency, their responsibility is to contact the centre management and their own supervisors. The centre management then takes over the incident. The issue is when do the service providers' responsibilities start and end in the area of fire risk management? Cleaning staff are involved with evacuation training under the service providers; however, the cleaners' involvement is limited and they are not normally on emergency committees. There were no interviews with the service providers such as cleaners, security, and contractors. They are under the control of the individual service providers. They are required to follow the instructions of management including attending evacuation training. The cleaners, security and maintenance personnel are in the centre to undertake a specific function, which is set out in the service contract. However, they should always be involved with the training and they are expected to be proactive in the area of risk control and advising centre management of any incidents. They are not permitted to undertake any evacuations or marshal people within the centres.

6.4 Primary data analysis – buildings

6.4.1 Interview with project managers

The interview was conducted with construction project managers who have been involved with major enclosed shopping centre constructions, renovations and extensions (Refer Appendix 4.7) They are a major contractor in the construction industry. Project managers have a coordinating role in the commercial building industry. Their role is to bring together the various components of the project including the building surveyor, architects, engineers, and other professional services. They deal directly with the owners and the managers of the enclosed shopping centres on a daily basis. The

owners/managers of enclosed shopping centres are engaged in new projects. This includes a 'green field' site when a new enclosed shopping centre is built on land not previously used. This type of project is the result of the growth in urban areas in the outer suburbs. However, new enclosed shopping centres are being built in regenerated land close to the cities. New projects can be the result of the expansion of established centres in older areas. The building is subject to the fire regulations in force at the time of completion. The project managers have to deal with a number of situations during the construction of new centres and the renovation of existing centres. This can have a major influence in the area of fire risk. This is especially true if the tenancies are still occupied while the renovations are continuing.

Enclosed shopping centres in central business districts (CBD)

In Australia, many enclosed shopping centres located in the central business districts of the capital and provincial cities are being renovated. Changes in the demographics of the cities has resulted in the demand for improved shopping centres. The regeneration of the shopping centres has posed a number of construction hurdles that new centres do not have. The CBD renovations are the result of older buildings not being able to service the customer according to requirements. The central business district projects raise a number of issues due to a range of factors including:

1. location close to other commercial buildings
2. heritage-listed properties
3. the continued use of the building as an enclosed shopping centre while the renovations are being completed

The project managers sub-contract to experts the adequacy of entry and exit points for the flow of people in the specific area. This is described in the next section.

6.4.2 Interview with building surveyors

The role of the building surveyor is important in the completion of new and refurbished commercial buildings. They are required to check a number of requirements before the issuing of occupancy certificates. They are responsible for ensuring the commercial building conforms to the building codes. The building surveyors work as a team with project managers, architects and the consulting engineers. An interview was conducted with a senior manager of PLP Building Surveyors of Melbourne to gain some understanding of the building surveyor's role and how they interact with the other teams in the building of enclosed shopping centres (Refer Appendix 4.4)

Q1. Do you treat the building of enclosed shopping centres in the same way as other commercial buildings?

Reply: 'All commercial buildings are treated in the same manner. They are required to conform to the building codes in force at the time of construction. Assuming the commercial buildings involve large people movements such as in hotels, shopping centres, and airports, we will consult with the project managers and specialised consulting engineers for an investigation into the people movement's questions'.

Q2. Are the building surveyors responsible for the simulation of people movements in commercial buildings?

Reply: 'As stated in Question 1, the building surveyors are not experts in this field and the client will require an independent assessment of the people movement models. The consulting engineers who have the expertise and the resources to conduct the required tests best handle this'.

Conclusion

Question 1 relates to an interview with specialist consulting engineers. This is the point when the consulting engineers are advised of the questions in relation to people movements. This is covered in the interview with the consulting engineers. They have the responsibility for advising the client (owner) of any anticipated problems with the movement of people. The building surveyors have an important role to play in the commercial building sector. Their role is central to ensure buildings comply with the regulations and building Acts. The building surveyors are part of a closely regulated system of checks and balances and the level of risk in the enclosed shopping centre buildings is low. However, extra risks come later when the buildings need renovating or extending.

6.4.3 Interview with consulting engineers in fire safety

The consulting engineers are engaged to conduct independent assessments of fire and risks in commercial buildings. The buildings may be hotels, offices, shopping centres, and airports. The objective of the assessment is for the building to conform to the codes and regulations. An interview was arranged with Scientific Fire Services of South Melbourne (Refer Appendix 4.5). The interview was conducted with the senior personnel.

Q1. Who engages you to carry out the consulting work?

Reply: 'We are engaged by the project managers and architects on behalf of the owners to do an independent assessment of the fire risks. We work with the building surveyors and project managers to get the best outcome for the building. We advise the project managers of any issues arising from the movement of people through the building'.

Q2. Do you use computer simulation for the fire risks?

Reply: 'As consulting engineers we use the latest computer simulation software. The process is that the variables are fed into the systems and the results are produced in the form of reports. The use of computers in the area of simulation is the only way to get the required information for analysis. The simulation measures the movement of people via the intended entry and exit points. This is calculated with the expected number of people visiting the enclosed shopping centre, and will include a "Worse Case Scenario"'.

Conclusions from interview: The consulting engineers are removed from the day-to-day management of fire risks. The systems appear to work well and the various parties do what is required to make sure all areas are covered. The risks in this area are low due to the checks and balances within the systems**.** However, their input is important to ascertain the level of influence in the area of fire risk management. The consulting engineer input is important to the safe movement of people in and out of the building. However, they are not responsible for the number of entry/exit points. This resides with the architects. The architects are governed by the building codes.

6.5 Primary data analysis – external stakeholders

6.5.1 Interview with fire services

Interview – fire service – Metropolitan Fire and Emergency Board (MFB)

The fire services for the majority of metropolitan Melbourne are provided by the Metropolitan Fire and Emergency Board or the MFB. There were no contacts made with the Country Fire Authority, as contact with the MFB was deemed sufficient. The interview was conducted with a senior commander at the MFB (Refer Appendix 4.2). The results of the interview were as follows:

Q1. Does the MFB have any special regulations or rules regarding enclosed shopping centres?

Reply: 'There are no special rules governing enclosed shopping centres. Commercial buildings must conform to the Building Codes Australia compliance regulations'.

Q2. How does the MFB review the entry/exit points in commercial buildings?

Reply: 'The MFB does not review the entry/exit points as such. However, the Fire Protection Association of Australia has been developing guidelines in this area. The MFB understands there have been some studies by Victoria University on the entry/exit point questions'.

Q3. Would the MFB like to see Victoria have the same regulations as Queensland?

Reply: 'The MFB believes the current system as it operates in Victoria is good. This is a political issue and as such needs to be referred to a higher authority. However, there will always be methods of improving the systems and processes. This would include increased responsibility for fire marshals'.

Q4. Would the MFB like to oversee the training in major enclosed shopping centres at least once a year?

Reply: 'There is no legal power available to the MFB to oversee the training in shopping centres. The responsibility remains with the building manager'.

Conclusions to interview with MFB

The fire services treat all commercial buildings in the same manner. However, it could be argued that not all commercial buildings are the same and need to be treated as such. MFB advised that the fire services wish to not be involved with training on the same scale as the professional organisations. The interview with the MFB commander was constructive. However, the MFB is a regulated body and follows both regulations and is required to follow certain protocols. The answers to the questions were general in nature. The fire services follow the regulations and act in that manner. They are answerable to the state government for all fire risk matters. They also liaison with the Country Fire Authority of Victoria in fire risks in urban areas in which the Country Fire Authority is involved. (www.mfb.vic.gov.au)

6.5.2 Interview with insurance consultants

An interview was arranged with a leading insurance company (Refer Appendix 4.3). The following questions were put to the principal of the risk services. They reflect the issues that confront the providers of insurance with respect to enclosed shopping centres.

Q1. Enclosed shopping centres are major commercial buildings. Are there any special issues with enclosed shopping centres (regional and sub-regional) that insurance companies are aware of?

Reply: 'For property insurance companies it would all be based on the total value (sum insured) of the property. The larger the property, the larger the potential property loss if the shopping centre burns down. However, the majority of shopping centres have automatic sprinklers installed (BCA requirement) that will assist in the mitigation of a property loss (control a fire at its source and alert the local fire brigade via electronic alarm). Issues that property insurers would focus on include: the fire systems being maintained to Australian Standards (including the fire pumps). The sprinkler system is designed in accordance with Australian Standards including the "back of store" areas of major retailers (where high-piled storage would be located); sufficient water supply available for the sprinkler system (large enough town's main, possible on-site tanks and correct fire pumps installed); fire impairment system which would be used whenever an automatic sprinkler system is shut down (tenancy fit out or property

redevelopment) & ensures that the fire system is restored'.Note: BCA refers to Building Code Australia and is the authority on building codes in each state.

Q2. Are insurance companies interested in the fire risk management processes in enclosed shopping centres?

Reply: 'Insurers are very interested in fire risk management processes being in place including: the fire impairment system (as mentioned in Question 1) where there are self-inspection programs, checking on housekeeping both in common mall and tenants' areas hot work permit systems (contractor welding activities)cleaning of grease build up within cooking hoods of food retailers annual water fire tests (automatic sprinklers and hydrants) confirmation of fire protection being maintained (portable fire extinguishers, fire blankets and hose reels – common mall & major retailers)emergency evacuation procedures (including training in the use of fire equipment) and dangerous goods/hazardous substances storage and summary of information' Property insurers would often conduct their own inspections of a shopping centre to seek evidence of fire risk management processes being in place. If the processes are unsatisfactory, then they would be issuing recommendations.

Q3. Do insurance companies grade shopping centres for risk? (old buildings, etc.)

Reply: 'The centres are based on risk such as age, size, location, sprinkler protection, and outstanding risk management recommendations, etc'.

Q4. Any other issues that affect the insurance of enclosed shopping centres?

Reply: 'If the property is located in an area in which natural hazards may cause damage such as flood, cyclone, earthquake, etc'.

Conclusions to interview with insurance consultants

The replies to the above questions were comprehensive and to the point. They reflected what is required from the owner/manager from an insurance company. The insurance company has a stake in making sure that the fire incident risks are under control and that the management is aware of this. The insurance company is concerned with all risks, whether it is the building, fixture and fittings or stock. The company also has the interest of the customers, tenants and centre management via public liability insurance. Therefore the insurance company has a unique position in the area of fire risks as it deals with various stakeholders in the same building. The various stakeholders may have different levels of control. The importance of moral hazard in insurance was discussed in Chapter 2. It is an important concept and needs to be considered when the principle and agent relationship are concerned.

6.5.3 Observation

As stated in the research methodology in section 5.1.1, observation is a minor part of this research. The study is centred on the management of the fire risks in enclosed shopping centres. The observation of fire evacuation training is not possible due to a number of factors. The managers do not wish external parties to witness the process for reasons of confidential information. It would be impossible to find out when the evacuation training was being planned without the agreement of the management. Therefore, this level of observation was not pursued. However, there were no restrictions on general observations at two enclosed shopping centres. The observations were as follows:

1. Large amounts of cardboard cartons outside a major supermarket ready to be collected for recycling. From the observation, there was no fencing between the public pathway and the stacked cardboard cartons. This would pose a fire risk if the cardboard cartons were left for any length of time, especially if they were uncollected overnight or for a weekend.
2. Large steel container with lid left unlocked and recycle material left next to the steel container.
3. Other than above observation there were no other major fire risk problems observed and those were deemed adequate in 1 and 2 to show important fire risk problems.

The above two observations were sighted at a sub-regional shopping centre in suburban Melbourne. There may have been good reason for the above situation. However, it does highlight the potential problems if there are reduced controls.

6.6 Secondary data analysis

The secondary data used in this study is sourced from various points and is covered in the text as appropriate. This includes government websites and reports available to the public. The fire regulations, for example, are available from the state and territory emergency department websites. The secondary data study involves major areas such as state fire regulations, shopping centres, and professional associations involved with fire risks. They all have important input in the area of fire management risks in commercial buildings and enclosed shopping centres. The data is important to the fire risk management in enclosed shopping centres.

6.6.1 Fire regulations

The fire regulations in Australia are governed at the state and territory level. There is no federal fire regulation legislation. The fire regulations cover such areas as building codes and fire fighting equipment. The fire regulations include the administration of the fire services in the particular state or territory. The regulations incorporate the fire and emergency organisational structures. The regulations, until the changes in Queensland, were in general terms the same – only the administration was different. As discussed in the interview with the Melbourne Fire Brigade, the fire services are dependent on buildings being compliant with the fire regulations. In the following table the Acts in each state and territory are shown. It is interesting that all have various dates and therefore uniformity is difficult. Fire regulations come under the acts as listed in the references. The Fire Acts, while not identical, do have the same basic requirements. The Acts are being changed at the present time. There are also the regulations that form part of the total emergency legislation in force in each state or territory. Queensland has made a number of major changes via regulations that came into effect in 2008 (see below). It is not known if other states and territories will follow suit and change the regulations to follow Queensland.

Queensland regulations

In Chapter 3, section 3.2, there is a discussion on the changes to the fire regulations in Queensland. The new regulations have made a profound impact on the management of fire risks in that state. The new regulations incorporate more detail on what is required and how it should be administered. It is understood that the training service providers are expected to be proactive and have higher responsibility in the management of fire risks in enclosed shopping centres.

Australian Stock Exchange (ASX)

The Australian Stock Exchange is highly influential in the area of corporate governance that includes risk management. The majority of the regional and sub-regional shopping centres are owned and managed by corporations listed on the Australian Stock Exchange (www.asx.com.au). The listing requirements require companies to have strong corporate governance controls both in the financial and operational areas. The shopping centres require large amounts of capital and therefore the funds required are beyond the reach of private and smaller shareholders. There are a large number of centres owned by unlisted funds such as syndicates and property funds (www.centro.com.au).

However, the level of information in the syndicates and property funds is limited to financial data and long-term operational information. The possible reason for this is that companies only issue what information is required to comply with the Corporations Act. However, as stated previously, the company website does give a limited level of information.

International Council of Shopping Centres and other industry bodies

The International Council of Shopping Centres is an important source of secondary data. They see the trends in risk management from an international point of view. The International Council of Shopping Centres is the world governing body on shopping centres and is based in the US (www.icsc.org) It has affiliates in many countries including Australia. The Property Council of Australia – Shopping Centre Division – is the main governing body in Australia. This body is the main conduit for enclosed shopping centre information in Australia. Enclosed shopping centre management in Australia should always be aware of the problems facing overseas, enclosed shopping centres so they can be related back to Australian conditions.

Professional associations

There are a number of professional associations in Australia such as the Fire Protection Association of Australia (www.fpa.org.au) dealing solely in relation to fire risks. They are a conduit for such issues as fire protection and training. They are involved with seminars and conferences at which organisations and individuals are able to present ideas and theories to participants.

Fire Protection Association Australia (FPA)

The major professional association in this area is the Fire Protection Association Australia, based in Box Hill, Victoria. The following is the objective of the association from the website:
The Fire Protection Association Australia is Australia's major technical and educational fire safety organisation aiming to achieve continual improvement in fire safety through active membership and a range of activities. FPA Australia provides a central source of information and services to promote the protection of life, assets and the environment in Australia. Members represent every aspect of the fire safety community – manufacturers and suppliers of fire protection products and services, fire-fighters, building owners, insurers, designers and surveyors, government and legislators, educators and anyone

*else working as part of the fire safety community – to provide a safer environment for all Australians (*www.fpaa.org.au).

Institution of Fire Engineers

The Institution of Fire Engineers Australia branch is the professional organisation representing fire engineers in Australia. The objective of the institute is as follows:

To encourage and improve the science and practice of Fire Extinction, Fire Prevention and Fire Engineering and all operations and expedients connected therewith, and to give an impulse to ideas likely to be useful in connection with or in relation to such science and practice to the members of the Institution and to the community at large (www.ifeaustralia.org.au).

The Institution of Fire Engineers now has over 11,000 members represented by 36 international branches that cover the complete cross-section of the fire engineering disciplines. This includes but is not limited to fire industry professionals as follows:

Fire engineers	Fire fighters and emergency service responders
Fire safety engineers	Rescue technicians
Fire protection equipment designers, technicians and service staff	Fire investigators and law enforcement

National Fire Industry Association

The National Fire Industry Association was founded in 1926 to undertake the following:

(a) To promote the interests of the fire protection industry in Australia.
(b) To act as an association and/or industrial union of employers under the laws of the Commonwealth of Australia and states within the Commonwealth.
(c) To represent employers in the fire protection industry in areas such as courts, commissioners, enquiry boards.

The National Fire Industry Association represents organisations such as sprinkler contractors, fire alarm and extinguisher companies, passive fire companies and training organisations. This is an important

part of the conceptual framework as they are able to influence changes within the industry. However, this association is only part of the fire risk strategy

Example of fire at Australian shopping centre

The paper by Patton and Appelbaum (2003) supports the use of case studies in research. A case study is a history of a past or current phenomenon drawn from multiple sources of evidence. It can include data from direct observation and systematic interviewing, as well as from public and private archives. In other words, any fact relevant to the stream of events describing the phenomenon is a potential datum in a case study, with the context being important. There are merits for a case study approach in this research. However, a full case study requires in-depth analysis of a major incident. There have been a number of fires in commercial buildings in recent times that involve the movement of people. However, many of the cases involve offices and other commercial buildings. There are relatively few involving enclosed shopping centres in Australia. The fire at Myers in Hobart is the only one to be used. It has all the elements of what can go wrong, with a small fire that becomes major damage. The information on this fire and resulting damage is on the public record including a major report by the Magistrates Court in Tasmania in following section.

6.6.2 Magistrates' Court of Tasmania report – Myer fire 2007

The Magistrates' Court of Tasmania issued a report on 14th August 2009 in respect to the fire on 22nd September 2007. The report deals with the fire that destroyed the Myer department store in the central business district of Hobart. The fire started at 3.06 pm in the cosmetic counter of the Myer store. The fire was extinguished over three hours later. The building has since been demolished and is awaiting redevelopment. The Magistrates' Court has made some major findings as follows (Webster 2009)

1. The Tasmanian Fire Service and its personnel did not have an adequate pre-determined strategy in operation for fighting fires in multi-storey buildings prior to the fire. This led to many errors in the fighting of the fire and hampered an effective response. The report also added that the Tasmanian Fire Service failed to set up hoses and use hoses as soon as possible upon realising there was a fire. The fire service failed to use a thermal imaging camera in a timely manner. There were statements made at the inquest that many of the fire fighters had never attended a fire in a multi-storey building.
2. The Myer building would not have been destroyed but for the actions in isolating the sprinkler system and that the fire damage, though significant, would have been limited to the internal structures. The booster system should not have been needed as the sprinkler system should not have been isolated. It was found that the isolation of the sprinkler system contributed significantly to the spread of the fire and additional damage.

3. The fire safety measures existing in the retail businesses surrounding the Myer (store) were inadequate at the time of the fire. The Myer store was in an enclosed shopping centre and close to other retail outlets in the central business district of Hobart. This increased the risk of the fire spreading.

The Myer store had been in the old building since 1959. There has been substantial structural and electrical work performed on the building and no comprehensive history of the electrical work was available. It was found that an electrical fault had started the fire. The report found that there were no immediate steps to evacuate staff and customers from the surrounding shopping precinct (including Cat & Fiddle and Elizabeth Plaza) and that the surrounding buildings were evacuated at 4.00 pm. However, foot traffic continued to use the Cat & Fiddle and Elizabeth Plaza. The following deficiencies were identified according to the report by the Magistrates' Court of Tasmania (Webster 2009)

1. A failure to evacuate customers and tenants in a timely manner, and once evacuation had occurred, a failure to keep the customers and tenants from returning to the shops. This had the effect of placing non-essential personnel in danger from the Myer fire.
2. A lack of communication between the fire officers and managers (Centro) who were not advised of the seriousness of the Myer fire and the desirability to evacuate the arcade and shopping centres.
3. A deficiency in fire training for employees of the surrounding businesses. In particular, there was a lack of practice evacuation; training for fire wardens; posting of evacuation plans; fire wardens had a limited understanding of their roles and responsibilities.

Conclusion – Magistrates' Court of Tasmania report – Myer fire 2007

The record of investigation into the Myer store fire in Hobart highlights the fact that major problems can be overlooked in fire risk management. The report stated that the issues had now been resolved. The day on which the fire took place was a Saturday afternoon, which, in the central business district, was more likely to have fewer customers. If the fire had taken place during a normal working day, the outcome could have been a major disaster. The major issues are the following:

1. The need for a detailed fire risk plan.
2. The need to involve all tenants in the plan.
3. The necessity for regular reviews of the building and the facilities including fire equipment and electrical systems.

The above findings are incorporated into the model in Chapter 7.

6.7 Summary

The operational area of this study is of prime importance. There are major interactions with each of the stakeholders and how they undertake their part of the process. The conclusions from the research indicated that centre management believed their systems and processes were acceptable. However, it is shown that when a real emergency takes place there are system and process problems such as those discussed in the Hobart Myer fire. This fire may have been a unique situation; however, it could have turned into a major catastrophe. It is therefore the operations area in which the model will be centred. The building issues with fire risk management should not be taken for granted. The building may appear to be safe; however, it has been shown that older buildings do pose a risk. Buildings are subject to various pressures and general deterioration including electrical systems that are a major source of fire risk. However, fire risk in respect to the building need to be part of the model and connect to other risk management processes.

The fire risks in commercial buildings including enclosed shopping centres depend upon a number of external stakeholders. The fire services are important in the event of a fire. It is noted, that with a fire in the central business district of a state capital there is the possibility of the problems as revealed in the Myer fire in Hobart. The secondary data involves the area of fire regulations. It is not part of this research to study the regulations in-depth, as this will not add to the study on how fire risks are managed in enclosed shopping centres. However, the Queensland government has made major changes to their fire regulations. This has resulted in changes in how commercial buildings including enclosed shopping centres conduct their fire safety processes and procedures. It is not known at this stage whether other states and territories will follow suit and enact the same level of regulations. The Magistrates' Court report into the Hobart fire is significant as it highlights the problems that this study has been researching. The report is a good example of what can go wrong in a relatively short space in time. From the findings in this chapter, we are able to construct the required model in chapter 7.

Chapter 7 Model of fire risk management in enclosed shopping centres

Introduction

Chapter 2 discussed the theory of risk and the components that make up risk and control. Chapter 3 discussed commercial buildings and fire risk management. Following on from discussing commercial buildings, the discussion moved to enclosed shopping centres and their impact on the shopping scene in Australia. Chapter 4 looked at the conceptual framework and the various components in fire risks management. Chapter 5 studied the methodology of the research and the relationship to fire risk management. Chapter 6 looked at the research and the resulting conclusions. This chapter moves the result of the research to the next level with the construction of a fire risk management model.

Purpose and justification of the model

The purpose of the model is to bring all the various inputs both internal and external into one document. It has been shown in this research here are many areas that require consideration when planning for risk management in enclosed shopping centres. There are many areas in fire risk management that can easily be overlooked and this can result in issues such as the Myer Hobart fire (Webster 2009). From both the questionnaires and interviews there are areas that require improvement in the systems and processes. This model brings together all the various elements that should be considered. Chapter 7 will bring together all the various parts of the study, so that the best way to bring all the elements is by way of a business model. There are many instances in business when models are used to show how process or system should be implemented such as when a complex manufacturing is undertaken.
Considering the above reasons the model is justified to provide a single resource chart which centre operational managers and others can use to ensure that they have covered all the necessary avenues. In an area lacking regulation and involving a large number of players, it is agreed that fire risks management model will allow such people a greater chance of preventing fires in enclosed shopping centres.

7.1 Initial research questions

The following research questions are the result of initial ideas and prior study by the writer as discussed in Chapter 1. Prior to the commencement of the study, the details of fire risk management in enclosed shopping centres were not researched. The extra propositions in Chapter 4 are included in the

conceptual framework. The resolution of the original research questions is discussed in the following section.

1. How is the management of the fire risk analysed and implemented?

The purpose of the question was to study the current processes and systems in place in enclosed shopping centres. However, review the Australian literature available on fire risks in enclosed shopping centres, there are no previous models to refer to for the Australian shopping centre industry. This is discussed in detail throughout this chapter. The management of fire risks is considered ad hoc and unlikely to achieve best practice.

1.(a) How are the risks assessed for each building and how are they graded?

The insurance consultants did state that the conditions of the buildings were taken into account for fire risks. They stated that low risks are assessed and graded. The owners and managers must keep the fire risks to a minimum. This includes having the highest possible building standards. However, as shown in the Hobart Myer fire, this is not reflected in all cases.

1.(b) Does the owner/manager have a detailed plan available to the tenants and is the public aware of the plan in light of an emergency?

The answers to this question were yes the line of communication is via the Emergency Control Organisation and they are responsible for the plan. The original question did not take into consideration the systems and processes in place at an enclosed shopping centre. The research shows that fire plans are not available to all tenants. In an emergency, direction will come from centre management, but tenants may not have prior information.

1.(c) Has the owner/manager completed a Fire Safety Audit under the Australian Standard 4655-2005?

The answers to this question were yes and most managers have completed a fire safety audit. It is not compulsory to implement Australian Standards. However, it would be unusual for any organisation not to implement the Australian Standard 4655:2005. This is part of the model and used as part of the review process.

1.(d) Is there a clear legal responsibility for managers and tenants to minimise the fire risk and is this enforced?

The enclosed shopping centres come under a number of regulations and Acts. This includes building regulations, occupational health and safety legislation. However, as discussed further in this study, the main basis of fire risk control is using the various Australian standards. This is not part of the regulations and as such does not have any legal standing. It is up to the individual centres to control the fire risks by having detailed fire risk plans.

1.(e) What is the relationship between the owners and managers in relation to fire safety in the centres?

The relationship between owner and manager is guided by the principal and agent concept and the managers need to exercise this in all dealings. The owners give the managers complete discretion in those matters as discussed in section 6.2.1. However, the owner should always be in touch with what the managers are doing to minimise the fire risks. There are enclosed shopping centres that are under the control of managing agents, who have no direct relationship to the owner and are governed by a management agreement.

2. What relationship does the owner/manager have with the fire and emergency services?

The owners/managers appear not have a direct relationship with the fire and emergency services as discussed in section 6.5.1. The centre management assumes that the services will respond to any emergency that takes place in the enclosed shopping centre. This was highlighted in the model as a concern.

3. What is the best process of fire control and evacuation procedures?

The research concludes that there is no one process to control fires and evacuation processes in enclosed shopping centres. This is the reason why the model is the ideal way of undertaking the processes. The model shows management what are the best practice ways of managing fire risks in enclosed shopping centres. The above questions are incorporated in the conceptual framework and in the research methodology. The research questions are incorporated into the questionnaires and interviews in Chapter 6. Following on from the research, the model has been produced using the information gained. The following section from 7.2 deals with the model and the processes to building the model.

7.2 Model inputs – operations

The main components of the model involve the centre management, specifically the operations section of the enclosed shopping centre. The other stakeholders, such as building and external bodies as discussed in the previous chapters, act in a secondary role in the model. The major operational stakeholders are centre management and the tenants, training providers and other service providers such as security, cleaning and maintenance personnel. Each area has a distinct role to play in the process of fire risk management. Those stakeholders should coordinate closely to make the process work. It requires a highly coordinated system and process by the centre management to get all stakeholders involved. The result of the research is a model that covers the major components of fire risk management in enclosed shopping centres. It can be used by centre operations management as a guide to fire risk management in enclosed shopping centres.

Type of model to be used

The theoretical model was discussed in Chapter 5 as part of the methodology of the research. This section takes the theory to the next step and discusses the type of model that best suits the situation. Business process management has close association with change management and how business systems can be improved. The type of model will therefore incorporate management processes that include corporate governance that is discussed in section 2.6.1. There are other operational models as discussed by Rivett (1993). However, they deal with operational types of issues such as purchasing, manufacturing and marketing. This model deals with management process and systems. Another type of modelling supports processes like accounting and recruitment. With the above in mind the most appropriate model will be a business reference model. This type of model concentrates on the functional and organisational aspects of the enclosed shopping centre. It is a means of describing the processes and systems of the enclosed shopping centre. The papers by Shergold and Reed (1996) and Carpinetti, Buosi and Gerolamo (2003) discuss the need for business models being part of the total quality management. The theory of total quality management refers to the concept by W Edwards Deming to reduce errors during manufacturing and service delivery including highest level of traing. There is also the Knowledge Management Reference Model or (KMSS) put forward by Abou-Zeid (2002) that aims at providing the basis for identifying the processes to be supported by any KMSS including developing methodology for information/communication-based KMSS. This supports the case that models are required to improve the processes and systems. The model proposed in this study does this. The model that is proposed is discussed in section 7.4 and follows on from that point.

7.2.1 Tenants input

This research highlights the need to have cooperative tenants in the area of fire risk management, as stated in section 6.2.4 question 3.2. Cooperation from the major tenants is pivotal in fire risk management due to their size and customers passing through. This research shows, for example, that when new tenants start in the centre there is a low induction rate for incident training. This is discussed with the training providers during the interviews in section 6.3.1. While the brand of the tenant may not change, there are movements in franchisees. The major tenants have large areas under their control that may be off limits to the centre management. It is the responsibility of the tenants to understand that, because of the close proximity to other tenants, cooperative fire risk management is critical. This is especially true in the food court where there are many tenants using food preparation equipment including lighted naked flame appliances.

7.2.2 Internal service providers input – cleaners, security and contractors

The study shows there is a need for the internal service providers to take an important role in the management of fire risks in enclosed shopping centres as shown in section 6.2.4 question 3.8. This involvement does not require increased responsibility, but rather an awareness of the fire risks in enclosed shopping centres. They should be part of the team that manages the risk in a proactive way. The maintenance personnel can advise management if there are concerns with the building. For example, the Hobart Myer store would have been better served if there had been an audit of the electrical system, thereby setting out the risks.

7.2.3 Major tenants and other specialty stores input

The major tenants and other specialty stores have an important role to play in the area of fire risk management. They have the highest trading areas in the enclosed shopping centres. They are also away from the control of centre management and, therefore, the responsibility of fire risks in their area is largely within their control. Centre managers do not have the right to enter the tenancy unless they have very good reason to do so.

7.2.4 Training organisations input

The training organisations have a pivotal role in the fire or incident risk management in enclosed shopping centres. They are under the direct control of the centre manager and are required to respond to their directions and requirements. There needs to be complete confidence by centre management in the training organisations. However, this can be influenced by the personalities of those involved in both management and training organisations. During the interviews with the training organisations there appears to be lack of communication between the training organisation and the centre management. They each have differing views on their roles and responsibilities. For example, while the training organisation will encourage all employees and tenants to participate, it is unable force tenants and their staff to attend training sessions. This is an ongoing problem for the training organisation.

7.3 Model input – buildings

The involvement of the building stakeholders is limited in the day-to-day operational issues. Their main thrust is to make sure the building is compliant before it is occupied or refurbishments are completed. However, the only proviso to this is when refurbishments are undertaken while the centre is open. This is standard practice as the centre owners are unable to close the centre during refurbishments for a number of reasons. There is the need to have strict limitations and control of machinery during the time the public and staff are occupying the centre. However, this may cause extra costs for the contractor. Fires have started during refurbishment of shopping centres during opening times. Normally, the sections being refurbished are behind temporary walls and hoardings. There is the issue with the management of the sprinkler systems within the building. The use of the sprinkler systems should always be the last resort due to the possible water damage to both the building and the tenancies.

7.3.1 Building extensions and renovations

There are fire risks during renovations and extensions at enclosed shopping centres. The project managers do what is required to minimise the risks; however, the project managers do not supervise the individual tenancies during the renovation work. This function is undertaken by the operations management. This issue is especially important if the tenancy is a major one. In regional and sub-regional enclosed shopping centres there are changes in the tenant mix happening at any given time. This can have a major impact on the movement of people through the centre. As a result of alterations and renovations, major tenancies have been subdivided. The subdividing of tenancies has led to more customers and people movements according to company websites (www.centro.com.au).

7.4 Model input – external stakeholders

Introduction

The model input by external bodies includes the insurance coverage, fire services and professional associations. The most important of these are the insurance and fire services. They each have a critical role in the management of fire risks in enclosed shopping centres. The role of the insurance company and fire services is discussed in section 6.5. It shows that the management needs to have close coordination with both stakeholders.

7.4.1 Fire regulations – commercial buildings

The fire regulations are under constant review. The fact that fire regulations are a state/territory issue means that there are always going to be changes that are not uniform. It is imperative that all regulations are understood and acted upon to support the management of fire risk. The recent major changes to the Queensland regulations are leading the way in fire regulations in commercial buildings that other states/territories may follow in the future.

7.4.2 Fire services

The fire services have an important role to play, just not when there is an emergency. They are needed to advise commercial building managers to support the best practice in fire risks prevention. They can have a positive input in relation to minimisation of the fire risk such as happened in the Myer store in Hobart. There would not have been a problem with the hoses if this were investigated at an earlier time. There are plenty of cases when it is only at the time of an emergency that there are complications and by then it is too late as in the case in Dakar, discussed in Chapter 1.

7.4.3 Insurance

The interview with the insurance consultants, discussed in section 6.5.2, highlights the insurance and its impact on the study. Such consultants have some positive input into the study and the answers show what the risks are. Insurance assessments need to be carried out at least once a year, or when there is a major change in the building structure resulting from extensions or renovations as discussed in section 6.5.2. They are part of the model in section 7.6

7.4.4 Professional associations – fire risks

The professional associations have an important role in the management of fire risks. They provide a forum to discuss important issues relating to fire risks. They have up-to-date information on trends, changes to regulations and associated inputs and are an important part of any model. They are the appropriate forum to discuss fire risks in commercial buildings that will affect all owners and tenants. They are able to present one voice to the appropriate regulatory authorities on the concerns of the owners and managers.

7.4.5 Australian Standards

The Australian Standards as discussed in section 3.2 are the basis for all risk management processes and systems in Australia. The Australian Standards are used to supplement the lack of regulations in this area. The Australian Standards give an organic view of risk management process. However, they presently form the basis of all the systems and processes in the fire and general risk area. It is also important that any changes to the Australian Standards are incorporated into the risk management process. They are, therefore, an important part of the model.

7.4.6 Occupational Health & Safety (O H & S) laws and regulations

This area of risk management has become more important as the laws and regulations affecting workers have increased (www.worksafe.vic.gov.au) This includes not just factories and construction sites but shopping centres and other work areas. There is a distinct obligation by employers to make workplaces safe. When framing risk management systems and processes, it is imperative that this is included. In Victoria, the laws affecting O H & S are as important as the fire regulations. Workcover inspectors have the right to enter any commercial building to review any aspects that will impinge on occupational health and safety laws. This includes enclosed shopping centres. They form an important part of the model.

7.5 Actual model proposed – Business Process Model

The Business Process Model is a model that concentrates on the functions and organisational aspects of an organisation. It is a means to describe the operations from an independent viewpoint. It describes the interacting functions that this model carries out.

7.5.1 Business reference model process

The model shows how all the various components come together to achieve the best practice in fire risk management. The aim of the model is to improve an organisation's performance by changing and improving fire risk management processes. Its objective is to map the fire risk management in enclosed shopping centres. The model shows shopping centre management the components that make up the total picture for fire risk management in enclosed shopping centres. The model benefits the owners and

managers of regional and sub-regional enclosed shopping centres in Australia. The model shows what processes and controls are required to minimise the fire risks. The result will be that the fire risks have been reduced to an acceptable level. The model is based around the use of flow charts. This shows in graphic form the components of the interconnecting parts to the research. The flow chart is supported by a detailed description of each section. It is by far the easiest way to describe the major parts in graphic form. The requirements of the model are first conceptualised in Chapter 4. It uses the information from the research to compile the major components of which management should be aware to manage fire risks in enclosed shopping centres. Each box will have information and state what the management requires to control the fire risks.

Descriptive model

The descriptive model is in the form of text highlighting the main components. This could be in the form of a manual individually framed for each enclosed shopping centre. It will include the major parts involved with fire risk management in enclosed shopping centres. A descriptive model may not be acceptable by operations management, as they tend to be time poor and they require information to be precise and contain less jargon. However, the model should include all information pertaining to the management of fire risks in enclosed shopping centres.

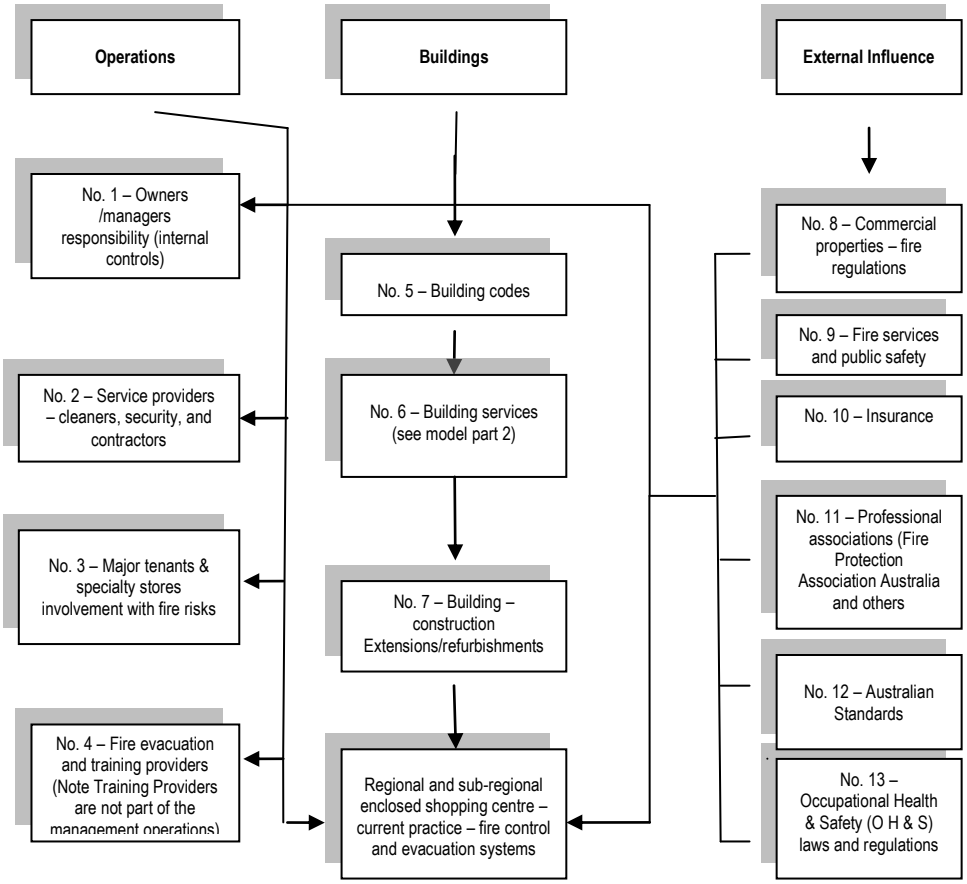
There have been a number of studies into the issue of organisation management using process models including Hammer and Champy (1993). The model is the basis for the majority of enclosed shopping centres. It can be adjusted to suit the individual enclosed shopping centre. The model's primary users will be the operations management in the enclosed shopping centres. They will use the model to build the processes and systems in the enclosed shopping centre. The model should have enough information from which sub-models that are more detailed can be built. There are many possible variations to the Business Process Model. The model needs to be 'user-friendly' to be acceptable by all stakeholders. This includes centre management, training providers, tenants, etc. Section 7.6 has the actual model. The model is a flow chart and supported by a description of the fire risk parts including reasons why they are important. The model can be tailored by changing the flow chart and changing the supporting description of the issues. Control of the information rests with centre management and it should drive the best practice model. The model was discussed in the conceptual framework in section 4.3.

7.6 Business process model – flow chart

The purpose of this section is to show how the flow charts model that is in three parts highlights the main components in fire risk management in enclosed shopping centres. The management of fire risks is complex in this model due to the interacting parties and requirements of the various stakeholders. The enclosed shopping centre is not a static commercial building that stays the same over a period of time, but a vibrant building that is constantly under pressure to serve the public. It is with those parts in mind that this model shows the various stakeholders involved with fire management. They all have an important role to play – some, of course, more than others. However, a failure by any of the stakeholders can have some impact on the fire risk management. The first part shows, by means of a graphical flow chart, the variety of inputs into the model. The next part of the models highlights the important areas of fire risk management and the reasons for their importance. The internal issues constitute the major components on how the fire risks are managed, whilst the building and external issues are not as critical. However, they do have important input into risk management in enclosed shopping centres.

Flow chart 1 – major components of fire risk management

The flow chart 1 shows how the three major areas contribute to the management of fire risks in enclosed shopping centres. It takes all the known components and it is shown in a diagrammatic form. Each box is represented by information boxes in section 7.6.1. The three major areas of the components are the operations, building and external influences. All the areas make up the total fire risk process. However, Figure 7.3 shows how the centre operations management has training as the pivotal role. It should be noted that the boxes from 1 to 4 relate to operations management and are all in relation to fire risk management. The boxes do not imply that they report directly to operations management, but are part of the fire risk management process.



Note: The numbers in the flow chart boxes refer to the description in 7.6.1.

Figure 7.1 Flow chart of 'best practice' model

The flow chart below shows the movement of information for managerial decisions at the time of the building construction and used during extensions or renovations. The major difference from the original construction and when the building is extended or renovated is that the centre continues to trade. This has important considerations for the entry and exit points. Therefore, it is important to maintain the optimum entry/exit points that satisfy all the requirements including the building codes for commercial buildings. All stakeholders have a responsibility to make sure the building attains best practice and conforms to the appropriate building regulations for the state/territory. The final decision on the entry/exit points is made by the owner, on the recommendations of the architects. However, the exit and entry points have a designed limit as they are calculated by the engineering consultants. They would be difficult to change once the building was complete. It is therefore of major importance that this people capacity is completely agreed upon before any plans are finalised. It should set a limit to future changes in occupancy.

Flow Chart, part 2 – building processes – fire risk management

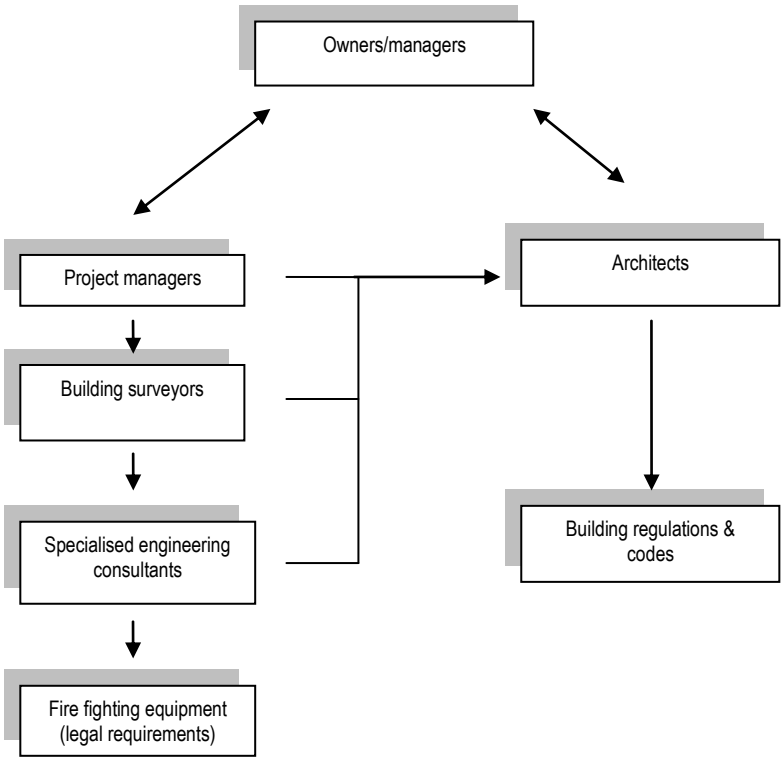


Figure 7.2 Building process – fire risk management

7.6.1 Operational responsibilities

The following information boxes are descriptions of each of the major components from Figure 7.1. The following text shows each of the components and the reasons for the importance. The important issues are listed first and they are the result of the questionnaires and interviews with the various stakeholders.

Table 7.1 Owners/managers responsibilities – internal controls

1. Owners/managers responsibilities – internal controls	
Issue	**Reasons**
Strong risk management is related to strong internal controls. This includes the management of fire risks in enclosed shopping centres. The centre must have strong internal controls over the systems and processes to manage the fire and other incidents. The controls need to be regularly reviewed to make sure the risks are minimised and that all stakeholders understand their responsibilities. There needs to be audits of both the processes and systems to make sure nothing is left to chance.	The more effective the internal controls, the less likely there will be a major incident. However, it is important to measure risk with the level of control required.
2. Excellent communication between centre management, tenants, and training providers	
Issue	**Reasons**
All lines of communication are open and transparent. This includes advice to all stakeholders of their duties and responsibilities in reporting all incidents that affect the fire risk management of the centre. All stakeholders should be part of the communications process and systems – this is the key to good governance and process.	Good communication between management, tenants and training providers is essential for good governance and the reduction of risk. The internal stakeholders in an enclosed shopping centre must work closely to reduce the risk of incidents occurring.
3. Major tenants and specialty retailers	
Issue	**Reasons**
This requires all tenants in the shopping centre to attend a minimum of one training session per year. The tenants take the risk of fire seriously and are part of the risk management team. The major tenants should advise the centre management of any issues that will change the fire risk profile of the tenancy. This could involve changes in the types of goods held in storage.	All tenants should know their obligations and commitments to make sure the enclosed shopping centre is as safe as possible. This includes tenants and their staff.
4. Fire evacuation and training	
Issue	**Reasons**
Fire evacuation and incident training is vital to reduce the risk level in enclosed shopping centres. It should be completed at least every three months and have most of the retailers and centre staff involved. There should be some level of testing of knowledge of the issues. There is an opportunity for the management to get major retailers involved in the processes and seek their ideas.	This area is important to the management of fire and other incidents in the enclosed shopping centres.
5 Management of Fire Equipment – Sprinklers, Extinguishers, Smoke Control	
Issue	**Reason**
Fire equipment is an important part of fire risk management. The maintenance of the equipment is important. Records should show it is being maintained and tested at regular intervals. During the time of renovations and upgrades that the equipment is not Disguarded and still functions. During renovations and upgrades there is high fire danger, due to the various construction equipment being used..	The equipment such as extinguishers is the first form of defence in the containment of fire.

7.6.2 Buildings

This part of the model gives information about the building components. Each section explains the section in the flow chart model and the aim is to give reasons why it is important. Enclosed shopping centres undergo renovations to individual tenancies, major renovations and extensions during the

building's lifetime. During this time, the centre will be open for business. Building contractors and other organisations will be involved with the work. It is normal for the remaining tenancies to continue trading. Centre management must be aware of the fire risks and liaise with the various parties to reduce this risk.

Table 7.2 Building Codes

5. Building codes	
Renovations and extensions	**Reasons**
Enclosed shopping centres are subject to renovations and extensions over the life of the centre. It is imperative that all renovations and extensions are not only compliant with the building code but take into consideration any changes in people movements. The recent changes in Queensland highlight the need to keep up to date in this area. It is critical that managers know what is correct at any given time.	It is what makes up the tenancies that are important. When changes are made there may be changes in the risk profile of the centre. For example, the number of food court tenants may increase the risk of fire and the level of traffic.
6. Building services	
Maintenance (Sprinkler Systems and other equipment)	**Reasons**
Enclosed shopping centres require regular maintenance if they are not undergoing renovations or extensions. This includes fire hoses, fire blankets, fire extinguishers and other related equipment. There is always the risk of equipment being overlooked and not being maintained.	Fire equipment is subject to regular testing and review. However, it is only in a real situation that fire equipment can be fully tested. This includes hoses and blankets.
7. Building construction	
Original construction	**Reasons**
The construction of the building according to the building codes is paramount to the management of fire risks. The building could deteriorate over time. This can affect areas such as electrical systems and fire doors. It is recommended that the areas should be reviewed at least every three years.	The older the building, the more likely there will be fire risks with the building. The original structure may have been modified over time and major changes may not be accessible.(See Myer Hobart store fire)
8. Fire regulations	
Fire	**Reasons**
The fire regulations in each state/territory are subject to regular change. As a result of the fire at the Childers Backpacker Hostel, Queensland has made major changes to the fire regulations.	It is imperative that all enclosed shopping centres conform to the fire regulations or any Act changes**.**
9. Combustible Material	
Fire	**Reasons**
The management of combustible materials is an important issue in enclosed shopping centres. There are instances when specific tenants will be holding combustible materials for various reasons. There should be a register held at Centre Management detailing the tenants who may have any such material. The register will need to be reviewed on a regular basis and be subject to audit, if possible.	Combustible material can cause fire and other emergencies if not correctly controlled.

7.6.3 External stakeholders

The external stakeholders have an important role to play in the management of fire risks in enclosed shopping centres. Insurance companies have in-depth knowledge in the area of fire risks and should be consulted at regular intervals. The professional associations also have an important role to play and should be used for information. The Australian Standards are under constant review and managers

should obtain up-to-date copies. This also applies to occupational health and safety that is state/territory-based and is subject to regular changes.

Table 7.3 External Stakeholders

9. Insurance	
Issue	**Reasons**
Insurance is an important part of the management of risks in enclosed shopping centres. The management of the enclosed shopping centre should always be aware of the needs of the insurance company. There needs to be close cooperation with the insurance company to obtain the lowest insurance rates by making the building comply with 'best practice' principles.	The insurance costs of the building are passed on to the tenants in some form. Lower insurance rates will flow on to the tenants.
10. Professional associations	
Issues	**Reasons**
The professional associations that are involved with both general and fire risks are a good source of information and ideas. They are normally at the forefront of the fire risk management and have regular seminars and conferences to discuss and generate ideas. They can be a good reference point for issues that may emerge from time to time.	The professional associations are there for a specific reason. They should be used at every opportunity.
11. Australian Standards	
Issues	**Reasons**
The Australian Standards are used as the basis for processes and systems in the area of risk management and fire risks in commercial buildings. It is imperative that centre management is completely aware of all the Standards. The training providers are, in fact, doing what the Standards have set down.	In most states the Australian Standards will form the basis of the management of fire risks in enclosed shopping centres.
12. Fire services (Including Local Government)	
Issue	**Reasons**
The local fire services need to be involved with fire risk management at enclosed shopping centres. This can be undertaken in a number of ways including an annual meeting and participation in the review of an evacuation exercise. There may be local laws and regulations to consider in the area of fire risk management.	The fire services are an integral part of the fire risk management at enclosed shopping centres. They need to be involved to get some understanding of how the enclosed shopping centre functions and to provide advice.
13. Occupational health & safety	
Issues	**Reasons**
Occupational health and safety has become more prominent in the past number of years. In Victoria, WorkCover inspectors can demand entry to work sites including shopping centres to review the occupational health and safety systems of the centre.	The issue of employee health and safety is important for a number of reasons including reduction in health costs and reducing workers compensation premiums for employers.
14. Evacuation assembly area	
Issue	**Reasons**
When there is an evacuation, whether it is a test or actual, safe places are where the public can be assembled as needed. Due to constant changes to properties, the previous area or building may not be available.	It is imperative that safe assembly areas are always available to the enclosed shopping centre.

The above sections from 1 to 14 show the major areas concerning fire risk management in enclosed shopping centres. The next section shows by means of a flow chart the interaction between the owner, centre management and training providers. It shows how the centre management is pivotal in the fire risk management process. This is especially important when the ownership is held by other parties as discussed in 3.6.3.

7.6.4 Flow chart 2 – movement of information, interaction with other stakeholders

The source of this flow chart is the result of the questionnaires, interviews with the centre management, training providers, building, and external stakeholders. It shows the pivotal role played by the centre managers in the fire risk management process. The manager, in turn, reports to the owner of the enclosed shopping centre. In some situations the ownership is divorced from the management in such cases of passive investors.

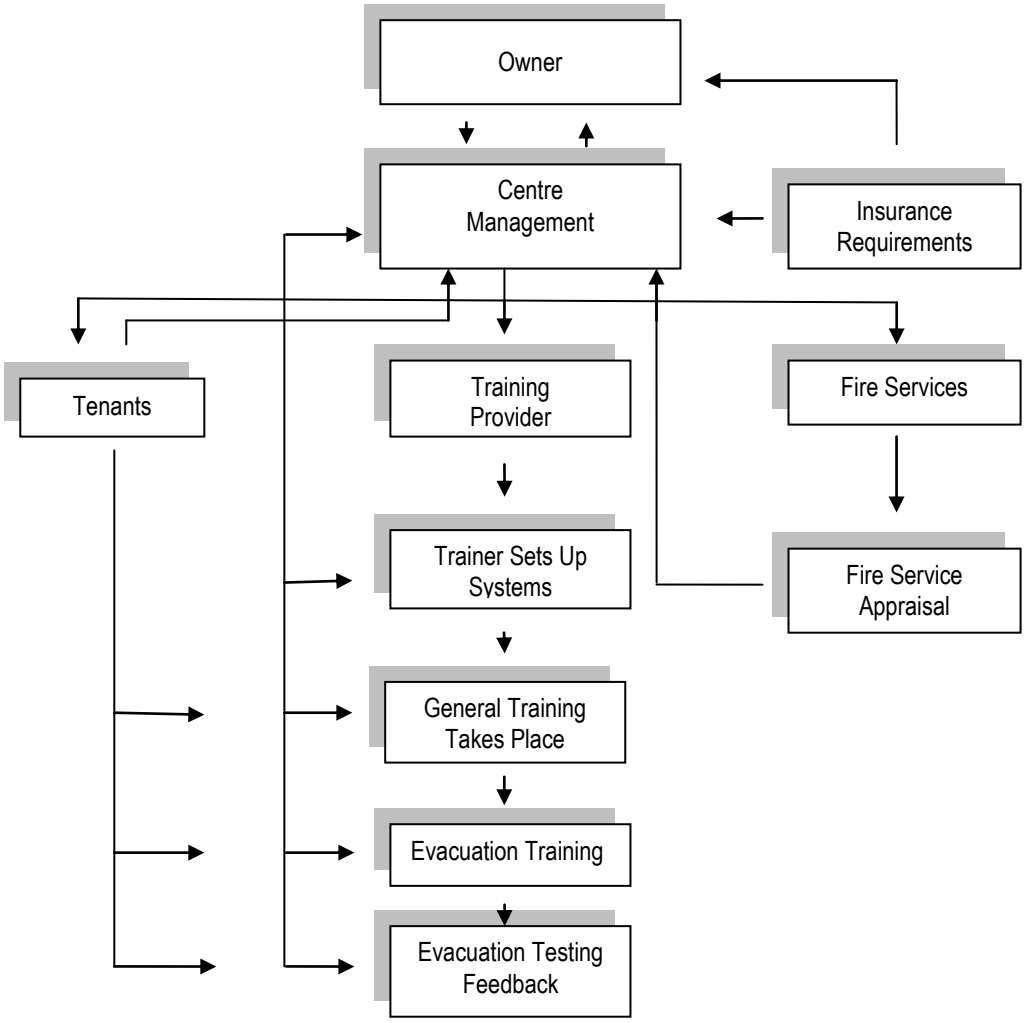


Figure 7.3 Centre readiness through regular training process

Figure 7.3 shows the pivotal role that the operations management plays in the area of fire risk management. They are the party that organises fire and incident training. They are the party that is also responsible for the evacuation training involving all the tenants. If for any reason they are not able to perform those tasks, then the training will not be performed as planned. There is no statutory external review of the process. However, it appears that in most cases, evacuation training would be completed.

The communication flow is important and the tenants need to be involved at every stage of the training process.

7.6.5 Flow chart 3 – movement of information, operations management (fire and incidents)

The following flow chart shows the information that operations management should be aware of when organising the fire or incident risk management processes. Operations management needs to have clear objectives to make the processes as transparent as possible. It needs to have all areas covered.

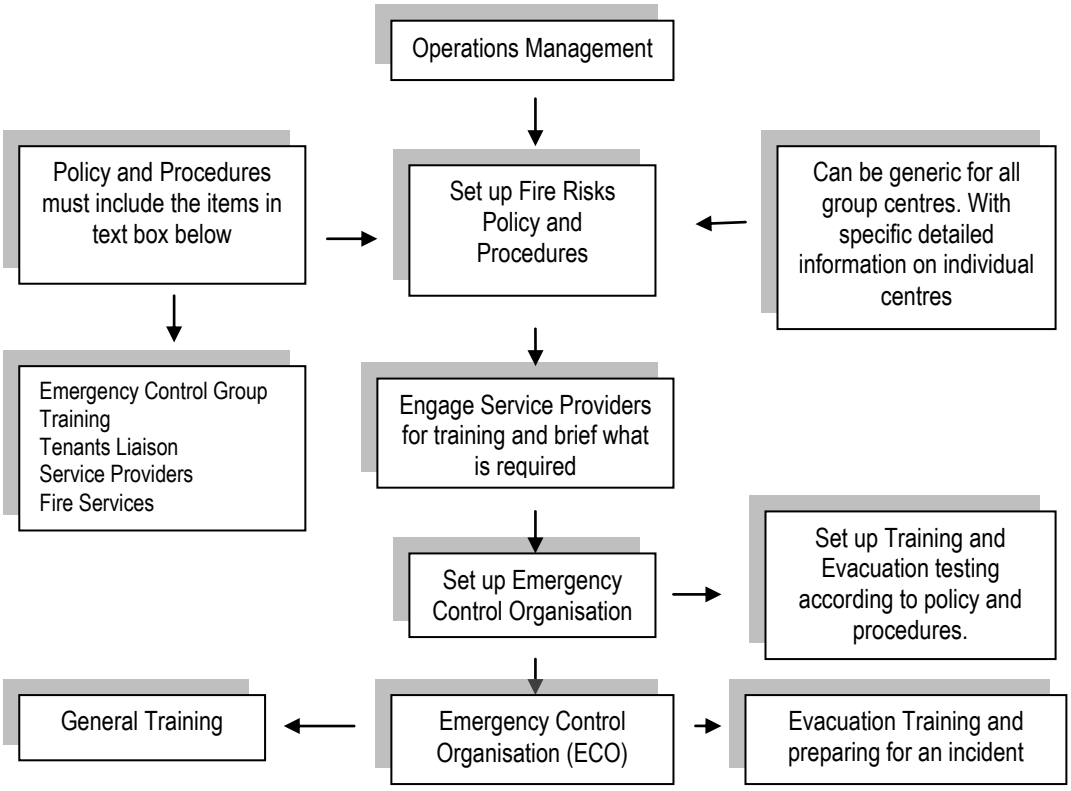


Figure 7.4 Movement of information – operations management (fire and incidents)

7.6.6 Model incorporated into managers' information process and systems

Models next step

The model once it has been localised should become part of the operation manuals of the centre management. The manual would be part of the training and be presented at workshops and other areas that involve both internal and external stakeholders. Every owner/manager will have systems and

processes that this model can be adapted. The model can be incorporated into the operation manuals without much effort and costs.

Policy and Procedures - Fire and incident risk management

It is normal practice in large organisations to have detailed policy and procedures. It is recommended that the fire risk model should become part of policy and procedures. This could be part of a more general policy and procedure and be precise in all aspects of fire risk control in enclosed shopping centres. The following table indicates the basic policy and procedures that the operations management should instigate before service providers are engaged. This could be integrated with other policy and procedures including occupational health and safety. Policy and procedures need to incorporate all levels of information and not be ambiguous in the detail.

Table 7.4 Policy and procedures – fire and incident risk management

Fire risk policy and procedures	
Item	**Details**
Emergency Control Group	The operations management will be responsible for the set and monitoring of the Emergency Control Group. The group will meet on a monthly basis. The number of participants in the group will be determined in consultation with the senior management and owners**.**
Training	Fire and incident training must be carried out on a quarterly basis. The training seminars must have a minimum of 10% representatives from all tenants.
Tenants Liaison	Centre management is to advise all tenants of the proposed training sessions and give all tenants at least 4 weeks' notice.
Service Providers	All service providers including security, cleaning and maintenance are to attend at least one training session a year.
Fire Services	Annual review by local fire services of the enclosed shopping centre, including a critique of the fire risk controls.
It is recommended that the above items will be supported with further subsections giving further details of the policy and procedure.	

7.6.7 The model attributes and functions

The model shows in detailed form the processes and systems required to manage fire risks in enclosed shopping centres. The model is made up of a number of components of which the management should be aware in order to manage the fire risks. The production of this model gives a clear guide to the areas that need constant attention in reduction of fire risks. The model can be the template for further research and be used in other commercial buildings fire risk management systems. The model gives a

detailed map of the fire risk management process in enclosed shopping centres. The model gives step-by-step information flow and covers the major components of which centre management must be aware, if it is going to be proactive in this area. Centre management will be able engage the tenants and they will be able to work together to reduce the fire risks with this model. I argue this type of model can also be used in other types of commercial buildings, involving large movements of people. This could include sports areas, hotels, airports that could have similar problems with people evacuations.

7.6.8 Model in relation to previous fires

The model can be related back to the Hobart Fire case study in section 6.6.2. The Hobart fire destroyed the Myer Store in the central business district of Hobart in September 2007. The Magistrates report highlighted a number of issues. The most important issue was the lack of communications between fire officers and Centro. If they were involved with the evacuation training at the shopping centres as described in the model, perhaps this problem could have been averted. The second part of the report mentioned the isolation of the sprinkler system; again this is part of the model. The Myer centre was close to other tenants and this caused problems in the area of evacuations and crowd control. This is also be part of the model. The Tasmania Fire service had issues fighting fires in multi-story buildings, which in model figure 7.3 is stated as Fire Service Appraisal. The fact that the proposed model can deal with the four issues validates its ability to help real fire events in enclosed shopping centres.

Model in the real world

The model has been given to a number of shopping centre managers and training bodies for feedback on whether the model is practical and will be of benefit to their organisation. The general consensus is that will be worthwhile to incorporate such a model within their general risk management processes and systems. This included policy and procedures of the organisation. The organisations did not want to be named for competition and commercial confidentiality.

7.7 Summary

The model brings together the known components that are integral to the fire risk management in the enclosed shopping centre. The components are in three distinct areas of operations, building and external stakeholders. They each have their role to play; however, the major influence is in the operations area. The operations management controls the day-to-day risk management in the centre.

The management group instigates the process in which evacuation training can be undertaken. The service providers are directly responsible to the operations management. The issue is who is reviewing the operations management? The opinion may be that if there are no major incidents then the risk management is under control. However, it is shown not to be so as in the fire in Hobart. This model shows how fire risk should be managed in enclosed shopping centres. The model described in this chapter is the basis for a more detailed analysis for individual shopping centres.

Chapter 8 Conclusions and implications

8.1 Introduction

The purpose of this study is to research the management of fire risks in enclosed shopping centres. Enclosed shopping centres are part of the wider commercial building sector. There are a number of related-type buildings including hotels and airports. Enclosed shopping centres are different in a number of ways including the number and types of tenancies and large people movements. No other commercial building has the level of people movements. Chapter 7 discussed the model in detail and the need for such a model and the answers to each research question and proposition. The research has highlighted a number of issues in the control of fire risks in enclosed shopping centres. This accumulates into a best practice model for shopping centre managers. This final chapter revisits the original research questions in Chapter 1 and the propositions advanced in the conceptual framework in Chapter 4. The research has shown that a model is required to map the fire risks in enclosed shopping centres. The reason for this finding is that, on the evidence from the literature review, there is no model presently available. There are models for fire risks in other types of commercial buildings; however, none in the area of enclosed shopping centres. The final chapter will bring all the previous information together and analyse the reasons why the model is needed.

8.2 Conclusions

8.2.1 Extra propositions – conceptual framework

The questions were further enhanced in the conceptual framework in Chapter 4, and their answers are discussed in this section. The questions in the conceptual framework were deemed closer to the required study.

1. **What are the current systems in place for the control of fire risks in enclosed shopping centres?**

   The study confirms that centre management has the control and responsibility for fire risk at the sampled enclosed shopping centres. Various fire risk processes are in place reflecting the company management style. However, all the centres use the Australian Standard AS 3745-2002 as the basis for fire risks control systems. There is a great reliance on the professional service providers to undertake training and evacuation testing. The management of the service providers is in the hands of the operations management that in turn reports to centre management.

2. **What is the responsibility of the various stakeholders to reduce fire risk in enclosed shopping centres?**

Overall responsibility is at the centre management level (see section 6.2.1) This, in turn, is delegated to the operations level as discussed in Question 1. In addition, there are the major tenants who have their own fire risk control systems in place. Other parties are indirectly involved with the control of fire risks at the centres. There are the owners who have responsibility to the shareholders. The insurance companies wish to limit the risk of fire damage to the building. The original builders of the centre and ultimately the builders who undertake the extensions and renovations are involved with fire risk management.

3. What systems and processes are in place to make sure the enclosed shopping centre adhered to all Australian Standards in respect to fire safety?

The three major Australian Standards that affect the enclosed shopping centres are discussed in this study. They are the Enterprise Risk Management AS 4360 (ERM) which was the basis of organisational risk management in Australia; AS/NZS 31000 has now superseded AS 4360 as the risk management standard; the new standard follows the previous standard, however, emphasis is on how risk management should be implemented and integrated into an organisation. Unfortunately, as before, the new standard has no legal binding. It would be highly unusual for any major organisation in Australia not to use it as a basis for risk management. The standard is generic and organisations are expected to set up their own risk management systems based on the standard. The other major standards are AS 3745-2002 for the emergency control organisation and procedures for buildings, structures and workplaces and AS 4655-2005 Fire safety Audits that is discussed in this study in section 3.2.2. There is no mandatory requirement that enclosed shopping centres follow the standard. However, it is the basis for all the fire risk controls.

4. Do external parties such as the local fire service, insurance companies and regulatory bodies such as occupational health and safety fully understand the enclosed shopping centre?

This research demonstrates the external parties view of enclosed shopping centres as commercial buildings. They appear not to appreciate the specific issues relating to enclosed shopping centres as revealed in this study. Therefore, it is incumbent upon centre management that they are able to adjust their processes and systems to remove any misunderstandings that the external parties may have. The model includes such matters.

8.3 Model – research problem and contribution

Introduction

The research problem was conceived from an initial study in the area of fire risk management in enclosed shopping centres. It was found that while there were fire risk management structures in place, they tended to be disjointed and not system-orientated. The objective of the research is to produce a model that is used by centre managers in fire risk management. The resultant model is a best practice model, and it is believed to incorporate the major issues that require attention. They are low risk and managed to a high standard. However, the issue is not whether they are high risk, but how the potential risk of fire is managed and controlled. This is important as fires or other incidents can take place at

anytime and when the centre is least prepared. There is no known model for fire risk management of enclosed shopping centres. The research has produced a model that can be used as a best practice reference. The model is a generic list of the logical steps required to manage the risk of fire. It can be modified for individual circumstances.

Risk theory and the relation to the model

Risk theory states that a major fire in an enclosed shopping centre has a low probability in the scheme of things. However, because the probability of a major fire and loss of life is low, should we be treating the situation with a low level of priority? The probability of a fire is not uniform across all enclosed shopping centres. There is a need to build onto the model according to the centre. The enclosed shopping centre may be in a central business district, which means there are other close commercial buildings. This will give a different risk profile to one in the outer suburbs. The other major risk is the age of the building. Many enclosed shopping centres were built when the fire regulations were not as stringent. The internal tenancies tend to be renovated over a period. However, the external parts of the building, including the entry and exit points, tend to stay the same, unless the centre goes through a major extension.

Model

The model is the first attempt at a formal model for fire risk management in enclosed shopping centres. The model consists of flow charts, function descriptions, responsibility schedules, and policy and procedure extracts. The model can be used by centre managers in mapping the management of fire risk in enclosed shopping centres. The information in the model has been taken by interview and questionnaires from all known areas for the management of fire risks in enclosed shopping centres. The only true way for the model to be seen to work is in an emergency that involves all stakeholders. However, there could be a limitless number of scenarios. The major influence in the model is the level of internal control by the centre management that has been discussed.

Model in Processes and Systems

In today's risk adverse environment any help in understanding and controlling fire risks is important. Process and systems tend to evolve from various factors and are at times ad hoc. This model endeavours to bring those various components together and so provide a better understanding of the fire risks in enclosed shopping centres. It is interesting that as result of the Victorian bush fires an

evacuation manual or model is available to those living in bush fire areas. Processes and systems can always be improved if organisations want to reduce risk and understand controls.

8.3 Limitations of research

Introduction

The study centred the research on one section of the enclosed shopping centre industry in Australia. The regional and sub-regional centres were the basis of the research due to their importance in the enclosed shopping centre industry. There are other related enclosed shopping centres such as those located at airports. The research did not include the move to include shopping centres in multilevel buildings in central business districts, as they require a completely different approach due to other risk factors. Enclosed shopping centres in overseas countries may have other risks that Australian centres do not have. It is considered likely that overseas shopping centres could use this model as a basis, to be transformed to their particular situation.

Model

The Business Reference Model as proposed in Chapter 7 covers many situations. However, this fire risk model is developed especially for enclosed shopping centres. Like the majority of models, they can be adjusted in some form for other applications. However, all models have their limitations. There are unique situations that all models are unable to cover. There is a basic assumption that the management of fire risks in enclosed shopping centres is the same whatever the centre. The major differences will be external influences such as regulations, fire services, and such like. The internal management processes will reduce the risks.

Model applicability

The model can be used in all regional and sub-regional enclosed shopping centres. The main criterion for the model being used is the following:

1. The centre management must have control over the fire risks management.
2. The systems and processes should be aligned in the same way as the model.
3. The interaction between the stakeholders should be carried out in the same way.

Enclosed shopping centres are moving into an integrated commercial building scene. The enclosed shopping centre may be part of an airport or railway station. This brings further complications and issues. However, with all buildings that have the same general characteristics as enclosed shopping centres, this model can be used with modifications. Large hotels would fall into those characteristics if they have shopping and entertainment precincts attached. Therefore, with these provisos in mind the model can be used in other commercial buildings that have the above attributes.

Interaction with large public companies

The nature of the research is an issue when dealing with major public companies. They are generally reluctant to divulge detailed information. The owners and managers of the enclosed shopping centres have major brands to protect. The reputation of the companies is critical and they will go to great lengths to protect the brand. However, it is in the best interests of all to have good processes and systems in place to reduce the risks.

Limitations of research – conclusions

The research was conducted with major retail property owners and managers. Due to competitive reasons, they tend not to release confidential information with respect to operational issues involving their centres. This makes the research of the issues that much more difficult. However, with the information gained, the research has produced a model that can be used by owners/managers of enclosed shopping centres to control and manage their fire risks. The research exposes the need for a model to show how fire risks should be managed in enclosed shopping centres. Management normally continues the same processes and systems. The attitude as discussed in this research is that if there are no major incidents then all must be well. The example with the fire in Myers Hobart shows that complacency can set in and it is only when a major incident happens that there are problems. The new model is an important step in the process to improve fire risk management in enclosed shopping centres. The model makes considerable progress in understanding the centre management process for fire risk management.

8.4 Conclusions on research issues and propositions

The conclusions that can be made from the research are that while enclosed shopping centres have processes in place for fire risk management, there is a need for a model to show what centre

management requires in order to achieve best practice in fire risk management. The process of managing the fire risks at enclosed shopping centres has become complex due to factors including tenant numbers and people movements. The management of the evacuation training and the relationship with the service providers is an important aspect of centre management. There are external influences including government bodies and fire services that need to be considered when framing management of fire risks. The propositions in 4.6 support the need for a model to manage fire risks in enclosed shopping centres. The enclosed shopping centres should not rely solely on the Australian Standards, but use such a model to manage fire risks. This will support best practice systems and make the process more transparent.

8.6 Implications of the Research

8.6.1 Future research

Queensland building regulations

There is an opportunity to take this research further once the results of the changes to the Queensland regulations are known. This will take a period of time. However, there are future research questions including the question of whether of other states and territories will follow suit with their regulations. In 2008, the change to the Queensland building regulations affecting commercial buildings was a major step towards having a more regulatory system rather than relying on the Australian Standards. The changes were adopted because of the backpackers' hostel fire in Childers in 2000, as discussed in Chapter 2. By their nature, government agencies tend to be reactionary to issues. Australia is moving to a uniform system of regulations and it could be that other states and territories will follow suit with stronger fire regulations. There are clear advantages for the business community to adopt uniform laws and regulations. This would allow training staff to be transferred between centres so that centres are better equipped to face new regulations. The research will follow on from what has taken place there and the effect of the regulations on commercial buildings in Queensland. Future research would include the study on how well the Queensland regulations were working and if they were affective in the area of fire risk management.

Central business districts

The model proposed is for use in regional and sub-regional enclosed shopping centres. There are many central business shopping centres which have a close operating relationship to the regional and

sub-regional centres. They may have additional risks such as transport hubs including railway and bus stations. This would result in the expansion of the research to incorporate the risks in a new model.

Overseas and Global research

Future research should involve overseas enclosed shopping centres. Fire risk management systems are important in all countries and jurisdictions. This includes enclosed shopping centres in both the US, Europe and Asia. This would include how the model would be modified to suit the various conditions in each of the areas or countries.

Computer simulation for people movements

There are a number of studies in the UK,USA and elsewhere in undertaking computer simulation in people movements (refer section 3.4.3). This is important research as buildings, including enclosed shopping centres, become multilevel in central business districts. Simulations by computer statistical models enhance the knowledge of people movements and aid the incident and fire risk management in all commercial buildings. This would not be possible without the use of computers. Such simulation is widely used in Australia and is an important tool in the theory and practice of people movements. The future research component includes how the computer simulation has improved with more advanced computer systems and 'what if' scenarios. Also how simulation relates to the 'best practice' model of shopping centre fire risk management, which is developed herein.

Model in use

The model could be sent to interested parties in enclosed shopping centres to seek their reaction and feedback. The model is not a static instrument and will need to be reviewed in the future. Fire risk management will change over time due to technology, government and public pressure.

8.6.2 Implications for theory

The theory of fire risk management in enclosed shopping centres is that, while on the surface the systems and processes are in place, it is only because the perceived risks are low and the number of major fires has been low, that everything appears to be working well. However, history suggests that that is not always the case and that risk management should always look at the worst case scenario

and all events should be considered. The facts are that many owners/managers tend to treat fire safety as a 'tick the box' scenario. If a real emergency occurred, the reality is that things could go wrong very quickly. The ideal situation would be to make all training as close as possible to the real situation. Strong evacuation testing is of prime importance in this period of stronger risk control. The prominence of fire risks in enclosed shopping centres is somewhat low due to the low incidence of fires. However, there were many incidents in the past that were inconceivable. Because there have been lower rates of fires in Australian enclosed shopping centres does not mean that a major fire cannot happen in Australia. In theory, Australia should have a good control over all fire emergencies. It has highly dedicated fire services in all areas, whether they are in urban or rural areas. Bush fires in Australia are a common occurrence. It is therefore disturbing that over 170 lives were lost in Victoria in February 2009. While bush fires are not the same as fires in urban areas, lessons can be learned in how the training and risk reduction are completed.

Implications for policy and practice

The basis of fire risk management in enclosed shopping centres has been driven until now by the Australian Standards. In Queensland, the system has progressed and has introduced new regulations. However, even with regulations, this does not give a detailed model on how the system should operate. The model proposed can be scrutinised and analysed to improve the processes and systems. The use of a model in fire risk management in enclosed shopping centres will improve the policy. However, this depends on how the model is accepted and used.

Appendix 1 Fire Risk Questionnaire

Fire Risk Questionnaire
Date
Questionnaire Number

Part 1 General Statistics

Centre Statistics

State/Territory	1.1	
Location (CBD, urban, country)	1.2	
Type of centre (regional, sub-regional, etc.)	1.3	
Area in square metres (excluding common areas)	1.4	
Area in square metres (including common areas)	1.5	
Total area in square metres (excluding cark parks)	1.6	
Number of permanent tenancies (inside centre)	1.7	
Number of majors (supermarkets, dept stores)	1.8	
Number of public entry/exit points	1.9	

Part 2 Questions Requiring Yes/No Answers

	No.	Yes	No
Do you manage the centre on behalf of an owner?	2.1		
Do you have a detailed fire risk plan?	2.2		
Do you conduct regular fire evacuation training?	2.3		
Is the fire evacuation training undertaken at times agreed with all the tenants?	2.4		
Do you liaise with tenants in respect to their fire plans?	2.5		
Are *new* tenants required to attend fire safety briefings?	2.6		
Are *new* tenants given a briefing on the centre fire evacuation plans?	2.7		
Do you conduct fire safety audits according to Australian Standards AS 4665-2002?	2.8		
Does your staff follow up with tenants who have not attended fire evacuation training on a regular basis?	2.9		
Does the centre management choose the fire wardens?	2.10		
Is the Emergency Control Organisation (ECO) adequately staffed to cope with an emergency at the centre?	2.11		
Are personnel appointed to all positions on the ECO, particularly the chief warden group?	2.12		
Has there been a change in use or change to the layout of the centre since the last Emergency Response Procedure (ERP) was produced?	2.13		
Has there been any change in the number of tenants/occupants at the centre that may affect emergency response procedures and the evacuation of the centre?	2.14		
Are evacuation routes from the centre safe and without structural or other hindrance?	2.15		
Has there been a change in the location or the use of the primary evacuation assembly area(s)?	2.16		

Part 2: Questions Requiring Yes/No Answers

	No.	Yes	No
Has there been a change in the tenancy structure that may increase the fire load of the centre?	2.17		
Has there been a change in the number of occupants at the centre using or storing chemicals or other hazardous materials?	2.18		
Could you benefit from a model on how fire risks should be managed in enclosed shopping centres? (available at later date)	2.19		
Do you use a service provider to conduct fire evacuations and training? If not why?	2.20		
Reasons (brief reasons required)			

Part 3: Questions Requiring Ratings – General (One tick in each line is the only requirement)

	Ratings					
Question	**No.**	**Strongly Agree**	**Agree**	**Neither Agree or Disagree**	**Disagree**	**Strongly disagree**
Are fire risks the greatest threat at your centre?	3.1					
Are all centre tenants likely to cooperate on fire risk issues?	3.2					
Is an annual independent assessment of the centre fire risks important to your company?	3.3					

Part 3(a) Questions Requiring Ratings – Fire Training

	Ratings					
Question	**No.**	**Strongly Agree**	**Agree**	**Neither Agree or Disagree**	**Disagree**	**Strongly disagree**
Are independent service providers such as 'First 5 Minutes' important in the training and prevention of the fire risks?	3.4					
Do you agree that fire evacuation training should be undertaken at the busiest time to maximise the learning?	3.5					
Do you agree that fire evacuation training can take place to suit the tenants?	3.6					
Should the public be involved with fire evacuation training?	3.7					
Is it important that owners of the tenancies are advised of the participation of staff in fire evacuation training?	3.8					
Is it important that all staff working for owners/managers participate in fire evacuation training?	3.9					

Part 3(b) Questions Requiring Ratings – Owners and Managers

		Ratings				
Question	**No.**	**Strongly Agree**	**Agree**	**Neither Agree or Disagree**	**Disagree**	**Strongly disagree**
Is it important that staff working for service providers (cleaners, security) participate in fire evacuation training?	3.10					
Is it important that the managers/owners have some connection with the local fire service?	3.11					
Should the local fire service visit the centre regularly to prepare itself for possible fires?	3.12					
Is close cooperation between owners and managers an important aspect of running a successful centre?	3.13					

Appendix 2 Summary of Questionnaires Part 2 & 3

Part 2

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
Yes	30	28	30	13	28	20	28	29	14	27	28	27	1	5	28	4	2	2	29	30
No	0	2	0	17	2	10	2	1	16	3	2	3	29	25	2	26	28	28	1	0
Total	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Yes	100%	93%	100%	43%	93%	67%	93%	97%	47%	90%	93%	90%	3%	17%	93%	13%	7%	7%	97%	100%
No	0	7%	0%	57%	7%	33%	7%	3%	53%	10%	7%	10%	97%	83%	7%	87%	93%	93%	3%	0%

Part 3

Frequency		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Strongly agree	1	4	4	19	17	6	0	6	14	21	26	20	23	24
Agree	2	10	16	7	12	3	10	12	9	8	4	8	6	6
Neither agree or disagree	3	11	4	3	0	17	9	8	3	1	0	2	1	0
Disagree	4	5	6	1	1	3	9	4	2	0	0	0	0	0
Strongly disagree	5	0	0	0	0	1	2	0	2	0	0	0	0	0
Total replies		30	30	30	30	30	30	30	30	30	30	30	30	30

Appendix 3 Interview Questions

Appendix 3.1 (For answers see sections 6.3.1) Major Service Providers (Training)

Questions

What sort training do you do?

Mandatory fire training

1. Is it mandatory that owners/managers engage a company like F5M to provide fire and evacuation training?

Influence with management

2. I assume that your contact is with the local management of the commercial building. If it is the managers, do the owners or head office request information on the fire training?

Attendance at training sessions

3. Whose responsibility is it to arrange attendance at the training sessions? Do you have any bench marking on minimum attendance at fire training (10% of 100 tenants)

Human resources

4. Do you hire your own trainers or are they on contract? And what are the minimum qualifications for a trainer?

5. Do you recommend a specific time to do an evacuation, or is it the sole decision of the managers/owners?

6. Who has responsibility for fire evacuation testing and compliance according to State/Territory laws?

Note the answers are in summary form in Chapter 6. The reason is that four training providers were interviewed and all wanted answers to be kept confidential.

Appendix 3.2 Interview Questions MFB

Q1 Does the MFB have any special regulations or rules regarding enclosed shopping centres?

Reply: There are no special rules governing enclosed shopping centres. Commercial buildings must conform to the Building Codes Australia compliance regulations.

Q2 How does the MFB review the entry/exit points in commercial buildings?

Reply: The MFB does not review the entry/exit points as such. However, the Fire Protection Association of Australia has been developing guidelines in this area. The MFB understands there have been some studies by Victoria University on the entry/exit point questions.

Q3 Would the MFB like to see Victoria have the same regulations as Queensland?

Reply: The MFB believes the current system as it operates in Victoria is good. This is a political issue and as such needs to be referred to a higher authority. However, there will always be methods of improving the systems and processes. This would include increased responsibility for fire marshals.

Q4 Would the MFB like to oversee the training in major enclosed shopping centres at least once a year?

Reply: There is no legal power available to the MFB to oversee the training in shopping centres. The responsibility remains with the building manager.

Appendix 3.3 – Interview With Insurance Consultants – Property Engineer

Q1 Enclosed shopping centres are major commercial buildings. Are there any special issues with enclosed shopping centres (regional and sub-regional) that insurance companies are aware of?

Reply: For property insurance companies it would all be based on the total value (sum insured) of the property. The larger the property, the larger the potential property loss if the shopping centre burns down. However, the majority of shopping centres have automatic sprinklers installed (BCA requirement) that will assist in the mitigation of a property loss (control a fire at its source and alert the local fire brigade via electronic alarm). Issues that property insurers would focus on include: the fire systems being maintained to Australian Standards (including the fire pumps). The sprinkler system is designed in accordance with Australian Standards including the 'back of store' areas of major retailers (where high piled storage would be located); sufficient water supply available for the sprinkler system (large enough town's main, possible on-site tanks and correct fire pumps installed); fire impairment system which would be used whenever an automatic sprinkler system is shut down (tenancy fit out or property re-development) & ensures that the fire system is restored. Note: BCA refers to Building Code Australia and is the authority on building codes in each state.

Q2 Are insurance companies interested in the fire risk management processes in enclosed shopping centres?

Reply: Insurers are very interested in fire risk management processes being in place including:

the fire impairment system (as mentioned in Question 1)
where there are self-inspection programs, checking on housekeeping both in common mall and tenants' areas
hot work permits systems (contractor welding activities)
cleaning of grease build up within cooking hoods of food retailers
annual water fire tests (automatic sprinklers and hydrants)
confirmation of fire protection being maintained (portable fire extinguishers, fire blankets and hose reels – common mall & major retailers)
emergency evacuation procedures (including training in the use of fire equipment) and dangerous goods/hazardous substances storage and summary of information
Property insurers would often conduct their own inspections of a shopping centre to seek evidence of fire risk management processes being in place. If the processes are unsatisfactory, then they would be issuing recommendations.

Q3 Do insurance companies grade shopping centres for risk? (old buildings, etc.)

Reply : The centres are based on risk such as age, size, location, sprinkler protection, and outstanding risk management recommendations, etc.

Q4 Any other issues that affect the insurance of enclosed shopping centres?

Reply: If the property is located in an area in which natural hazards may cause damage such as flood, cyclone, earthquake, etc.

Appendix 3.4 Building Surveyors

Q1 Do you treat the building of enclosed shopping centres in the same way as other commercial buildings?

Reply: All commercial buildings are treated in the same manner. They are required to conform to the building codes in force at the time of construction. Assuming the commercial buildings involve large people movements such as in hotels, shopping centres, and airports, we will consult with the project managers and specialised consulting engineers for an investigation into the people movement's questions.

Q2 Are the building surveyors responsible for the simulation of people movements in commercial buildings?

Reply: 'As stated in Question 1, the building surveyors are not experts in this field and the client will require an independent assessment of the people movement models. The consulting engineers who have the expertise and the resources to conduct the required tests best handle this'.

Appendix 3.5 Consulting Engineers

Q1 Who engages you to carry out the consulting work?

Reply: We are engaged by the project managers and architects on behalf of the owners to do an independent assessment of the fire risks. We work with the building surveyors and project managers to get the best outcome for the building. We advise the project managers of any issues arising from the movement of people through the building.

Q2 Do you use computer simulation for the fire risks?

Reply: As consulting engineers we use the latest computer simulation software. The process is that the variables are fed into the systems and the results are produced in the form of reports. The use of computers in the area of simulation is the only way to get the required information for analysis. The simulation measures the movement of people via the intended entry and exit points. This is calculated with the expected number of people visiting the enclosed shopping centre, and will include a 'worse case scenario'.

Appendix 3.6 Major Retailer

Q1. Do you depend on the enclosed shopping centre management to control the fire/incident risk management?

Reply: 'We control indicants of such nature within our stores and cooperate with centre management if the risk is in the shopping centre and they have control of these situations'. This reply was understood to mean that the major tenants control the internal fire risks and cooperate on external fire risks.

Q2. Do your stores in enclosed shopping centres have their own fire risk management systems including evacuation training and testing?

Reply: 'Our wardens are trained in-house and we have our fire equipment tested as required monthly, 6-monthly or yearly'.

Q3. Do you encourage store management be part of the fire/incident training at the enclosed shopping centres?

Reply: 'Yes, we do. In most cases it is part of our lease agreement that we do participate in the training'.

Q4 Do you request centre management to pass on the details of the fire/incident training so as to make sure the centre is complying with best practice?

Reply: 'In most cases we do not request this: it is passed on voluntarily to store management'.

Appendix 3.7 Project Managers

Q1 what role do you play in respect of construction or renovations to enclosed shopping centres?

Reply: The role of project manager is one of coordination of the project. This will involve the building surveyors, architects, engineering services on behalf of client.

Q2 If computer evacuation software is used such as EXODUS, SIMULEX, EGRESS for people movements.

Reply: the Consulting Engineers in consultation with the architects and building surveyors handle this.

Q3 Who manages the aspect of the building codes?

Reply: The building surveyors handle the building codes regulations and advise the architects and project managers if there are any issues.

4. Appendix – Leading Australian Shopping Centre Owners and Managers 2000

Leading Australian shopping centre owners and managers 2000

Owner	Category in Australia			Total	Floor space in (000) square metres	% of total retail	Retail sales ($m)	Annual shopper visits (m)
	Regional	Sub regional & DDS	Local					
Westfield	23	6	1	30	1,449,149	3.8	7,300	280
AMP	11	11	1	23	834,402	2.2	4,050	170
Lend Lease	12	5	2	19	708,808	1.8	4,040	155
Centro (inc. MCS)	10	28	12	50	707,332	1.8	3,510	135
Gandel	5	5	0	10	465,921	1.2	2,240	75
QIC	7	2	0	9	427,584	1.1	1,980	80
Yu Feng	2	10	4	16	294,840	.08	1,300	55
Colonial	0	8	1	9	254,304	.07	1,260	55
Commercial Bank/FCM	1	4	7	12	221,342	.06	1,150	45
Armstrong Jones/Mercer	2	7	1	10	208,288	.05	990	33
Stockland	0	6	2	8	178,167	.05	960	35
Deutche	1	5	0	6	174,329	.05	835	33
ISPT	0	12	0	12	168,165	.04	965	65
Countrywide	0	1	29	30	157,860	.04	1,145	38
Pacific Group	0	6	0	6	151,525	.04	615	31
Perron Investments	1	3	0	4	134,461	.04	575	24
Advance Property Fund	0	3	0	3	115,887	.03	440	18
Suncorp	1	2	0	3	114,865	.03	285	16
Mirvac	2	4	1	7	106,207	.03	515	18
National Mutual (AXA)	1	2	0	3	100,419	.03	500	21
Intro International	2	0	4	6	98,240	.03	515	17
Total	**82**	**130**	**65**	**276**				

Appendix 5 Factors for Enclosed Shopping Malls by James P Smith Deputy Chief Fire Officer – US Philadelphia Fire Department

WATER
- Long hoseline stretches must be anticipated.
- Sprinkler systems will need to be supplemented.
- There may be standpipe systems that can be utilized.
- Large-diameter hose may be needed in areas of limited water supply.
- Cars in the parking lots may impede the stretching of hose lines.

Construction/Collapse
- Newer suburban malls are built of non-combustible construction. Older malls in downtown (CBD) areas of cities can be fire resistive, ordinary, or non-combustible construction.
- Renovated malls must comply with codes in effect at the time of renovation.

AREA
- Large square meter areas can contain a substantial amount of stock.
- Stores can exceed thousands of square meters with high open ceilings and stock on shelves reaching floor to ceiling.
- Pre plans containing plot plans are critical to ensure that responders arrive at the correct location. Callers may identify the location of the fire by the store name, by the colour of the zone or the store number as identified on a plot plan.

Exposures
- Fire exposures are usually internal and severe. Adjacent stores will need to be checked for fire spread.

Weather
- Normally weather has no appreciable effect, though inclement weather may increase the number of occupants.

Life Hazards – If fire starts
- Life hazards are severe during hours of operation; chaos and panic must be anticipated.
- Thermal imaging cameras can assist in the primary and secondary searches.
- Handicapped individuals may require assistance to evacuate.
- Restaurants (Food Courts) may operate past normal shopping hours.
- People may walk for exercise in the open areas of the mall during hours when the stores are closed.
- Many people unfamiliar with the mall will attempt to exit the same way they entered.
- Large numbers of shoppers can have an impact on fire fighters attempting to evacuate the area.
- Maintenance personnel and security staff should be available in the mall at all hours to assist the fire fighters.
- Hoselines cannot be stretched into the building through areas that people are using for exits; this will impede their evacuation.

Auxiliary Appliances
- Sprinklers, standpipes, detection systems, heating, ventilation and air conditioning (HVAC) systems, and automatic roof vents may be present.
- Stock may be piled up to the sprinkler heads and, in some cases, above them negating their effectiveness.
- Sprinklers may be non-functional in areas where renovations are occurring.
- Consider using HVAC system for ventilation.

Special Matters
- Fire drills are nonexistent.
- Security is normally not helpful with fire protection devices.
- Parking areas may be below or above grade.
- Large sprawling parking areas surrounding suburban malls can contain numerous vehicles attempting to exit, which can be impede the fire departments response.

Location and Extent
- Determining the location of the fire can be difficult and time consuming. The malls can be sprawling. Multiple entry points and occupants will be exiting if a fire exists.
- Use fire alarm panels to determine the location from which alarms are being received.
- Thermal imaging cameras can assist in checking walls, ceilings, and floors for hidden fires.

Height
- Enclosed shopping malls are generally one to four stories.

Occupancy
- Large quantities of stock will feed fires.
- Limited storage space can cause clutter in shopping area.
- Store renovations may be underway with construction materials involved with fire.

Apparatus & Personnel
- Due to the severe life hazard, an adequate number of personnel should be initially dispatched.
- If the sprinkler system functions are designed, the fire should be controlled in the incipient stage; if the system fails, a major fire can ensue.
- Seek the assistance of security personnel and police in evacuation in evacuating the fire area.

Time
- The life hazards are most severe during hours of operation, but the building can be occupied at any hour.

Appendix 6 Strategic Considerations for Fires in Enclosed Malls (Shopping Centres) (J P Smith)

Strategic Goals For an Offensive Attack	Strategic Goals for a defensive attack
• Evacuate and perform search and rescue for occupants. • Call for a sufficient amount of resources. • Hose lines cannot be stretched through doorways being used as exits by occupants. • Confine fire to the store of origin, if possible. This can best be accomplished by simultaneous attack on the fire and an immediate check of adjacent stores. • Hose lines of a certain size may be ineffective use largest possible • Ventilation will be difficult. Roof vents may be present see if they are open. Opening the roof may be possible Try using HVAC system to remove smoke. • Overhaul will be extensive and resource intensive • Salvage can be tremendous. In a multistorey mall, the floor below should be considered.	• If changing from an offensive to a defensive attack, ensure a personnel accountability report • Set up collapse zone • Use master streams • Protect exposures, if necessary
Incident Management System Consideration/Solution for Offensive Attack • Incident Commander • Safety Officer • Rapid intervention team (s) • Operations (If Needed) • Staging • Ventilation Group • Search and Rescue/Evacuation Group • Divisions 1, 2, 3, etc. (For multistorey mall, a division can be implemented for any floor where deemed necessary) • Division B and D (To check the adjacent exposed stores) • Medical group or branch	**Incident Management System Consideration/Solutions for a Defensive Attack** • Incident Commander • Safety Officer • Operations (if needed) • Staging • Logistics (for water supply, if needed) • Divisions on the exterior on sides A, B, C, D • Exposure divisions (if needed)

Appendix 7 Australian Standards AS/NZS 4360:2004

The objective of the Standard is to enable the achievement of:

a. *a more confident and rigorous basis for decision-making and planning*
b. *better identification of opportunities and threats*
c. *gaining value from uncertainty and variability*
d. *a pro-active rather than re-active management*
e. *a more effective allocation and use of resources*
f. *improved incident management and reduction in loss and the cost of risk, including commercial insurance premiums*
g. *improved stakeholder confidence and trust*
h. *improved compliance with relevant legislation*
i. *better corporate governance.*

The Standard is broken down into the following sections:

1. *scope and general including definitions including objectives, definitions, terminology and translations, reference documents*
2. *risk management process review*
3. *risk management process*
4. *establishing effective risk management.*

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