THE EFFECTIVENESS OF FIRE SAFETY TRAINING FOR EMPLOYEES IN COMMERCIAL PREMISES

EXECUTIVE LEADERSHIP

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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ABSTRACT

The problem was that the New South Wales Fire Brigades (NSWFB) was unable to describe the outcomes of the fire safety training it delivered to employees in commercial premises. The purpose of this study was to investigate whether the fire safety training delivered to employees in commercial premises in New South Wales (NSW), Australia by the NSWFB's Commercial Safety Training Services (ComSafe) Section resulted in employees taking effective action in the event of a fire in their workplace. This was an evaluative research project and the research questions were:

1. What do descriptive statistics derived from incident data collected by the NSWFB show in relation to fires in commercial premises in NSW?

2. Which fire safety training courses currently provided by the ComSafe Section to employees in commercial premises in NSW are the most appropriate to evaluate?

3. What do representatives of selected ComSafe customers report in relation to their satisfaction with the fire safety training provided to their employees?

4. What do representatives of selected ComSafe customers report in relation to their employees putting into practice what they had learned during fire safety training?

The procedures involved the statistical analysis of incident data collected by the NSWFB, as well as a survey instrument completed by representatives of commercial premises, whose employees had received selected fire safety training from the ComSafe Section.

The results showed that respondents reported a high level of confidence regarding their employees being able to take effective action in the event of a fire. This was supported by the evidence of a number of fires occurring in workplaces that were successfully extinguished and staff who were safely evacuated.

The major recommendation of this study was for the ComSafe Section to review its course material to ensure that it addresses the specific needs of high-risk occupancies. It was also recommended that statistics in relation to fires in commercial premises be made available to fire department officers to assist the development of effective strategies to address this problem within their jurisdictions.

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INTRODUCTION

Fire departments protecting large urban areas routinely respond to major fires in commercial premises. These operations usually require the deployment of large numbers of apparatus and firefighters, involve significant impact on the surrounding community as well as considerable risk to firefighters, and unfortunately are often unable to prevent extensive damage and loss of property. However, such situations may often be prevented through the actions of appropriately trained employees who are on-scene in the early stages of the fire's development and are able to effectively use portable fire extinguishers or hose reels installed in the building. It is for this reason that many departments, including the New South Wales Fire Brigades (NSWFB), deliver fire safety training to employees in commercial premises on subjects such as fire prevention, workplace evacuation, and first attack firefighting.

Commercial premises may be described as properties used for business purposes, including offices, shops, storage facilities, or factories. Despite the availability of incident statistics relating to fires in these types of premises, many fire department officers have a poor understanding of the problem of fires in commercial premises, and as a result may be unable to implement an effective strategy to address this problem within their jurisdiction. The delivery of fire safety training is likely to be a key element of such a strategy and it is important to ensure that it actually results in employees being able to effectively deal with fires prior to the arrival of the fire department. Further, it is argued that if fire safety training is to meet the needs of at-risk commercial premises it should be integrated into the risk management plans of the company.

The problem is that the NSWFB is unable to describe the outcomes of the fire safety training that it delivers to employees in commercial premises in New South Wales (NSW), Australia. This means that the NSWFB's Commercial Safety Training Services (ComSafe) Section, which currently delivers this training on a fee-for-service basis, does not know whether the training actually results in employees taking effective action in the event of a fire in their workplace.

The purpose of this study is to investigate whether the fire safety training delivered to employees in commercial premises by the NSWFB's ComSafe Section has actually resulted in employees taking effective action in the event of a fire in their workplace. This is an evaluative research project, which will involve the statistical analysis of incident data collected by the NSWFB, as well as a survey instrument completed by representatives of selected ComSafe customers using the Internet. The research questions are:

1. What do descriptive statistics derived from incident data collected by the NSWFB show in relation to fires in commercial premises in NSW?

2. Which fire safety training courses currently provided by the ComSafe Section to employees in commercial premises in NSW are the most appropriate to evaluate?

3. What do representatives of selected ComSafe customers report in relation to their satisfaction with the fire safety training provided to their employees?

4. What do representatives of selected ComSafe customers report in relation to their employees putting into practice what they had learned during fire safety training?

BACKGROUND AND SIGNIFICANCE

The NSWFB is the largest urban fire department in Australia, and its responsibilities include providing fire prevention and suppression services in urban centers throughout the state of NSW. The state's population is more than 6 million, with approximately 4 million people living in the capital city of Sydney. The latest annual departmental statistics available show that, in the year to June 30, 2004, the NSWFB responded to almost 7,500 structure fires, of which almost 900 involved commercial premises (NSWFB, 2004).

While most fire related fatalities and injuries in NSW occur in residential structures (Nicolopoulos, 2002), fires in commercial buildings in NSW result in significant property damage and economic loss to the community. Analysis of incident data collected by the NSWFB during the period July 1, 2003, to June 30, 2004, shows that the average amount of property damage resulting from fires in commercial premises in NSW was estimated to be over $138,000. In addition to this direct cost, Weiner (2001) points out that fires in commercial premises also usually result in significant indirect costs, including lost production, reduced market share, and that even temporary closures of businesses may have significant economic effects for the staff who are unable to work.

The ComSafe Section was first established in 1986 and was known then as the NSWFB's Public Education Section. It delivered fire safety training on a request basis to businesses and industries mostly located in Sydney, with an occasional letter box drop in some industrial areas in an attempt to generate further business. The charges levied for this training were minimal and were intended to only cover the costs associated with delivering the training. The manager of the ComSafe Section reports that in 2000 the focus of the unit changed to generating income for the NSWFB. In addition to changing the name of the unit, additional trainers were recruited, a business plan was developed, and courses were actively marketed to commercial premises across NSW (S. Mathias, personal communication, January 24, 2005).

At the present time, more than 30,000 people participate in ComSafe courses each year, and this provides annual revenue to the NSWFB of over $1.4 million (NSWFB, 2004). The ComSafe Section currently delivers a range of training courses that have been designed to meet the needs of the owners of commercial premises in NSW, with the most popular ones dealing with basic fire prevention in the workplace, practical first attack firefighting, and workplace evacuation. These courses have generally been structured to address the responsibilities of employers in NSW under the Occupational Health and Safety Act (2000), which states that:

> An employer must ensure the health, safety and welfare at work of all the employees of the employer. That duty extends (without limitation) to . . . providing such information, instruction, training and supervision as may be necessary to ensure the employee's health and safety at work.

Despite the apparent acceptance by businesses and industries in NSW that the fire safety training delivered by the ComSafe Section meets their responsibilities under this legislation, there is currently little evidence that the training actually results in safer workplaces.

There is also an intention within the NSWFB to further expand the ComSafe Section in the near future (S. Mathias, personal communication, January 24, 2005). This would mean additional trainers located in regional centers across NSW, with the increased revenue generated being able to be used for other programs across the department. It is argued that the NSWFB should ensure that the training delivered by the ComSafe Section is as effective as possible before any plans to expand this service are implemented. It is possible that some members of the community may perceive that an expanded ComSafe Section is more about raising revenue than improving safety within the community. This perception may be damaging to the NSWFB and therefore needs to be addressed through research such as this study.

This study is important to the NSWFB for two reasons. First, evidence that the training delivered by the ComSafe Section results in employees taking effective action in the event of a fire in their workplace would validate the content and delivery of the courses involved. This would represent key information that could be used to market ComSafe training programs more effectively. However, if no such evidence is found, then it is expected that this study would then provide an impetus for the course designers and trainers within the ComSafe Section to review their fire safety courses to produce better outcomes for their customers.

Second, this study may provide some insight into the number of unreported fires affecting commercial premises in NSW. The number of fires reported in any jurisdiction is usually based on the number of incidents attended by the fire department. This obviously represents an incomplete picture of the real fire problem, since many fires are never reported, either because they are extinguished by the occupants in the incipient stages or possibly because the owner or occupier is embarrassed by their actions in causing the fire. The literature review will present research that suggests the number of unreported fires in commercial premises may be significant. Estimates of the size of this problem would be very useful to the NSWFB in developing an effective strategy to reduce the risks faced by businesses and industries in NSW.

This Applied Research Project (ARP) relates to the importance of decision making, which was a key concept covered in the *Executive Leadership* course at the National Fire Academy (NFA). This part of the course explored a model for decision making that requires the leader to have sufficient information about the problem in order to make a quality choice about the most effective course of action (NFA, 2000). The aim of this ARP is to provide relevant information to executive officers within the NSWFB regarding the effectiveness of the current commercial fire safety training program. It is expected that this information will assist in effective decisions being made regarding any improvements that are needed to the program of courses delivered by the ComSafe Section.

The issue of then being able to effectively influence the implementation of any necessary changes was also addressed within the *Executive Leadership* course. The foundation of this part of the syllabus was the text by Conger (1998), which dealt with the techniques required for effective persuasion in modern organizations. Conger states that building credibility for

ourselves is one of the key elements necessary to influence others to support our position, and that our knowledge of the subject matter and the availability of supporting evidence are important factors in building this credibility. This study is intended to provide such credible evidence regarding the effectiveness of fire safety training in order to assist the persuasion of executive officers within the NSWFB to support any changes that may be necessary in the content and delivery of ComSafe's training courses.

This ARP also relates to the United States Fire Administration's (USFA's) operational objective to "promote within communities a comprehensive, multihazard risk-reduction plan led by the fire service organization" (NFA, 2003, p. II-2). The literature review will show that training the employees of businesses and industries in first attack firefighting and evacuation is currently considered to be a key element of a comprehensive strategy that fire departments can implement for commercial premises within their jurisdiction. This research will investigate whether this assumption is justified by investigating the actions of employees when confronted by a fire in their workplace following participation in a fire safety training course.

LITERATURE REVIEW

The purpose of this literature review is to summarize the findings of other researchers in three areas that are central to the research questions posed in this ARP. First, the importance of fire safety training for employees is discussed within the context of other risk treatment options that may be undertaken for commercial premises. Second, the research literature relating to fires in commercial premises is examined in order to define the significance of this problem for fire departments. Finally, the various approaches used to measure the effectiveness of fire safety training are considered in order to guide the selection of the most appropriate methodology for this study.

Importance of Fire Safety Training for Employees in Commercial Premises

In order to improve the level of fire safety in commercial premises, fire departments may work with the managers of businesses and industries within their jurisdiction to implement a range of initiatives. It has been argued that the most appropriate programs are usually those which address the specific needs of each individual enterprise and which support the risk management plans of the company (Lewis & Dailey, 2000). Training employees to respond effectively to fires and other emergencies is only one of number of activities that may assist in enhancing safety in the workplace and reduce the risks for commercial premises.

As previously mentioned, major fires in commercial premises usually require a significant response of fire department resources and may result in considerable disruption to the community. A relevant example is a fire which occurred at around 9:00 a.m. on March 11, 2005, which destroyed a large furniture factory and showroom in Sydney's inner suburbs. At the height of operations, which were continuous for over three days, there were 37 apparatus and more than 150 firefighters committed to the fire. In addition, approximately 200 residents were evacuated from neighboring homes and a major Sydney road was closed for an extended period (NSWFB,

2005). These consequences may be contrasted with the situation that occurred when an employee was able to effectively use an installed hose reel at another Sydney furniture factory fire on April 12, 2005, to stop the fire spreading to adjoining premises prior to the arrival of the fire department (Gibson, 2005).

An appropriate framework within which to consider the importance of fire safety training for employees of commercial premises is the standard for risk management used in Australia (Standards Australia & Standards New Zealand, 2004). This standard suggests that those risks which cannot be eliminated from the workplace, should be minimized by either reducing the likelihood of their occurrence or reducing the consequences of an event when it occurs. Cronstedt (2002) extends this concept by proposing that the use of prevention, preparedness, response, and recovery (PPRR) may be a useful way to classify risk treatment options for emergency situations, since this framework is very familiar to fire services across Australia. Within this framework, fire safety training for employees would be considered to be a preparedness activity, while putting this training into effect by ensuring all occupants are evacuated safely and the fire is controlled or extinguished before the arrival of the fire department would be classified as a response activity.

When considering the development of a strategy to treat the risks that have been identified for commercial premises, it is important to remember that there is not a "linear and temporal relationship between the elements [of PPRR]" (Salter, 1998, p. 27). This means that the appropriate order of activities to be undertaken is not prevention first, then preparedness, then response, then recovery. It also means that even if prevention activities have been implemented at a particular site, there will still be a need to consider activities from the areas of preparedness, response, and recovery. If a fire occurs within commercial premises, then the prevention activities undertaken have already been unsuccessful and the company's risk management plan must have alternative risk treatment options available.

Lewis and Dailey (2000) also recommended that fire safety training for staff must be viewed within the context of other risk treatment options that should be undertaken for commercial premises. They list activities including identifying fire hazards in the workplace, management procedures, planning for emergencies, as well as staff training as part of the overall risk reduction approach that should be implemented. A practical example of this are the guidelines developed for business and industry in Portland, Oregon (Farland, 1995). These guidelines are designed to assist the owners and occupiers of these premises to develop comprehensive fire response plans, which include understanding their building's fire and life safety features, relevant fire prevention activities, the operation of fire extinguishers, emergency evacuation procedures, and guidelines for conducting effective fire drills.

There is a wide range of views regarding the effectiveness of fire safety training for employees, although there appears to be little empirical evidence to support any one position. Baldwin (2005) reports that a commonly held misconception in the fire protection industry is that occupants should not attempt to extinguish fires, but rather should evacuate immediately and call the fire department. He states that, while casualty data for residential premises show that many occupants are injured attempting to fight fires, this is not the best course of action for occupants in commercial premises. He argues that training reduces the risks associated with first attack

firefighting and that fires, left to develop until the arrival of the fire department, are likely to pose a far greater risk to other occupants within the building.

The importance of fire safety training for employees in commercial premises is demonstrated by a study undertaken by Marsland (1999). This research focused on the human factors associated with evacuations from commercial premises involved in fire. Marsland considered a number of scenarios that would affect the success or otherwise of an evacuation, including the knowledge of occupants regarding the location of safe exits, dealing with people with disabilities, and occupants attempting to re-enter the building. He concluded that inadequate staff training in conducting evacuations could be a major contributor to subsequent fatalities and injuries.

Significance of the Fire Problem in Commercial Premises

As previously stated, the actual size of the fire problem in commercial premises in NSW is not accurately known. The manager of the NSWFB's Strategic Information Unit has previously attempted to access insurance claims data in order to estimate the number of unreported fires in NSW, but was unsuccessful due to the privacy concerns of insurance companies (N. Nicolopoulos, personal communication, February 21, 2005). A literature search was conducted to identify research conducted in this area for other jurisdictions, however the author was only able to identify a small number of relevant studies that infer that the number of unreported fires in commercial premises may be significant.

Bonnett (2002) reported that a survey on the use of fire extinguishers in workplaces conducted in the United Kingdom in 2000 found that for 80 percent of fires a portable fire extinguisher was successfully used to extinguish the fire in its incipient stage. Bonnett also related that in the vast majority of these cases, the fire service was not called to attend and therefore the incident was probably not recorded by the fire department. The original research on which Bonnett was reporting was unable to be sourced, and therefore the procedures used and the actual survey results are not known. For this reason, as well as the fact that these findings relate to the fire problem in another country, means that it is unclear whether they could be applied with any confidence to NSW.

Interestingly, similar results were reported in a comprehensive survey undertaken regarding emergencies affecting residential premises in NSW. The Australian Bureau of Statistics (ABS) (ABS, 2003) undertook a survey of community preparedness for emergencies in NSW, and found that for only approximately 20 percent of house fires did the household require any assistance. Although the survey did not relate to commercial premises, it also found that the overall level of emergency preparedness for households was low. If those results were applied to commercial premises in NSW, then the need for the ComSafe Section to deliver effective fire safety training would have increased importance. However, it must be emphasized that there is no evidence that these findings for residential property have any application to the commercial fire problem in NSW.

There is also some relevant research into the actions of people in fire situations, which deal with specific behaviors, such as reporting fires to the fire department. For example, Dowling (1994) summarizes a number of case studies of human behavior in fire, including a major fire that occurred in a Woolworths department store in Manchester in 1979. Despite the size of the fire, which killed 10 people, and the fact that a large number of staff and customers witnessed the fire, not one call was made from the store to the fire department. In a more comprehensive survey of case studies concerned with human behavior in fire situations, Canter (1985) found that a significant proportion of people will attempt to extinguish the fire, rather than warn others or call the fire department.

Fire safety training may improve this facet of human behavior in fire, as Bennett (2002) found that "people who had received training or instruction on what to do in a fire situation were more likely to raise the alarm or to organize an evacuation as a first reaction" (p. 40). This conclusion has obvious implications for the present study, in that using a sample made up entirely of representatives of premises which had recently received fire safety training from the NSWFB's ComSafe Section, may be unlikely to provide evidence of under-reporting of fires which could then be applied to all commercial premises in NSW. This is based on the fact that the importance of calling the fire department, even for small fires in the workplace, is covered in ComSafe training courses.

Measuring the Effectiveness of Fire Safety Training

Many fire departments often presume that by simply delivering fire safety training to an audience, the intended knowledge will be imparted and the resultant behavior of individuals in the event of fire will be improved (Kiesow, 2004). This view cannot be supported without evaluating the training and "unless one can demonstrate that a program is achieving this goal, it will be hard to convince decision makers in the long run that the program should be supported" (Frush & Hall, 2003, p. 517).

The research literature suggests that there are many different methods of evaluation that may be undertaken in relation to fire safety training. Frush and Hall (2003) argue that these may be classified into four main types: formative evaluation, process evaluation, impact evaluation, and outcome evaluation. They describe formative evaluation as a qualitative process, which is often used during the design stage to ensure that the training is appropriate for the intended audience. Process evaluation measures whether the training is reaching the target audience, for example by counting how many people attend the training. Impact evaluation measures "changes in the target population's knowledge, attitudes, beliefs, or behaviors associated with the program" (Frush & Hall, 2003, p. 518). Finally, outcome evaluation attempts to measure how well the program has achieved its overall goal, for example in reducing the severity of fires affecting the target group.

Oberman (1996) recommends that in order to properly measure the effectiveness of any safety training, the evaluation should incorporate measurement of each of the above types and goes on to discuss typical methods that may be used to collect data in each case. At the first level, he suggests that the student's satisfaction with the training material could be evaluated

through the use of a questionnaire. The next level of evaluation may be conducted by assessing the trainee's understanding of the principles, skills, and techniques covered during the course, for example through a quiz or practical assessment administered immediately following the training session. At the third level, the ability of the student to apply what was learned during the course could be assessed by their supervisor following their return to the workplace. Finally according to Oberman, the fourth level evaluation could involve an assessment of the organization's performance over a longer time frame, for example by identifying trends in insurance claim data.

While many fire departments, including the NSWFB, routinely undertake evaluation at the first two levels in relation to their fire safety training courses, it is important to note that "each successive stage in evaluation adds enormous value to the store of information available to make good educational choices" (Frush & Hall, 2003, p. 520). This view is supported by Machles (2003) who points out that measuring how well the training is applied in the workplace is often difficult because the skills taught may not be able to be used for some time, if at all. Training in areas such as first attack firefighting, workplace evacuation, and first aid would fall into this category. Cheeseman (1997) suggests that asking supervisors to complete a questionnaire regarding the behavior of their staff some time after the training has been completed is an option for evaluating fire safety training at the third level.

A note of caution is raised by Enders (2001) regarding evaluating changed behavior following a person's exposure to emergency related information, for example after attending a fire safety training course. She states that a number of factors may influence whether the person behaves in a way that is consistent with the training. These include the credibility of the source of the information; the clarity of the message and the media used to deliver it; and factors relating to the individual such as age, intelligence, level of active participation, and attitudes. Based on these factors, she offers the following advice regarding the most appropriate type of data collection method to be used in this area. Qualitative methods, such as in-depth interviews, are able to provide "information on **why** people feel or behave the way they do" (Enders, 2003, p. 55), while quantitative methods, such as surveys, allow the researcher "to make inferences about the frequency of certain events or items in the wider population" (Enders, 2003, p. 55). Enders concludes that qualitative and quantitative approaches may be used to complement each other since they provide different kinds of evidence.

In summary, the literature reviewed suggests that fire safety training for employees should be considered as only one possible treatment option for the risks faced by commercial premises. Fire safety training is considered to be a key component of any comprehensive plan by management, since there is evidence that suggests effective staff training in conducting evacuations may prevent fatalities and injuries in the event of fire. In relation to the significance of the fire problem in commercial premises, findings that suggest only approximately 20 percent of fires may be reported to the fire department must be treated with caution and there is no evidence that this figure represents the fire situation for commercial premises in NSW. Analysis of human behaviour in fire situations through case studies, suggest that reporting fires to emergency services is often not the highest priority for occupants, however this may be improved through fire safety training.

Finally, the evaluation of fire safety training by fire departments often ignores the measurement of how the training will be applied by the participants when they return to their workplaces. In this study, an impact evaluation approach will be used to measure whether the employees of commercial premises take effective action in the event of a fire in their workplace after receiving fire safety training from the NSWFB's ComSafe Section. A quantitative method in the form of a questionnaire will be used because the purpose of the research is to identify the frequency of appropriate fire response behavior. Given that it is often difficult to measure the use of practical skills taught during fire safety training, the option to survey a single, supervisory representative of each of ComSafe's customers will be used.

PROCEDURES

The research method used in this study consisted of three parts. The first part involved using data collected by the NSWFB through the Australian Incident Reporting System (AIRS) to develop descriptive statistics for fires in commercial premises in NSW. AIRS is based on the National Fire Incident Reporting System (NFIRS) that is used widely in the United States and, despite some changes since its introduction in Australia, retains most of the data elements currently found in NFIRS. Statistical data was extracted from the AIRS database for all fires involving commercial premises in NSW for a one year period from July 1, 2003, to June 30, 2004. This data included the following items for each incident: type of property use, area of fire origin, major method of extinguishment, and estimated dollar loss.

The second part of the research involved examining documentation produced by the ComSafe Section relating to the content of its courses that are available to businesses and industries in NSW. The manager of the ComSafe Section provided the necessary documents, which included customer brochures, as well as the objectives of each of the courses currently delivered. This information was reviewed using two criteria. First, which courses were likely to have the greatest impact on improving the behavior of employees in the event of a fire in their workplace? Second, could the effectiveness of that training be evaluated using a survey instrument distributed to the representatives of ComSafe's customers?

The third part of the research involved developing a survey instrument to be completed by representatives of ComSafe's customers using the Internet and analyzing the data collected. The questionnaire was developed according to the basic steps suggested by Sarantakos (2001). The first step involved the drafting of the survey questions and the response sets based on the research questions and issues identified in the literature review. Second, these were then scrutinized by a panel of NSWFB personnel made up of Nick Nicolopoulos, manager of the Strategic Information Unit; Selwyn Mathias, manager of the ComSafe Section; and Anne Pickles, the NSWFB's Privacy Coordinator. Third, the questionnaire was revised and then written in hypertext mark-up language and hosted on the NSWFB's Internet web site to test its functionality. Fourth, a pre-test of the questionnaire was conducted on the Internet for a one week period commencing March 21, 2005, using a sample of ten respondents selected at random from the ComSafe customer database. Fifth, based on feedback received through follow-up telephone calls to these respondents, the questionnaire and the design of the web site were modified slightly.

The key contact person for each organization that received the selected ComSafe training during the period July 1, 2003, to June 30, 2004, and their e-mail address was identified by accessing the ComSafe customer database. An e-mail was sent to all persons on the resulting list on April 11, 2005, the text of which is shown in Appendix A. The e-mail contained a link to the on-line questionnaire, with the questions and response sets reproduced in Appendix B. Of the 201 e-mails originally transmitted, 43 were returned as undeliverable. The on-line questionnaire was designed so that the responses submitted by each person were automatically saved to a database enabling them to be later down loaded and analyzed. The number of responses in the database was checked on April 27, 2005, and a reminder e-mail was transmitted to those persons on the customer list who had not responded, in order to improve the response rate to the survey. The questionnaire on the NSWFB's Internet web site remained accessible to respondents until May 5, 2005, when the data was down loaded from the web site for analysis.

Limitations and Assumptions

The analysis of AIRS data for fires in commercial property did not investigate the number of fatalities or injuries that may have occurred. This decision was based on the fact that the numbers of events where persons are killed or injured in fires in commercial premises in NSW are rare, and therefore any statistical analysis was unlikely to be meaningful.

This analysis also did not consider the reported time of day or the day of the week. This is a limitation since only fires that occurred inside the normal operating hours of the premises are likely to have been able to be extinguished by employees. Since many commercial premises now operate outside of what were once considered traditional business hours, and AIRS does not record what those hours were at the time of the fire, it was decided not to attempt any analysis based on these variables.

The Internet survey instrument was distributed to persons identified in the ComSafe customer database as representing their organization in matters of fire safety training. It was assumed that this was the most appropriate person to answer questions regarding the organization's satisfaction with the content and delivery of the training and to provide information on any fires or other emergencies that may have occurred at the premises since the training was completed.

The results of this study are based on fires in commercial premises in NSW. The conclusions drawn from this evaluation cannot be assumed to apply to fires involving other types of premises in NSW or to commercial fires occurring in other jurisdictions, for example where factors such as the building regulations in relation to commercial premises are significantly different. Any attempt to do so must be undertaken with caution.

Definition of Terms

Area of fire origin--the area within a property where the fire originated, defined according to its use at the time of ignition, and which was selected by the reporting officer from a list within the *AIRS Reference Manual* (NSWFB, 1998).

Commercial premises--properties used for the sale of merchandise, transaction of business, manufacture of goods, or storage of materials or products.

Estimated dollar loss-- the reporting officer's estimation of the damage to property and contents caused by the fire and firefighting operations, expressed in whole Australian dollars (NSWFB, 1998).

Major method of extinguishment--the method that had the most significant effect in extinguishing the fire (NSWFB, 1998).

Type of property use--the predominant use of the property involved, selected by the reporting officer from a list within the *AIRS Reference Manual* (NSWFB, 1998).

RESULTS

Research Question 1. What do descriptive statistics derived from incident data collected by the NSWFB show in relation to fires in commercial premises in NSW?

Analysis of the AIRS database showed that 881 incidents were reported to have occurred in commercial premises in NSW from July 1, 2003, to June 30, 2004. The number of fires for each type of property use is presented in Table 1 in Appendix C, with this data organized according to the major categories of property use employed in AIRS. Analysis of the data shows that the largest number of reported fires occurred in offices (13 percent), food or beverage sale premises (11 percent), vehicle storage premises (10 percent), and general item stores (10 percent). Fires in these four types of properties accounted for almost half of the reported fires in commercial premises in NSW.

The average estimated dollar loss associated with fires in each of the major categories of commercial property is presented in Table 2 in Appendix C. This data shows that while fires in shops, stores, or offices occurred more often, on average they resulted in a much lower direct dollar loss ($47,630) compared to the other categories of commercial premises. Fires in basic industry and utility properties accounted for less than 7 percent of all commercial fires, but cost on average $273,370. Fires in manufacturing and storage properties were more frequent than this and were estimated to have cost an average of $157,990 and $95,950 respectively.

The number of fires recorded for each area of fire origin is presented in Table 3 in Appendix C. This data shows that the largest number of commercial fires were reported to have originated in functional areas, such as offices or process manufacturing areas (32 percent); storage areas, including loading docks and vehicle parking areas (26 percent); and service and

equipment areas, such as workshops and paint spraying areas (10 percent). Fires originating in these three types of areas accounted for more than two-thirds of reported fires in commercial premises in NSW.

The major method of extinguishment reported for commercial fires attended by the NSWFB is presented in Table 4 in Appendix C. This data shows that for approximately 60 percent of reported fires in commercial premises, the methods that had the most significant effect in extinguishing the fire were deployed by the fire service, including hose lines or portable fire extinguishers carried on the apparatus. Reported major methods of extinguishment that may have been deployed by non-fire service personnel represented approximately 14 percent of fires. These included the use of manual firefighting aids, such as fire blankets, hose reels and portable fire extinguishers installed in premises, or portable extinguishers installed in neighboring premises. Other major methods of extinguishment were reported for almost 12 percent of incidents, including self-extinguishment or the fire being suppressed by an automatic extinguishing system.

Research Question 2. Which fire safety training courses currently provided by the ComSafe Section to employees in commercial premises in NSW are the most appropriate to evaluate?

Documentation provided by the manager of the ComSafe Section showed that four general courses and eight specialised courses are currently offered to commercial premises in NSW. The general courses cover fire prevention, first attack firefighting, workplace evacuation, and an introduction to hazardous materials spillage control. The specialised courses cover topics such as the use of self-contained breathing apparatus (SCBA), working in confined spaces, and other advanced courses, which are usually designed to meet the needs of the specific organization requesting the training. Following a review of this documentation, including the description, objectives, and practical components of each course, it was determined that the courses *Practical First Attack Firefighting* and *Workplace Evacuation* would be evaluated using a survey instrument distributed to representatives of ComSafe customers whose employees had participated in these courses.

Research Question 3. What do representatives of selected ComSafe customers report in relation to their satisfaction with the fire safety training delivered to their employees?

A total of 49 completed surveys were received using the on-line questionnaire, which represents a response rate of 31 percent. According to statistical tables cited by Sarantakos (2001), this sample size cannot be considered representative of the population of ComSafe customers who had undertaken the selected fire safety training courses. This means that the following results, based on the responses of the respondents to the on-line survey, cannot be applied with any confidence to all ComSafe customers.

A summary of the results in relation to the reported satisfaction with ComSafe training is shown in Appendix D. Of the 49 respondents, 48 indicated that their employees had completed the *First Attack Firefighting* course and 34 indicated that their employees had completed the *Workplace Evacuation* course. The data in Table 1 in Appendix D shows that all respondents reported a high or very high level of satisfaction with the content and the delivery of the first

attack firefighting training provided to their staff by the ComSafe Section. The results in Table 2 in Appendix D show that the respondents reported similar high levels of satisfaction in relation to the evacuation (warden) training received by their staff, although two respondents rated their satisfaction as low or very low.

Research Question 4. What do representatives of selected ComSafe customers report in relation to their employees putting into practice what they had learned during fire safety training?

A summary of the results in relation to employees being able to take effective action in the event of an emergency in their workplace is shown in Appendix E. As with the results in relation to the previous research question, the sample sizes which occurred here also mean that these results cannot be considered to be representative of all ComSafe customers.

The results summarized in Table 1 in Appendix E show that almost all respondents reported a high level of confidence that the training provided by the ComSafe Section adequately prepared their staff to take effective action in the event of a fire or other emergency in their workplace. For the course *First Attack Firefighting*, 92 percent of respondents rated their level of confidence as being high or very high, 4 percent as being low, and a further 4 percent were unable to provide a rating. For the course *Workplace Evacuation*, 79 percent of respondents rated their level of confidence as being high or very high, 6 percent as being low or very low, with 15 percent being unable to provide a rating.

The data in Table 2 in Appendix E shows that, since the training was undertaken, employees in the surveyed organizations who completed the *First Attack Firefighting* course were able to successfully extinguish nine small fires. It was further reported that the fire department was called to attend only five of these incidents. In relation to the surveyed organizations whose employees completed the *Workplace Evacuation* course, it was reported that employees responded to seven emergencies in the workplace and were required to evacuate staff on four of these occasions. It was also reported that the fire department was called to attend five of these incidents.

DISCUSSION

Prior to this study, there had been little analysis by the NSWFB of the problem of fires in commercial premises, despite the availability of statistics relating to these incidents. The results of this study showed that specific types of commercial premises in NSW are at a greater risk of fire, and that the direct costs of fires are not the same for all types of commercial occupancies. These descriptive statistics could be used by the ComSafe Section to effectively target premises where there is the greatest likelihood of fires, such as shops, stores, and offices, through the development of effective marketing materials. The results of the analysis of AIRS data also showed that fires originating in three specific types of areas within commercial premises in NSW account for more than two-thirds of the reported fires in these premises. This finding has implications for the content of the course material delivered by ComSafe, and as suggested by Lewis and Dailey (2000), there may be some benefit in tailoring the training courses to address the specific needs of each type of business.

While the available AIRS data shows that fires in commercial premises usually result in a large amount of direct property damage, it is able to provide little insight into the indirect costs, which are likely to be significant (Weiner, 2001). It is clear that further research needs to be undertaken in this area, and that insurance claims data would be very useful in this regard. As previously stated, there has been a previous unsuccessful attempt to access this information, and the NSWFB should investigate alternative means of estimating the total cost of fires in commercial premises. This data would also be of benefit in undertaking an outcome evaluation in relation to fire safety training in commercial premises (Frush & Hall, 2003). As suggested by Oberman (1996), evaluations at this fourth level may be undertaken by identifying trends in insurance claims data for affected businesses.

Prior to this study, the NSWFB also had little evidence regarding the effectiveness of fire safety training for employees in commercial premises. The evidence that was available was limited to reports, such as recently provided in relation to the different outcomes for fires in two Sydney factories (Gibson, 2005; NSWFB, 2005). Such anecdotal evidence is not comprehensive or systematic, and is unable to provide the necessary information for fire departments to make effective decisions about reducing the risks faced by commercial premises within their jurisdiction. The results of this study support the view that fire safety training is able to influence whether employees are able to take effective action in the event of a fire in their workplaces. However, there are a number of issues in relation to this study, which mean that it is not possible to make definitive conclusions regarding the effectiveness of fire safety training for the employees in commercial premises.

First, the low response rate to the on-line questionnaire means that the sample used in this evaluation is not representative, and cannot be applied with any confidence to all commercial premises where employees have participated in fire safety training. Second, the use of impact evaluation was selected for this study, which means that the application of the training was measured following the return of the employees to the workplace. The approach used was that recommended by Cheeseman (1997), where a key contact person for each business was selected to respond on behalf of each workplace. It is possible that the selected person may not have had the necessary knowledge of employee behavior or incidents in the workplace. Further, the first attack firefighting and evacuation skills taught in selected the fire safety training courses may not have been able to be used for some time following the training, which may limit the value of such an approach (Machles, 2003). Finally, there are likely to be a range of factors, in addition to the course content and delivery, which affect whether the exposure the fire safety training results in changed behavior (Enders, 2001).

The results of this study also suggest that the selected representatives of commercial premises are satisfied with both the content and the delivery of the selected courses offered by the ComSafe Section. In addition, almost all of the respondents reported that they were confident that the training provided by ComSafe adequately prepared their employees to take effective action in the event of a fire or other emergency in the workplace. However, the presumption that their obligations under the Occupational Health and Safety Act (2000) will be satisfied as a result of their staff participating in fire safety training courses may be based on a limited view of the risk treatment options available. Lewis and Dailey (2000) recommended that a comprehensive strategy is required to manage risk in commercial premises, which may include a range of

activities in addition to training staff to respond in the event of a fire, such as identifying hazards in the workplace, fire prevention, understanding the building's installed fire protection, and procedures and planning by management.

Based on the small number of responses to the on-line questionnaire, this study is also not able to provide any quantitative data regarding the number of unreported fires affecting commercial premises in NSW. However, like the study cited by Bonnett (2002) for workplaces in the United Kingdom and the research conducted by the ABS (2003) for households in NSW, the results do indicate that for a proportion of fires extinguished by occupants, the fire department will not be called. There is also evidence such as the findings of Bennett (2002), who found that people who had received fire safety training were more likely to call the fire department in the event of a fire. The fire safety training delivered by the ComSafe Section currently covers the importance of calling the fire department and evacuating nearby people before attempting to extinguish any fire. The importance of this advice is based on relevant case studies of human behavior in fire (Dowling, 1994; Canter, 1985), and the survey results suggest that this issue may not be being adequately addressed during the ComSafe training.

RECOMMENDATIONS

Based on this study, it is recommended that the NSWFB undertake further analysis of the AIRS data in relation to fires in commercial premises. This should be undertaken on an annual basis in order to monitor trends in the number and severity of fires in commercial premises in NSW. The results of these analyses should also be made available to the relevant fire department officers as a guide to the development of effective strategies to address this problem within their jurisdictions.

It is further recommended that the ComSafe Section update its marketing material to better promote fire safety training to those types of commercial premises identified in this study as being at a greater risk of fire. Further, the ComSafe Section should review the content of its fire safety courses to ensure that the courses address the needs of the specific types of occupancies where fires occur more frequently or which result in significantly higher losses.

Given the problems encountered in this study with the size of the research sample, it is recommended that the ComSafe Section undertake to resurvey its customers during 2006. It is proposed that a different survey technique be used to provide a more representative number of responses than was able to be achieved using the on-line questionnaire in this study.

Finally, further research is also required into estimating the indirect costs that result from fires in commercial premises in NSW. A proposed method is for the NSWFB to routinely contact the owners and occupiers of those premises that have received ComSafe training and who have also reported a fire. This information should then also be used to conduct an outcome evaluation of the fire safety training provided by ComSafe.

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Appendix A
E-mail to Representatives of Selected ComSafe Customers

Dear recipient

The NSW Fire Brigades is undertaking a research project investigating the effectiveness of the fire safety training that it delivers to businesses and industries through its ComSafe Training Services.

The objective of the survey is to learn more about whether your staff, who have participated in previous ComSafe fire safety training, are better prepared to take effective action in the event of a fire or other emergency at your workplace.

The results of this research will be used to improve the design of fire safety training delivered by ComSafe Training Services and is also expected to contribute to the body of knowledge associated with fire safety training and its effectiveness.

The survey is designed to be completed by you, on behalf of your organization. The questionnaire can be completed on-line by simply clicking on the following link: Fire Safety Training Survey. The survey is designed to take less than five minutes to complete and your responses will be anonymous and confidential.

Thank you in advance for taking the time to participate in this survey. If you have any questions about the survey, please do not hesitate to contact Mark Brown on 02 9318 4314 or by e-mail at mark.brown@fire.nsw.gov.au.

Appendix B
Survey for Representatives of Selected ComSafe Customers

Questionnaire instructions

To complete this survey all questions need to be answered and only one response can be selected for each question. Please select the most appropriate response by clicking on the answer that most closely corresponds to your view.

When you have finished the questionnaire, click on the submit button and your responses will be saved.

What type of fire safety training did ComSafe Training Services provide to your staff?

- First attack firefighting training
- Evacuation (warden) training
- First attack firefighting and evacuation (warden) training

First attack firefighting training

How would you rate your satisfaction with the *content* of the first attack firefighting training course provided to your staff by ComSafe Training Services?

- Very high
- High
- Low
- Very low
- Don't know or not applicable

How would you rate your satisfaction with the *delivery* of the first attack firefighting training provided to your staff by ComSafe Training Services?

- Very high
- High
- Low
- Very low
- Don't know or not applicable

How would you rate your confidence that the first attack firefighting training adequately prepared your staff to successfully attack a small fire in your workplace?

- Very high
- High
- Low
- Very low
- Not known or not applicable

Since participating in fire safety training, has there been any small fire(s) at your workplace?

- Yes
- No

If Yes

Were your staff able to successfully extinguish these fire(s)?

- Yes
- No

Was the Fire Brigade also called to attend?

- Yes
- No

Evacuation (warden) training

How would you rate your satisfaction with the *content* of the evacuation/fire warden training course provided to your staff by ComSafe Training Services?

- Very high
- High
- Low
- Very low
- Don't know or not applicable

How would you rate your satisfaction with the *delivery* of the evacuation/fire warden training provided to your staff by ComSafe Training Services?

- Very high
- High
- Low
- Very low
- Don't know or not applicable

How would you rate your confidence that the evacuation/fire warden training adequately prepared your fire wardens to safely evacuate staff during an emergency at your workplace?

- Very high
- High
- Low
- Very low
- Don't know or not applicable

Have you conducted an emergency evacuation exercise on your premises involving fire wardens and other staff this year?

- Yes
- No

Since participating in fire safety training, has there been an emergency at your workplace?

- Yes
- No

If Yes

Did your fire wardens need to evacuate staff?

- Yes
- No

Was the Fire Brigade also called to attend?

- Yes
- No

OPTIONAL

The NSW Fire Brigades may use this information to contact you to get more information about your responses to the questionnaire.

What is your name?

What is the name of your business or organization?

Telephone contact number during business hours?

Thank you again for taking the time to participate in this survey.

SUBMIT

Appendix C
Descriptive Statistics for Fires in Commercial Premises

Table C1
Reported Fires in Commercial Premises from July 1, 2003, to June 30, 2004, According to Property Use (n = 881)

Major property use category	Type of property use	Reported fires
Basic industry and utility property	Agricultural property	20
	Other basic manufacturing	11
	Communications facilities	8
	Glass manufacturing	7
	Energy production	6
	Energy distribution	5
	Laboratories	1
	Mining property	1
	Total	59
Storage property	Vehicle storage	91
	Other storage property	46
	General item storage	34
	Agricultural products storage	13
	Paper or fibre product storage	8
	Textile storage	7
	Processed food storage	4
	Total	203

Major property use category	Type of property use	Reported fires
Shops, stores, and office property	Office	110
	Food or beverage sales	99
	General item stores	87
	Specialty stores	42
	Motor vehicle or boat sales	36
	Other commercial properties	19
	Professional services	16
	Household goods sales	15
	Clothing or textile sales	8
	Recreation or hobby sales	7
	Total	439
Manufacturing property	Wood, furniture, paper, or printing	48
	Metal or electrical products	44
	Food manufacturing	39
	Other manufacturing	18
	Chemicals, plastics, or petroleum	15
	Vehicle assembly or manufacturing	9
	Textile manufacturing	4
	Beverage manufacturing	2
	Rubber products	1
	Total	180

Table C2
Estimated Dollar Loss Associated with Fires in Each Major Category of Commercial Premises from July 1, 2003, to June 30, 2004 (n = 881)

Major category	Number of reported fires	Average dollar loss
Shops, stores, and office property	439	$47,630
Storage property	203	$95,950
Manufacturing property	180	$157,990
Basic industry and utility property	59	$273,370

Table C3
Reported Fires in Commercial Premises from July 1, 2003, to June 30, 2004, According to Area of Fire Origin (n = 881)

Area of fire origin	Examples	Reported fires
Functional area	Offices, process manufacturing areas	279
Storage area	Loading docks, vehicle storage areas	226
Service, equipment areas	Workshops, paint spraying areas	90
Undetermined or not reported		75
Structural areas	Concealed roof or floor spaces	68
Assembly, sales area	Showrooms, display areas	57
Service facilities	Ducts	46
Other location	Areas outside or being renovated	30
Transportation, vehicle areas	Engine compartment	10

Table C4
Reported Major Method of Extinguishment for Fires in Commercial Premises from July 1, 2003, to June 30, 2004 (n = 813)

Major method of extinguishment	Reported fires
Hose line(s) deployed from fire apparatus tank	405
Self extinguished	73
Manual firefighting aid(s), for example fire blankets	64
Unknown portable fire extinguisher	50
Hose line(s) deployed from pump	49
Portable fire extinguisher(s) installed in premises	46
Hose line(s) deployed directly from hydrant	45
Portable fire extinguisher(s) carried on fire apparatus	32
Automatic extinguishing system(s)	29
Portable fire extinguisher(s) installed in neighboring premises	18
Monitor deployed by the fire service	2

Appendix D
Summary of Responses for Satisfaction with ComSafe Training

Table D1
Survey Responses in Relation to the First Attack Firefighting Training Delivered by ComSafe (n = 48)

Rating	Responses
Satisfaction with the content of the training	
Very high	21
High	27
Low	0
Very Low	0
Don't know or not applicable	0
Satisfaction with the delivery of the training	
Very high	19
High	27
Low	0
Very Low	0
Don't know or not applicable	2

Table D2
Survey Responses in Relation to the Evacuation (Warden) Training Delivered by ComSafe (n = 34)

Rating	Responses
Satisfaction with the content of the training	
Very high	9
High	20
Low	2
Very Low	1
Don't know or not applicable	2
Satisfaction with the delivery of the training	
Very high	9
High	21
Low	0
Very Low	1
Don't know or not applicable	3

Appendix E
Summary of Responses for Effective Action by Employees

Table E1
Reported Confidence that ComSafe Training Adequately Prepared Employees to Take Effective Action in the Workplace

Rating	Responses
Able to successfully attack a small fire (n = 48)	
Very high	13
High	31
Low	2
Very Low	0
Don't know or not applicable	2
Able to safely evacuate staff during an emergency (n = 34)	
Very high	6
High	21
Low	1
Very Low	1
Don't know or not applicable	5

Table E2
Reported Actions by Employees to Fires or Other Emergencies in the Workplace Following ComSafe Training

Type of action	Responses
First attack firefighting training received by employees (n = 48)	
Small fire in workplace	9
Staff able to extinguish successfully	9
Fire Brigade also called to attend	5
Evacuation (warden) training received by employees (n = 34)	
Emergency evacuation exercise conducted this year	16
Emergency in workplace since training	7
Fire wardens needed to evacuate staff	4
Fire Brigade also called to attend	5