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# **Public Street Surveillance: A psychometric study on the perceived social risk.**

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Thesis submitted for:

**Masters Degree in Science (Security)**

Principal Supervisor: Associate Professor Clifton Smith

Submission Date: 12<sup>th</sup> May 2003

## Abstract

Public street surveillance, a domain of Closed Circuit Television (CCTV), has grown enormously and is becoming common place with increasing utilization in society as an all-purpose security tool. Previous authors (Ditton, 1999; Davies, 1998; Horne, 1998; Tomkins, 1998) have raised concern over social, civil and privacy issues, but there has been limited research to quantify these concerns. There are a number of core aspects that could relocate the risk perception and therefore, social support of public street surveillance.

This study utilized the psychometric paradigm to quantitatively measure the social risk perception of public street surveillance. The psychometric paradigm is a method that presents risk perception in a two factor representation, being *dread risk* and *familiarity to risk*. Four additional control activities and technologies were tested, being radioactive waste, drinking water chlorination, coal mining disease and home swimming pools. Analysis included spatial representation, and multidimensional scaling (MDS) Euclidean and INDSCAL methods. The study utilized a seven point Likert scale, pre and post methodology, and had a target population of N=2106, with a sample of N=135 ( $\alpha=0.7$ ).

The investigation presented the social risk perception of public street surveillance as *low dread* and *familiar risk*. MDS *underlying* dimensions presented public street surveillance as a *low sense of risk perception* and a *low perceived community exposure to risk*. Females presented a lower social risk perception than males, a *unique* outcome in psychometric risk perception. This appeared to indicate that females felt safer when public street surveillance was present. The factors of age or distance had no significant

affect to the sense of public street surveillance risk perception. The study also demonstrated that although public street surveillance may be an *intellectual risk*, as opposed to a *physical risk*, the psychometric model could successfully measure both *types* of risk. The study demonstrated that public street surveillance was an acceptable social risk, a perceived benefit that outweighed its social risk.

But it appeared that the community had and maintained a social concern over the ability to ensure appropriate public street surveillance control. The risk characteristic of *control* located public street surveillance towards a significantly *higher dread*, although still a *familiar risk*. It was found that increased exposure to public street surveillance did not change the overall sense of social risk perception. Although, increases in the risk characteristics of *control* and *involuntary exposure* were demonstrated, and MDS INDSCAL gender relocated from a *familiar risk* to an *unfamiliar risk*. Finally, *familiarity to risk* provided a consistently neutral response in both study phases, indicating that there may have been little social thought given to public street surveillance.

Public street surveillance occupied a relatively safe and non-adversary social position, accepted and supported by the community. But as demonstrated within the study, there were risk characteristics that indicated that there were *underlying* social concerns over public street surveillance. With little social thought given to public street surveillance and being prone to increased social awareness, these issues could be a driving force to relocate the social risk perception of public street surveillance. The study findings indicated that public street surveillance may not have yet found its true social risk perception measure and that social support was not necessarily defined or robust.

## Declaration

*I certify that this thesis does not, to the best of my knowledge and belief:*

- (i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institute of higher education;*
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or*
- (iii) contain any defamatory material.*

Signed: .....

David Jonathan Brooks

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- G. Brooks, D.J. (2001). Closed Circuit Television: Legal considerations for the security industry regarding digital processed video images. In H.Armstrong (Ed). Proceeding of the 5<sup>th</sup> Australian Security Research Symposium. (pp. 29-42). Edith Cowan University, Perth.
- H. Brooks, D.J. (2001). Is Closed Circuit Television socially acceptable? A proposition for a psychometric study. In H.Armstrong (Ed). Proceeding of the 5<sup>th</sup> Australian Security Research Symposium. (pp. 43-54). Edith Cowan University, Perth.



# Chapter 1

## *Introduction*

There was of course no way of knowing whether you were being watched at any given moment...You had to live ... did live, from habit that became instinct ... in the assumption that ... except in darkness, every movement [*is*] scrutinised. (Orwell, 1954, p.6).

### **1.1 Introduction**

Orwell wrote *Nineteen Eighty Four* long before public street surveillance became relatively common place within society, but is Orwell's novel relevant in today's society? With current infrared camera technology, even darkness cannot provide protection from surveillance. Public street surveillance has grown enormously, and is becoming common place and increasingly popular within society (Privacy International, 2002; Banisar & Davies, 2000; Maley, 2000; Norris & Armstrong, 1999; Short & Ditton, 1998).

This chapter presents the background, significance and purpose of the study. Public street surveillance risk perception issues are discussed, including the professionalism of the security industry, type and extent of media coverage, the social risk perception of public street surveillance, public awareness, privacy and civil concerns, legislation and changing technology. The research outcomes, research questions and an overview of the method of study are given. This chapter concludes with the closed circuit television (CCTV) domains and the study's definition of terms.

### **1.2 Background of Study**

Public street surveillance is often portrayed as the all purpose security tool that will greatly enhance the level of protection of personnel and asset against risk. The security industry prompts the high performance of public street surveillance, with a typical example being "CCTV continues to be the buzz word around the country, most councils

look to the Brisbane experience for arguments to convince ratepayers of the importance of the gadgetry.” (Adam, 1998, p.30). The media does not report negative or ineffective system findings, instead only practitioner led claims of success (Norris & Armstrong, 1999, p.205). It can be argued that the majority of CCTV media coverage is of a positive nature, with little or virtually no adverse media coverage. This frequent positive media coverage increases the introduction of public street surveillance into society (Brooks & Smith, 2002).

Research has shown that public street surveillance provides a decrease in levels of crime (Adam, 1998; Horne, 1998), but research has also shown that this may only be for a short period of time and only in certain crime categories (Norris & Armstrong, 1999; Painter & Tilley, 1999; Ditton, 1999; Short & Ditton, 1998; Waters, 1996; Brown, 1995; Tilley, 1993). Society views public street surveillance as a social benefit, which outweighs the perceived social risk. But it can be argued that society does not fully understand public street surveillance capability, as the layperson has only a limited awareness and exposure of public street surveillance, reinforced through the media. This may leave public street surveillance prone to sudden risk perception change, towards possible adverse social risk perception. Therefore, it is important that there is a method to measure social risk perception and hence, social acceptance of public street surveillance.

### ***1.2.1 Risk Perception Issues***

What issues could change the risk perception of society towards public street surveillance? It can be argued that it will not be a single incident nor will it be immediate, but that changes will be slight and extend over a period of time. Issues that could change the risk perception of public street surveillance include the:

- Professionalism of the security industry, as a concern raised by Tate (1997) and the way in which the industry manages, operates and promotes public street surveillance;
- Type and extent of media coverage of public street surveillance;

- Perceived and applied effectiveness of legislation to control public street surveillance;
- Level of understanding individuals, groups and communities have of public street surveillance;
- Level of protection public street surveillance actually provides or is perceived to provide;
- Level of actually or perceived social control of public street surveillance; and
- Community concern over civil and privacy issues.

Social perception change will come about due to a combination of complex and interwoven issues. A number of possible key relocation issues are addressed (Figure 1.1).

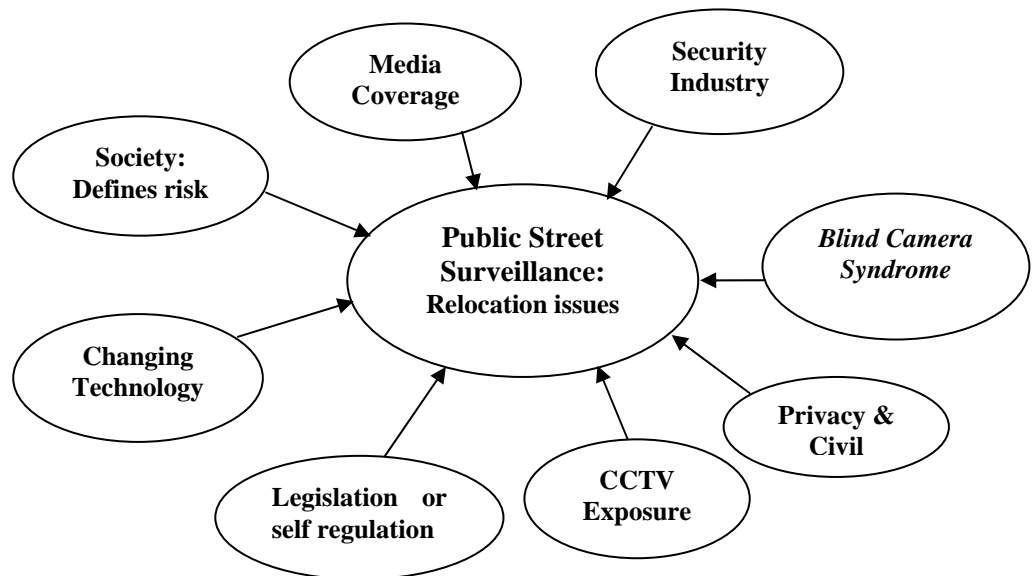


Figure 1.1. Key public street surveillance relocation issues.

Does the security industry lack the professionalism necessary to ensure that it can respond to society’s ever changing perception of public street surveillance risk? There has for a number of years been a concern regarding the lack of professionalism of security practitioners. Hess and Wroblewski stated that “knowledge and skills beyond

those associated with security are clearly needed” (1996, p.694) and this was also confirmed by Blades, when he stated that “One of security’s downfalls has been its lack of application of relevant theory.” (n.d, p.3.15).

It can be argued that this general lack of professionalism may be due to the fact that the “security industry is a still an emerging industry” (Tate, 1997, p.9). Higgins goes further, when he stated that “the security industry has a notoriously poor reputation for the quality of its personnel” (1990, p.75). Also, consumers generally have a poor understanding of their own security requirements and are acting from a reactive stance when procuring security services. The Hallcrest Report stated that “consumers appear to be generally uninformed ... prior to a system being ‘recommended’ to them by the alarm company” (Cunningham & Taylor, 1985, p.252). There is a requirement to take a social view of public street surveillance, but it can be argued that the industry does not have the necessary level of professionalism to achieve this.

But the expansion of public street surveillance has been unprecedented (Privacy International, 2002; Norris & Armstrong, 1999; Banisar & Davies, 2000; Short & Ditton, 1998) and will continue to increase. This was demonstrated by Harowitz, when she stated that “Expenditure for CCTV equipment have tripled during the 1990’s and are expected to increase 13% per year over the coming years.” (2000, p.43). This expansion will increase public exposure and media attention, resulting in the public becoming far more educated about public street surveillance and particularly CCTV. The media also focuses on special interest groups and dramatizes issues, which will further highlight failures. As Covello, Sandman and Slovic stated, “The media are prime transmitters of information on risks. ... are generally more interested in politics than in risk; more interested in simplicity than complexity; and more interested in danger than safety.” (1989, p.303).

Does the public really understand public street surveillance? It can be argued that at the present moment they do not. Waters stated that the “chilling effect of surveillance is

difficult to quantify, but is clearly recognised by the public.” (1996, p.1). It can be argued that the reverse is true, as the limited research on the subject has found that people feel safer within the coverage of a public street surveillance system (Ditton, 1999). Also, if public street surveillance is so chilling, why does society continually accept public street surveillance into their environment?

The general perception of public street surveillance is that the public support these systems, that it improves safety and is a social concern only among the minority. But this social acceptance appears to be reducing and is not robust (Painter & Tilley, 1999). In Dundee (UK), after public street surveillance was installed in the city centre, a survey found that 96% of those surveyed thought that public street surveillance would not infringe on civil liberties (Horne, 1998, p.321). Research by Ditton found that “67% ... did not mind being observed by street cameras.” (1999, p.1). But a recent telephone survey found that only 63% of adults favoured expanded public street surveillance (France, Green, Kerstetter, Black, Salkever & Carney, 2001). Norris and Armstrong (1999) has raised concern over these high levels of public street surveillance support, demonstrating that the question context can reduce this level of measured public support. But it does appear that the community supports public street surveillance and considers it a social benefit, which outweigh the risk and therefore, acceptability.

It can be argued that with increasing exposure to public street surveillance and a growing public awareness, this view may alter. Slovic, Fischhoff and Lichtenstein reinforced this, when they stated that the “frequent discovery of new hazards and the widespread publicity they receive is causing more and more individuals to see themselves as the victims, rather than the beneficiaries, of technology.” (1986, p.3). As Thompson discussed, “an individuals perception of ... risk can change. So can the level of risk that they are prepared to accept. These changes, which can be large, sudden and widely spread within a population” (1982, p.62). A number of authors have raised concern over the social affect of surveillance (Ditton, 1999; Davies, 1998; Tomkins,

1998; Waters, 1996). Society defines its own level of risk, not the expert or industry (Slovic, 1992).

Legislation provides little social protection against public street surveillance. Relevant Western Australian legislation includes the Privacy Act 1988, Security & Related Activities (Control) Act 1996, Evidence Act 1995 and the Surveillance Devices Act 1998. There was a belief that public street surveillance privacy issues are covered by the Privacy Act 1988 (Privacy Commission Tenth Annual Report, 1998). This is not so, as the Act only provides protection when Commonwealth government agencies are “collecting, storing, using and disclosing personal information.” (Privacy Commission, 1999). The Australian Privacy Commission Tenth Annual Report stated that “Optical Surveillance” rated 6.9% of enquires outside their jurisdiction. (Privacy Commission, 1998, p.45).

It can be argued that legislation generally lags behind social concerns and that society perceives legislation as lacking in its ability to provide sufficient protection. As Slovic, et al., stated, the “gap between perceived and desired risk levels suggest that people are not satisfied with the way the market and other regulatory mechanisms have balanced risks and benefits.” (1986, p.5). The Select Committee on Science and Technology summarised that “case law is too slow a process to generate the required degree of legal confidence in time to keep pace with developments in digital imaging technology.” (Home Office, 1998, Section 5.8). This leaves legislation lagging behind technology and applied public street surveillance technology.

*Blind camera syndrome* is another concern, as public perception of safety may be reinforced by the belief that there is a trained operator behind every street camera, ready to react to a situation they view in their control room. But this may not be the case as public street surveillance systems are generally large, utilizing multiple cameras and few operators. A public street surveillance camera is selected via a switcher to the monitor, either by the operator or automatically by the sequential switcher function.

Sequential switching selects one camera in sequence for a predetermined dwell period. The selected camera is then displayed on the monitor. This could result in a camera not being watched by the operator, or being *blind* for a large majority of the time. This can be defined as *blind camera syndrome*. Public street surveillance systems then become post incident investigative tools, not meeting their design intent as a proactive technology installed to improve safety on the streets.

Changing technology can alter social perception through a seemingly sudden and wide introduction of a new technology. This may be as a system multiplier, where a number of discrete technologies assimilate to increase capability. Crime methods change to overcome crime prevention technology. "CCTV ...potentially fit[s] into processes of innovation and adaptation, which can affect both the efficacy and social significance of measure." (Painter & Tilley, 1999, p.8). Technological expansion will increase awareness and therefore, social concern of public street surveillance. Algorithmic surveillance may be one example of a technology that could cause this sudden increase in social *dread risk*. Cameras may link into a digital biometric system, which will have capability to data match individuals. This may result in these system having "implication for civil liberties and possible discriminatory or exclusionary use." (Painter & Tilley, 1999, p.8).

There is currently limited legal consideration from the industry when utilising recorded digital images in public street surveillance systems. In the UK, the "courts have demonstrated an uncharacteristic willingness to accept visual recordings as evidence in criminal proceedings" (Murphy, 1999, p.401). Currently digital video images are admissible evidence in a court of law, but will this remain so? As Ainsworth stated "can video evidence be compromised ... or more importantly, can alluding to this possibility raise the issue of reasonable doubt." (1997, p.101). Rieger and Rode further reinforced this issue when they stated that "it is likely that the susceptibility of digital images to manipulation will lead to increasing doubt with respect to the authenticity of ... images in the era of digital data processing." (1999, p.262).

For public street surveillance digital video images to remain admissible requires transparency of process and a holistic approach in the management, application and use of public street surveillance systems (Brooks, 2001). The Select Committee on Science and Technology summarised that there was no problem with digital images for the courts, but raised concern over public awareness, that Government should encourage the use of authentication techniques, that technological measures are adopted to authenticate images, that procedural measures are applied, that there are no breaks in the audit trail, that the Government produces guidance on the use of data matching and “in particular the linking of surveillance systems with other databases.” (1998, Chapter 5.14). With society increasing their understanding of digital images, this raises social concerns regarding the integrity of digital video images (Grundberg, cited in Mitchell, 1994).

### ***1.3 Significance of Study***

Due to the increasing expansion of CCTV into society, it is important that there is an understanding of the social risk perception of public street surveillance. There is also an increasing reliance of this technology to provide the security solution. It can be argued that public street surveillance maintains a positive level of social risk perception, which outweigh the social risk to most of society. But this may leave public street surveillance prone to sudden negative social shift and therefore, an adverse social risk perception. It is important that there is a theoretical model and measure of the social risk perception of public street surveillance.

There has not been any known attempt to develop and implement a theoretical quantitative measure of the social risk perception of public street surveillance. Social concerns have been raised by a number of authors (Ditton, 1999; Davies, 1998; Tomkins, 1998; Waters, 1996) and demonstrated by others (Horne, 1998; Brown, 1995). But none of these authors have proposed a method, or even alluded to, the need to measure this social concern. There has also been a recommendation that the UK



Government commissions an independent study into the cost and effectiveness of public funded street surveillance systems. (Select Committee on Science & Technology, 1998, Chapter 5.11). This recommendation has been implemented, with preliminary national evaluation on the implementation of CCTV being published (Brandon, 2003).

There are numerous social issues that may change the risk perception of society towards public street surveillance, and these are complex and inter-woven. Social change may come about due to a combination of these issues, including media coverage, professionalism of the industry, *blind camera syndrome*, ever increasing exposure of CCTV to society, legislation, changing technology and how the security industry manages, operates and promotes public street surveillance. It would be difficult to assess how each item may have an overall social affect. But it can be argued that it will not be a single incident or immediate, but that change will be slight and extended over a period of time.

Therefore, this study impacted on knowledge by providing a:

- Theoretical model to measure the social risk perception of public street surveillance. No previous known attempts had been made, or methods suggested, but authors have raised social concerns of public street surveillance;
- Measured social risk perception of public street surveillance. This provided an ability to measure the social effectiveness against the social risk perception of public street surveillance, beyond just technological capabilities;
- Demonstration of whether public street surveillance was a sociably acceptable risk;
- Demonstration of whether public street surveillance significantly affected certain demographic groups; and
- Through longitudinal psychometric studies of public street surveillance, a comparison from this study could be made. This will provide the ability to measure social risk perception shift over a period of time. Without this ability, social impact may lead to a reduced effectiveness of CCTV technology.

#### ***1.4 Purpose of Study***

The purpose of this study was to assess the social risk perception of public street surveillance, within the context of the psychometric paradigm. This was achieved by measuring the social risk perception of public street surveillance, and after increased exposure to public street surveillance and a defined time period, measuring any change in social risk perception.

The outcome of this study, in the context of the target population, was to demonstrate:

- A theoretical model to measure the social risk perception of public street surveillance;
- The social risk perception of public street surveillance;
- Whether public street surveillance was a sociably acceptable risk within the community; and
- Whether public street surveillance significantly affected risk perception of certain demographic groups.

Due to their complex and interwoven nature, this study did not attempt to address what issues increased social risk perceptions or how these may be reduced, relocated or eliminated.

#### ***1.5 Research Question***

The research questions were developed, to ascertain the extent at which society perceives the risk of public street surveillance. The research questions addressed by this study were:

- What was the factor loading of public street surveillance, within the psychometric paradigm spatial factor representation?
- Was public street surveillance a sociably acceptable risk?
- Did public street surveillance significantly affect the risk perception of certain demographic groups?

- Did increasing lay community exposure to public street surveillance alter their social risk perception towards public street surveillance, within the context of the psychometric paradigm?

The study proposed that public street surveillance was located within the psychometric spatial factor representation quadrant of *low dread risk* and *unfamiliarity to risk*. This defined public street surveillance as controllable, low risk to future generations and that exposure was voluntary. But that public street surveillance had an unknown capability, that the risk was not observable, that the risk was new and delayed. This demonstrated public street surveillance as a low threat to society and socially acceptable. But when public street surveillance exposure was increased, the risk perception of public street surveillance would shift to the psychometric quadrant of *high dread risk* and *familiar risk*. This would increase the perceived threat to society, making public street surveillance less sociably acceptable.

### ***1.6 Overview of the Methods of Study***

The investigation used a number of methods to achieve the study outcomes. A number of draft and pilot studies were completed to develop the research instrument, with the investigation using a pre and post study methodology. The theoretical framework included the use of the psychometric paradigm, which presented the data in a spatial factor representation. Further data analysis used multidimensional scaling (MDS) techniques to elicit further underlying perceptions.

The theoretical framework used to assess the level of risk perception was the psychometric paradigm. The psychometric paradigm is a method that attempts to assess and understand risk perception, and therefore risk acceptance to activities and technologies. This presented data results in a two factor analytical representation, with the factor one axis being defined as *dread risk* and factor two axis being defined as *familiar risk*. *Dread risk* was a dominating risk factor and can be made of various independent research characteristics. These characteristics being controllability of risk,

risk to future generations and whether exposure to the risk was voluntary. These characteristics were found to be highly correlated (Slovic, 1992, p.121). The other factor was *familiarity to risk*, again made up of various characteristics, being how observable was the risk, whether the risk was known to those exposed, age of risk and immediacy of risk.

The measure of each factor defined the perceived level of risk towards certain activities or technologies. A high sense of *unfamiliarity to risk* and *dread risk* may lead to an increase in the perception of risk. Whereas *familiarity to risk* and a low sense of *dread risk*, may lead to a reduced perception of risk. As the two factors alter within the community, so will the level of perceived risk for certain activities or technologies felt within that community. This investigation used the term *risk perception*, cognisant that it took the social psychology definition and included attitudes, beliefs and judgements.

MDS is a statistical technique within the area of multivariate data analysis. MDS reduces complex dimensional data and presents these data in a spatial representation. The reduction in data complexity, through presentation in dimensional space, allows hidden structure to be shown in data. This demonstrates object proximity, with *proximity* being how similar or dissimilar objects are or are perceived to be (Kruskal & Wish. 1978).

MDS commences with a set of objects, being the activities and technologies. The objects are paired and dissimilarities measured. The distances between pairs of objects are placed within a half matrix format. A configuration of points is sought in dimensional space, with each point representing an object. The aim of MDS is to find a dimensional space configuration where the points distance *match* as close as possible, the paired dissimilarities. The different notions of *matching* defines the different techniques of MDS (Cox & Cox, 2000). MDS was used within the study as an additional statistical procedure to elicit further *underlying* group and individual risk perceptions from the research data. As Wilford stated, there has been a “lack of study

on individual perceptions.” (2002, p.1). Primary MDS models used were the Classical Euclidean Distance and Individual Differences (Weighted) Scaling (INDSCAL) models.

Classical scaling treats dissimilarities as Euclidean distances. Young and Householder, in the 1930s, demonstrated that a matrix of distances between points in Euclidean space can be preserved from point coordinates (cited in Cox & Cox, 2000). This was further developed and made popular by Torgerson (1952). While the INDSCAL model, developed by Carrol and Chang (1970), converts dissimilar data into distance estimates. Weightings are found by least squares and individual distances are doubled centred to produce matrices. Recurring least square is then applied, until convergence is achieved (Cox & Cox, 2000).

The investigation developed a seven point Likert risk perception survey questionnaire, containing 60 questions. Three additional questions included the participants gender, age group and distance to the centre of the geographical research nucleus. The survey questionnaire contained the five activities and technologies of public street surveillance, radioactive waste, home swimming pools, drinking water chlorination and coal mining disease. The additional four *control* activities and technologies not only provide spatial relationship comparisons of where public street surveillance was located, but also allowed a comparison of previous psychometric studies (Bouyer, Bagdassarian, Chaabanne and Mullet, 2001; Slovic, 1997). They were chosen, as according to Slovic (1997), they represent one object from each quadrant of the spatial factor representation model.

The study target population (N=2106) were community members who lived and/or worked within 0.5km distance of Rockingham beachfront, within the City of Rockingham, Western Australia, and were  $\geq 16$  years old at the time of survey. The sample participants (N=169) were random volunteers selected from the target population. At the geographical nucleus of the target population, the shire proposed the

installation of a public street surveillance system. The pre study was completed before this system was installed, with the post study completed approximately seven months after the system had been installed.

Between the pre and post study phases, no additional crime prevention methods or environmental improvements were made within the study area. This improved the ability to isolate the social affect of the public street surveillance system. The data analysis resulted in a number of significant interpretations. These interpretations included the measured risk perception of public street surveillance, that public street surveillance was a socially acceptable risk, that females feel safer with public street surveillance, dominant risk perception characteristics, the changing social risk perception of public street surveillance and why only limited change was demonstrated.

The investigation showed that the social risk perception of public street surveillance was *low dread risk* and *familiarity to risk*. MDS supported this analysis, but provided additional *underlying* dimensions and presented public street surveillance with its *own* unique characteristics. Public street surveillance had a low sense of *community risk perception* and a low *perceived community exposure to risk*. Females presented a lower social risk perception than males, a unique outcome in risk perception. This appeared to indicate that females feel safer when public street surveillance was present. Age or distance had no significant affect to the sense of risk perception.

From the characteristics of risk, the community risk perception of public street surveillance was defined as a low risk to future generations, that exposure was voluntary, the risk was observable, that the community understood the risk, that the risks were known and would be immediate. This resulted in public street surveillance having a perceived low social risk perception, demonstrating a social benefit that outweighed the perceived risk to the community.

Although, it appeared that the community had a social concern over the ability to ensure appropriate public street surveillance control. The risk characteristic of control located public street surveillance towards a significantly *higher dread*, but still within the *familiarity to risk* quadrant. Therefore, it appeared that the community had and maintained a social concern over the ability to ensure appropriate public street surveillance control.

### ***1.7 Definitions of Terms***

This section provides general definitions of terms related to the study.

**Attitude.** “Is a mental view” (Dictionary, 1992, p.60) or a “relatively enduring predisposition to respond in a reasonably consistent manner towards a person, object, situation, or idea.” (Smith, 1998, p.628).

**Blind Camera Syndrome.** Large CCTV systems can utilize many cameras connected to few monitors. A camera is selected via a switcher to the monitor, either by the operator or set automatically by a sequential switch. Sequential switching selects one camera in sequence for a predetermined dwell period. The selected camera is displayed on the monitor. A lay person may perceive that there is a CCTV operator watching every camera, ready to react to an incident. But with many cameras being fed into a single monitor, this could result in a camera not being watched by the operator for a large majority of the time.

**Closed Circuit Television (CCTV).** Is “any instrument, apparatus, equipment, or other device that is connected electronically from the image capture device to the display device, that is capable of being used to visually observe an activity” (Adjusted by Brooks, D, from the Surveillance Devices Bill, 1997, Part.1.3.1). With present technology, this allows the term to be expanded beyond a traditional physically closed connection, to include system images that can be transmitted via the phone line, fibre optic cable, wireless and micro wave transmission.

**Digital Video Recorder.** A CCTV recorder that compresses, saves, stores and sorts, in a binary format, an analogue video image.

**General Risk.** Risk inflicted on others (Sjoberg & Fromn, 2001).



**Intellectual Risk.** An activity or technological risk that does not or is perceived not to have, the possibility of causing direct harm to the person.

**Multidimensional Scaling (MDS).** A multivariate data analysis statistical technique, MDS reduces complex dimensional data and presents data in a spatial representation. The reduction in data complexity, through presentation in dimensional space, allows hidden structure to be shown in data. This demonstrates object proximity, with *proximity* being how similar or dissimilar objects are or are perceived to be (Kruskal & Wish, 1978). Primary MDS models used were the Classical Euclidean Distance and Individual Differences (Weighted) Scaling (INDSCAL) models.

**Perception.** An attitudinal awareness, feeling or understanding of a person's surroundings gathered from interpretation and categorisation through sensory mechanisms (Smith, 1998, p.105-153).

**Physical Risk.** An activity or technological risk that may have or is perceived to have, the possibility of causing direct harm to the person.

**Public Place.** Is "open to all ... maintained at the expense of, serving, or for the use of a community ... the community or people in general." (Dictionary, 1992, p.800). This includes shared areas, which have no public restrictions ie. roads, parks, car parks and general local or federal government owned areas or buildings that have no access restriction placed on them.

**Public Street Surveillance.** A CCTV system that is located within, or is able to view, a public place. Within the study a CCTV domain was developed (Figure 1.2) to define the position of public street surveillance.

**Privacy Risk.** See Intellectual Risk.

**Psychometric Technique.** A methodology that assesses social risk perception to the physical risk of activities and technologies. It utilises psychophysical scaling and multivariate analysis to produce a two factor quantitative graph that represents a spatial comparison of activities and technologies.

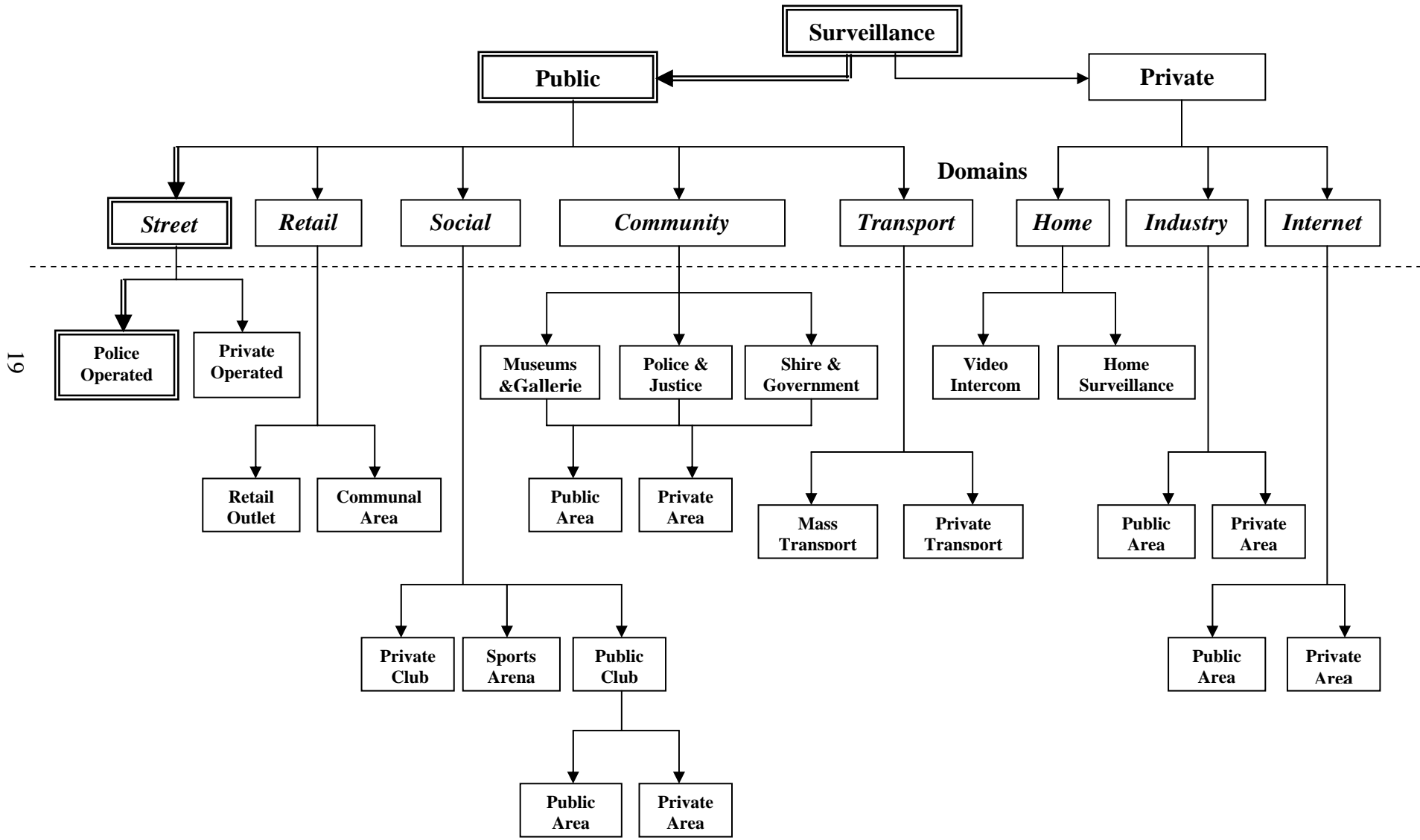
**Relocation.** A changing social perception towards risk, which produces a spatial shift or move in an activity or technology situated within the psychometric model.

**Risk.** The possibility of incurring loss, danger, hazard or misfortune. Risk comprises of a wide range of cognitive beliefs, which extend beyond what a hazard consequence may be. (Australian Standard AS/NZS 4360, 1999).

**Risk Perception.** The investigation took the social psychology definition and included the attitudes, beliefs and judgments of the group.

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*Figure 1.2.* Closed circuit television domain, showing public street surveillance.



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Figure 1.2. Closed circuit television domain, showing public street surveillance.

## Chapter 2

### *Review of Literature*

#### **2.1 Introduction**

The literature review provides an analytical summary of related theories and references within risk and security disciplines. Risk includes the psychometric theory of social risk perception, which provided the theoretical framework. Cultural theory of risk provided an opposing theory of social risk. Security and public street surveillance literature presented related social and technical issues of CCTV. This included the admissibility of digital images, technological changes, the effectiveness of CCTV and social concerns raised by authors on public street surveillance. Finally theories of risk communication, developed from psychometric and cultural risk theories, concludes the chapter.

#### **2.2 Psychometric Theory of Risk**

Psychometric theory of risk is a quantitative methodology of the study of human behavior. Slovic (1997; 1992) developed a method, which was termed the “psychometric paradigm”, to study the social risk perception and therefore, acceptance to risk to certain activities and technologies. As Slovic stated “psychometric paradigm ... uses psychophysical scaling and multivariate analysis techniques to produce quantitative representations or cognitive maps of risk attitudes and perceptions.” (1987, p.281). This results in a two factor analytical representation, with the factor one axis being defined as *dread risk* and factor two axis being defined as *familiarity to risk*.

These factors represent the social risk perception to various activities and technologies. The psychometric theory of risk perception presents “risk attitudes and perception” (Slovic, 1997, p.234) of the layperson or a “personality profile ... [which] showed that every hazard had a unique pattern of qualities” (Slovic, 1992, p.121). *Dread risk* was a dominating risk factor and can be made of various risk characteristics, which were

found to be highly correlated. The other factor of *familiarity to risk*, can again be made up of various characteristics (Slovic, 1992). This methodology has been developed over the previous 30 years, beginning with the primary characterisation of risk, defined by Starr (1969).

Starr (1969), in his paper titled “Social Benefit versus Technological Risk” was the forerunner in the development of the psychometric paradigm. The intent was to achieve a quantitative analysis of the societal cost of technology, both direct and indirect. A single characteristic of the psychometric paradigm was discussed, being whether the risk activity was voluntary or involuntary. The paper produced some interesting outcomes; being that voluntary activities are roughly 1000 times more acceptable, that the acceptability of risk appears proportional to the third power of the benefit and that social acceptance is directly influenced by public awareness of that risk (Starr, 1969). Although a recent study has shown that public awareness and social acceptance is not a linear relationship and that the only relationship can be seen with direct risk, which increases risk perception (Paton, Smith & Johnson, 2000).

One of the most significant findings within the psychometric paradigm, was how lay people and experts distinguish between perceived and actual risk. There is a mismatch in perception between the layperson and the industry expert. This results in a different perception and therefore, acceptance of risk to an activity or technology. This mismatch comes about due to the utilisation of different language content, that both groups may be attempting to solve different problems, that the risk process may be manipulated to achieve their own outcomes, that they disagree about what is feasible and that communication can fail between parties (Fischhoff, Slovic, & Lichtenstein, 1986). Psychometric research has attempted to evaluate the difference between rational or expert risk and initiative or lay risk (Shaw & Shaw, 2001).

Psychometric research argued that quantitative risk assessment could not provide the necessary holistic methodology necessary to address the laypersons perception of risk

(Slovic, Fischhoff, & Lichtenstein, 1986). This expanded to confirm that certain activities or outcomes were perceived as a greater risk, even when the risk was of an equal or lesser actual risk. During this period it was highlighted that this method may not be valid in assessing an individual's perception of risk, as it provides only social response. It has been concluded that social perception of risk is multi-dimensional and based on several characteristics. These primary characteristics being technology, catastrophic potential, dreadness and severity of consequence (Slovic, Fischhoff, & Lichtenstein, 1986).

Lope reinforced this risk perception mismatch, when he stated that "Lay people do not understand statistics well enough to make intelligent use of all this information" (1992, p.57). He discussed public perception and acceptance of risk statistics, and how these alter from that of experts. Lope (1992) came to the conclusion that the public is more knowledgeable regarding risk, once they receive the relevant information, being direct and to the point. Although this does not lead to lay people accepting risk, becoming physically prepared or acting to reduce risks (Paton, Smith & Johnson, 2000). Lay people "infer from an ability to cope with an (objectively) minor impact ... a capability to deal with any future occurrence. This attritional bias can result in their overestimating their perceived preparedness and/or underestimating the risk" (Paton, Smith & Johnson, 2000, p.88).

An expert views risk as synonymous with fatalities and therefore, their recitations of risk will have little acceptance by the public. This leads onto the need for effective communication between experts and lay people. The outcome being that risk assessment needs to be made in the real world, with both political and social context, and that trust and accountability are important in this process (Slovic, 1997). But the affect heuristic appears to demonstrate that this will still not provide the ability to logically communicate risk. Affect heuristic supports "the theory that risk and benefit judgments are casually determined, at least in part, by the overall affective evaluation."

(Slovic, Finucane, Peters, & MacGregor, 2002, pp12-13) and that society judges risk not on facts, but by what they *think* and how they *feel* about the activity or technology.

Psychometric research continued to expand the characterisation of social risk into sixteen discrete items, being dread, controllability, global catastrophic, consequence, equitable, individual, risk to future generations, ability to reduce, risk decreasing, voluntary, familiar, observable, known to exposed, effect immediate, age of risk and the knowledge of science. Studies showed that there were different demographic risk acceptance between white males, white females, black males and black females, with the conclusion that white males have a far higher acceptability to risk. That risk perception was “influenced by the interplay of psychological, social and political factors ... [and that] the reason the public often reject scientists risk assessment is a lack of trust.” (Slovic, 1997, p.237). Although this has been opposed by recent research, which has found that there appears to be little significant difference between gender depending on the activity or technology (Brooks & Smith, 2002; Bouyer, Bagdassarian, Chaabanne & Mullet, 2001).

A concern, addressed in the background of the study (Section 1.2), was that social impacts have some casual relationship to social risk perception. These impacts, whether driven by accidents, media coverage, sabotage, product tampering, system failures, etc., have found to have a far greater or lesser effect than what has traditionally been measured through loss of life, financial loss, etc. This traditional methodology can be defined as classical risk management and assessment, as defined in the Australian Standard AS4360:1999. A correlation can be made to such impacts, through the understanding of social risk perception (Slovic, 1992). As Fineberg highlighted, risk assessors have to analyse risk beyond the process of “translating the results ... into non-technical terms.” (1996, p.8) to be effective.

Trust also became an additional important characterisation element in risk perception and was further developed in that trust displayed an asymmetrically principle weighted



towards *dread risk*. Slovic (1997) stated that trust destroying, as opposed to trust building, was more visible, had greater weighting, provided more creditable media coverage and tended to reinforce and perpetuate distrust. This reinforced the need to review risk communications (Section 2.5) and raised the issue of how the media can transmit adverse social images and become a driving force behind risk relocation.

It can be argued that the theory of risk perception cannot be effective in measuring risk due to the complex and multidimensional nature of risk. Lay people could not analyse these complex and multidimensional issues and provide valid responses. Paton, Smith and Johnson supported this, as they stated “Risk perception is a highly interpretive and dynamic process.” (2000, p.86) and that the “measurement of risk perception, and the identification of the information used when making such judgements, is complex.” (2000, p.86). Psychometric research has been criticized for assessing risk perception as an objective reality and not taking a holistic approach, being either cultural or social (Shaw & Shaw, 2001). But, numerous studies have been completed and these have continually demonstrated that consistent and valid risk perception representations have resulted. But to apply psychometric results across all cultural environments could prove invalid, as each culture may have unique perceptions on the risk of each activity and technology.

It has been shown that greater exposure to risk will have an impact on a layperson’s risk perception. This can be either direct (physical experience), or indirect exposure (media, peer). Paton, et al., showed that those exposed and had experienced a direct risk, “exercised a positive influence on risk perception” (2000, p.87), their perceived threat of the risk increased. Wilford (2002) argued that it was the level of awareness that defined the level of risk perception, and that perception and awareness are intrinsically linked. This appears to be supportive of affect heuristic, that society judges risk not on facts, but by what they *think* and how they *feel* (Slovic, Finucane, Peters & MacGregor, 2002).

There has been numerous research studies, testing up to 90 activities and technologies, completed throughout the world (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Sjoberg & Fromm, 2001; Slovic, 1997; Slovic, 1992). The activities and technologies researched and tested ranged from radioactive waste, DNA technology, AIDS, radon, nuclear reactor accidents, microwave ovens, smoking, caffeine, power mowers, downhill skiing, large dams, auto racing and commercial aviation.

Some of the most significant findings within these studies was that while an activity or technology was seen to provide a social benefit which outweighs its social risk, then it will generally be an acceptable risk (Brooks & Smith, 2002; Fischhoff, Nadai & Fischhoff, 2001; Sjoberg & Fromm, 2001; Slovic, 1997). Those risk perceptions were consistent, stable, and not primarily affected by their personnel philosophy and anxiety (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997).

### ***2.3 Cultural Theories of Risk***

Cultural risk theory “attempts to address the wider cultural and political context of risk” (Shaw & Shaw, 2001) and can be presented in either a two-dimensional model, or expanded into three-dimensions, utilising grid, group and the third dimension, manipulation (Thompson, 1982). Grid can be defined as a group of rules and constraints that culture imposes on its people. Group emphasizes the level of social interaction between people. Grid and group relationship presents a “fourfold typology of ways of life, each reflecting a cohesive and coherent cluster of attitudes, beliefs and styles of relationships.” (Mars & Frosdick, 1997, p.116). This leads to five archetypal ways of life, being individualist, egalitarian, fatalist, hierarchy and hermit. These groups depend on each other to support and maintain their way of life, but give rise to different perceptions of risk (Shaw & Shaw, 2001; Mars & Frosdick, 1997).

Cultural risk theory takes an opposing view on a primary finding of psychometric theory, being that society defines risk. Cultural risk theory states that society is driven by predetermined cultural constraints and that these are predictable (Douglas, 1990;

Thompson, Ellis & Wildavsky, 1990). But both psychometric and cultural risk theory concur that social risk perception can relocate. As Thompson concluded, the “changed perception of risk results from a changed social context” (1982, p.59) and the grid/group theory showed that an individual and/or populations perception and acceptance of risk can and does change.

Douglas and Wildavsky argued that risk and the level of social risk acceptance was based on cultural “collective construct” (1983, p.186) and that society can be divided into four groups, being market individualist, hierarchies, sectarian and border claims. The group that generally highlights and voices concern over risk within society are the border dwellers, due to their position outside normal constraints. Douglas (1990) further defined the concept of social risk and how the concept can alter depending on the time, place, perception and acceptance by a particular society or culture of the concept of *risk*. Cultural process and dialogue, defines and accepts accountability, therefore it is the context of *risk* that is important.

But, cultural risk theory has been criticized as being too restrictive, simplistic, static and has a limited ability to translate into empirical research (Shaw & Shaw, 2001; Mars & Frosdick, 1997). Douglas and Wildavsky concluded that selection of risk was a social process, in accord with psychometric risk theory. But that the management of risk was an organisational problem, opposing psychometric risk theory.

#### ***2.4 Security and Public Street Surveillance Literature***

Security and public street surveillance literature provided discussion on issues that could be one of many multidimensional and complex issues (Section 1.2.1) that may have an effect on the social risk perception of CCTV, or as a domain, public street surveillance. Issues include the admissibility of digital images, technological changes, the effectiveness of CCTV and the social concerns raised by authors on public street surveillance. There were a number of authors who expressed concerns over the social

aspect of public street surveillance and discussed what has been termed within this study, attitudinal relocation issues.

Norris and Armstrong (1999) in their book titled “The maximum surveillance society: The rise of CCTV” addresses some of the social concerns with CCTV. The two faces of surveillance were discussed, being the protector and totalitarian rule. But, it can be argued that these two faces can be defined as social benefit versus social risk. The selling of CCTV provided a critical review of criminology studies in the social acceptance of CCTV and that public support of CCTV has been skewed due to the framing of research instruments. This was supported by Ditton (cited in Painter & Tilley, 1999, p.7), where Ditton demonstrated that the support for CCTV can be influenced by the context of the previous questions. The “general public support stands at between two-thirds and three-quarters of those surveyed, although it may fall to below a half of those actually using city centre space” (Norris & Armstrong, 1999, p.62). This was lower than generally accepted and raises concern as half of those using a city centre appear to have a social concern over public street surveillance.

Philips (1999) evaluated a number of studies that had evaluated the effectiveness of CCTV systems in reducing crime, fear and improving safety. This utilized Tilley’s (1993) model of realist evaluation, which focused on the functions and the environment of crime prevention measures. Issues of displacement, the impact of CCTV on crime, personal and public crime, and the offenders perspective were discussed. Finally, the impact of CCTV on the fear of crime and public attitudes are covered. The paper concludes that in some aspects CCTV was effective in reducing crime, but that outcomes were mixed for fear reduction and crimes against the person.

Today, with the interest in reality shows, CCTV and the media are well suited. Norris and Armstrong refer to the visual medium and the media’s love affair with CCTV (1999, p.163). That negative findings are not reported by industry, but led by practitioner claims of success (1999, p.205). This supports the media’s positive

portrayal and support of public street surveillance, that public exposure and therefore knowledge is media driven.

Norris and Armstrong (1999) researched who and what the operators on the streets were watching. CCTV operators discriminated by age, race and gender, with young men being the main targets of operators. This study found that females feel safer when within a public street surveillance system. It can be argued that this was due to the perception that they were being covered by surveillance, with help close at hand. But Norris and Armstrong found that women accounted for only 7% of primary persons placed under surveillance and that out of nearly 600 hours of surveillance tapes, only one woman was actively viewed as a protective measure (1999). “If social groups experience CCTV surveillance as an extension of discriminatory and unjust policing, the consequential loss of legitimacy may have disastrous consequence for social order.” (Norris & Armstrong, 1999, p.176).

The use of digital technology in CCTV is rapidly expanding. This can be supported by IndigoVision Ltd., when they stated that the “trend is clear, namely, that as computer processing power increases and becomes cheaper, old analog technology is being replaced by improved digital systems. .... Increasing numbers of CCTV equipment manufacturers are producing digital products.” (2002, p.5). Due to this rapid expansion of digital technology within CCTV and a lack of holistic understanding in the security industry, police and legal professions, it can be argued that this may become a key social relocation issue. It can be further argued that this is particularly valid with digital video recorders and the admissibility of digital evidence.

Murphy, in “The admissibility of CCTV evidence in criminal proceedings” (1999) examined the issue of CCTV digital images and their admissibility within a court of law. Video admissibility has developed from photographs to analogue video, but CCTV has now taken a quantum leap in the use of digital processed and stored video images.

In the UK, the “courts have demonstrated an uncharacteristic willingness to accept visual recordings as evidence in criminal proceedings” (Murphy, 1999, p.401).

Currently digital video images are admissible evidence in a court of law and the Select Committee on Science and Technology summarized that they found no difficulty for the courts on digital video images (1998, Section 5.1). IndigoVision Ltd. takes this further, stating that “existing UK legislation, House of Lords Committee report and the recent Police Scientific Development Branch report are clear that digital images are admissible as evidence in UK courts, provided that digital images are appropriately authenticated.” (2002, p.11). But, the ability to provide this authentication has to be questioned, beyond just a technological method.

As Ainsworth stated “can video evidence be compromised ... or more importantly, can alluding to this possibility raise the issue of reasonable doubt.” (1997, p.101). Rieger and Rode further reinforced this issue when they stated that “it is likely that the susceptibility of digital images to manipulation will lead to increasing doubt with respect to the authenticity of ... images in the era of digital data processing.” (1999, p.262). With society increasing their understanding of digital images, this raises social concerns regarding the integrity of digital CCTV images (Grundberg, cited in Mitchell, 1994) and that public confidence will be lost through the perception of improper use (1998, Section 5.11).

For public street surveillance digital video images to remain admissible, will require transparency of process and a holistic approach in the management, application and use of public street surveillance systems (Brooks, 2001). As the Select Committee on Science and Technology summarized, there was no problem with digital images for the courts. But there was a concern over public awareness, authentication techniques, procedural measures, digital audit trail and that the UK Government produces guidance on the use of data matching and “in particular the linking of surveillance systems with other databases.” (1998, Section 5.1-5.16). But ultimately, this will require a number of

court challenges, leading to definition and legal precedence, before any certainty of digital video image status can be achieved.

A debate between Horne (1998) and Davies (1998) discussed whether CCTV should be introduced within town and city centres. Horne argued that CCTV should be, whereas Davies argued against the case. Social concerns over public street surveillance were discussed and that research studies generally demonstrated that there was little concern shown by the public. This supported the research outcome, being that public street surveillance was a low dread and familiar social risk. But concern was raised over the introduction of surveillance into social life, like pubs, clubs and cinemas. What was highlighted, was that “people did not mind police viewing tapes, but they were strongly opposed to access by security personnel” (Horne, 1998, p.322) and this extended to the ability of staff to select their own CCTV views and record. As Horne (1998) conceded, this goes against the majority of public street surveillance system operations.

Davies (1998) primarily questioned the ability of public street surveillance to be effective in the long term, the subjective and political nature of public street surveillance installations and that there was no concern for public privacy. But Davies only utilised a single 1992 study as a source of reference. Both Horne (1998) and Davies (1998) did address that there may be an underlying social concern over public street surveillance, but did not offer any indications as to the level, nature or the need to measure this social concern. Also, both authors only addressed a snapshot of social feeling, without considerations for underlying and shifting social concerns. But the Select Committee on Science and Technology did recommend that the UK Government “commission a substantial, rigorous and independent study of the cost and effectiveness of publicly funded surveillance systems” (1998, Section 5.11).

Waters (1996) discussed additional relocation issues, albeit in only a subjective manner, as there was no research to justify his statements. However, he raised similar concerns as addressed in the background of this study (Section 1.2). This included the unchecked

introduction of CCTV within all parts of society, a general discussion on street surveillance, relevant legislation, law enforcement justification for CCTV and social effects of surveillance. Waters (1996) also questioned a secondary use of public street surveillance, the control and monitoring of minor social misdemeanors.

Waters stated that the “chilling effect of surveillance is difficult to quantify, but is clearly recognised by the public” (1996, p.1). It can be argued that this is not the case and that present studies do not demonstrate this. The limited research in this area has found that people feel less anxious within a public street surveillance system (Ditton, 1999). This investigation also demonstrated that public street surveillance was a socially acceptable risk, primarily due to the social belief that the benefits outweigh the social risk.

The ability of public street surveillance to remain effective and reduce crime over time has been questioned by a number of authors (Ditton, 1999; Short & Ditton, 1998; Waters, 1996; Brown, 1995; Tilley, 1993). In the paper titled “Town Centres: Three Case Studies” Brown (1995) discussed the concerns that public street surveillance effectiveness had not been truly evaluated. That crime reduction was short lived and that it only reduced some types of crimes over an extended period. Tilley (1993) supported this issue, in that there was a reduction in the levels of crimes when the public street surveillance systems were first installed, but that these reductions were only in some crime categories and faded over time. Also, that very few arrests followed from public street surveillance coverage.

The general perception of public street surveillance was that it improved safety, that people feel safer when they were aware of public street surveillance (Ditton, 1999; Brown, 1995) and that there was little evidence of opposition from the public regarding the public street surveillance systems (Tilley, 1993). In Dundee (UK), after public street surveillance was installed in the city center, a survey found that 96% of those surveyed thought that public street surveillance would not infringe on civil liberties



(Horne, 1998, p.321). But Brown did state that “one third of people were concerned with being watched” (1995, p.66), although little further considerations was given to this social issue. More recent research by Ditton found that “67% ... did not mind being observed by street cameras.” (1999). But the Australian Privacy Commission stated “Queries about the legality of video surveillance were also common”, being rated 6.9% of all enquires outside their jurisdiction (1998, p.43). But generally, it appears that the public does view street surveillance as a benefit.

Davies (1992) in “Big Brother” discussed a holistic process of social surveillance, including privacy, government agency roles, technology and information. Technologies also included smart cards, biometrics, intelligent phone systems, computer matching and networks. The author discussed a model termed the five zones of surveillance, being *zone 1-restricted surveillance; zone 2-conditional surveillance; zone 3-routine surveillance; zone 4-mass surveillance* and *zone 5-total surveillance*. The conclusion being that Australia is currently located within *zone 4-mass surveillance*. Davies stated that this zoning model “is a simple five zone chart that shows the way surveillance and control influences the life and environment of a community.” (1992, p.18). But there was no demonstration as to how these variables were defined, analyzed, assigned or how this conclusion was reached. Generally the text appeared subjective, with little or no scientific evidence given. Although it was produced by a member of the media and could demonstrate what could become typical arguments for or against public street surveillance.

## ***2.5 Theories of Risk Communication***

This section examined specific texts on the theories of risk communication. This was particularly relevant in risk perception relocation (Section 1.2.1). The theories of risk communication have developed from classical risk theory, cultural and social risk. As with any method of communication, the appropriate message must pass between the sender and receiver, which may be most prevalent for errors between the expert and

layperson. Risk communication must be cognizant of social and cultural risk perception.

Paton, Smith and Johnson (2000) discussed conceptual and methodological issues in risk communications, demonstrating that perceived risk does not lead to risk preparation, irrespective of media communication. But that risk perception did increase when affected by direct risk experience. DeJoy (1999) examined warning and risk effectiveness in society. He stated that risk can be divided into three main categories, being threat-related expectations, outcome related expectations and receiver characteristics. As found by Starr (1969) in the original psychometric risk perception research, warning effectiveness increased with perceived hazardousness, although this opposed direct risk perception found by Paton, et al., (2000).

DeJoy (1999) highlighted how bias in risk perception included overconfidence, optimism, availability, suppression, cost of compliance and receiver characteristics. Receiver characteristics included familiarity, demographic factors and personality. A number of these characteristics being shown through psychometric risk studies (Slovic, 1997; 1992). As argued by psychometric risk theory, attitude and belief factors (expectations) affect how the individual perceives and accepts risks.

Risk management has to be based on the ability to communicate the appropriate risk message. A comparison between empirically and analytical methods of decision making and assessment, to gauge what method was most appropriate for the *real world* was studied by Larichev, Brown and Flanders (1998). Two similar case studies of decision making were assessed, one by the Russian Government and the other by the American Government. Three groups of criteria were taken into consideration, being methodology, institutional and personal. Results detailed the difference in the analysis, implementation and communication of quantitative and qualitative data. The outcome summarized that risk communication must improve and that cultural differences must be taken into account.

What a number of authors (Paton, Smith & Johnson, 2000; Australian Standards, 1999; Yosie & Herbst, 1998) have concluded and this was supported by both cultural and psychometric risk studies, is the need to involve lay people and stakeholders in the risk management process. To be effective, there has to be an inevitable and continual expansion of stakeholder involvement in risk decision making. A study by Yosie and Herbst, examined some of the major reasons behind the need to involve stakeholders, including “key issues, challenges associated with managing them, and analyses factors shaping their future use.” (1998, p.1). From the examination of twenty nine case studies, the following key observations and findings were highlighted. Social interest was becoming more interactive, current stakeholder processes are generally not well managed, that there was a need to achieve a better match between stakeholder and the solution, there was no specific agreement on the definition of a stakeholder and that the stakeholders challenge the effectiveness of experts in the decision making process.

The type and extent of media coverage given to public street surveillance could change the risk perception of public street surveillance. The media will have a key role in risk communication and therefore, risk relocation (Section 1.2.1). Dunwoody (1992) discussed how journalists select and structure risk messages in his paper, titled “The media and public perceptions of risk: How journalists frame risk stories.” The paper discussed two types of patterns that appeared in media coverage. The first pattern being coverage does not mirror reality and the second, that risk stories contained very little risk information. Dunwoody (1992) believed that this was due to two aspects that involved news framing, individual knowledge of information relevant to risk and the journalistic occupational norms. What was highlighted was the need for the journalist to not only inform their reader, but also their need to attract readers. This was one of the reasons why they dramatise, simplify and play politics with media coverage (Covello, Sandman & Slovic, 1989). It can be argued that this may be why the media is a key in defining levels of risk perception in society.

## ***2.6 Conclusion***

This chapter provided an analytical review of the literature relating to this study. The psychometric theory of risk provided the theoretical framework and structure for the study. That risk perception can be presented in a quantitative two factor representation of *dread risk* and *familiarity to risk*. Significant findings being that there is a mismatch between the expert and layperson's perception of risk. But, primarily that the psychometric method has been demonstrated in numerous research studies, producing consistent and valid results.

Cultural risk provided an opposing theory on risk and attempts to address the holistic context. This takes an opposing view to psychometric risk theory, being that society defines risk. But both theories concur that risk perception in societies can change. The chapter concluded with risk communication, which developed from classical, cultural and psychometric theories of risk. This discussed why the media dramatize, simplifies and plays politics, and that the media is a key messenger in levels of social risk perception.

Security and public street surveillance literature demonstrated that there was little research into the social affect of public street surveillance. Authors have raised concern over public street surveillance, but these have generally been limited and with little supporting scientific data. The media is supportive of CCTV, with positive media coverage. Operationally, CCTV operators discriminate and target young males, but women are rarely actively monitored. This may reduce the crime prevention ability of CCTV to protect women. Also digital CCTV is expanding, but the admissibility of digital evidence is still to be tested in a court of law.

Research has shown that CCTV can be effective in reducing crime, but that outcomes were mixed for fear reduction and crimes against the person. It appeared that CCTV can only be effective in certain environments and has to be applied in a holistic crime prevention package. Although this study has demonstrated that this may not be the key issue, as public street surveillance appears to be meeting its objective, making individuals and the community feel safer.

## Chapter 3

### *Theoretical Framework*

#### **3.1 Introduction**

The theoretical framework chapter provides the structure for the study and theories supporting the methodology. The study utilized the theory of psychometric risk perception (Section 3.2), which measures the social risk perception to activities and technologies. The research variables, characteristics of risk and inter-relationships are identified (Section 3.2).

The study proposed the location of public street surveillance risk perception within the psychometric paradigm (Section 3.3). The term *risk perception* was expanded within the context of both clinical and social psychology, as *risk perception* is utilized throughout the psychometric paradigm (Section 3.4). Multidimensional Scaling (MDS) is discussed (Section 3.5), being an additional method to analyse and present proximity data in a spatial format. This supported and complemented the psychometric paradigm technique. Theories that supported the research methodologies utilized within the study are presented (Section 3.6) and the chapter is finalized with a conclusion (Section 3.7).

#### **3.2 Psychometric Paradigm**

Psychometric paradigm provided the measurement and assessment of the social risk perception of public street surveillance. It is a method that attempts to assess and understand social risk perception and therefore risk acceptance, to certain defined activities and technologies. As Slovic stated “psychometric paradigm, which uses psychophysical scaling and multivariate analysis techniques to produce quantitative representations or cognitive maps of risk attitudes and perceptions.” (1987, p.281). This results in a two factor analytical representation (Figure 3.1), with factor one axis being defined as high *dread risk* to low *dread risk*. Factor two axis is defined as *unfamiliar risk* to *familiar risk*.

Slovic (1997) demonstrated how 81 different activities and technologies relate within the psychometric paradigm. This allows a spatial comparison to be made between these activities and technologies, to assess the level of social perception in terms of factors *dread* and *familiarity*.

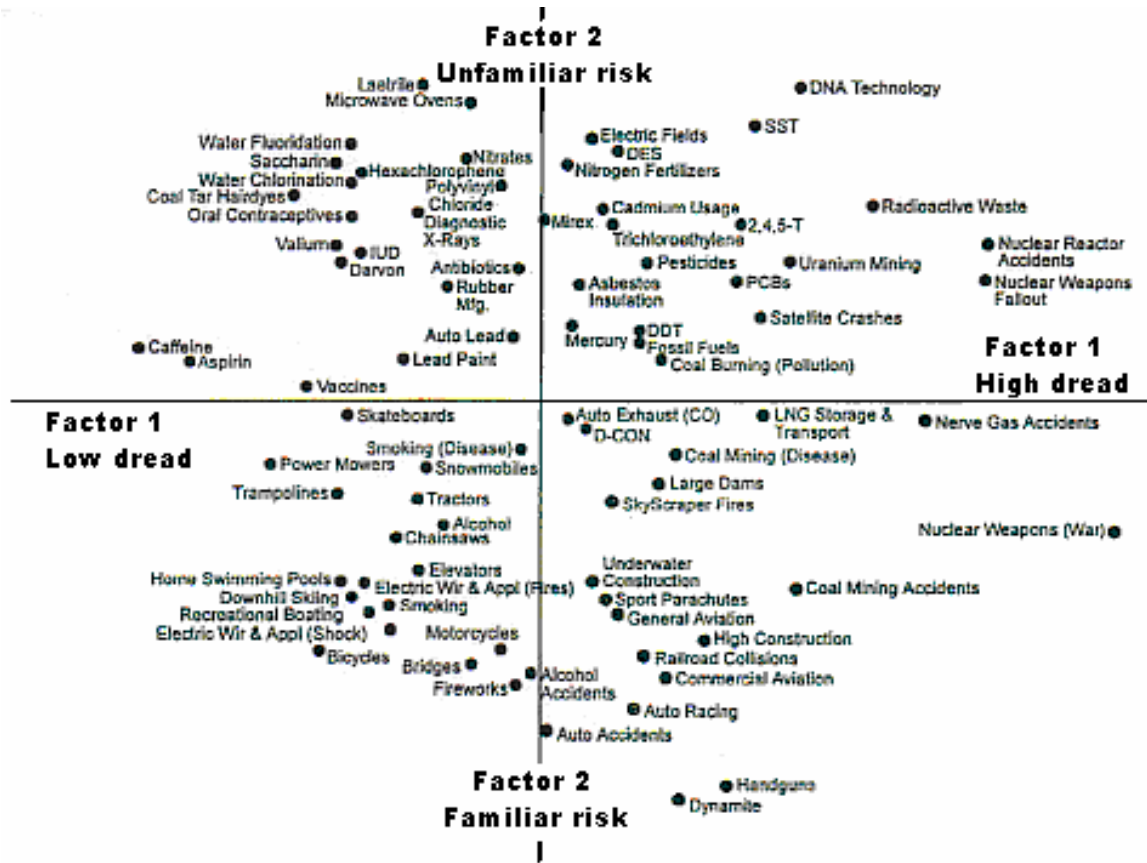


Figure 3.1. Psychometric paradigm: Location of 81 hazards.  
(Revised from Slovic, 1997, p.236).

The two risk factors can be further expanded into the characteristics of risk (Table 3.1), being the study's independent variables. *Dread risk* is a dominating risk factor and can be made of various risk characteristics, found to be highly correlated (Slovic, 1992, p.121). The other factor was *familiar risk*, again made up of various risk characteristics.

This investigation tested the two risk factors of *dread risk* and *familiar risk*. Although not all risk characteristics were tested within each factor.

Table 3.1

*Characteristics of Risk*

<b>FACTOR 1 – <i>Dread Risk</i></b>		<b>FACTOR 2 - <i>Familiar Risk</i></b>	
Low dread	High dread	Familiar risk	Unfamiliar risk e
Controllable	Uncontrollable	Observable	Not observable
Not global catastrophic	Global catastrophic	Known to those exposed	Unknown to those exposed
Consequence not fatal	Consequence fatal	Effect immediate	Effect delayed
Equitable	Not equitable	Old risk	New risk
Individual	Catastrophic	Risks known to science	Risks unknown to science
Low risk to future generations	High risk to future generations		
Easily reduced	Not easily reduced		
Risk decreasing	Risk increasing		
Voluntary	Involuntary		

(Slovic, 1997, p.236).

The theoretical framework (Figure 3.4) of the psychometric causal relationship model demonstrates the relationship between the independent and dependent variables. Unlike previous psychometric research studies, where up to twenty risk characteristics were tested, this study tested nine risk characteristics (Table 3.2). These tested the dependant variable of social risk perception.

Table 3.2

*Characteristics of Risk: Independent Research Variables*

<b>FACTOR 1 - <i>Dread Risk</i></b>		<b>FACTOR 2 - <i>Familiar Risk</i></b>	
Low dread	High dread	Familiar	Unfamiliar
Controllable	Uncontrollable	Observable	Not observable
Low risk to future generations	High risk to future generations	Known to those exposed	Unknown to those exposed
Voluntary	Involuntary	Old risk	New risk
		Effect immediate	Effect delayed



The construct of risk perception was measured by two risk factors, being the *sense of dread* and the *sense of familiarity*. The measure of each factor defined the perceived level of social risk towards certain activities or technologies. A high sense of *unfamiliarity* and *dread* may lead to an increase in the perception of risk. Whereas *familiarity* and a low sense of *dread*, may lead to a reduced perception of risk (Figure 3.2).

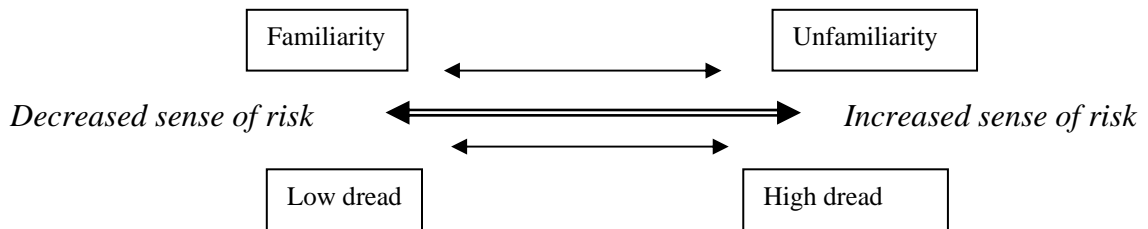
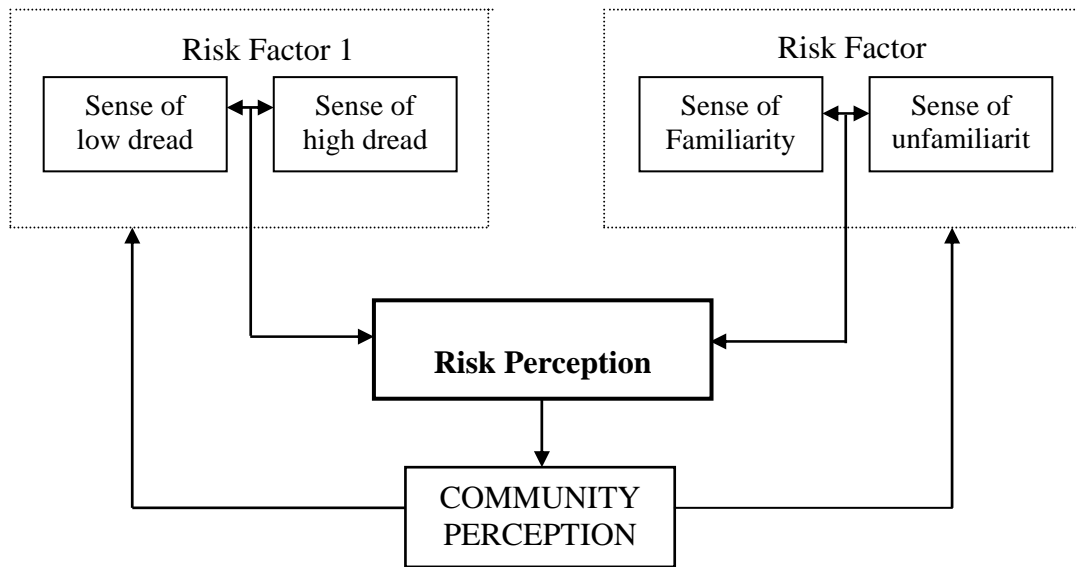


Figure 3.2. Risk perception factor model.

As the two factors alter within the community, so will the level of perceived risk for certain activities or technologies within that community. These factors were the independent variables that were utilized to measure the dependant construct of *risk perception*. Change in perceived risk will alter the community *risk perception* and through feedback, affect the independent variables (Figure 3.3). How community members felt regarding the two factors defined the level of *risk perception* towards certain activities or technologies felt within the community. This defines the social risk acceptance to activities and technologies.



*Figure 3.3.* Risk perception casual model.

One of the research outcomes was to demonstrate the social risk perception of public street surveillance. To provide proximal data and demonstrate research instrument reliability and validity, four additional activities and technologies were tested. These were radioactive waste, home swimming pools, drinking water chlorination and coal mining disease. The additional four activities and technologies not only provided this spatial relationship comparisons of where public street surveillance was located, but also allowed a comparison of previous psychometric studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997). They were chosen as, according to Slovic (1997), they represent one object from each quadrant of the spatial factor representation model.

INSERT FIGURE

*Figure 3.4.* Psychometric risk perception causal relationship model, showing the risk characteristics.

### 3.3 Possible Public Street Surveillance Psychometric Proposition

The study proposed that public street surveillance would be located within the quadrant of *low dread* and *unfamiliar risk*. Seen as controllable, but with an unknown capability. This was an area that would provide little known public knowledge of public street surveillance capabilities or deficiencies and minimal adverse media coverage, but be prone to social change once the familiarity to the risk altered. Increased social exposure to public street surveillance may cause the risk perception to relocate to *high dread* and *familiar risk* (Figure 3.5). But as demonstrated in the study, this was not the location of public street surveillance.

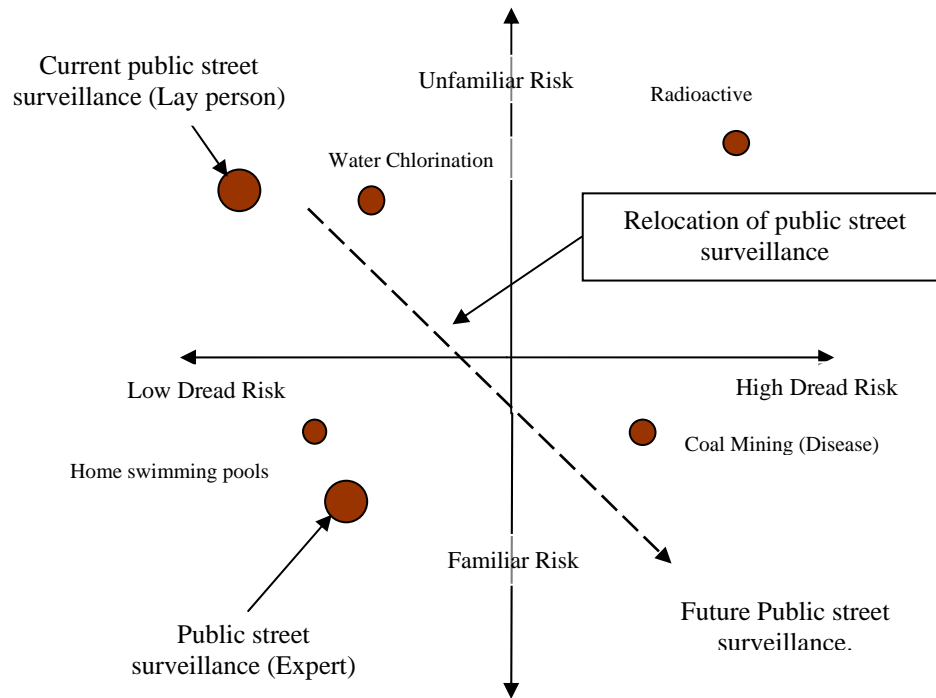


Figure 3.5. Psychometric paradigm proposition: Possible public street surveillance relocation of hazard.

### 3.4 Perceptions or Attitudes

The term *risk perception*, although not a clinical definition, was used in this study for a number of reasons. The first being that Slovic (1997; 1992) utilized this term throughout his research and was therefore, maintained to provide continuity. As Slovic

stated “the word perception is used here and in the literature to refer to various kinds of attitudes and judgements.” (1992, p.152). The second was whether the research was measuring perceptions or attitudes?

The psychology definition of perception can be defined as the “mental process of organizing sensations into meaningful patterns.” (Coon, 1998. p.G-12). Perception is derived through our biological sensors, being vision, audition, gestation, olfaction, somesthesia and proprioception. “Perception is the active process by which the brain interprets and categorizes sensory stimuli to determine their nature and meaning.” (Smith, 98, p.152).

Both internal and external influence affects perception. Internal influence includes expectations, motivation and past learning. External influence includes the intensity, contrast, similarity, conformity, closure and simplicity of the messenger. Although perception involves a reflexive response, it is also a cognitive process. This has been shown through research into very young children (Wittig, 2001, p.59), where perception is a part of the cognitive stage of social information processing, which is interrelated to behavioural response (Figure 3.6).

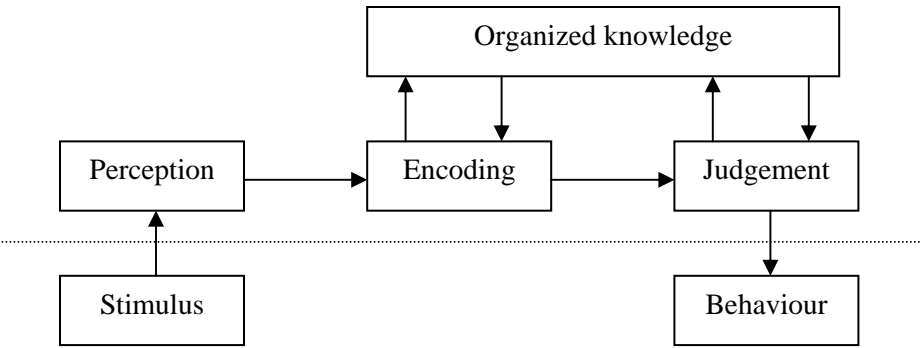


Figure 3.6. Cognitive information processing.  
(Revised from Fielder & Bless, 2001, p.122).

Social cognition processing can be broken down into a number of stages. This includes perception, encoding, organization, inference, retrieval and judgement. At all stages, old knowledge interacts with new, either overriding or reinforcing one, or the other. The social environment, among other aspects, alters the cognitive process and therefore, may affect the behavioural outcome (Fielder & Bless, 2001, pp.122-148).

Attitude can include beliefs, thoughts, feelings, emotions and behaviour. They are learned, relatively stable over time and influence our behaviour. Attitude can be defined as a “learned tendency to respond to people, objects, or institutions in a positive or negative way.” (Coon, 98. p.G-2). Attitudes are made up of a number of components, being cognitive (beliefs), affective (emotions, feelings) and behavioural (action) component and are acquired through a complex process, but learned process.

Demarcation between attitude and perception cannot be made. Psychology defines these as two distinct processes, but in social psychology they are closely interrelated. This is seen through social psychology cognitive stages of information processing. As Fielder and Bless stated “the different processing stages, from perceptual input to behavioural output – are interdependent and characterised by various feedback loops” (2001, p.123). Psychology is the biological process that does not provide this cognitive relationship. Social psychology however, views the interaction between the individual and the group or society.

Perception and attitude are cognitive, affect each other and are interrelated. This reduced the ability to provide a clear and concise demarcation between perception and attitude. Slovic (1992) did not attempt to segregate these terms, but utilized the term risk perception to refer to both risk attitude and risk perception. Therefore, the term *risk perception*, was used throughout the thesis, cognisant that it takes the social psychology definition, which includes perception, attitudes and judgements. But that primarily the research reviews the individual attitudes within a group or social environment.

### ***3.5 Multidimensional Scaling***

MDS is a statistical technique within the area of multivariate data analysis. MDS reduces complex dimensional data and presents these data in a spatial representation. “This ability to spatially represent a complex set of data is the major feature of MDS” (Smith, 1984, p.89). Cox and Cox define MDS as “the search for a low dimensional space, usually Euclidean, in which points in the space represents the objects, ... such that the distance between the points in space, ... match, as well as possible, the original dissimilarities.” (2000, p.1).

The reduction in data complexity, through presentation in dimensional space, allows hidden structure to be shown in data. This demonstrates object proximity, with proximity being the measure of how similar or dissimilar the objects are perceived to be. “A proximity is a number which indicates how similar or how different two objects are, or are perceived to be” (Kruskal & Wish. 1978, p.7).

MDS was developed and theorised within behavioural science, but is now used by many disciplines (Cox & Cox) such as psychology to interpret perception, sociology to determine structure of groups, anthropology to compare different cultural groups, economist to determine consumer reaction to goods and educators, to research the structure of intelligence (Smith, 1984, p.88).

MDS commences with a set of objects, being the activities and technologies. The objects are paired and dissimilarities measured. The distances between pairs of objects are placed within a half matrix format. A configuration of points is sought in dimensional space, with each point representing an object. The aim of MDS is to find a dimensional space configuration where the points distance *match* as close as possible, the paired dissimilarities. The different notions of *matching* defines the different techniques of MDS (Cox & Cox, 2000). MDS was used within the study as an additional statistical procedure to elicit further *underlying* group and individual risk perceptions from the research data. Primary MDS models used were the Classical

Euclidean Distance and Individual Differences (Weighted) Scaling (INDSCAL) models.

### 3.5.1 Multidimensional Scaling Models

MDS includes a number of techniques, depending on the proposed analysis and datum sets. But each technique has a set of  $n$  objects, with measured dissimilarities between pairs of objects. Configuration of  $n$  points is sought in  $p$  dimensional space, with each point  $n$ th representing an object. When the space configuration that the  $n$ th points distance *match* as close as possible, the paired dissimilarities, MDS has achieved its aim.

Classical scaling treats dissimilarities as Euclidean distances. Young and Householder, in the 1930s, developed this technique and demonstrated that a matrix of distances between points in Euclidean space can be preserved from point coordinates. This was further developed and made popular by Torgerson (1952). Metric least squares scaling again treats dissimilarities as Euclidean, but transforms these as a continuous monotonic function. These methods are both metric scaling techniques (Cox & Cox, 2000). The Euclidean distance algorithm is:

$$\delta_{re} = \left\{ \sum_i (x_{ri} - x_{si})^2 \right\}^{1/2}$$

Nonmetric scaling allows interpretation of dissimilar data that is not Euclidean. In 1962 Shepard (cited in Cox & Cox, 2000), produced an algorithm to calculate nonmetric MDS, although this did not contain a loss function. During MDS, there is a requirement to obtain a close *match* within dimensional space and to know the level of mismatch or error. There was no method to measure this error or loss of function in nonmetric scaling although Kruskal (1964) introduced a loss function, removing previous limitation of nonmetric MDS.



Procrustes analysis allows analysis of data from different configuration of points. This analysis “dilates, translates, reflects and rotates one of the configurations of points to match, ... the other, enabling a comparison of the two configurations to be made.” (Cox & Cox, 2000, p.7). Other MDS techniques include biplots, unfolding and correspondence analysis.

Individual differences model provides an overall configuration of points, termed group stimulus space, with a configuration of points in subject (individual) space. Group space presents the objects and forms the *underlying* configuration of points. Individuals are presented as points in subject space, with the coordinates of each weighted, to provide the weighted Euclidean distance between the points in group space (Cox & Cox, 2000).

An individual differences model (INDSCAL) was developed by Carrol and Chang (1970), although Tucker and Messick (1963) had proposed a method that utilized the mean of individuals. The INDSCAL method converts the dissimilar data into distance estimates. Weightings are found by least squares and individual distances are doubled centred to produce matrices. Recurring least square is then applied until convergence is achieved. The INDSCAL algorithm utilized within the study being:

$$\delta_{rs} = \left\{ \sum_i w_i (x_{ri} - x_{si})^2 \right\}^{1/2}$$

MDS was used within the study as the additional statistical procedure to elicit further *underlying risk perceptions* within the research data and support the psychometric paradigm analysis. MDS provided “a way of reducing the data ... to two dimensions representing the hidden structure of the data. By finding key differences between ...

opposite ends of each dimension, we can attempt to develop indicators of variables that can be measured” (Kruskal & Wish, 1978, p.5).

INDSCAL provided a measure of subject space, through spatial representation. This also presented the angular separation and vector length of the configuration of points, which can demonstrate “salience that the individual attributes to each dimension of subject space” (Smith, 1984, p.95). This method is referred to as the Analysis of Angular Variation (ANAVA), which can be utilized to provide further analysis of difference between groups (Mardia, 1972).

### ***3.6 Research Methodology***

This section presents the primary research theories that supported the research methodologies utilized within the study. These include the descriptive methodology, use of the Likert Scale to measure the risk perception of the target population, and the assessment and selection of an appropriate sampling size.

#### ***3.6.1 Methodology***

A number of previous psychometric studies had utilized descriptive methodology to measure the perception of risk (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1992; Slovic 1997). The descriptive method was suited to these types of studies and measured what existed through observation (Gay, 1981). Observation views individuals and measures defined variables, but does not attempt to influence a response (Multivariate statistical analysis, n.d). This met the research objectives of the study and was consistent with previous psychometric studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997).

#### ***3.6.2 Likert Scale***

The risk perception of the five activities and technologies were tested using a qualitative test instrument, utilizing a seven point Likert Scale. The Likert Scale comprises of a number of statements that are designed to elicit the participant’s perception towards a

particular topic (Aiken, 1997). The survey questionnaire should be constructed with both positive and negative statements (Hopkins, 1990), with the polarity realigned in the data analysis.

The Likert Scale was chosen for a number of reasons. Previous psychometric studies utilized this method (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997) and the Likert scale has been utilized extensively in opinion research. There is a robustness within the statements, as correctness was not critically important, only that the participants could express their varying degrees of opinion (Best, 1981). The Likert Scale assigns a numerical value from *strongly agree* to *strongly disagree* statements. The scale can be realigned to all positive values, and the mean score from each participant and mean total produced. This indicated the sense of risk perception for each factor *dread risk* and *familiarity to risk*.

But there are a number of possible errors with Likert Scales. The participants may not really know what they feel, the nature of the issue may be abstract or they may never have considered the issue. They may also only express their opinion, as opposed to their true feeling or perception (Best, 1981). The possible non-linear nature of the scale has to also be considered, as the scale may have differing values for individuals. Finally, the Likert Scale does not provide an opportunity for wider independent thought among the test participants, possibly restricting their response (Aiken, 1997). Therefore, it was necessary to infer that the instrument was measuring perception, demonstrated by the repeated and consistent results achieved.

### ***3.6.3 Population Sampling Size***

Probability sampling supported the study, utilizing simple random sampling techniques. Participants are selected from within the population in a random, but defined method (Fink, 1995; Best, 1981). The target population were community members within a defined geographical area, representative of the population. National census data was utilized to provide population data. The census data can also provide secondary

analysis to statistically demonstrate that the target population is representative of the population (Fink,1995; De Vaus, 1992).

To achieve a statistical valid sample of the population, Fink (1995) and Leedy (1989) suggested  $\geq 30$  per cell and De Vaus (1993) 50 to 100 per cell. Consideration has to be taken for possible variations in characteristics, with linear division through the cells. Although, there has to be a compromise between sample size, cost, accuracy and the objectives of the study (De Vaus, 1993). The study utilized nine research cells and sample size of 135 participants, producing  $\geq 15$  participants per cell. But with linear variations in characteristics through the cells, this could produce a possible sample size of  $\geq 3.38$  per cell. Although not achieving statistical appropriate sample size in each cell, the sample size was deemed to be appropriate for the objectives of the study. This being to demonstrate the spatial representation of public street surveillance.

### **3.7 Conclusion**

This chapter provided the theoretical framework for the study and theories supporting the methodology. This included the psychometric paradigm, psychometric risk perception causal relationship model, definition of the term *risk perception*, statistical analysis technique of MDS and primary theories that supported the research methodologies.

The psychometric paradigm measures and assesses the social risk perception and therefore, risk acceptance of activities and technologies. This presented risk perception as a two factor analytical representation, with factor one defined as *dread risk* and factor two as *familiarity to risk*. The risk factors are further expanded into the characteristics of risk, where nine characteristics were utilized as the independent variables of social risk perception. The characteristics for *dread risk* being controllability of risk, risk to future generations and whether exposure to the risk was voluntary. The *familiarity to risk* characteristics being how observable was the risk, whether the risk was known to those exposed, age of risk and immediacy of risk.

To provide proximal data, demonstrate research instrument reliability and validity, four additional *control* activities and technologies were tested. These were radioactive waste, home swimming pools, drinking water chlorination and coal mining disease. The additional activities and technologies not only provided spatial relationship comparisons of public street surveillance, but also allowed a comparison of previous psychometric studies.

The term *risk perception* was used throughout the study. Slovic (1992; 1997) utilized this term in his research and it was maintained to provide continuity. Also, the study measured not only perceptions, but also attitudes and beliefs. Psychology defines perception and attitude as two distinct processes, but in social psychology they are closely interrelated. Perception and attitude are cognitive, affect each other and are interrelated. Therefore, the term *risk perception*, was used cognisant that it refers to the social psychology definition, which includes perceptions, attitudes and judgements.

MDS is a statistical technique within the area of multivariate data analysis. MDS reduces complex dimensional data and presents these data in a spatial representation. The reduction in data complexity, through presentation in dimensional space, allows hidden structure to be shown in data. This demonstrates object proximity, with *proximity* being how similar or dissimilar objects are or are perceived to be.

MDS commences with a set of objects, which are paired and dissimilarities measured. The distances between pairs of objects are placed in a half matrix format. Configurations of points are sought in dimensional space, with each point representing an object. The aim of MDS is to find a dimensional space configuration where the points distance *match* as close as possible, the paired dissimilarities. The different notions of *matching* define the different techniques of MDS. MDS was used within the study as an additional statistical procedure to elicit further *underlying* group and

individual risk perceptions. MDS models used were the Classical Euclidean Distance and Individual Differences (Weighted) Scaling (INDSCAL) models.

A number of psychometric studies had utilized descriptive studies and Likert Scales to measure the perception of risk (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997; Slovic 1992). Likert Scales had also been utilized extensively in opinion research (Best, 1981). Likert Scales comprise of a number of statements that are designed to elicit the participant's perceptions, with statements from *strongly agree* to *strongly disagree* assigned numerical values. But Likert Scale could be prone to errors, as participants may not know what they feel, the nature of the issue, the issue may be abstract or the scale could limit wider independent response.

Probability sampling supported the study data collection, using simple random sampling techniques. This involved selecting participants from within a population in a defined, but random method (Fink, 1995; Best, 1981). The study utilized nine research cells and a sample size of 135 participants, producing  $\geq 15$  participants per cell. But with linear variations in characteristics through the cells, this could produce a possible sample size of  $\geq 3.38$  per cell. The sample size was deemed to be appropriate for the objectives of the study.

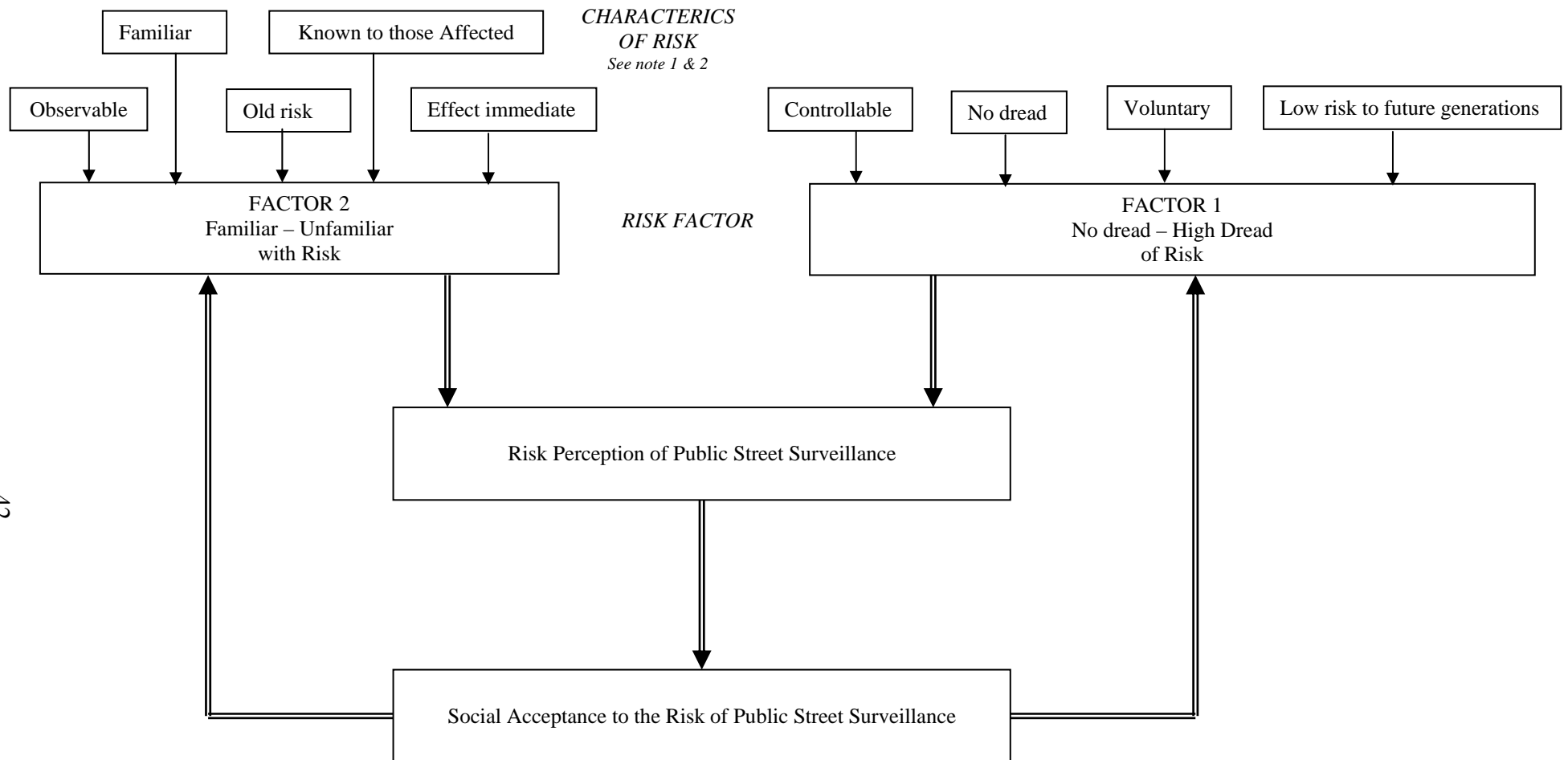


Figure 3.4. Psychometric risk perception causal relationship model, showing the independent variables characteristics of risk.

Note:

1. Only the most optimistic characteristic of the outcome have been included.
2. The order or location of the Risk Characteristics gives no importance or power over others.

## Chapter 4

### *Materials & Method*

#### ***4.1 Introduction***

This chapter provides a description on the methodology utilized within the research study. It presents the target population (Section 4.2), study design (Section 4.3), research instrument (Section 4.4) and an overview on how the collected data were analyzed (Section 4.5). Draft pilot studies were performed to assess the suitability of the research instrument and method of research (Section 4.6). This section examines the development and assessment of the research instrument, with the pilot instrument validity and reliability provided. The academic review of the research proposal and recommended research changes to improve the study are discussed (Section 4.7).

Data collection methodology ensured a random collection of data (Section 4.8). A pilot study (N=20) followed from the draft pilot studies and utilized target population participants (Section 4.9). This section includes the pilot study demographics, instrument reliability and validity, pilot study spatial factor representation, and final instrument modifications. Finally, research study limitations (Section 4.10) and applied ethics (Section 4.11) complete this chapter.

#### ***4.2 Target Population***

The target population (N=2106) were community members who lived and/or worked within 0.5km distance of Rockingham beachfront, within the City of Rockingham, Western Australia, and who were  $\geq 16$  years old at the time of survey. A sample of participants (N=135) were taken from the target population.

The research area is a prime tourist location within Rockingham and is utilized by both local people and visitors. The area comprises of mixed commercial, residential and tourist zones. Commercial enterprise includes hospitality, retail and medical



businesses. Residential zones are generally medium to low density housing, ranging in value from A\$80,000 to A\$1,500,000, while tourist attractions include a local museum, tourist bureau, markets, retail outlets, foreshore parks, boardwalk, hospitality and the beach.

The local shire installed a public street surveillance system within the centre of the geographical target population nucleus. This comprised of two cameras placed at each end of Railway Terrace (Appendix C, Geographical research location). The cameras were pan, tilt and zoom (PTZ) cameras, controlled and recorded from the local Police Station. The Police Station was located approximately 2.5km from the cameras and monitored via a microwave link. The public street surveillance operators consisted solely of Police Officers. There was also an additional monitor, which repeated the Police monitoring, located in the Rockingham Shire Security Manager's office.

#### ***4.3 Study Design***

The study comprised an initial pre-survey, which presented the spatial loading of the participants as a social group within the psychometric paradigm. Once the public street surveillance system had been installed and operating for approximately six months, the post-survey was completed. Both pre and post studies utilized the same survey instrument. To assess the suitability of the research methodology and survey instrument additional pilot studies were completed. This included two draft pilot studies and a final pilot study. The phases of the study (Figure 4.1) provided a structured approach to the development and application of the research method.

INSERT FIG 4.1 – Research flow chart. (WHOLE PAGE)

The study contained three distinct research items, being the introduction letter, general information survey and the pre and post survey. The introduction letter provided research information to the participants and contained the informed consent. The general information survey and pre/post survey were combined into a single questionnaire. This questionnaire became the research instrument, designed to gather the research data.

An introduction letter (Appendix A), stating the intent of the research, the researcher's contact details and ethical issues was supplied to the participant before any data was gathered. This introduction letter highlighted that participation in the study was voluntary, that the participant could withdraw at any point, that data collected would remain strictly confidential at all times, that data would not be used outside this research, that the participant would not be named or identified in any manner within the research thesis and that ethical approval had been given by Edith Cowan University. This letter also included the consent form for the participant to sign.

#### ***4.4 Research Instrument***

The general information survey and pre/post survey were combined to provide a single research instrument, being the survey questionnaire (Appendix B). This survey questionnaire contained two distinct parts. Part 1 was the general information survey, with part 2 being the pre/post risk perception survey.

##### ***4.4.1. Part 1. General Survey***

The general survey gathered specific data about the participants, being gender, age group and distance to the centre of the geographical research nucleus. It was designed to gather general information, provide subgroups within the data results and to determine whether certain subgroups may have been significantly more affected. It comprises of a total of 12 research cells, although with the amalgamation of the group "distance to the centre of Rockingham" this was effectively reduced to nine cells.

#### **4.4.2. Part 2. Pre/Post Survey**

The primary instrument within the study was the pre/post risk perception survey, using a seven point Likert test. The draft pilot survey contained a total of five activities and/or technologies, with two factors containing 10 questions per factor. This resulted in two questions for each selected risk characteristic and a total of 20 questions per activity or technology. The final survey contained 12 questions per activity or technology, with six questions on each factor and one question on each risk characteristic. This allowed analysis and subsequent selection of questions during the draft pilot and pilot studies to improve the reliability and validity of the survey questionnaire. The survey questionnaire was constructed with both positive and negative statements, in accordance with Hopkins (1990), with the polarity realigned in the data analysis matrix. The matrix listed participants only as a number, ensuring that there was no ability for participants to be identified at any point in the survey, maintaining research ethics.

The survey questionnaire contained five activities and technologies, being *public street surveillance*, *radioactive waste*, *home swimming pools*, *drinking water chlorination* and *coal mining disease*. The four additional activities and technologies were chosen, as according to Slovic (1997), they represented one object from each quadrant of the spatial factor representation model. This provided spatial relationship comparisons of where public street surveillance was located, but also allowed a comparison of previous psychometric studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997). The ability to provide a spatial match between longitudinal research studies further supported the reliability and validity of the research instrument.

#### **4.5 Data Analysis**

The collected data results were placed into a data analysis matrix, developed in Microsoft® Excel 97. The negative polarity questions were reversed, to produce all positive outputs. Each measured activity and technology had a summed mean total and

standard deviation (SD) for each factor. The general survey data were also converted into numerical data. For example, those participants who's current age was 16-25 years old were assigned a "1", those participants who's current age was 26-35 years old were assigned an "2", etc. This allowed statistical analysis of the general survey data. The data was further analyzed using SPSS statistical program (Table 4.1).

Table 4.1

*Statistical Analysis Program*

SPSS for Windows Student Version
Release 10.0.5 (5 January 2000)
Product limit to 50 cases, 1500 variables
Copyright © SPSS Inc., 1989-1999

Relevant data were imported into the statistical program (SPSS) for data analysis. Data analysis, beyond reliability and validity, included:

- Mean and SD between the pre survey, post survey, research cells, and activities and technologies.
- T tests (paired) to demonstrate significance differences between the pre survey, post survey and research cells totals, at  $\geq 95\%$  confidence level.
- Spatial factor representation analysis and distribution of the mean and individual totals, to demonstrate the location of activities and technologies.
- Multidimensional Scaling (MDS) Euclidean distance model of the total means to present the spatial dimensional representation distribution of group space.
- Multidimensional Scaling (MDS) INDSCAL model of the individual means to present the spatial dimensional representation distribution of group space.
- Spatial factor and dimensional representation analysis and distribution comparisons.

#### ***4.6 Overview of the Draft Pilot Studies***

Two draft pilot studies were performed to assess the suitability of the survey questionnaire and method of research. This developed and assessed the research instrument, allowed improvements to be made to the survey questionnaire and ensured that the instrument was acceptable for progression to the pilot study. This also demonstrated an acceptable validity and reliability result of the survey questionnaire. During this phase changes were made to the survey questionnaire, including the planned reduction in survey questions through the removal of *poor* questions, rearrangement of the activities and technologies, and changes in semantics.

Reliability of the survey questionnaire was tested to demonstrate that the “measure will produce the same result from one occasion to another.” (Clark-Carter, 1997, p.27). The alpha reliability of the survey questionnaire was checked at each development phase, including the draft surveys, pilot survey and between each independent factor. This demonstrated the reliability of the survey and ensured that the final survey produced an acceptable alpha reliability measure. As Malim stated “it is very important that any test which is used in a piece of research should be reliable” (1997, p.46).

The validity of the questionnaire was tested through the measure of face validity and concurrent validity. These items were tested to demonstrate the “extent to which the research instrument measures what it developers purport it to measure.” (Angus & Gray, 2001, p.23). Concurrent validity used Pearson product moment correlation coefficient and was utilized as it “measures the extent to which two variables are related to one another.” (Malim & Birch, 1997, p.42). This demonstrated the measure of consistency between the responses of each independent factor at each survey phase.

##### ***4.6.1 Draft Pilot Survey 1***

The draft pilot survey tested the survey questionnaire on participants (N=11) who worked within the researcher’s workplace, comprising of females (N=5) and males (N=6). The survey questionnaire contained the five activities and technologies, with

two factors each with 10 questions. The activities and technologies were arranged in the order of home swimming pools, coal mining disease, drinking water chlorination, radioactive waste and public street surveillance. Each participant was also given a copy of the introduction letter.

After each participant had completed the questionnaire, they were asked predefined questions. They were also timed on how long they took to complete the research instrument, resulting in a mean time of 17.6 minutes (SD 5.08). The participants were asked to grade each predefined question from a scale of one to five, with one being “very easy”, three being “moderate” and five being “very hard”. This achieved the following results (Table 4.2).

Table 4.2

*Draft Pilot Survey 1 Predefined Survey Questions*

<b>Predefined draft pilot survey 1 questions</b>	<b>Description</b>	<b>Mean</b>	<b>SD</b>
In your opinion, was the questionnaire well laid out?	Moderate	2.5	0.67
Were instructions simple, to the point and provided sufficient direction?	Very easy	1.4	0.67
Did you find the questions easy to read?	Easy to moderate	2.5	1.21
Could you understand the questions?	Easy	2.7	0.84
Did you feel the survey was relevant to the problem discussed in the Intro Letter?	Easy	2.2	0.98
Would you be willing to do the survey again?	Yes 82%		No 18%
Approximately, how long did it take to read the Intro Letter and do the survey?	17.6 minutes		5.08

The completion, analysis and interpretation of the pilot draft study resulted in a number of changes to the survey questionnaire. This included the rearrangement of the activities and technologies, a change in the semantics, and a reduction in the research cells and survey questions.

The rearrangement of the activities and technologies provided the participants with the ability to become accustomed to the survey questions with an activity or technology that they appeared and later demonstrated, to have a strong (high) sense of risk perception towards. This resulted in the survey questionnaire being presented in the order of radioactive waste, drinking water chlorination, home swimming pools, coal mining disease and public street surveillance.

The semantics of the survey questions was changed to read in the first person i.e. change “people” to “I” or “me”. Also, the removal of the use of *activities and technologies* in the survey questions and replacement with the actual activity or technology being tested. This allowed the survey questions to elicit the participant’s true risk perceptions, be more defined, easier to read and further remind the participant what activity or technology they were completing.

The questionnaire took the participants (N=11) a mean time of 17.6 minutes (SD 5.08) to complete. This was considered too long, although the questionnaire was to be reduced from 10 questions to six questions per factor for the final survey questionnaire. This reduced the number of survey questions from a total of 104 to a final total of 64. In the general survey, the qualification cell began with “year 10”. Some participants noted that they did not have this level of qualification. Therefore, this question was amended to read “year 10 or less”. Although in the later development of the survey instrument, this question was removed from the survey questionnaire (Section 4.7).

The gathered data were compiled and tested for reliability (Table 4.3), using the Alpha (Cronbach) reliability model. This produced a *dread* (factor 1) mean of 0.5 (SD 0.24) and a *familiarity* (factor 2) mean of 0.8 (SD 0.03). From this result, the questions 3, 7, 8, 9, 14, 16, 17 and 20 were removed from the draft pilot survey questionnaire. This reduced the two factors down to a total of six questions per factor and resulted in all but coal mining disease *dread* (0.6), radioactive waste *dread* (0.6) and public street surveillance *dread* (0.8) producing high (Angus & Gray, 2001) results ( $\geq 0.8$ ).



Table 4.3

*Draft Pilot Study 1 using Ten Questions: Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>					
<b>ITEM</b>		<b>Factor 1 – Dread</b>		<b>Factor 2 – Familiarity</b>	
Radioactive waste DRED		0.5			
Radioactive waste FAM				0.8	
Drinking Water Chlorination DRED		0.5			
Drinking Water Chlorination FAM				0.8	
Home swimming pools DRED		0.8			
Home swimming pools FAM				0.8	
Coal mining disease DRED		0.4			
Coal mining disease FAM				0.8	
Public street surveillance DRED		0.1			
Public street surveillance FAM				0.8	
<b>MEAN</b>	<b>SD</b>	<b>0.5</b>	<b>0.24</b>	<b>0.8</b>	<b>0.03</b>

Face validity (Table 4.2) received an acceptable response from the participants (mean 2.2, SD 0.98). The participants appeared to feel that once they had completed the survey questionnaire, that there was a clear relationship between the context of the study (detailed in the introduction letter) and survey questionnaire. But before completing the public street surveillance questions, they did not feel that there was a comparison.

Concurrent validity was tested using the Pearson two tailed correlation at a  $\geq 95\%$  confidence rate. This was completed between the response for each factor of the five activities or technologies, with results ranging from low to high. These were not conclusive in defining final selection of questions. The mean and SD measure for both factors of all activities and technologies produced a low to moderate result (Table 4.4), but produced a moderate total (mean 0.4, SD 0.06).

Table 4.4

*Draft Pilot Study 1 using Ten Questions: Pearson Two Tailed Correlation Mean & SD*

<b>ITEM</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Radioactive waste DRED	44	0.3	0.27
Radioactive waste FAM	44	0.4	0.22
Water chlorination DRED	45	0.4	0.24
Water chlorination FAM	44	0.4	0.24
Home swimming pools DRED	44	0.4	0.19
Home swimming pools FAM	45	0.5	0.28
Coal mining disease DRED	45	0.3	0.15
Coal mining disease FAM	44	0.4	0.21
Public street surveillance DRED	45	0.4	0.26
Public street surveillance FAM	42	0.4	0.24
Person two tailed correlation @ ≥95% confidence rate.			

#### **4.6.2 Draft Pilot Survey 2**

A second draft pilot survey was completed to further test the revised survey questionnaire, again on participants (N=11) from the researchers workplace, but comprising of females (N=6) and males (N=5). The survey comprised of participants (N=6) who had not previously completed the survey and participants (N=5) who had previously completed the survey. The revised draft pilot survey questionnaire contained six questions per factor, with two factors for the five activities and technologies, resulting in a total of 64 questions.

The revised questionnaire took the participants a mean time of 7.8 minutes (SD 2.45) to complete and this was considered acceptable. The participants were again asked a number of predefined questions, with the following results (Table 4.5). When compared to the draft pilot survey 1 (Table 4.2), this demonstrated a reduction in mean for the majority of predefined questions. All questions apart from “Were instructions simple, to the point and provided sufficient direction?” reduced, demonstrating an improvement in the survey questionnaire. Additionally all predefined questions standard deviations reduced (SD mean total: 1=0.88, 2=0.56), indicating commonly held views among the participants.

Table 4.5

*Draft Pilot Survey 2 Predefined Survey Questions*

<b>Predefined Draft Pilot Survey 2 Questions</b>	<b>Description</b>	<b>Mean</b>	<b>SD</b>
In your opinion, was the questionnaire well laid out?	Easy	1.6	0.50
Were instructions simple, to the point and provided sufficient direction?	Very easy	1.4	0.50
Did you find the questions easy to read?	Easy to moderate	2.0	0.63
Could you understand the questions?	Easy	1.8	0.60
Did you feel the survey was relevant to the problem discussed in the Intro Letter?	Easy	1.9	0.57
Would you be willing to do the survey again?	Yes 82%		No 18%
Approximately, how long did it take to read the Intro Letter and do the survey?	7.8 minutes		2.45

The gathered data from the second draft pilot survey was compiled and tested for reliability, using the Alpha (Cronbach) reliability model. Each activity or technology factor was tested and all but coal mining disease *dread* (0.7), radioactive waste *dread* (0.6) and public street surveillance *dread* (0.5) produced results that were  $\geq 0.7$ . This produced a high Alpha mean result for *familiarity* (factor 2) of 0.8 (SD 0.09), but only a moderate result for *dread* (factor 1) mean of 0.7 (SD 0.12).

Table 4.6

*Draft Pilot Study 2 Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>					
<b>ITEM</b>		<b>Factor 1 – Dread</b>		<b>Factor 2 – Familiarity</b>	
Radioactive waste DREAD		0.6			
Radioactive waste FAM				0.8	
Drinking Water Chlorination DREAD		0.8			
Drinking Water Chlorination FAM				0.7	
Home swimming pools DREAD		0.8			
Home swimming pools FAM				0.9	
Coal mining disease DREAD		0.7			
Coal mining disease FAM				0.7	
Public street surveillance DREAD		0.5			
Public street surveillance FAM				0.9	
<b>MEAN</b>	<b>SD</b>	<b>0.7</b>	<b>0.12</b>	<b>0.8</b>	<b>0.09</b>

Face validity received an acceptable (1.9, SD 0.57) response from the participants (Table 4.5). Again, the participants appeared to feel that once they had completed the survey questionnaire, that there was a clear relationship between the context of the study and survey questionnaire. Concurrent validity was tested using the Pearson two tailed correlation at a  $\geq 95\%$  confidence rate. This was completed between each response for each factor of the five activities or technologies. The mean and SD measure for both factors of all activities and technologies produced results ranging from low to high (Table 4.7), but a low Pearson validity mean measure of 0.5 (SD 0.09).

Table 4.7

*Draft Pilot Study 2 Using Six Questions: Pearson Two Tailed Correlation Mean & SD*

<b>ITEM</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Radioactive waste DREAD	15	0.3	0.17
Radioactive waste FAM	15	0.4	0.18
Water chlorination DREAD	15	0.4	0.22
Water chlorination FAM	15	0.5	0.26
Home swimming pools DREAD	15	0.5	0.26
Home swimming pools FAM	15	0.6	0.23
Coal mining disease DREAD	15	0.4	0.21
Coal mining disease FAM	15	0.5	0.26
Public street surveillance DREAD	15	0.5	0.25
Public street surveillance FAM	15	0.5	0.21
Person two tailed correlation @ $\geq 95\%$ confidence rate.			

A spatial factor representation analysis was completed, using the mean totals of all participants in each activity or technology. The spatial factor representation reflected a similar spatial distribution response to that achieved by Slovic (1997; 1992) studies, when considering the quadrant alignments. Although, drinking water chlorination was located in the *high dread* and *familiar risk* quadrant, as opposed to a *low dread* and *unfamiliar risk* (Figure 4.2).

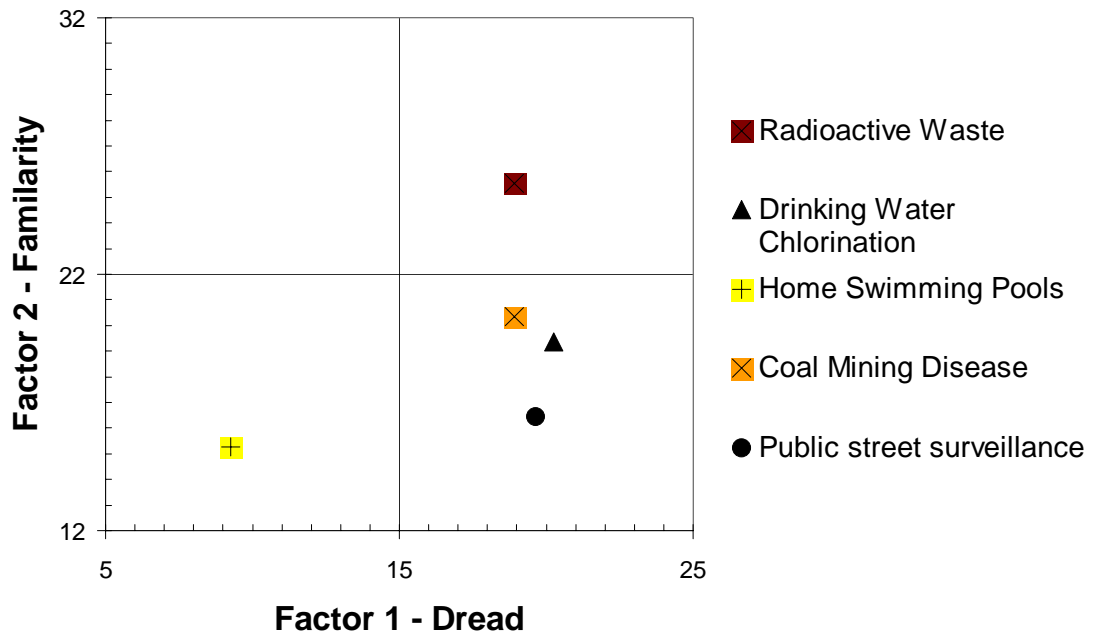


Figure 4.2. Draft pilot study 2 spatial factor representation result.

It was important that previous psychometric research results (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997; Slovic, 1992) could be emulated, ensuring that the research instrument demonstrated high concurrent validity. Also, to be able to confidently demonstrate where public street surveillance was located within the psychometric model. This was achieved with a 75% matching spatial factor result [three of four activities or technologies located within the correct spatial factor quadrant].

#### 4.6.3 Draft Pilot Survey Test Comparison

The data from both draft pilot surveys were analyzed and compared, with the final mean and SD for each survey factor given (Table 4.8). It should be noted that the range between each draft pilot survey changed, due to the decrease from 10 questions per factor, to six questions per factor in the second draft survey.

Table 4.8

*Pilot Draft Survey 1 & 2: Mean & Standard Deviation Results*

ITEM	FACTOR 1 – Dread				FACTOR 2 – Familiarity			
	Mean	Mean	SD	SD	Mean	Mean	SD	SD
Survey No. <sup>3</sup>	1	2	1	2	1	2	1	2
Radioactive waste	43.0	25.5	4.65	3.86	32.0	18.9	8.76	5.05
Water chlorination	37.5	19.3	5.70	4.86	35.4	20.3	6.87	4.38
Home swimming pools	25.0	15.3	7.36	5.46	21.7	9.3	8.17	4.05
Coal mining disease	31.7	20.4	4.63	4.50	25.2	18.9	7.26	4.55
Public street surveillance	31.8	16.5	4.12	4.16	30.0	19.6	8.99	6.39
Notes: 1. Total min/max mean for study 1 = 10 to 50. 2. Total min/max mean for study 2 = 10 to 30. 3. Change in measure due to a reduction from 10 to 6 questions between survey 1 and 2.								

Between the draft pilot study 1 and 2, there was a decrease in the SD on all activities and technologies, excluding public street surveillance *dread* (4.1, 4.2). This demonstrated that the changes in the questionnaires, in both factors, produced a less diverse view of opinions for the majority of the activities and technologies. The time between participants completing study 1 and study 2 was approximately two weeks. This may have affected some of the participant's responses through their long-term memory retention, although this affect was reduced through the use of six new participants.

There was a number of significant results gathered from the participants (N=5) who completed both draft pilot studies, through a comparison between these survey results. The mean between both draft pilot studies remained relatively constant (Table 4.9) and this demonstrated a high correlation in both factors (Table 4.10).

Table 4.9

*Draft Pilot Study 1 and 2: Total Participants Means Who Completed Both Studies*

ITEM Survey No.	FACTOR 1 – Dread		FACTOR 2 – Familiarity	
	1	2	1	2
Radioactive waste	27.8	26.4	15.6	20.6
Water chlorination	21.2	19.4	19.2	21.4
Home swimming pools	17.0	15.2	8.4	7.4
Coal mining disease	20.8	19.8	12.4	20.0
Public street surveillance	19.6	16.6	18.4	18.0

Table 4.10

*Mean Total Factor Correlation (Pearson Two Tailed) between Draft Pilot Study 1 & 2*

<b>Pearson Correlation</b>	<b>Study 1 Dread</b>	<b>Study 2 Dread</b>
<b>Study 1 Dread</b>	1	0.9868**
<b>Study 2 Dread</b>		1
<b>Pearson Correlation</b>	<b>Study 1 Fam</b>	<b>Study 2 Fam</b>
<b>Study 1 Familiarity</b>	1	0.7769*
<b>Study 2 Familiarity</b>	.	1
* Correlation is significant at the 0.05 level (2-tailed)		
** Correlation is significant at the 0.01 level (2-tailed)		

*Familiarity* (factor 2) demonstrated consistency between the first and second draft pilot study (Tables 4.9, 4.10 and 4.11). But *dread* (factor 1) did not provide a consistent result, as coal mining disease relocated from position four within the order of highest perceived risk in activities and technologies, to position two (Table 4.11). All other items remained within the sequential order of perceived risk. But the Pearson correlation measure (Table 4.10) for *dread* (factor 1) was high (0.9868).

The relocation of coal mining disease may have been caused by a number of reasons. One new participant to the draft pilot study 2 had a mother who had died of a medical respiratory condition known as “coal miners disease”. There was also a relatively short time span between surveys, allowing the participants time to think about the survey.

But this relocation was not considered significant, considering the high correlation measures.

Table 4.11

*Activities & Technologies: Order of Perceived Risk.*

ITEM	FACTOR 1 – Dread		FACTOR 2 – Familiarity	
	Survey 1	Survey 2	Survey 1	Survey 2
<b>Highest</b>  <b>to</b>  <b>Lowest</b>	Radioactive	Radioactive	Water chl	Water chl
	Water chl	<b>Coal min dis</b>	Radioactive	Radioactive
	Public surveill	Water chl	Public surveill	Public surveill
	<b>Coal min dis</b>	Public surveill	Coal min dis	Coal min dis
	Hswim pools	Hswim pools	Hswim pools	Hswim pools

Individual factor responses, between study 1 and study 2, of the five activities or technologies were also tested using the Pearson correlation measure. *Dread* (factor 1) produced a moderate to high result, with the moderate result achieved with radioactive waste (0.4065) to the high result for home swimming pools (0.9198). *Familiarity* (factor 2) produced a moderate to high results, with the moderate result achieved with coal mining disease (0.3227) to a high for home swimming pools (0.9906). This demonstrated that there was a moderate to high correlation between the draft pilot studies in both factors (Table 4.12).



Table 4.12

*Individual Mean Factor Correlation (Pearson Two Tailed) between Draft Pilot Study 1 and 2*

<b>Pearson correlation</b>		
	<b>Rawdred Study 1</b>	<b>Rawdred Study 2</b>
<b>Rawdred Study 1</b>	1	0.4065
<b>Rawdred Study 2</b>	.	1
	<b>Rawfam Study 1</b>	<b>Rawfam Study 2</b>
<b>Rawfam Study 1</b>	1	0.7484
<b>Rawfam Study 2</b>	.	1
	<b>Wchdre Study1</b>	<b>Wchdre Study 2</b>
<b>Wchdre Study 1</b>	1	0.6892
<b>Wchdre Study 2</b>	.	1
	<b>Wchfam Study 1</b>	<b>Wchfam Study 2</b>
<b>Wchfam Study 1</b>	1	0.5308
<b>Wchfam Study 2</b>	.	1
	<b>Hspdred Study 1</b>	<b>Hspdred Study 2</b>
<b>Hspdred Study 1</b>	1	0.9198
<b>Hspdred Study 2</b>	.	1
	<b>Hspfam Study 1</b>	<b>Hspfam Study 2</b>
<b>Hspfam Study 1</b>	1	0.9906
<b>Hspfam Study 2</b>	.	1
	<b>Cmddre Study 1</b>	<b>Cmddre Study 2</b>
<b>Cmddre Study 1</b>	1	0.7381
<b>Cmddre Study 2</b>	.	1
	<b>Cmdfam Study 1</b>	<b>Cmdfam Study 2</b>
<b>Cmdfam Study 1</b>	1	0.3227
<b>Cmdfam Study 2</b>	.	1
	<b>Cctvdre Study 1</b>	<b>Cctvdre Study 2</b>
<b>Cctvdre Study 1</b>	1	0.7835
<b>Cctvdre Study 2</b>	.	1
	<b>Cctvfam Study 1</b>	<b>Cctvfam Study 2</b>
<b>Cctvfam Study 1</b>	1	0.8191
<b>Cctvfam Study 2</b>	.	1

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance)

#### **4.6.4 Draft Pilot Summary**

The two draft pilot studies assessed the suitability of the survey questionnaire and research methodology, and allowed improvements to be made to the survey

questionnaire to ensure that the research instrument was acceptable for progression onto the pilot study. These also demonstrated an acceptable validity and reliability result of the survey questionnaire. During this phase, changes were made to the survey questionnaire, including the planned reduction in survey questions through the removal of *poor* questions, rearrangement of the activities and technologies, and changes in semantics.

Draft pilot study 1 Alpha reliability for the initial ten question research instrument achieved a moderate mean result (0.5, SD 0.24) for *dread* (factor 1) and a high mean result (0.8, SD 0.03) for *familiarity* (factor 2). Removal of *poor* questions, to a six question research instrument, produced a high (Angus & Gray, 2001) result ( $\geq 0.8000$ ), except for coal mining disease *dread* (0.6213), radioactive waste *dread* (0.6419) and public street surveillance *dread* (0.7576). Face validity produced an acceptable mean (2.2, SD 0.98) measure. Concurrent validity was tested using the Pearson two tailed correlation measure and ranged from moderate to high, with a moderate mean total (0.4, SD 0.06). Although this was a measure between single factors, the factor comprised of different risk characteristics. Therefore, it was expected that these different risk characteristics would produce lower correlation measures.

Draft pilot study 2 Alpha reliability achieved a high result (0.8, SD 0.09) for *familiarity* (factor 2), but only a moderate result (0.7, SD 0.09) for *dread* (factor 1). Face validity received an acceptable mean response (1.9, SD 0.57) from the surveyed participants. Concurrent validity was tested using the Pearson two tailed correlation at measure. The results ranged from moderate to high, with a moderate mean total (0.5, SD 0.09). But as with study 1 results, this was a measure between risk characteristics.

The draft pilot studies Pearson correlation mean totals were compared, demonstrating a high (0.9868) result for *dread* (factor 1) and a moderate (0.7769) result for *familiarity* (factor 2). The order of perceived risk also stayed consistent, apart from coal mining disease. The individual responses to *dread* (factor 1) and *familiarity* (factor 2) also produced a moderate to high result between the draft pilot studies.

Spatial factor representation analysis, using the mean totals of all participants, reflected a similar spatial distribution response to those achieved by previous psychometric studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997), when considering quadrant alignment. Although drinking water chlorination was located in the *high dread* and *familiar risk* quadrant, as opposed to a *low dread* and *unfamiliar risk*. This achieved a high (75%) matching spatial representation result.

Although the research instrument did not produce all high measures of validity and reliability throughout all factors, this was due to the diverse nature of the measured activities and technologies. This produced diversity in the survey instrument and required a compromise on the final risk perception survey questions, while attempting to maintain high results across all activities and technologies. But, the draft pilot studies had produced moderate to high and consistent results for both reliability and validity, demonstrating that the research instrument was suitable for progression onto the main study.

#### ***4.7 Research Proposal Review***

During the research proposal seminar and subsequent reviewer report performa, the academic reviewers raised a number of research concerns. This section expands on some of the more poignant items including the definition of public street surveillance, the purpose of the study, the use of the Likert scale, the application of the psychometric model, the terminology of *risk perception* and the size of the proposed sample size.

The term Closed Circuit Television (CCTV) was originally used throughout the research proposal, as opposed to public street surveillance. There was a concern that the definition of *CCTV* was too broad to be able to achieve a valid research outcome. Also, that the target population may have differing views on what was *CCTV* and this may introduce variance in the ability to measure their likely risk perception to this technology. It was suggested that *CCTV* domains be developed to further define the research definition (Figure 1.2). This was developed into the definition of *public street surveillance* and the generic reference to *CCTV* was removed.

In the initial research proposal, it was suggested that one purpose of the study was to ensure that any social relocation or issues that may be a driving force can be proactively addressed and processes put into place by practitioners to reduce any negative relocation. This would provide the security industry with a method to assess current social concerns, raise internal and external awareness, and therefore reduce likely adverse relocation. It would also ensure that society could be provided with the most socially appropriate and effective crime reduction or security solution. But due to their complex and interwoven nature, this research would not attempt to address what relocation issues may increase social risk perception or how these may be reduced, relocated or eliminated.

During the academic review process, there was debate on the need to achieve this practitioner outcome. Therefore the study purpose was further defined, in the context of the target population, to provide academia with the social risk perception of public street surveillance. Also, demonstrate whether increased exposure significantly affects the social risk perception of lay people or certain demographic groups.

The use of a five point Likert scale was originally proposed and utilized during the draft pilot studies. But to provide an increased ability for participants to demonstrate subtle changes in risk perception, this was expanded to a seven point Likert scale. The seven point Likert scale also matched the scaling utilized by Slovic (1997; 1992).

The psychometric paradigm measured physical risk perception, whereas the risk perception of public street surveillance may be seen as intellectual or privacy risk. How previous researched activities and technologies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997) compared between these risks was not assessed until the study data was gathered and analyzed. But this study did demonstrate that both physical and intellectual risk could be measured using the psychometric paradigm.

The research bridged the academic disciplines of psychology, sociology and security science. This initially led to potential confusion over the use of specific terminology between these disciplines. This was particularly apparent with the terminology of *perception* and *attitudes* from a psychology or sociology perspective. To resolve this issue required further reading and definition by the researcher, which resulted in the expansion of these definitions (Chapter 3.3).

During the review of the research instrument, it was suggested that that the demographic data of *qualification* be removed, as this provided no useful data relevant to the research problem. This was agreed and subsequently removed from the final survey questionnaire. It was also suggested that the demographic data of *gender*, *age* and *distance* be relocated from the start of the survey questionnaire to the rear, proposed to reduce the participant agitation at answering this commonly requested data. This was rejected due to the layout of the survey questionnaire and to maintain the survey to a maximum of two full pages.

It was suggested that the proposed sample population size of 50 participants was too small, when considering the target population size and number of research cells. Therefore, the target population had to be measured and a sample size selected to provide a statistically valid sample. The number of residential properties and commercial enterprises were counted within the target population area. It was found that there were 356 residential properties and 118 commercial enterprises. The

Australian Bureau of Statistics stated that within the research area the mean household size was 2.6 persons (Clib, 1996). This equated to 925.6 total residents, although this included those people under the target population age of  $\geq 16$  years old. Due to the nature of the commercial enterprises subjective 10 workers per business was used, resulting in a total of 1180 people. Therefore, the calculated target population size was measured at 2106 people.

The proposed research instrument cell size was originally 16, but further review of this reduced this number to 12 cells. If all the data collected from the 50 participants produced a linear outcome, this would provide an insignificant cell size of 4.2 participants per cell. Therefore, the size of the sample size had to be increased to obtain an average of 15 participants per cell. As the intent of the variant *Distance to Rockingham Beachfront* was to obtain the division between whether the participant was a resident or worker, then this could be reduced to a cell size of two. Therefore, the total cell size then became nine, requiring a sample size of 135 participants. Add a pre study to post study loss rate of 20%, then the sample size for the pre-study had to achieve a response rate of  $\geq 162$  participants.

#### ***4.8 Data Collection***

The data were collected to achieve a random selection of participants. This was achieved through a defined methodology of participant selection. The researcher approached likely participants by visiting their business or residence and requesting their participation in the study, if they met the target population criteria. The utilized methodology is detailed below:

- Each approach began on the corner house of the proposed research street.
- From there, every third house was approached.
- The first person to answer the door, if they met the criteria, was requested to participate.
- If they refused or there is no response from that residence, the next house was approached.

- Once a participant volunteered, the cycle began again, with the following third house being approached.

For business, the following process was used:

- Each approach began on the corner business of the proposed research street.
- Every second business was then approached.
- The first person to approach the researcher was requested to participate.
- If they refused or there was no response from that business, the next business was approached.
- Once a participant volunteered, the cycle began again, with the second business being approached.

If the participants provided an initial positive response and volunteered, they were given a copy of the Introduction Letter to read. Once they had read this letter, they were asked if they understood the research within the context of the letter, that participation was voluntary, that they can withdraw at anytime during the survey and whether they have any further questions. They were then requested to participate in the research. If they answered in the affirmative, they were requested to complete the informed consent form.

At this point they were given the Survey Questionnaire, with a stamped address envelope. The participant then completed the questionnaire in their own time and posted the completed survey back to the researcher. This was altered from the initial proposed research method and changed as a better response was received, increasing the participation success rate and reducing the time taken by the researcher to obtain completed surveys.

Although the researcher was present during the initial commitment by the participant to complete the survey, the researcher gave no incentives, suggestions or ideas to the participants about how to answer the questions. The only advice offered was to answer

the questions as honestly as possible and that there was no *right* or *wrong* answer. The participant was advised that all answers are correct, as the survey was about perception. This method was selected over a postal survey to improve the survey response rate (Table 4.13) and allow linkage with the pre survey and post survey results.

Table 4.13

*Data Collection Statistics*

Survey questionnaires issued	485
Questionnaires completed	169
Success rate	34.8%

**4.9 Pilot Study**

The pilot study was completed using participants (N=20) within the sample population, with their data later utilized within the main study. The participant's data were gathered using the prescribed data collection methodology, but was restricted to a single street within the defined research area.

**4.9.1. Demographics**

The participation demographics (Figure 4.3) comprised of females (55%, N=11) and males (45%, N=9). The largest proportion of participants (40%, N=8) were those between the ages of 46 to 55 years old, followed by those aged 26 to 35 years old (35%, N=7). There were no participants over the age of 56 years old (Figure 4.4). The majority of the participants (90%, N=18) lived within 1km of Rockingham Beach front (Figure 4.5).



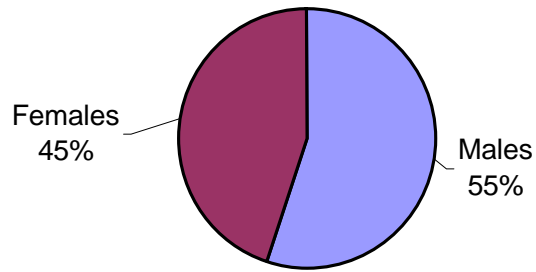


Figure 4.3. Demographics gender.

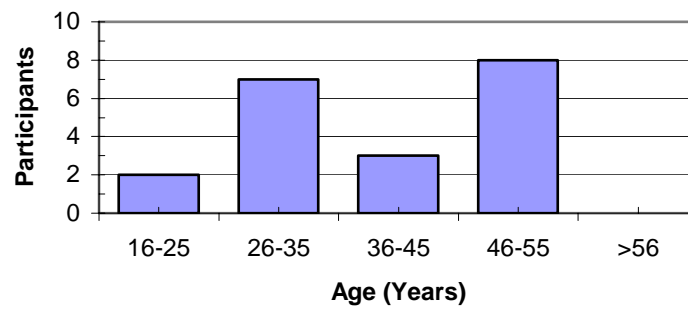


Figure 4.4. Demographics age.

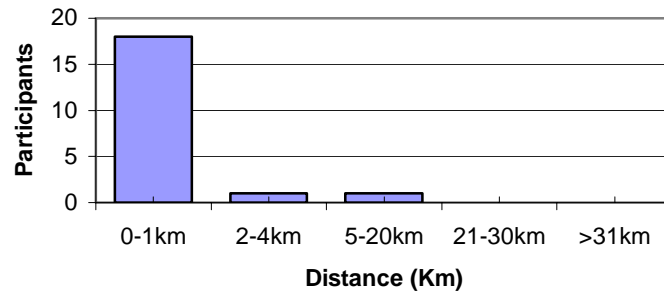


Figure 4.5. Demographics distance.

#### 4.9.2. Reliability

The gathered data were compiled and tested for reliability, using the Alpha (Cronbach) reliability model. Each activity or technology produced a moderate result in both factors (Table 4.14). *Dread* (factor 1) produced a mean result of 0.6 (SD 0.08) and a *familiarity* (factor 2) mean result of 0.6 (SD 0.17).

Table 4.14

*Pilot Study Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>					
<b>ITEM</b>		<b>Factor 1 – Dread</b>		<b>Factor 2 – Familiarity</b>	
Radioactive waste DREAD		0.7			
Radioactive waste FAM				0.5	
Drinking Water Chlorination DREAD		0.5			
Drinking Water Chlorination FAM				0.6	
Home swimming pools DREAD		0.7			
Home swimming pools FAM				0.8	
Coal mining disease DREAD		0.6			
Coal mining disease FAM				0.3	
Public street surveillance DREAD		0.5			
Public street surveillance FAM				0.7	
<b>MEAN</b>	<b>SD</b>	<b>0.6</b>	<b>0.08</b>	<b>0.6</b>	<b>0.17</b>

### 4.9.3. Validity

Face validity was not tested at this stage, with reliance being placed on the satisfactory results achieved in the draft pilot studies (Section 4.6.4). Concurrent validity, using Pearson two tailed correlation at  $\geq 95\%$  confidence rate, was tested. This was completed between each response, for each factor of the five activities or technologies, with results ranging from low to high (Table 4.15). This produced *low* mean total of 0.5 (SD 0.06), *dread* (factor 1) mean of 0.4 (SD 0.02) and a *familiarity* (factor 2) mean of 0.5 (SD 0.05). But, this low result was due to the correlation test being between single survey factors, not between concurrent surveys. This measured each factor, comprising of different risk characteristics. Therefore, as demonstrated in the draft pilot studies (Section 4.6.4), it was expected that these different risk characteristics would produce lower correlation measures.

Table 4.15

*Pilot Study Pearson Two Tailed Correlation Mean & SD*

<b>ITEM</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Radioactive waste DRED	15	0.4	0.16
Radioactive waste FAM	15	0.5	0.15
Water chlorination DRED	15	0.4	0.14
Water chlorination FAM	15	0.54	0.14
Home swimming pools DRED	15	0.43	0.21
Home swimming pools FAM	15	0.6	0.17
Coal mining disease DRED	15	0.4	0.18
Coal mining disease FAM	15	0.4	0.17
Public street surveillance DRED	15	0.4	0.16
Public street surveillance FAM	15	0.5	0.19
Person two tailed correlation @ $\geq 95\%$ confidence rate.			

### 4.9.4. Spatial Factor Representation Analysis

A spatial factor representation analysis was completed, using the mean totals of all participants in each activity or technology. This demonstrated where each item was located within the psychometric model. The spatial analysis reflected a similar spatial distribution response to that achieved by Slovic (1997; 1992) and the pilot draft studies

(Figure 4.2), when considering the quadrant alignments. This demonstrated replication of previous research studies, showing high concurrent validity and retest reliability. Although, as produced in the draft pilot studies, Drinking Water Chlorination was again located in the *high dread* and *familiar risk* quadrant. Public street surveillance also shifted from a *high dread* and *familiar risk* quadrant to a *low risk* and *familiar risk* quadrant (Figure 4.6).

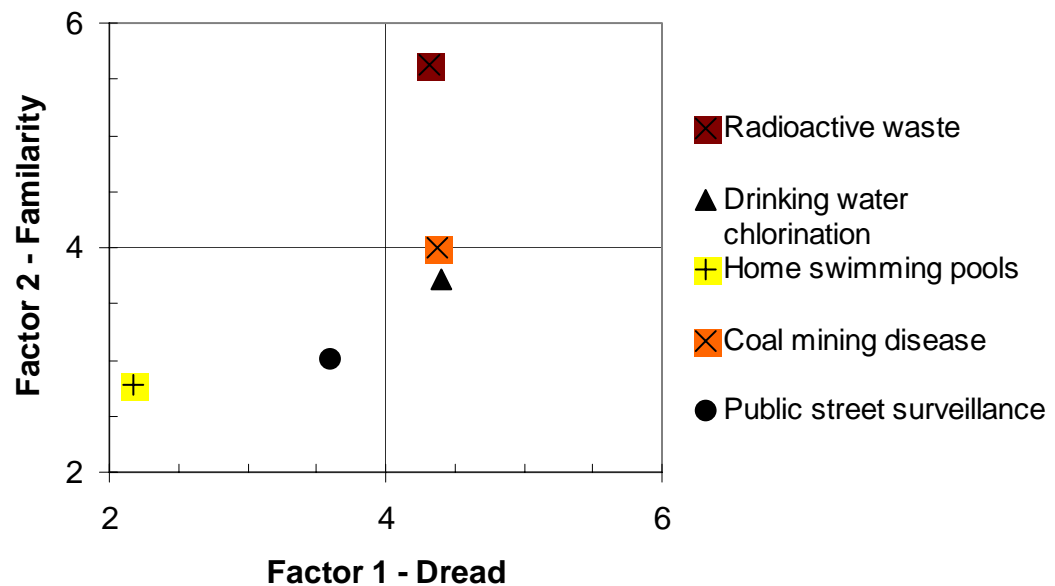


Figure 4.6. Pilot study spatial factor representation result.

#### 4.9.5. Research Instrument Modifications

During the pilot study data collection phase, it was found that it improved participation response rates if the researcher informed the participants that he was also a local resident. Also, to further improve face validity of the survey, the participant was informed that the local shire was installing a public surveillance system within the local community. Therefore, the introduction letter was amended to read as follows: “The City of Rockingham is in the process of installing street surveillance cameras along

Railway Terrace. I am a local resident and also a Master of Science student at Edith Cowan University, presently undertaking a research study on the social attitudes of public street surveillance.” (Appendix 1, Introduction Letter).

Also during the data collection phase, a number of participants questioned the need to answer questions on the additional control activities and technologies, being *radioactive waste, home swimming pools, drinking water chlorination and coal mining disease*. This was found not to be a significant concern for the participant, once the researcher gave a brief review of the study. But, when the survey was left with the participants to complete in their own time, a small number of participants expressed concern over answering these additional questions. This was addressed during the pilot study, through the addition of two lines in the introduction letter, which stated “The survey contains questions regarding a number of other activities or technologies i.e. radioactive waste, etc. These items have a known research location and are only used as a measure for public street surveillance.” (Appendix 1, Introduction Letter).

#### **4.9.6. Summary**

Comparison of Alpha reliability between the draft studies and pilot study was completed. *Dread* (factor 1) remained moderate and relatively constant (0.5, 0.7, 0.6). The pilot study *dread* (factor 1) SD, when compared to the draft studies, reduced. *Familiarity* (factor 2) reduced throughout the studies (0.8, 0.8, 0.6), from a high to moderate result.

Concurrent validity, using Pearson two tailed correlation, mean individual responses remained consistently low throughout the studies. This was caused by the correlation test being autonomous, between risk characteristics and not between concurrent surveys. It was not possible to test between surveys, due to the change between a five point Likert scale in the pilot draft studies, to a seven point Likert scale for the pilot study. But, the five point Likert draft pilot studies did demonstrate a high correlation result.

Spatial factor representation of the draft pilot study 2 and pilot study demonstrated consistent replication of results from previous studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997). This indicated that the research instrument did produce acceptable reliability and validity results. Also, as the draft pilot studies had also produced moderate to high results, this demonstrated that the research instrument was suitable for progression onto the main study.

#### ***4.10 Study Limitations***

This section provides an overview on the limitations of the study. With the psychometric paradigm this included the lay people assessment of the complex nature of risk, the measure of intellectual risk and psychometric analysis. The research study instrument reliability and validity, diversity of the activities and technologies, and the size of the public street surveillance system.

##### ***4.10.1 Psychometric Paradigm***

There was concern raised in the ability of lay people to provide meaningful responses to what can be very complex and multi-dimensional risk issues. As Slovic (1992, p.119) stated “the questions typically assess cognition – not actual behavior.” But ensuring that the survey questions were as simple and clear as possible, that the survey instrument produced acceptable reliability and validity, these limitations did not appear to compromise the results. This has been demonstrated by previous studies consistent results and that this study replicated these results (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997).

The psychometric paradigm assessed activities and technologies that could be a physical risk. But public street surveillance does not cause physical harm and can be seen more as a *privacy risk* or *intellectual risk*. It was found that public street surveillance could be measured with perceived physical risk activities and technologies, demonstrated through achieving consistent and valid results.

The psychometric paradigm measures risk perception in a social group context and does not assess individual perception. Psychometric research has also been criticized for treating risk as purely objective and not accounting for cultural or social bias, which are hidden in the quantitative analysis and representation (Shaw & Shaw, 2001). These items were overcome through the application of additional analysis techniques of MDS Euclidean and INDSCAL techniques.

MDS INDSCAL provided the measure of subject space, through spatial representation. This also presented the angular separation and vector length of the configuration of points. This method is referred to as the Analysis of Angular Variation (ANAVA), and can be utilized to measure and demonstrate individual and group difference of subject space (Smith, 1984; Mardia, 1972). Although this method of analysis would have been appropriate and further demonstrated outcomes, the final investigation did not use this method of analysis.

#### ***4.10.2 Research Study***

The reliability measure of the research instrument could have been higher. The results achieved were caused by a number of factors, being the length of the survey (Angus & Gray, 2001, p.26) and the diverse activities and technologies tested. By measuring a total of five activities and technologies, this increased the length of the survey. But there was a self-imposed requirement to keep the number of questions to a time commitment acceptable by the participants. This reduced the possible total number of activities and technologies, and also questions for each risk characteristic. Therefore, measuring the five activities and technologies led to a compromise on the number of questions utilized, which ultimately reduce the reliability.

Diversity also reduced both the reliability and validity of the research instrument, through the need to compromise on question selection. Some activities and technologies produced high results, but others produced only moderate results. The

quandary was to select the best performing questions across all technologies and activities. But it was felt that the ability to spatially represent the activities and technologies, using all four quadrants, outweigh the possible disadvantages.

The measure of the additional four activities and technologies facilitated the ability to be able to confidently demonstrate the location of public street surveillance. This led to a compromise between demonstrating the spatial factor representation relationship or developing a statistically reliable instrument, as the study tested a relatively low number of activities and technologies when compared to other psychometric studies. Using the MDS technique, this low number of activities and technologies reduced the ability for the data to produce and provide defined clusters (Kruskal & Wish, 1978, pp.43-46) and increased the subjective interpretation of the dimensions. This requires further validation to quantify and confirm the MDS dimensions of *risk perception* and *perceived community exposure to risk*. With future studies, it may be appropriate to measure an increased number of activities and technologies.

To achieve a statistical valid sample of the population, Fink (1995) and Leedy (1989) suggested  $\geq 30$  per cell and De Vaus (1993) 50 to 100 per cell. Consideration has to be taken for possible variations in characteristics, with linear division throughout cells. The study utilized nine research cells and had a calculated sample size of 135 participants, producing  $\geq 15$  participants per cell.

The study produced the expected  $\geq 15$  participants per cell in all cells, apart from distance 21-30km and  $>31$ km from Rockingham Beach front. But these cells had been combined with the other distance cells, for the design intent to extract those who worked or lived within the geographical research area. This produced two distance cells, being 0-1km or  $>2$ km. According to Fink (1995) and Leedy (1989) out of the nine cells, two did not meet a statistical valid sample, being those aged 16-25 and 26-35 years old. But reviewing the final demographic figures, this could have only been achieved through increasing the research area and/or population size.



The public street surveillance system comprised of two cameras within a central zone and at key crossroads. There was limited public exposure of the system when installed, either through the installation, media or signage of the system. They were also landscaped into the environment, through being installed on existing poles or having similar poles to existing lighting. There was also no other CPTED or crime prevention initiatives applied during the survey period. It could be argued that the system may have been too small to produce a strong risk perception.

#### ***4.11 Research Study Ethics***

A number of ethical issues were considered in the study, primarily the protection of participants taking part in the study. It was a requirement that participation in the study was voluntary, that the researcher disclosed their identity, that an overview of the study was given and that all participants were  $\geq 16$  years old.

Although the questionnaire was designed to be as simple and easy to complete as possible, it was still anticipated that some participants might have experienced some level of stress. To reduce this, it was stated that no question could be answered incorrectly and that there were no right or wrong answers. These issues were clearly detailed in the Introduction Letter. Participants were only selected if they volunteered and if they complied with the target population criteria.

There were no financial incentives to complete the survey, bias or deception made during the completion of the survey. It was made clear to the participant that they could withdraw from the study at any time. Also, that their completed surveys would remain strictly in confidence, that they would not be quoted or identified in any form within the report or that the survey information would be released to any other person or organization.

It was also a requirement that collected data be restricted to the defined research period, any changes to the research design which may have ethical implications or any unforeseen risk or actual harm arising to participants be reported back to the committee. New research team members were to be registered with the committee and annual reports were provided to the committee. All research complied with Edith Cowan University ethics policy. Edith Cowan University Human Research Ethics Committee gave the research study, based on the above processes, ethical approval to proceed.

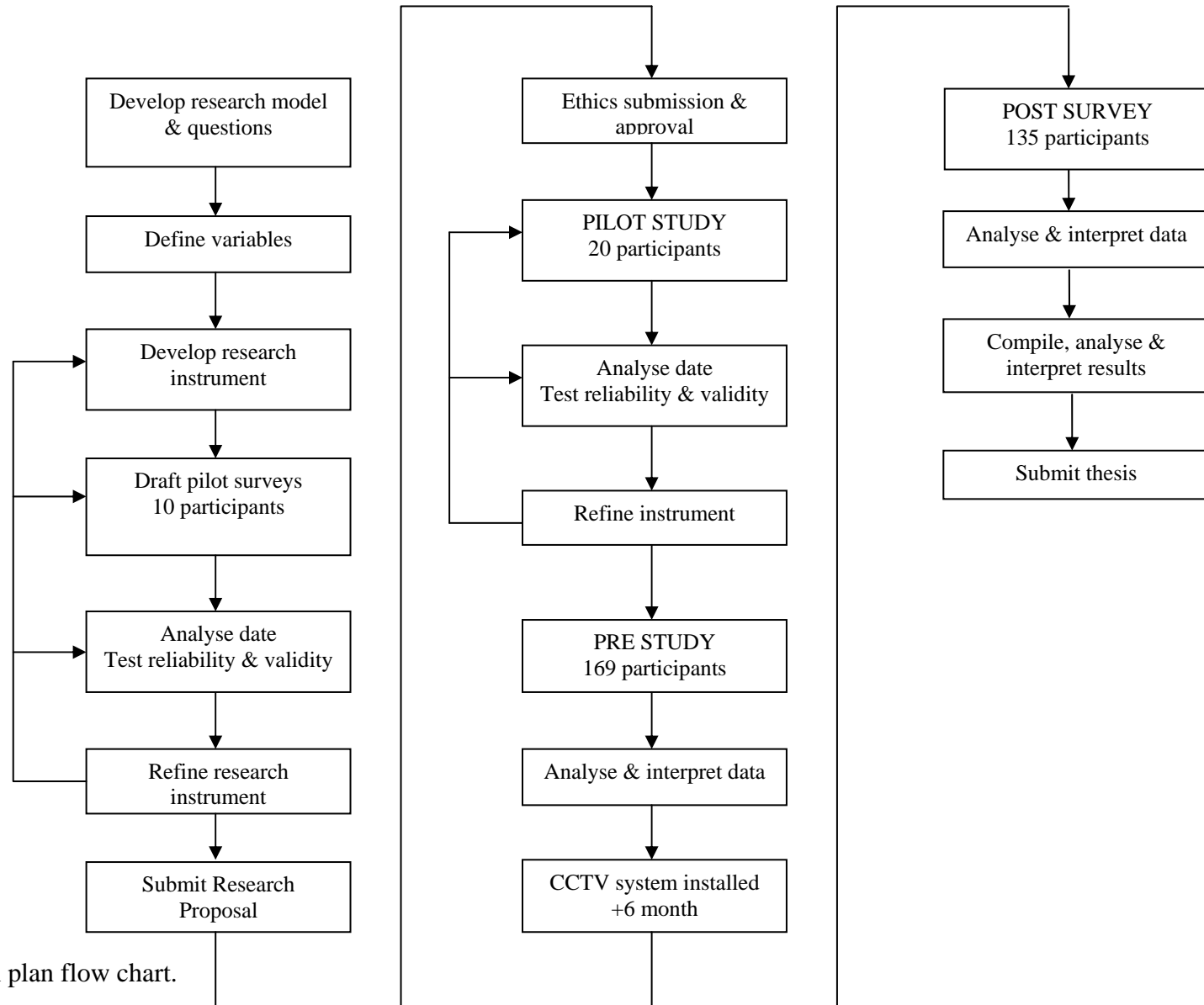


Figure 4.1. Research plan flow chart.

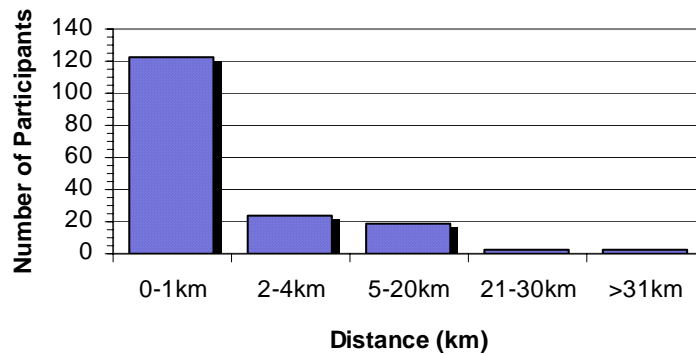


Figure 5.3. Distance to the nucleus of the research center demographics.

This demonstrated that the majority of the target population (86.4%, N=146) generally worked and/or lived within close proximity to Rockingham beachfront, being  $\leq 4\text{km}$ . Therefore, their likely physical exposure to public street surveillance would generally be limited, with the local shire installed system being the only public system within the area's proximity. Although they would have been exposed to local retail outlets and public transport systems.

### 5.3 Psychometric Risk Perception Pre Study

This section presents the pre study data analysis, which included the perceived gender risk, the affect of age and distance on perceived risk, and spatial representation of the activities and technologies. The risk perception characteristic profiles are presented, with the characteristic of control being a significant risk perception issue. MDS Euclidean and INDSCAL analysis showing the *underlying* risk dimensions are given, supporting the spatial factor representation outcomes.

#### 5.3.1 Gender Risk Perception

Independent t tests were completed between males (group 1) and females (group 2), in relation to all activities and technologies. This tested factors, *dread risk* and *familiarity to risk*. The t test measured “whether the difference in means observed is greater than that which might be accounted for by random variation” (Malim & Birch, 1997, p.124). Radioactive waste *dread risk* (factor 1), demonstrated a significant mean difference of 2.9 [t(166)=-2.635,p=0.009] between males and females.

Drinking water chlorination gender demonstrated a significant difference in both *dread risk* and *unfamiliarity to risk*, with a mean difference of 2.7 [t(166)=-2.335,p=0.021] for *dread risk* and 2.5 [t(166)=2.4965,p=0.045] for *unfamiliarity to risk*. All other activities and technologies demonstrated no significant differences between gender.

Females exhibited greater *dread risk* and/or *unfamiliarity to risk* levels across all technologies and activities, apart from public street surveillance (Figure 5.4). This had been demonstrated by a number of previous studies (Bouyer, Bagdassarian, Chaabanne and Mullet, 2001; Slovic, 1992). As Slovic stated “sex differences were quite interesting. Close to two dozen studies have found that women have a higher perceived risk ... than men.” (1992, p.129). Traditional difference in gender perceptions was believed to be due to biology, educational levels or a lack of understanding of technical issues. However, empirical studies appear to suggest that the difference in risk perception was in some part biological, but this still does not appear to provide a full explanation (Finucane, 2002; DeNorma, 2001).

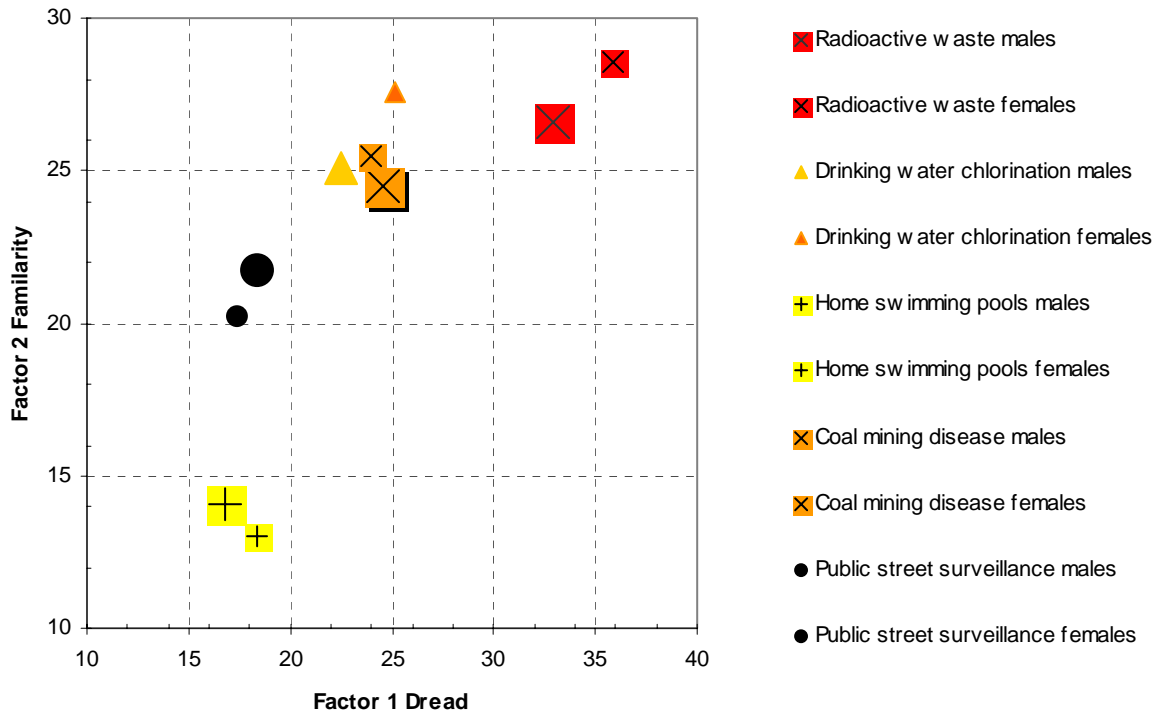


Figure 5.4. Spatial factor representation relationship between males & females for all activities and technologies.

(Note: Large fonts = males; small fonts = females).

But for public street surveillance, females demonstrated a lower sense of *dread risk* and greater *familiarity to risk* than males. This appeared to indicate that females not only feel safer when public street surveillance was present, but that they felt public street surveillance was a social benefit which outweighed the perceived risk. Therefore, females would support the introduction and maintenance of public street surveillance systems.

Was this a common female risk perception of public street surveillance or a unique outcome of this study? In previous studies females have consistently shown greater levels of risk perception than males in all activities and technologies (Bouyer, Bagdassarian, Chaabanne and Mullet, 2001; DeNorma, 2001; Slovic, 1992). Coal mining disease demonstrated an increase in *unfamiliarity to risk* (factor 2), but a *lower dread risk* (factor 1). All other activities and technologies showed females having a

greater sense of *dread risk* and *unfamiliarity to risk* than males. Whereas, public street surveillance showed a lower perceived risk in both factors of *dread risk* and *familiarity to risk*. This appeared to demonstrate that for females public street surveillance did increase the level of perceived safety.

### **5.3.2 Age Risk Perception**

The level of risk perception did not appear to be related to age, as there was limited significant difference between all age groups in all activities and technologies. The only significant difference being within radioactive waste and water chlorination. For radioactive waste, a significant [t(54)=-2.513,p=0.015] mean difference of 4.5 was found between 16-25 year olds and 26-35 year olds. With drinking water chlorination, those aged 36-45 years old and greater than 56 years old produced a significant [t(92)=2.889,p=0.005] mean difference of 4.7.

Also for public street surveillance, the sense of risk perception did not appear to be related to age. This was further demonstrated by the spatial distribution of age, which presented the closest dimensional cluster of all tested activities and technologies.

### **5.3.3 Distance Risk Perception**

As with age, there was minimal significant difference in the perception of risk in the relationship of how close the participant lived and/or worked to the nucleus of the public street surveillance center. The only significant differences were within the technology of radioactive waste *familiarity to risk* (factor 2). This was in the subgroups of those who lived 0-1km and 2-4km away, producing a significant [t(144)=-2.1060,p=0.0369] mean difference of 3.5, 21-30km and greater than 31km away, producing a significant [t(2)=-19.7990,p=0.0025] mean difference of 14.0, and 2-4km and 21-30km away, producing a significant [t(24)=2.4225,p=0.0233] mean difference of 11.1.

It appeared that the distance from the nucleus of the public street surveillance system did not cause any significantly different in the sense of risk perception. As with age, this can be further demonstrated by the spatial distribution, which again presented the closest dimensional cluster all tested activities and technologies. Although, those who

lived 21 to 30km from the nucleus (group 4, N=2) did present a possible outlier and have not been considered due to the low statistical number.

Therefore, it appeared that living and/or working within the coverage of a public street surveillance system had no affect on the sense of risk perception, that for females it increased the perception of safety. This reinforced and supported the spatial factor representation and how the community felt that the public street surveillance was a social benefit.

#### ***5.3.4 Risk Perception of Public Street Surveillance***

The pre study spatial factor representation presents the location and relationship between the five activities and technologies (Figure 5.5), utilising the mean total of all participants. As shown within Chapter 3, this reflected the spatial response demonstrated by Slovic (1992) and “replicated across numerous groups and laypeople and experts judging large and diverse sets of hazards.” (1992, p.123). Although coal mining disease occupied the *low dread risk* and *unfamiliar to risk* quadrant, whereas according to Slovic (1992), this activity should have been located within the *high dread risk* and *familiar risk* quadrant. But these study results were consistent with the draft and pilot studies (Chapter 4).



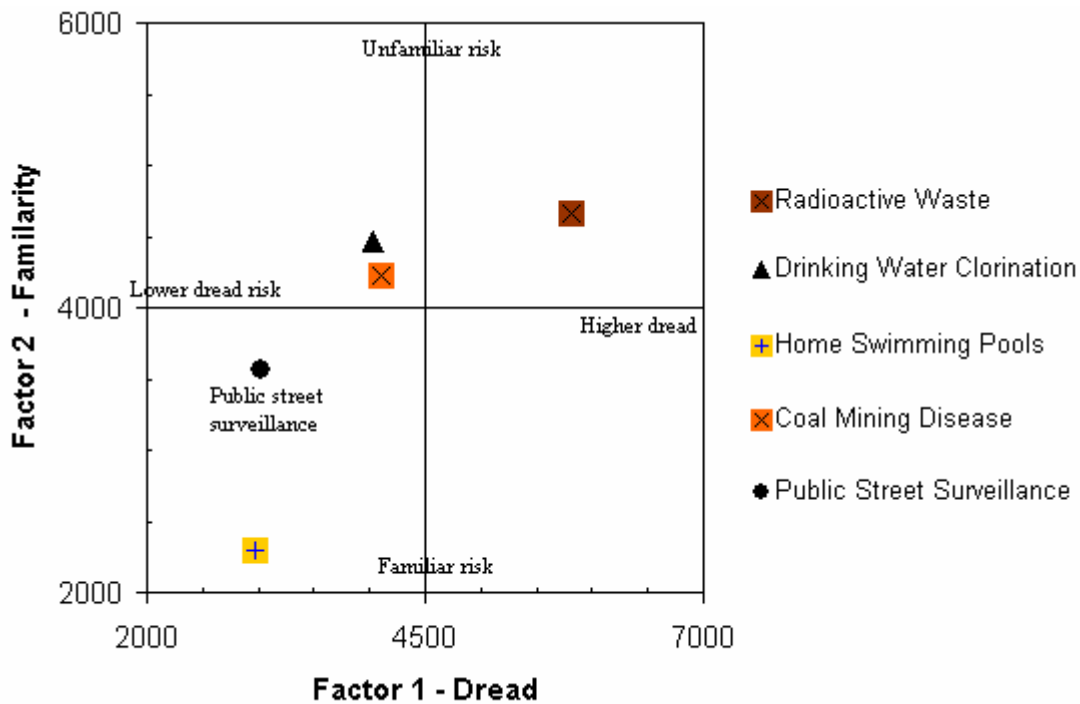


Figure 5.5. Pre study spatial factor representation of all activities and technologies.

Public street surveillance ( $mean^{total}$ ) occupied the same spatial quadrant as home swimming pools, with *low dread risk* and *familiarity to risk*. The population perceived public street surveillance as a low risk to future generations, that exposure was voluntary, the risk was observable, that they understood the risk, that the risks are known and would be immediate. This resulted in public street surveillance having a perceived low social risk perception, demonstrating a social benefit that outweighed the perceived risk to the community. This was supported by Ditton (1999), when he found that public street surveillance reduced the feeling of anxiety and perceived likelihood of becoming a victim.

### 5.3.5 Risk Perception Characteristic Profiles

The risk characteristics of each activity or technology was analysed, showing how each risk characteristic was related to another (Figure 5.6). As Slovic stated, “every hazard had a unique pattern of qualities that appeared to be related to its perceived risk.” (1992, p.121). Where the characteristics were separated  $\geq 0.4$  (mean) apart

indicated a significant difference. This was demonstrated by the characteristic of *dread risk*, as all activities and technologies were significantly different to each other.

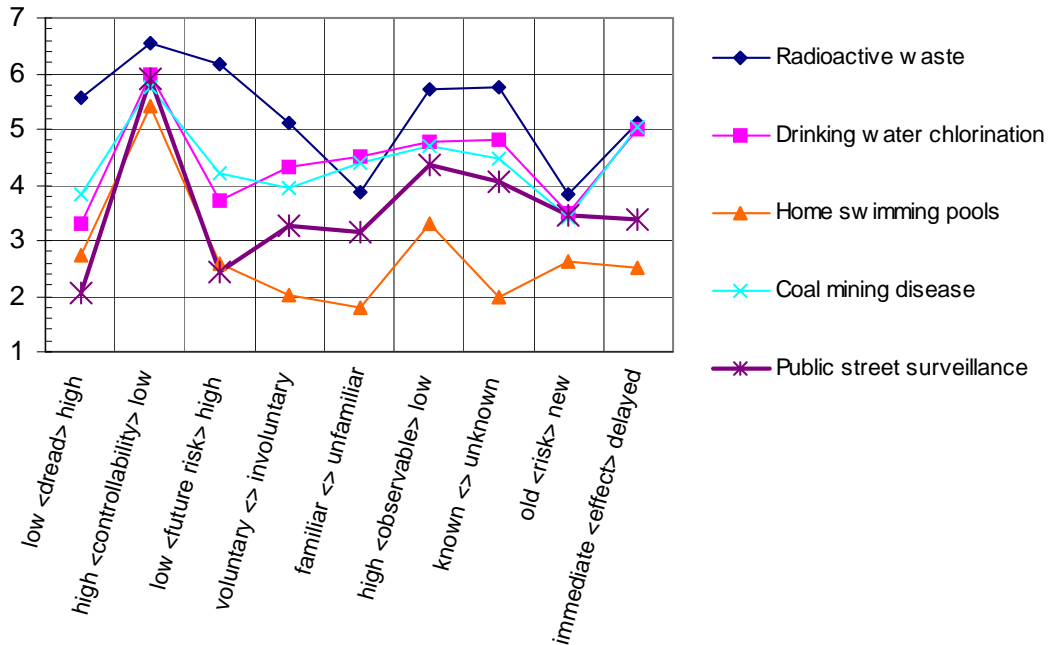


Figure 5.6. Factor characteristic profiles of each activity and technology.

Public street surveillance produced the lowest levels of *dread risk* and *risk to future generations*. But for the *familiarity to risk* characteristic, public street surveillance was located close to the centreline. This may indicate neutral risk perception, that the participants did not have strong feelings or that little social thought had been given to public street surveillance. The characteristic that presented further investigation was *controllability*. *Controllability* demonstrated a significant [ $t(165)=21.7, p=0.0000$ ] difference from *dread risk*, indicating that there was a social concern over the ability to maintain appropriate public street surveillance control.

### 5.3.6 Public Street Surveillance Control

Control of public street surveillance appeared to be a significant social concern. As Sjöberg and Fromm (2001, pp427-439) found when testing information technology risk, *general risk* was higher than *personnel risk* for all tested activities and

technologies. *General risk* was defined as a risk inflicted on others. Information technology risks had a wider gap between *personnel risk* and *general risk*, whereas traffic accidents, greenhouse effect and ozone were closer in proximity.

As Sjoberg and Fromm concluded, this “closely related to the fact that people perceive little ability to protect themselves” (2001, p.438). This supports previous studies (Slovic, 1997) in coming to the conclusion that the level of perceived risk is dependent on the level of perceived control. Another supporting characteristic was voluntariness. If exposure to risk was a choice, taken voluntarily, then the level of risk perception was lower. A classical example of this is the increased fear of flying as opposed to driving a vehicle, even when flying is statistically safer.

Public street surveillance systems are operated, managed and controlled by either state or private organisations. They are also, by their nature, within public and community centres. This investigation’s public street surveillance system was owned by the Shire and operated by State Police Service. This may remove the perceived ability of the community to have control of, or reduce exposure to, these types of systems.

Public street surveillance controllability produced a significantly lower result than radioactive waste [ $t(163)=4.3969, p=0.000$ ], but significantly greater result than home swimming pools [ $t(163)=-2.6651, p=0.0085$ ]. Extracting the characteristic of control located public street surveillance towards a *higher dread risk*, but still within the *familiar risk* quadrant (Figure 5.7). The mean difference between total *dread risk* (3.0277) and *controllability* (5.8916) was significant [ $t(165)=21.7, p=0.0000$ ]. This demonstrated an increase in the social risk perception of *dread risk*, in relation to the level of control that can be attributed to public street surveillance. It appeared that the community had a social concern over the ability to ensure appropriate public street surveillance control.

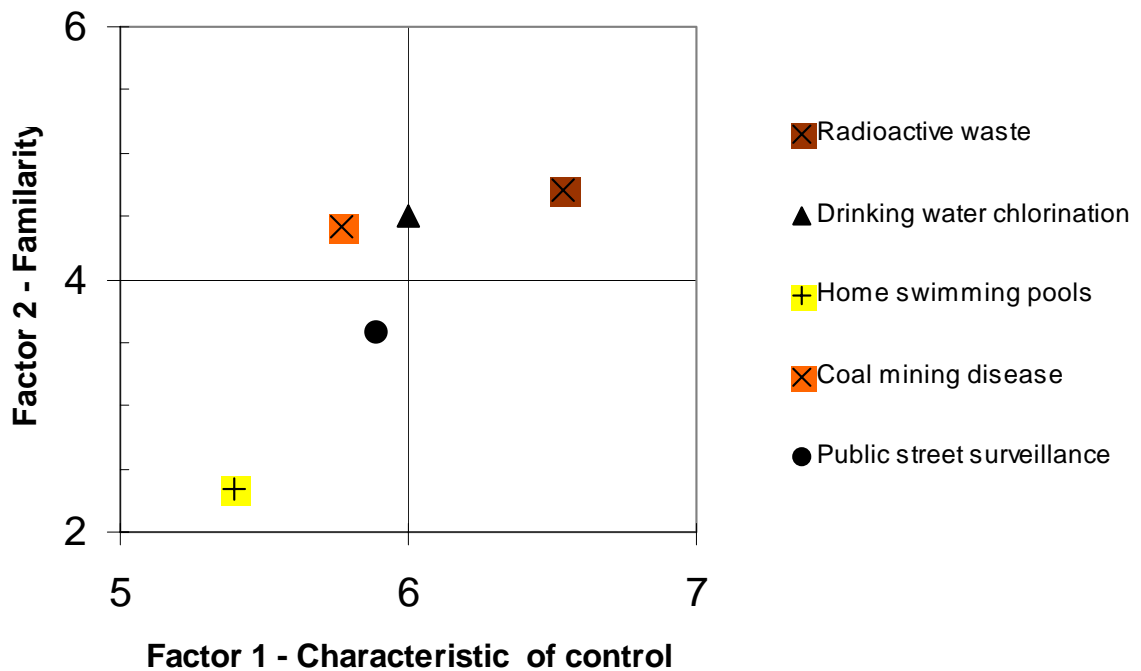


Figure 5.7. Public street surveillance spatial factor representation risk characteristic of control and familiarity<sup>(total)</sup>.

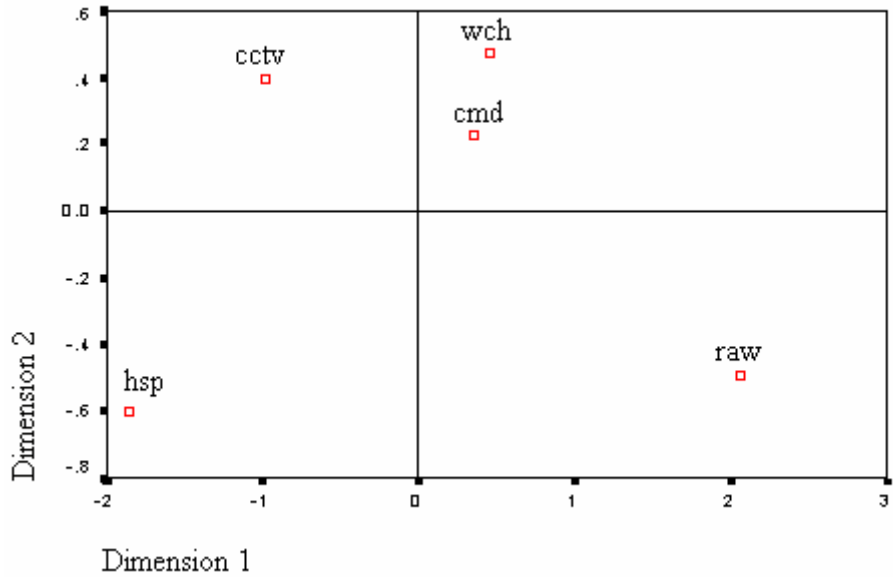
But these representations did not demonstrate the *underlying* individual differences with the participants, or represent concept space. Therefore, the spatial data further analyzed using MDS.

### 5.3.7 MDS Underlying Risk Perception of Public Street Surveillance

MDS was applied to the pre study data to reduce the dimensional data and provide a spatial representation. This was applied to the various participant groups, using mean dissimilarities of objects. Using the Euclidean distance model, the total mean of all activities and technologies were tested. This presented the spatial representation distribution [interval data, stress 0.0039, RSQ 0.9999]. This demonstrated the group space of the activities and technologies, and formed the *underlying* configuration of points (Cox & Cox, 2000).

The two MDS dimensions were reduced to one-dimensional representations. This produced a dimension 1 spectrum that matched in distribution, both *dread risk* and *familiarity to risk*. Drinking water chlorination and coal mining disease *dread risk* were in reverse order, but this reversal was not considered significant due to the spatial similarity of these objects. Therefore, this dimension appeared to measure the *community risk perception* of the activities and technologies. Dimension 2 produced a spectrum that placed radioactive waste and home swimming pools together at one end of the distribution. This showed that the spatial representation (Figure 5.5) did not fully demonstrate the *underlying* risk perceptions. Dimension 2 was defined as the *perceived community exposure to the risk*.

This placed public street surveillance within its *own* quadrant and indicated that it had unique characteristics, when compared to the other activities and technologies. Applying the MDS dimensional characteristics, public street surveillance appeared to have a low level of *community risk perception* and a low *perceived community exposure to risk* (Figure 5.8). Although the interpretation of the dimensions was subjective (Kruskal & Wish, 1978. pp 43-46) these were further tested at the post study phase.



*Figure 5.8.* MDS spatial representation of concept space for all activities and technologies.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

### ***5.3.8 MDS INDSCAL Gender Risk Perception of Public Street Surveillance***

Individual differences (weighted) Euclidean distance (INDSCAL) technique was applied to the subgroup of gender for all activities and technologies. A spatial representation distribution [interval data, stress 0.0789, RSQ 0.9713, matrices mean] similar to the spatial factor representation model was presented (Figure 5.9).

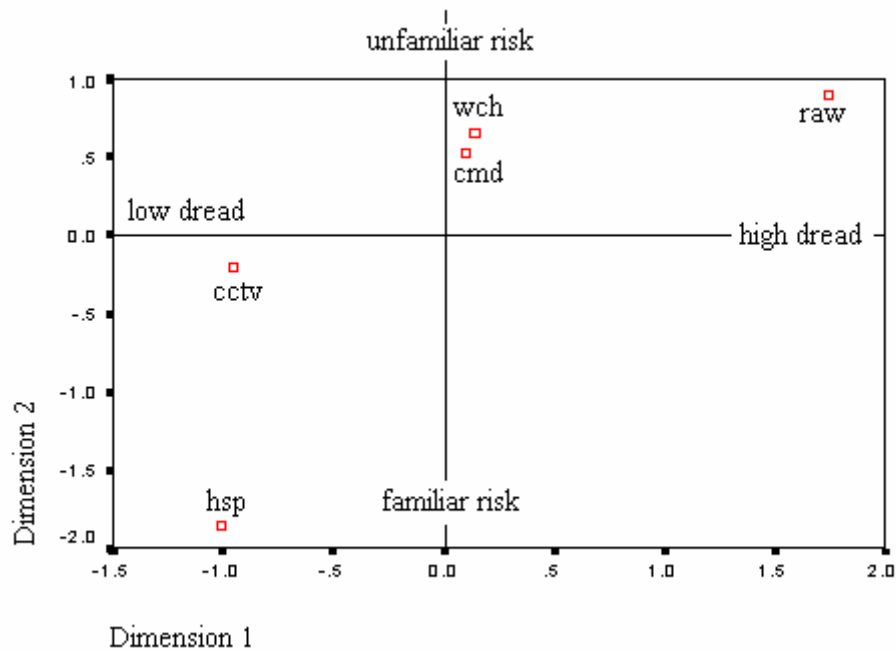


Figure 5.9. MDS INDSCAL gender spatial representation of concept space for all activities and technologies.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

Unlike the MDS spatial representation (Figure 5.8), the gender spatial distribution dimensions matched the factor distribution. Dimension 1 was similar to *dread risk* (factor 1) and dimension 2 was similar to *familiarity to risk* (factor 2). But this distribution placed drinking water chlorination and coal mining disease in the quadrant, higher *dread risk* and *unfamiliar to risk*. This plot opposed the spatial factor representation distribution (Figure 5.5), by shifting the axis location of *familiarity to risk* (factor 2) left.

INDSCAL demonstrated that public street surveillance had a similar level of *dread risk* as home swimming pools. This also demonstrated that public street surveillance was located within the spatial factor representation (Figure 5.5), quadrant of *low dread risk* and *familiar to risk*. Public street surveillance was located close to the centre of dimension 2 *familiarity to risk*, showing a neutral response and that there

may have been little thought given to the social issues of public street surveillance. This supported the factor characteristic profiles (Figure 5.6).

### ***5.3.9 Psychometric Risk Perception Pre Study Conclusion***

The pre study measured the social risk perception of public street surveillance, using psychometric and MDS spatial representation techniques. The pre study investigation showed that the social risk perception of public street surveillance was *low dread risk* and *familiarity to risk*. MDS supported this analysis, but provided additional *underlying* dimensions and presented public street surveillance with its *own* unique characteristics.

Public street surveillance had a low sense of *community risk perception* and a low *perceived community exposure to risk*, demonstrating a social benefit that outweighed the perceived risk to the community. This was supported by Ditton (1999), when he found that “79% thought [public street surveillance] ... would make people feel less likely that they would become victims of crime”. Therefore, the community would generally support the introduction and maintenance of public street surveillance.

For public street surveillance, females presented a lower social risk perception than males. This appeared to indicate that females feel safer when public street surveillance was present. For public street surveillance, age did not have any significant affect to the sense of risk perception. Also, the distance that a participant lived and/or worked from the nucleus of the public street surveillance did not have any significant affect to the sense of risk perception. This reinforced and supported the spatial factor representation and that the community felt that the public street surveillance was a social benefit.

But it appeared that the community had a social concern over the ability to ensure appropriate control, with the characteristic of *controllability* being significantly higher than *dread risk*. Although, even when control was presented in a spatial representation, public street surveillance remained a *low dread* and *familiar risk*. Although *familiarity to risk* did provide a neutral response, indicating that there may have been little thought given to public street surveillance.



#### **5.4 Psychometric Risk Perception Post Study**

This section presents the post study analysis, with emphases on aspects that demonstrated differences between the study phases. This includes the perceived risk between gender, the affect of age and distance on the perceived risk, and the spatial representation and risk characteristic profiles of the activities and technologies. MDS Euclidean and INDSCAL analysis demonstrated the *underlying* risk dimensions, supporting the spatial factor representation outcomes.

##### **5.4.1 Gender Risk Perception**

Independent t tests were completed between gender, in all activities and technologies. This tested both *dread risk* (factor 1) and *familiarity to risk* (factor 2). Unlike the pre study, where radioactive waste *familiarity to risk* and drinking water chlorination *dread risk* and *familiarity to risk*, there was no significant difference between gender for all activities and technologies. But females still demonstrated greater *dread risk* and/or *unfamiliarity to risk* across all technologies and activities, apart from public street surveillance (Figure 5.4).

##### **5.4.2 Age Risk Perception**

In the post study, age produced greater significant results than the pre study. These were in home swimming pools and coal mining disease. Home swimming pools produced a significant [t(67)=3.4342,p=0.0010, t(67)=3.3839,p=0.0012] mean difference in both factors, *dread risk* (6.4508) and *familiarity to risk* (5.9228) between those aged 46-55 year old and greater than 56 years old. Home swimming pools *familiarity to risk* produced a significant [t(36)=2.2419,p=0.0312] mean difference of 6.8756 between those aged 16-25 years old and 46-55 years old, a mean difference [t(52)=3.0826,p=0.0033] of 6.9770 for those aged 26-35 years old and greater than 56 years old. Also, home swimming pools *dread risk* produced a significant [t(64)=2.9718,p=0.0042] mean difference of 5.3064 between those aged 36-45 years old and greater than 56 years old.

Coal mining disease *familiarity to risk* produced a significant [t(42)=2.0450,p=0.0472] mean difference of 4.8125 between those aged 26-35 years

old and 36-45 years old, a mean difference [ $t(45)=3.4817, p=0.0011$ ] of 8.3528 between those aged 26-35 years old and 36-45 years old, and a mean difference [ $t(52)=2.3596, p=0.0221$ ] of 5.5099 between those aged 26-35 years old and greater than 56 years old. For public street surveillance, the sense of risk perception did not appear to be related to age, as there was no significant difference between these groups.

#### ***5.4.3 Distance Risk Perception***

There was minimal significant difference in the perception of risk in the relationship of how close the participant lived and/or worked to the nucleus of the public street surveillance system. In all activities and technologies, the only significant differences were radioactive waste *dread risk* and home swimming pools *familiarity to risk*.

Radioactive waste *dread risk* produced a significant [ $t(25)=3.1606, p=0.0041$ ] mean difference of 10.7600 between those who lived 0-1km and greater than 31km away, and a mean difference [ $t(3)=3.1843, p=0.0499$ ] of 8.6667 between those who lived 21-30km and greater than 31km away. Home swimming pools *familiarity to risk* produced a significant [ $t(81)=2.2990, p=0.0241$ ] mean difference of 10.5750 between those who lived 0-1km and greater than 31km away. As with the pre study outcomes, the distance from the nucleus of the public street surveillance system did not appear to cause any significantly different in the sense of risk perception.

#### ***5.4.4 Risk Perception of Public Street Surveillance***

The post study spatial factor representation presented the location and relationship between the five activities and technologies, and reflected the outcome from the pre study (Figure 5.5). Again coal mining disease occupied the *low dread* and *unfamiliarity to risk* quadrant, whereas according to Slovic (1997) this activity should have been located within the *high dread risk* and *familiar risk* quadrant. Public street surveillance (mean<sup>total</sup>) occupied the *low dread risk* and *familiar risk* quadrant, supporting the pre study outcome.

#### ***5.4.5 Risk Perception Characteristics Profiles***

The risk characteristics of each activity or technology was again analysed, showing how each risk characteristic was related to another (Figure 5.10). The results replicated the pre study risk characteristic profiles (Figure 5.6), with public street surveillance again producing the lowest level of *dread risk* and *risk to future generations*. But for the *familiarity to risk* characteristics, public street surveillance was again located close to the centreline.

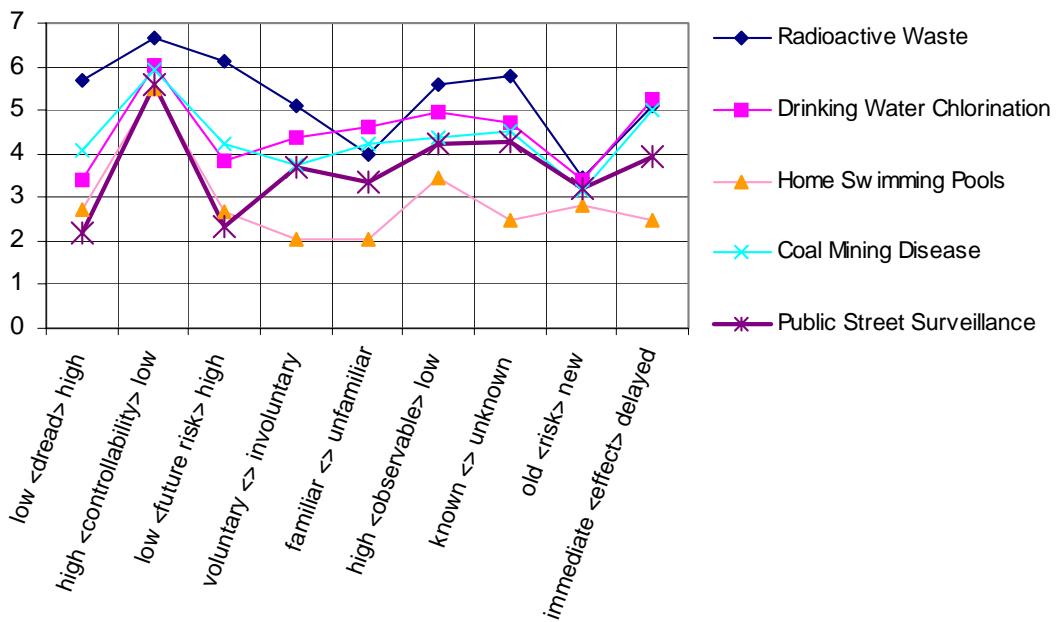


Figure 5.10. Post study factor characteristic profiles of each activity and technology.

#### 5.4.6 MDS Underlying Risk Perception of Public Street Surveillance

MDS was applied to the post study data to reduce the dimensional data and provide the MDS spatial representation (Figure 5.11). Using the Euclidean distance model, the total means of all activities and technologies were tested. This presented the post study spatial representation distribution [interval data, stress <0.0050, RSQ 1.0000], demonstrating a similar and supporting MDS spatial representation as achieved in the pre study (Figure 5.8).

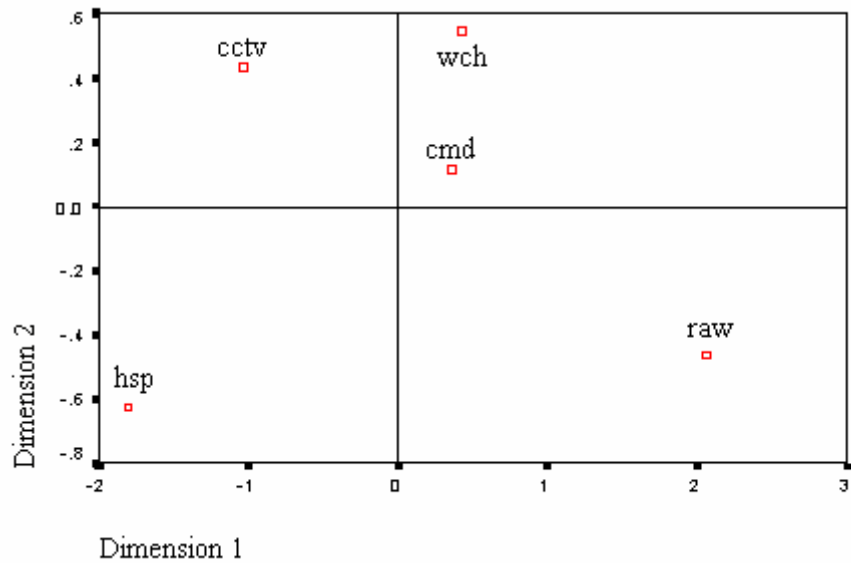


Figure 5.11. Post study MDS spatial representation of concept space for all activities and technologies.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

#### 5.4.7 MDS INDSCAL Gender Risk Perception of Public Street Surveillance

Individual differences (weighted) Euclidean distance (INDSCAL) technique was applied to the post study data set subgroup of gender. A spatial representation distribution [interval data, stress 0.0409, RSQ 0.9934, matrices mean] similar to the spatial factor representation model (Figure 5.9) was presented (Figure 5.12).

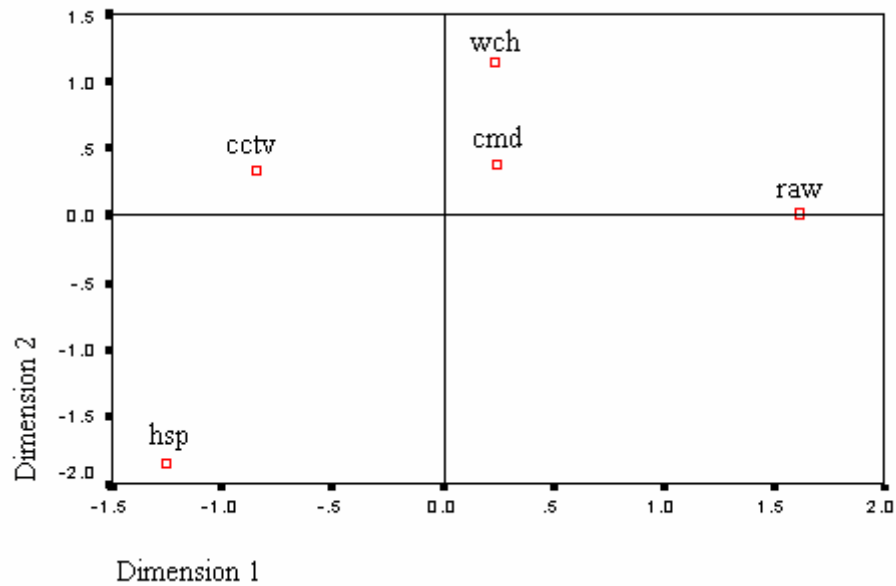


Figure 5.12. MDS INDSICAL gender spatial representation of concept space for all activities and technologies.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

#### 5.4.8 MDS INDSICAL Age & Distance Risk of Public Street Surveillance

INDSCAL was applied to the post study data set subgroup of age and distance. The INDSICAL age spatial representation produced an outcome that placed public street surveillance within the same quadrant as home swimming pools [interval data, stress 0.1077, RSQ 0.9459, matrices mean], being consistent with the pre study.

The INDSICAL distance spatial representation produced an outcome that placed public street surveillance within its own quadrant [interval data, stress 0.2015, RSQ 0.7709, matrices mean]. This opposed the pre study, which located public street surveillance within the same quadrant as home swimming pools.

#### ***5.4.9 Psychometric Risk Perception Post Study Conclusion***

The post study replicated and therefore supported, the analysis of the pre study in a majority of the psychometric results. Again various analysis techniques were applied, including psychometric and MDS techniques. The post study analysis demonstrated that the social risk perception of public street surveillance was *low dread risk* and *familiar risk*. MDS supported this analysis, but provided additional *underlying* dimensions and presented public street surveillance with its *own* unique characteristics.

A number of key differences were found between the pre and post study phases that may have been attributed to a social risk perception relocation, caused by the introduction of the public street surveillance system. Critical differences between the study phases are given in the following section.

#### ***5.5 Psychometric Risk Perception Pre & Post Study Comparison***

This section presents significant differences between the pre study and post study phases. A primary research question was to investigate and measure any risk perception relocation when lay people were exposed to a public street surveillance system. The pre study was completed before the public street surveillance system was installed, with the post study completed approximately seven months after this period.

There was insignificant difference between the pre and post study public street surveillance outcomes in the general analysis of the datum sets. This included the spatial factor representation and the subgroups of gender, age and distance. But, both datum sets supported each other to present the location of public street surveillance, as being a *low dread risk* and *familiar risk*. The pre and post spatial factor representation of all activities and technologies (Figure 5.13) demonstrated the similarity and insignificance relocation between study phases.

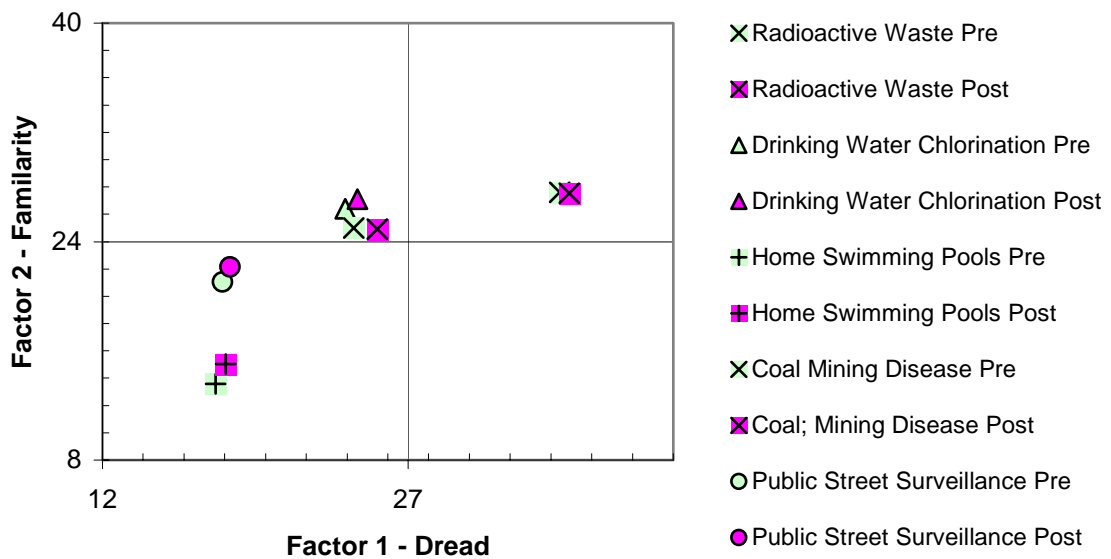


Figure 5.13. Pre & post spatial factor representation of all activities and technologies.

The risk characteristic profile of public street surveillance was tested at each phase of the study. It was found that a number of *dread risk* characteristics were significantly different between study phases. The characteristic of control produced a reduced, but significant, mean difference of 0.4103 [t(116)=2.4008,p=0.0179] towards greater perceived control. This opposed the results demonstrated in public street surveillance control (Section 5.3.6). But the characteristic of control still produced a significant mean difference of 2.8782 between *dread risk* and control [t(118)=14.9264,p=0.0000], with control still located towards higher *dread risk*.

The characteristic of involuntary exposure also increased significantly by a mean of 0.4786 [t(116)=2.6897,p=0.0567]. The *familiarity to risk* characteristic of immediate affect increased significantly by a mean of 0.5739 [t(114)=2.3361,p=0.0096]. The pre and post study phase characteristic profile is presented, demonstrating the difference between key characteristics (Figure 5.14).



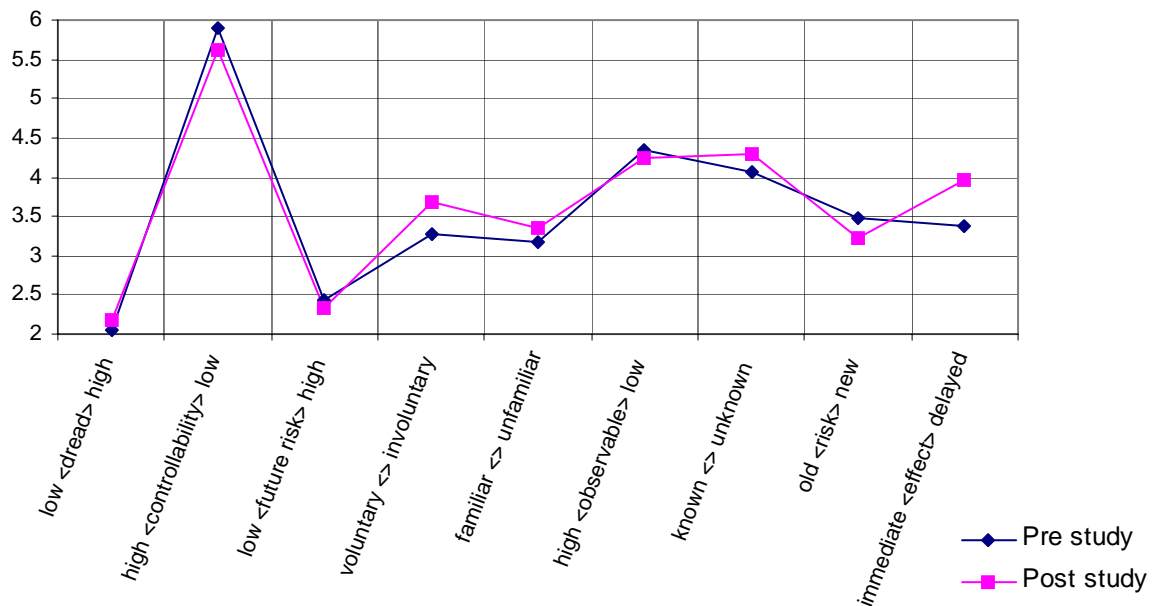


Figure 5.14. Pre & post factor characteristic profile for public street surveillance.

MDS analysis was applied to elicit *underlying* risk perceptions. Although the psychometric representation did not produce significant changes in risk perception between study phases, a number of MDS analyses did demonstrate risk perception change. These included the MDS INDSCAL measure of gender and distance.

In the INDSCAL gender spatial representation pre study result, public street surveillance occupied the same quadrant as home swimming pools. All other activities and technologies remained consistent and within the same quadrant at the pre and post study phases. In the pre study, dimension 1 produced a similar outcome as home swimming pools and dimension 2, an outcome midway between coal mining disease and home swimming pools. In the post study, dimension 1 produced a similar outcome as home swimming pools and dimension 2, as coal mining disease (Figure 5.15). Public street surveillance had relocated along dimension 2 axis to its *own* quadrant, presenting a similar spatial representation as the MDS Euclidean total result (Figure 5.8).

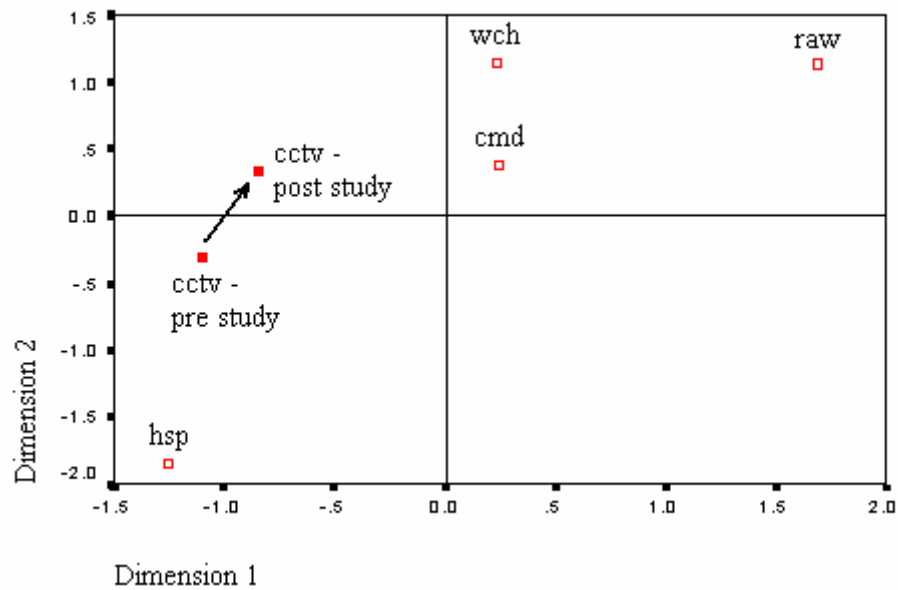


Figure 5.15. MDS INDSCAL gender public street surveillance relocation.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

As with the MDS INDSCAL gender outcome, the distance spatial representation produced an outcome that placed public street surveillance within its *own* quadrant. This opposed the pre study result that located public street surveillance within the same quadrant as home swimming pools.

## 5.6. Study Reliability and Validity

This section presents the reliability and validity results of the investigation. This includes the results from the pre and post study phases, and a comparison. Methods of analysis include Alpha reliability and Pearson two tailed correlation.

### 5.6.1 Reliability

The pre study survey questionnaire achieved a moderate acceptable Alpha reliability (Table 5.1) *dread risk* (factor 1) mean of 0.6 (SD 0.05) and *familiarity to risk* (factor 2) mean of 0.7 (SD 0.09). As discussed in the draft pilot study (Chapter 4), the use of five different activities and technologies resulted in difficulty in removing unreliable questions across the whole survey instrument. Each activity or technology had different *poor* reliability questions and in the draft pilot studies these questions were removed, although there was still compromise in the final survey questionnaire. The five activities and technologies are not mutually inclusive, leading to a reduced ability of developing a statistically high reliability outcome.

Table 5.1

#### *Pre Study Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>					
<b>ITEM</b>		<b>Factor 1 – Dread</b>		<b>Factor 2 – Familiarity</b>	
Radioactive waste DREAD		0.6			
Radioactive waste FAM				0.5	
Water chlorination DREAD		0.7			
Water chlorination FAM				0.7	
Home swimming pools DREAD		0.7			
Home swimming pools FAM				0.7	
Coal mining disease DREAD		0.6			
Coal mining disease FAM				0.6	
Public street surveillance DREAD		0.6			
Public street surveillance FAM				0.7	
<b>MEAN</b>	<b>SD</b>	<b>0.6</b>	<b>0.05</b>	<b>0.7</b>	<b>0.09</b>

The post study survey questionnaire achieved a moderate acceptable Alpha reliability (Table 5.2) *dread risk* (factor 1) mean of 0.6 (SD 0.06) and *familiarity to risk* (factor 2) mean of 0.6 (SD0.10).

Table 5.2

*Post Study Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>					
<b>ITEM</b>		<b>Factor 1 – Dread</b>		<b>Factor 2 – Familiarity</b>	
Radioactive waste DREAD		0.5			
Radioactive waste FAM				0.5	
Water chlorination DREAD		0.6			
Water chlorination FAM				0.6	
Home swimming pools DREAD		0.7			
Home swimming pools FAM				0.8	
Coal mining disease DREAD		0.6			
Coal mining disease FAM				0.6	
Public street surveillance DREAD		0.6			
Public street surveillance FAM				0.7	
<b>MEAN</b>	<b>SD</b>	<b>0.6</b>	<b>0.06</b>	<b>0.6</b>	<b>0.10</b>

From both surveys, these measures produced a moderate mean Alpha reliability total *dread risk* (0.6, SD 0.01) and *familiarity to risk* (0.6, SD 0.01). The total Alpha reliability was tested, producing consistently moderate and acceptable results for both the pre study ( $\alpha=0.7240$ ) and post study ( $\alpha=0.7716$ ). This resulted in the investigation producing an overall acceptable moderate Alpha reliability mean ( $\alpha^{\text{total}}=0.7478$ ).

Table 5.3

*Total Study Reliability Scale*

<b>RELIABILITY ANALYSIS – SCALE (ALPHA)</b>
Pre study Alpha = 0.7240
Post study Alpha = 0.7716
Total Mean Alpha = 0.7478

Additional reliability was demonstrated through comparison between previous psychometric research studies. Internally, the investigation produced high and consistent matching spatial results in all draft, pilot and final phases. The spatial representations produced a moderate match to previous psychometric research studies (Slovic, 1997; Slovic, 1992) in all but one item, being the local social risk perception to coal mining disease. The pre and post studies only produced one factor item that was significantly different [t(119)=-2.1410,p=0.034] between studies, being home swimming pool *familiarity to risk*.

These results demonstrated the reliability of the research instrument, which produced consistent and moderately acceptable measures throughout the study, both internally and externally. This demonstrated that if the research instrument was utilised within another study, that it would seem that consistent results could again be achieved.

### **5.6.2 Validity**

Correlation was tested using the Pearson two tailed correlation method. Each activity and technology was tested between each of the factor's six questions, producing low to moderate results (Table 5.4). The pre study Pearson Correlation produced a moderate *dread risk* ( $r=0.2$ , SD 0.03) and moderate *familiar risk* ( $r=0.3$ , SD 0.08) measure.

Table 5.4

*Pre Study Pearson Two Tailed Correlation between Factor Questions*

<b>ITEM</b>	<b>MEAN</b>	<b>SD</b>
Radioactive waste DREAD	0.2	0.16
Radioactive waste FAM	0.2	0.14
Water chlorination DREAD	0.3	0.18
Water chlorination FAM	0.3	0.23
Home swimming pools DREAD	0.3	0.18
Home swimming pools FAM	0.3	0.16
Coal mining disease DREAD	0.2	0.10
Coal mining disease FAM	0.2	0.18
Public street surveillance DREAD	0.2	0.18
Public street surveillance FAM	0.3	0.16

The post study Pearson Correlation produced a *dread risk* ( $r=0.2$ ,  $SD0.04$ ) and *familiar risk* ( $r=0.4$ ,  $SD0.07$ ) measure (Table 5.5). These demonstrated a moderate test result.

Table 5.5

*Post Study Pearson Two Tailed Correlation between Factor Questions*

<b>ITEM</b>	<b>MEAN</b>	<b>SD</b>
Radioactive waste DREAD	0.2	0.15
Radioactive waste FAM	0.2	0.16
Water chlorination DREAD	0.3	0.23
Water chlorination FAM	0.3	0.15
Home swimming pools DREAD	0.3	0.18
Home swimming pools FAM	0.4	0.23
Coal mining disease DREAD	0.2	0.12
Coal mining disease FAM	0.3	0.16
Public street surveillance DREAD	0.2	0.15
Public street surveillance FAM	0.3	0.16

Although these correlation tests were between different factor risk characteristics, it was expected that they would generally produce a moderate to high result. This was in consideration that high *dread risk* would have characteristics of high uncontrollability, high risk to future generations and a high involuntary exposure. “Dread risk is a dominating risk factor and can be made of various characteristics ... which were found

to be highly correlated” (Slovic cited in Brooks & Smith, 2002, p.29). But, this should have been applicable to both factors of *dread risk* and *familiarity to risk*.

But as the risk characteristic of control demonstrated, there may be unique and individual risk perception to each risk characteristic. These may have reduced the correlation measure, although this would not appear to be a robust analysis of why moderate or low correlation results were achieved. The difference between each pre and post study risk characteristic was low (M0.01, SD0.03), demonstrating that consistent results were achieved.

The Pearson correlation pre to post study produced a *dread risk* ( $r=0.5$ , SD0.07) and *familiar risk* ( $r=0.4$ , SD0.11) measure, presenting a moderate test-retest result (Table 5.6). The investigation also produced only one factor item that was significantly different [ $t(119)=-2.1410, p=0.034$ ] between studies, being home swimming pool *familiarity to risk*. Internally, the investigation produced high and consistent spatial results in all draft, pilot, and pre and post study phases.

Table 5.6

*Pre and Post Study Pearson Two Tailed Correlation between Factors*

<b>ITEM</b>	<b>Dread</b>	<b>Familiarity</b>
Radioactive waste	0.4836**	0.4162**
Water chlorination	0.6306**	0.5660**
Home swimming pools	0.5007**	0.2740**
Coal mining disease	0.4750**	0.3837**
Public street surveillance	0.6123**	0.4401**
<b>Mean</b>	<b>0.5404</b>	<b>0.4160</b>
<b>SD</b>	<b>0.0748</b>	<b>0.1052</b>
<b>** Correlation is significant at the 0.01 level (2-tailed).</b>		

The correlation between the public street surveillance characteristic profiles were tested (Table 5.7). This presented a moderately acceptable mean result (0.4<sup>total</sup>).

Table 5.7

*Pre and Post Study Public Street Surveillance Characteristic Profile Correlation*

<b>Paired Samples Correlation's</b>				
<b>PAIR</b>	<b>ITEM</b>	<b>N</b>	<b>Correlation</b>	<b>Sig. <sup>95%</sup></b>
Pair 1	Pre dread & post dread	118	0.6735	0.0000
Pair 2	Pre control & post control	117	0.4331	0.0000
Pair 3	Pre future & post future	118	0.5378	0.0000
Pair 4	Pre voluntary & post voluntary	117	0.4142	0.0000
Pair 5	Pre familiar & post familiar	118	0.3501	0.0001
Pair 6	Pre observe & post observe	113	0.2071	0.0278
Pair 7	Pre known & post known	115	0.4014	0.0000
Pair 8	Pre old & post old	112	0.2975	0.0014
Pair 9	Pre immediate & post immediate	115	0.4664	0.0000
<b>Mean Total</b>			<b>0.4201</b>	

Externally, the spatial representations produced a moderate spatial match (0.7500) to previous psychometric research studies (Slovic, 1997; Slovic, 1992). This was in all but one item, being coal mining disease. These results demonstrated the validity of the research instrument, which produced consistent and moderately acceptable measures throughout the study, both internally and externally.

### **5.6.3 Reliability and Validity Summary**

The investigation produced an acceptable Alpha reliability measure ( $\alpha^{\text{total}}=0.7$ ), with the pre study producing an acceptable *dread risk* factor mean ( $\alpha=0.6$ , SD0.05) and *familiarity to risk* mean ( $\alpha=0.7$ , SD0.09). The post study also produced an acceptable Alpha reliability measure *dread risk* factor mean ( $\alpha=0.6$ , SD0.06) and *familiarity to risk* mean ( $\alpha=0.6$ , SD0.10).

The pre study Pearson correlation produced moderate *dread risk* ( $r=0.2$ , SD0.03) and *familiar risk* ( $r=0.3$ , SD0.08) measure. The post study Pearson correlation again produced a moderate *dread risk* ( $r=0.2$ , SD0.04) and *familiar risk* ( $r=0.3$ , SD0.07) measure. Although these correlation tests were between different risk characteristics, it



was expected that they would generally produce a moderate to high result. This was in consideration that a high *factor* had high risk characteristics. This was not demonstrated in this study.

Internally, the investigation produced high and consistent spatial results in all draft, pilot and study phases. The Pearson correlation pre to post study produced a *dread risk* ( $r=0.5$ ,  $SD0.07$ ) and *familiar risk* ( $r=0.4$ ,  $SD0.11$ ) measure, presenting a moderate test-retest result. Externally, the spatial representations produced a moderate match to previous psychometric research studies (Slovic, 1997; Slovic, 1992) in all but one item, being the local social risk perception to coal mining disease. The pre and post studies only produced one factor item that was significantly different [ $t(119)=-2.1410, p=0.034$ ] between studies, being home swimming pool *familiarity to risk*. These results demonstrated that the research instrument produced consistent and moderately acceptable measures throughout the study.

### **5.7 Summary**

This chapter presented the analysis of the research data. It included the demographics of the study, pre and post study data analysis, comparison of these data sets, and study reliability and validity. The data analysis resulted in a number of significant findings.

Demographics demonstrated that the majority of the target population (86.4%,  $N=146$ ) worked and/or lived within close proximity ( $\leq 4\text{km}$ ) to Rockingham beachfront. The investigation showed that the social risk perception of public street surveillance was a *low dread risk* and *familiarity to risk*. MDS supported this analysis, but provided additional *underlying* dimensions and presented public street surveillance with its *own* unique characteristics. Public street surveillance had a low sense of *community risk perception* and a low *perceived community exposure to risk*. Females presented a lower social risk perception than males, a unique outcome in risk perception. Age or distance had no significant affect to the sense of risk perception.

Through the characteristics of risk, the community risk perception of public street surveillance was defined as a low risk to future generations, that exposure was voluntary, the risk was observable, that the community understood the risk, that the risks were known and would be immediate. This resulted in public street surveillance having a perceived low social risk perception, demonstrating a social benefit that outweighed the perceived risk to the community. But it appeared that the community had a social concern over the ability to ensure appropriate public street surveillance control. The risk characteristic of *control* located public street surveillance towards a significantly *higher dread*, but still within the *familiarity to risk*.

The investigation found that increased exposure did not change the social risk perception of lay people towards public street surveillance. Although increased risk perception between study phases for the risk characteristics of *controllability* and *involuntary* exposure was demonstrated. Also, the factor *familiarity to risk* did provide a neutral response, indicating that there may have been little thought given to public street surveillance. These issues could drive and alter the social risk perception of public street surveillance. This appeared to be indicated within the MDS INDSCAL gender representation after increased exposure, as public street surveillance relocated from a *familiar risk* to an *unfamiliar risk*.

The investigation produced an acceptable Alpha reliability measure ( $\alpha^{\text{total}}=0.7$ ), with the study phases producing an acceptable *dread risk* factor mean ( $\alpha^{\text{pre}}=0.6$ ;  $\alpha^{\text{post}}=0.6$ ) and *familiarity to risk* mean ( $\alpha^{\text{pre}}=0.7$ ;  $\alpha^{\text{post}}=0.6$ ). But the Pearson correlation produced only moderate results, with a *dread risk* ( $r^{\text{pre}}=0.2$ ;  $r^{\text{post}}=0.2$ ) and *familiarity to risk* ( $r^{\text{pre}}=0.3$ ;  $r^{\text{pos}}=0.3$ ) measure. Although these correlation tests were between risk characteristics, it was expected that they would generally produce higher results ( $r \geq 0.7$ ). Internally, the investigation produced high and consistent spatial results. The Pearson correlation between phases produced a *dread risk* ( $r=0.5$ ) and *familiarity to risk* ( $r=0.4$ ) measure, presenting moderate results. Externally, the spatial representations produced a moderate match to previous psychometric studies. These results demonstrated that the

research instrument produced consistent and moderately acceptable measures throughout the study.

## Chapter 6

### *Interpretations*

#### **6.1 Introduction**

This chapter presents interpretations of the data analyses. These included the measured risk perception of public street surveillance and dominant risk perception characteristics (Section 6.2), that public street surveillance was a socially acceptable risk (Section 6.3), why females felt safer with public street surveillance (Section 6.4), the changing social risk perception of public street surveillance (Section 6.5) and why only limited risk perception change was demonstrated (Section 6.6). The study outcomes (Section 6.7), limitations of outcomes (Section 6.8), areas for further research (Section 6.9) and conclusions (Section 6.10) finalize the study.

#### **6.2 The Psychometric Risk Perception of Public Street Surveillance**

This investigation measured the social risk perception of public street surveillance, utilizing the psychometric factor and MDS representation techniques. The psychometric spatial factor representation demonstrated that public street surveillance occupied *low dread risk* and *familiarity to risk*. MDS presented public street surveillance as a *low community risk perception* and a *low perceived community exposure to risk*.

Public street surveillance ( $\text{mean}^{\text{total}}$ ) was presented within the psychometric spatial representation and occupied the same spatial quadrant as home swimming pools, within the quadrant of *low dread risk* and *familiarity to risk*. Public street surveillance *dread risk* matched home swimming pools, with *familiarity to risk* being located mid way between coal mining disease and home swimming pools. The spatial representation of the *control* activities and technologies were supported by previous psychometric studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; DeNorma, 2001; Slovic, 1997), reinforcing the measured position of public street surveillance.

MDS Euclidean distance technique also presented a spatial representation distribution. MDS demonstrated the group space of the activities and technologies, and formed the *underlying* configuration of points (Cox & Cox, 2000). The two MDS dimensions were reduced to one-dimensional representations, producing dimension 1 spectrum that matched in distribution, both *dread risk* and *familiarity to risk*. This dimension appeared to measure the *community risk perception* of the activities and technologies. Dimension 2 produced a spectrum that showed that the spatial representation (Figures 5.5 & 5.10) did not fully demonstrate the *underlying* risk perceptions. Dimension 2 was defined as the *perceived community exposure to risk*. Placed onto the group space, was the psychometric spatial factor representation of *dread risk* and *familiarity to risk*, which displayed a 45° rotation (Figure 6.1).

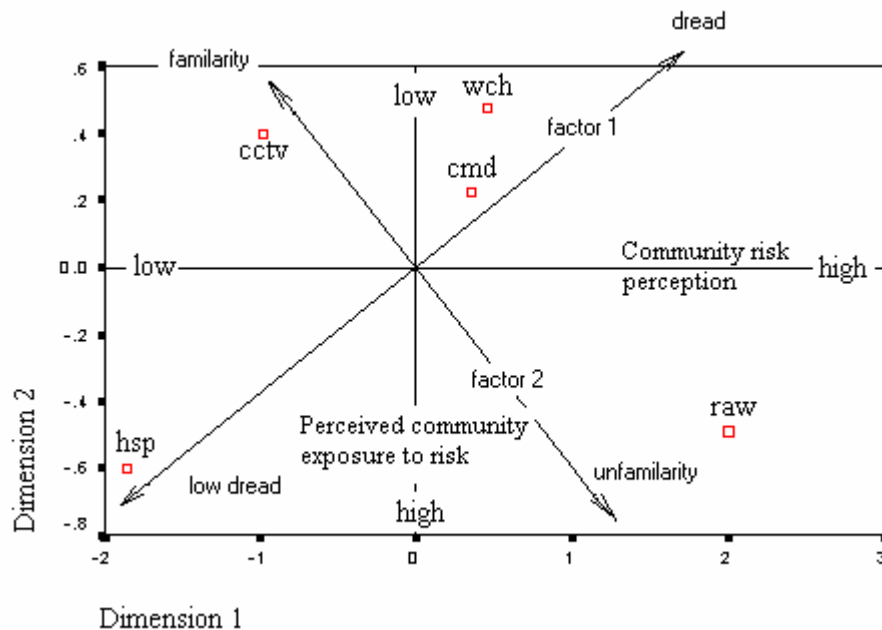


Figure 6.1. Psychometric factor and MDS spatial representation of concept space for all activities and technologies.

(raw= radioactive waste, wch= drinking water chlorination, hsp= home swimming pools, cmd= coal mining disease, cctv= public street surveillance).

Where the psychometric spatial representation placed public street surveillance within the same quadrant as home swimming pools, MDS placed public street surveillance within its *own* quadrant. This indicated that public street surveillance had unique characteristics, when compared to the other activities and technologies. Applying the MDS dimensional characteristics, public street surveillance appeared to have a *low level of risk perception* and a *low perceived community exposure to risk*.

INDSCAL demonstrated that public street surveillance had a similar level of *dread risk* as home swimming pools. This effect also demonstrated that public street surveillance was located within the spatial factor representation quadrant of *low dread* and *familiar risk*, but that it had appeared to relocate between studies toward an increased *unfamiliarity to risk*. Public street surveillance was located close to the centre of dimension 2 *familiarity to risk*, showing a neutral response and that there may have been little thought given to the social issues of public street surveillance. This supported the *familiarity to risk* characteristic profiles.

The ability of the psychometric model to measure *intellectual risk* was also demonstrated; *intellectual risk* being an activity or technology that does not cause direct risk to the person. Previous studies of the psychometric paradigm assessed activities and technologies that could be a physical risk (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; DeNorma, 2001; Slovic, 1997). But public street surveillance does not cause physical harm and can be seen more as a *privacy risk* or *intellectual risk*. Whereas radioactive waste, swimming pools, etc., can be perceived by a layperson as a physical risk. It was found that an *intellectual risk*, being public street surveillance, could be measured with perceived physical risk activities and technologies.

### ***6.3 Is Public Street Surveillance a Sociably Acceptable Risk?***

Public street surveillance (mean<sup>total</sup>) occupied the same psychometric spatial quadrant as home swimming pools, with a *low dread risk* and *familiarity to risk*. Through the

characteristics of risk, the community risk perception of public street surveillance can be defined as a low risk to future generations, that exposure was voluntary, the risk was observable, that they understood the risk, that the risks are known and would be immediate. This would support CCTV “apparent public popularity of the measure” (Painter & Tilley, 1999, p.2) and resulted in public street surveillance having a perceived low social risk perception, demonstrating a social benefit that outweighed the perceived risk to the community.

Ditton (1999) supported this finding when he found that there “was a slight reduction in those who said they were anxious about becoming a victim of crime” and went further when “79% thought [public street surveillance] ... would make people feel less likely that they would become victims of crime”. Painter and Tilley also stated that “public support or acceptance for CCTV in public spaces ... appears to be high” (1999, p.7). Therefore, it can be stated that public street surveillance system was an acceptable social risk.

MDS Euclidean distance model supported the psychometric spatial outcome, with public street surveillance being located within the dimensional space of *low level of risk perception* and a *low perceived community exposure to risk*. Although MDS did produce a result that placed public street surveillance within its *own* unique quadrant when compared to the other *control* activities and technologies. This indicated that public street surveillance had unique characteristics from the other activities and technologies. Therefore unlike the psychometric representation, this produced an outcome that placed public street surveillance within an area that although acceptable, may be prone to risk perception relocation.

The risk characteristic of *controllability* demonstrated a factor that could cause risk relocation. Extracting the characteristic of control from *dread risk* located public street surveillance towards a *higher dread*, but still within the *familiarity to risk* quadrant. In both phases of the study, the mean difference between total *dread risk* and the

characteristic of control was significant [t(165)=21.7,p=0.0000, t(116)=2.4008,p=0.0179]. It appeared that the community had and maintained a social concern over the ability to ensure appropriate public street surveillance control. Philips supported this outcome, although did indicate that “fears about abuse and control may be alleviated by the regulation of CCTV.” (1999, p.140).

As Painter and Tilley stated “some feel uncomfortable at the thought that their private out-of-doors actions may be focused on by surveillance specialists’ (1999, p.6). This could include our everyday actions, not just illegal behavior. The methodology of surveillance targeting community members may become a social concern, intimidated by this risk characteristic of *controllability*. These issues have been raised by several authors in the past (Painter & Tilley, 1999; Norris & Armstrong, 1999).

Public street surveillance produced the lowest level of *dread* and *risk to future generations*. But for the *familiarity to risk* characteristics, public street surveillance was located close to the centre. This may indicate neutral risk perception or that little social thought had been given to public street surveillance. These results were replicated and supported in both phases of the study.

Public street surveillance did appear to demonstrate a social benefit in both the psychometric and MDS representations. This was repeated in both phases of the investigation. But there were a number of key issues that could cause public street surveillance to relocate, primarily being the *controllability* of public street surveillance. Although public street surveillance did demonstrate that it was a sociable acceptable risk which outweighed the social risk.

#### ***6.4 Public Street Surveillance Risk Perception Demographic Affect***

The investigation demonstrated that public street surveillance did have an affect on the risk perception of certain demographic groups. This was particularly apparent with gender risk perception. Females exhibited greater *dread risk* and/or *unfamiliarity to*



*risk* levels across all technologies and activities, excluding public street surveillance. For the *control* items this had been demonstrated by a number of previous studies (Bouyer, Bagdassarian, Chaabanne & Mullet, 2001; Slovic, 1997).

Brown (cited in Philips, 1999, p.139) noted that “CCTV is unlikely to make women feel safer in town centres.” But public street surveillance gender spatial spread appeared to oppose this and also provided a unique risk perception outcome. This demonstrated that females had a *lower dread risk* and *familiarity to risk* for the technology of public street surveillance, with the result consistently achieved in both study phases. This opposed Philips (1999), indicating that females not only felt safer when public street surveillance was present, but that they felt that public street surveillance was a social benefit that outweighed perceived risk. Traditional difference in gender risk perceptions was believed to be due to biology, educational levels or a lack of understanding of technical issues. However, empirical studies appear to suggest that the difference in risk perception is in some part biological. This still does not provide a full explanation (Finucane, 2002; DeNorma, 2001), but supports the findings of this study.

The study found that females felt safer within a public street surveillance system. It can be argued that this was due to the perception that they were within a surveillance zone, with official help close at hand. But Norris and Armstrong found that women accounted for only 7% of primary persons placed under surveillance and that out of nearly 600 hours of actual surveillance tapes, only one woman was actively targeted as a protective measure (1999, p.172). Norris and Armstrong (1999) studied who and what public street surveillance operators watched, and how operators discriminated by age, race and gender, resulting in young men being their primary targets.

MDS INDSCAL gender provided a spatial representation distribution that appeared similar to the psychometric spatial factor representation. Unlike the MDS spatial representation, the gender spatial distribution dimensions matched the factor distribution. Dimension 1 was similar to *dread risk* and dimension 2 was similar to

*familiarity to risk*. But this distribution placed drinking water chlorination and coal mining disease in the quadrant of *higher dread* and *unfamiliar risk*. This plot adjusted the spatial factor representation distribution by shifting the axis location of *familiarity to risk* (factor 2), but still supported the spatial representation

Using the psychometric spatial representation, public street surveillance sense of risk perception did not appear to be related to age or distance, which produced no significant difference and resulted in the closest spatial cluster of all activities and technologies. The distance that the participants lived and/or worked from the nucleus of the public street surveillance system did not induce any significant difference in their sense of risk perception. Again, this factor presented the closest dimensional cluster of all tested activities and technologies.

Public street surveillance provided females with increased levels of perceived safety. Therefore, it can be argued that females would support the introduction and maintenance of public street surveillance systems. The factors of age or whether a layperson lived or worked within the field of view of a public street surveillance system did not have any significant affect.

### ***6.5 Changing Social Risk Perception of Public Street Surveillance***

The study research question proposed that public street surveillance was located within the psychometric spatial factor representation quadrant of *low dread risk* and *unfamiliarity to risk*. This would have defined public street surveillance as controllable, a low risk to future generations and that exposure was voluntary. But that public street surveillance had an unknown capability, that the risk was not observable, and that the risk was new and delayed. Resulting in public street surveillance being perceived as an unknown threat, but socially acceptable.

But when public street surveillance exposure was increased, during and after the installation of the system, the risk perception would relocate to the psychometric

quadrant of *higher dread risk* and *familiarity to risk*. This would increase the perceived threat to society, making public street surveillance less sociably acceptable.

The investigation measured the psychometric risk perception of public street surveillance and placed public street surveillance within the same spatial quadrant as home swimming pools, being *low dread risk* and *familiarity to risk*. MDS reinforced the psychometric spatial factor representation, presenting public street surveillance as a *low community risk perception* and a *low perceived community exposure to risk* (Figure 6.1). This result opposed the research question, locating public street surveillance in a quadrant that was not expected at the beginning of the investigation. Also, within the psychometric factor and MDS representations, increased exposure to public street surveillance did not appear to cause any significant relocation of social risk perception.

But MDS INDSCAL did demonstrate gender relocation. Also a number of findings did suggest that public street surveillance risk perception did demonstrate relocation after increased lay exposure, although there was limited statistical evidence to demonstrate a robust and high degree of risk relocation. What appeared to demonstrate risk relocation were a number of the risk characteristics, being those of *controllability* and *involuntary exposure*. Also, *familiarity to risk* presented a result close to the spatial centreline.

Public street surveillance controllability produced a significant [ $t(165)=21.7, p=0.0000$ ,  $t(116)=2.4008, p=0.0179$ ] difference in mean towards a *higher dread* result, although this still located controllability within the *lower dread risk* quadrant. The difference between factor *dread* and the characteristic of control was significant in both study phases. Also, the risk characteristic of involuntary exposure increased significantly [ $t(116)=2.6897, p=0.0567$ ]. It appeared that the community had and maintained a social concern over the ability to ensure appropriate public street surveillance control.

*Familiarity*, in all risk characteristics for public street surveillance, was located close to the centre. Also, between study phases this did not change significantly. This appeared

to indicate a neutral risk perception towards public street surveillance, that the community did not at that time have strong views on the system or that little social thought had actually been given to public street surveillance. Increased awareness, through the media, increasing systems and better understanding of public street surveillance may cause risk perception relocation.

Initial MDS INDSCAL gender spatial representation presented results that placed public street surveillance within the same quadrant as home swimming pools. But after increased exposure, public street surveillance relocated across dimension 1 to its own *unique* quadrant (Figure 5.15). All other activities and technologies remained consistent and within the same quadrant during the investigation. Public street surveillance had relocated along dimension 2 axis, remaining a *low dread risk*, but relocating from a *familiar* to an *unfamiliar risk*. This result appeared to demonstrate that there had been social risk perception relocation during the investigation.

There were a number of key public street surveillance areas of concern, shown with the risk characteristics of *controllability* and *involuntary*. *Familiarity to risk* produced a result that was neutral in outcome, prone to increased awareness and therefore, risk relocation. Also, MDS INDSCAL provided gender relocation during the investigation. This may indicate that like all new technologies, public street surveillance has not yet found its true social risk perception measure. Painter and Tilley supported this, when they suggested that CCTV “public support is not necessarily robust.” (1999, p.5).

### ***6.6 Limited Changing Social Risk Perception of Public Street Surveillance***

Community risk perceptions are defined by society and not the expert or industry (Brooks & Smith, 2002). To attempt or expect that the risk perception of public street surveillance would relocate with increased exposure was naive in the initial research question. As discussed within the introduction (Chapter 1), the issues that could change the social risk perception of public street surveillance are complex and interwoven, and therefore, beyond the scope of this investigation. But in the context of this study, there

were some interesting aspects that may have led to this limited risk perception relocation. Considering the research findings, it can be argued that the study would have been unlikely to have demonstrated public street surveillance risk relocation within the research period.

The media are a driving force behind the type and extent of coverage given to issues of social risk. They dramatize issues, elevate social concerns, focus on minority groups, and expose and propose individual fears as that of the general population. But, with current public street surveillance “media coverage is of a positive nature, with little or virtually no adverse media coverage” (Brooks & Smith, 2002, p.28). The media does not appear to target public street surveillance as a social concern, but takes the community stance that it is a social benefit there to do good.

The local media comprises of two local community papers. Between them they have each covered the public street surveillance system twice. In each case that was due to the local city council filing a press release on the newly installed public street surveillance system. The *Sound Telegraph* did discuss the introduction of the council investment in the security cameras as “Big brother is watching, but unlike the television show this is a realistic situation.” (Millimaci, 2002). The city council also has the *City Chronicle*, which has covered the public street surveillance system twice. Therefore, locally there has been relatively little media coverage of this system. In the state press during the period of the study, the *West Australian* newspaper (Harvey, 2002) did one story on CCTV cameras. This covered new laws for nightclubs and their requirement to have camera surveillance. But the story focused on gay clubs and their attempt to get exceptions from the law due to privacy.

Therefore it could be argued that the media, being a driving force behind risk perception relocation, did not provide the vehicle and that the media coverage of the public street surveillance did support the measured social risk perception. Public street surveillance has a low perceived social risk, providing a perceived benefit for the community and

when raised with the community, generating little adverse response. Painter and Tilley (1999) supported this, when they stated that “the mass media have raised few critical questions.” Therefore, why would the media provide stories that are of little interest to the public or increase their readership.

But it can be argued that in the future the media will address the more diverse social concerns. These include the limited legislation protection against public street surveillance systems. That changing technology may become a force multiplier, through digital imaging, biometrics and data matching technology, and how effective or ineffective public street surveillance is perceived to be in the future. These issues also raise social concerns over privacy and civil liberties.

The public street surveillance system had little media coverage. The cameras blend in with the streetscape and providing little visual sign that they exist (Appendix D). The city council security manager felt that they should be as inconspicuous as possible (K. Ashfield, personal communication, December 5, 2002) and has, after the system has been operating for over eight months, just proposed to install signs that inform people using the area that they are under video surveillance. This has led to limited increased awareness by the community using the area that they are now under public street surveillance.

The local Police Service monitor and operate the public street surveillance system. But they have not used the system to its full and recommended potential. The system should have been utilized as a tool to reduce crime through deterrent, detection and apprehension. Through the media, the effectiveness to apprehend criminals can be highlighted, raising the awareness of the public street surveillance system. This has led to the public street surveillance system being relatively ineffective in reducing crime, although there are no quantified statistics to demonstrate this outcome.

Within the social climate of the community, there was an increase in the subjective level of fear against terrorism attacks. The community had suffered a major world terrorism event on the 11 September 2000, with the World Trade Centre Towers, New York attack. This was not measured within the investigation and was outside the scope of the study, but it could be argued that this increased fear would lead to an increase in the perceived need for public street surveillance.

The community perceived the public street surveillance as a social benefit, which outweighed the social risk. It could be argued that the investigation could never have achieved a measured change in social risk perception in the current environment. That was unless additional research controls were applied to test groups in an attempt to increase social awareness. This could have been achieved through highlighting weakness in public street surveillance systems, their technical capability and presenting recent research findings into effectiveness of public street surveillance systems against personal crime.

### ***6.7 Study Outcomes***

This section reviews and presents the outcomes of the study, demonstrating a number of key findings. These include the ability of the theoretical model to measure and represent the social risk perception of public street surveillance, that public street surveillance was a sociable acceptable risk, that both *intellectual* and *physical risks* can be concurrently measured and that females presented a unique, but opposing, risk perception measure.

#### ***6.7.1 What Theoretical Model can be Utilized to Measure the Social Risk Perception of Public Street Surveillance?***

By the utilization of the psychometric factor and MDS representation techniques, these models demonstrated methods to measure the social risk perception of public street surveillance. The psychometric factor model was shown to be both reliable ( $\alpha^{\text{total}}=0.7$ ) and valid in measure, replicating previous risk perception studies (Bouyer,

Bagdassarian, Chaabanne & Mullet, 2001; DeNorma, 2001; Slovic, 1997). This study also demonstrated that although public street surveillance may be seen as an *intellectual* or *privacy risk*, as opposed to a *physical* or *direct risk*, that the psychometric model still appeared to achieve a successful outcome in measuring this type of risk.

### ***6.7.2 What was the Social Risk Perception of Public Street Surveillance?***

The social risk perception of public street surveillance was found to be a *low dread risk* and *familiarity to risk*. This placed public street surveillance within a similar risk domain as that measured for home swimming pools, supported by INDSCAL. But MDS Euclidean distance model placed public street surveillance within its *own* quadrant, indicating that public street surveillance had unique characteristics. Applying the MDS dimensional characteristics, public street surveillance appeared to have a *low level of risk perception* and a *low perceived community exposure to risk*.

### ***6.7.3 Is Public Street Surveillance a Sociably Acceptable Risk?***

The study demonstrated that public street surveillance was a socially acceptable risk, which outweighed the perceived social risk to the community and that this outcome had been supported by previous studies (Painter & Tilley, 1999; Ditton, 1999). This placed public street surveillance into a domain that through the characteristics of risk, the community risk perception could be defined as a low risk to future generations, that exposure was voluntary, the risk was observable, that the community understood the risk, that the risks are known and would be immediate. Although with *familiarity to risk*, there appeared to have been little social thought given to this factor of risk.

But there was a community concern over the ability of society to control public street surveillance and therefore, CCTV. This had been supported by previous studies (Philips, 1999; Painter & Tilley, 1999). The media appeared to support the community's risk perception, being non-adversary in the representation of public street surveillance. But these issues may cause social relocation, although public street surveillance was located in a non-adversarial position and likely to remain within that



position for some time. Finally, it can be argued that this outcome can be applied to all domains of CCTV, not just public street surveillance.

#### ***6.7.4 Did Public Street Surveillance Significantly Affect the Risk Perception of Certain Demographic Groups?***

Females demonstrated a unique and significant demographic affect with the risk perception of public street surveillance, being a *lower dread risk* and increased *familiarity to risk*. Previous studies (Slovic 1992; Slovic 1997) had shown that females generally have a *higher dread* and increased *unfamiliarity to risk* to activities and technologies when compared to males. Also, research has stated that CCTV would be unlikely to improve the perception of safety for women (Philips, 1999). This result appeared to demonstrate that this might not be the case. Public street surveillance produced a result that demonstrated that females felt increased perceived levels of safety with this technology, and would support and maintain public street surveillance systems. The factor of age or distance a person lived or worked from a public street surveillance system appeared to have no affect on their level of risk perception.

#### ***6.8 Limitations of Outcomes***

There were a number of areas that limited the study's robust demonstration of the social risk perception of public street surveillance. This included limitations in the psychometric theoretical model, MDS analysis, the research instrument reliability and validity, the size and exposure of the public street surveillance system and a naive research question.

The ability of lay people to provide meaningful responses to what can be very complex and multi-dimensional risk issues have to be questioned. With public street surveillance, it can be argued that the participants gave these issues very little thought, which may have been demonstrated within the study's neutral response to the *familiarity to risk* factor. As Slovic (1992, p.119) stated "the questions typically assess cognition – not actual behavior."

The psychometric model measures social risk perception in a group context and does not assess individual risk perception. Psychometric research has been criticized for treating risk as purely objective and not accounting for cultural or social bias, which are hidden in the quantitative analysis and representation (Shaw & Shaw, 2001). Within this investigation, this issue was reduced through the application of additional analysis using MDS Euclidean and INDSCAL techniques. But this limitation was not fully eliminated, as dissimilarity data collected at the individual level would be required, resulting in a requirement for a revised research instrument.

MDS Euclidean distance model analyzed a total of five activities and technologies. This produced a data matrix with ten parameters and data values. The total number of parameters being estimated, being the number of stimulus coordinates plus the number of weights, was large relative to the number of data values in the data matrix. Therefore, the results may not have produced a high reliability measure, since there may not have been enough data to precisely estimate the values of the parameters. To increase reliability would require increased data values or reduced parameters (dimensions).

MDS INDSCAL provided the measure of subject space, through spatial representation. This also presented the angular separation and vector length of the configuration of points. This method is referred to as the Analysis of Angular Variation (ANAVA), and can be utilized to measure and demonstrate individual and group difference of subject space (Smith, 1984; Mardia, 1972). Although this method of analysis would have been appropriate and further demonstrated outcomes, the final investigation did not use this method of analysis. By applying this technique, this may have increased the ability to further demonstrate significant findings.

This study tested a relatively low number of activities and technologies, when compared to other psychometric studies. But only a limited number of previous studies had

utilized MDS analysis techniques. MDS analysis allowed greater data interpretation, resulting in *underlying* dimensions of public street surveillance. But with MDS, the low number of activities and technologies tested reduced the ability for the data to produce and provide defined clusters (Kruskal & Wish, 78. pp. 43-46), and increased the subjective interpretation of the MDS dimensions. This will require future validation to quantify and confirm the MDS dimensions of *community risk perception* and *perceived community exposure to risk*.

The study only produced acceptable reliability and validity measures. This was particularly relevant with the study achieving only moderate validity (correlation) outcome between phases of the risk characteristics. But with the inherent difficulty in achieving statistically high results across diverse risks, high results may not be achievable. As Slovic stated “Yes, I also found that reliabilities were low for some of the scales. As I recall, knowledge (known/unknown) had quite low reliability. Despite this limitation, the psychometric technique still seems able to produce useful results.” (Personal communication, September 9, 2002).

The results achieved were caused by a number of factors, being the length of the survey (Angus & Gray, 2001, p.26) and the diverse activities and technologies tested. By measuring a total of five activities and technologies, this increased the length of the survey. But there was a imposed requirement to keep the number of questions to a commitment acceptable by the participants. This reduced the possible total number of activities and technologies, and also questions for each risk characteristic. Therefore, measuring the five activities and technologies led to a compromise on the number of questions utilized, which ultimately reduce the reliability. Diversity also reduced both the reliability and validity of the research instrument, through the need to comprise on question selection. Some activities and technologies produced high results, but others produced only moderate results. The quandary was to select the best performing questions across all technologies and activities.

The public street surveillance system comprised of only two cameras within the nucleus of the community and these blended in with streetscape. There was also limited media exposure of the system (Section 6.6). Additionally, there was no other CPTED or other crime prevention initiatives applied during the survey period, which may have reduced the security awareness within the research area. Although this was a research benefit through reducing variables. It could be argued that these items may have limited the installation and operational exposure of the public street surveillance system.

A research question proposed that increased public street surveillance exposure would cause increased awareness, leading to some level of risk perception relocation. This demonstrated a naive research question and it can be argued that due to the current location of public street surveillance, that the study could not have measured any social risk relocation. There are complex and diverse factors that develops and implements levels of social risk perception. These issues limited the ability of the study to demonstrated risk perception relocation.

## ***6.9 Further Research***

There are a number of key areas that can be applied in future research, not only in the risk perception of public street surveillance, but also in the measure of social risk perception. Therefore this section has been divided into two, being further research into psychometric risk and the second, CCTV and its domain of public street surveillance.

### ***6.9.1 Psychometric Techniques***

As with this study, previous psychometric studies have demonstrated only moderate levels of reliability (P.Slovic, personal communication, September 9, 2002), although the psychometric technique does appear to demonstrate high levels of reliability in spatial outcomes. But the reason why the psychometric model presents only moderate statistical reliability measure has to be investigated. Therefore, it may be appropriate to attempt to test the reason why this method only produces moderate reliability levels, as from a spatial representation perspective, results appear to be high and robust.

How the risk perception of an activity and technology develops, is cognitively implemented and alters over time, requires investigation. These are complex and interwoven issues, but could be assessed through risk communication. This will enable improved methodologies to test, measure and assess significant aspects that produce social risk perception levels, why lay people have these perceived levels of risk and how they may react due to these perceived ideas.

Further MDS analysis should be applied to test the psychometric technique, to measure the *underlying* risk perception of previous activities and technologies, and see how techniques compare and contrast. Future studies could be structured specifically to gather and analysis the collection of dissimilar data at the individual level. As Slovic stated “INDSCAL analysis indicates that our previous studies, relying on factor analysis of group means, may have missed important individual differences in perceptions” (1992, p.139-140). This can only result in psychometric further maturing as a technique to measure risk perception.

With this study, a relatively low number of activities and technologies were tested. With MDS, this low number of activities and technologies reduced the ability for the data to produce and provide defined clusters (Kruskal & Wish, 78. pp. 43-46), and increased the subjective interpretation of the MDS dimensions. This also limited the ability of the data set to produce only one or two dimensions, again reducing interpretation. Therefore, future studies could increase the number of tested activities and technologies.

MDS INDSCAL provided the measure of subject space, through spatial representation. This also presented the angular separation and vector length of the configuration of points, referred to as ANAVA. ANAVA can be utilized to measure and demonstrate individual and group difference of subject space (Smith, 1984; Mardia, 1972). This can be used to reinforce MDS analysis and further demonstrate results.

### ***6.9.2 Public Street Surveillance***

This study utilized a public street surveillance system that comprised of a relatively small and unobtrusive system. Applying a similar study on a larger population and with a larger public street surveillance system may produce more pronounced effects. Although it can be argued from the outcomes of this study, further studies in the near future will only produce very similar results.

Other methodologies could be utilized to investigate the risk characteristic of control, given the critical nature of this characteristic for public street surveillance. These may include focus groups or through the application of control tests, with the aim to produce results that measure how significant this risk characteristic is and what issues have the greatest affect. It may also demonstrate how awareness alters risk perception levels within the psychometric technique.

The investigation measured the social risk perception in a group context. This bias is an error in the psychometric technique (Cox & Cox, 2001), although this was reduced through the application of MDS Euclidean and INDSCAL techniques. But this limitation was not fully eliminated, as dissimilarity data collected at the individual level would be required, resulting in a revised research instrument. Using dissimilar data at the individual level would allow a measure of the *individual underlying* risk perception of public street surveillance. Also, providing the ability to further quantify the MDS dimensions of *community risk perception* and *perceived community exposure to risk*.

Research into the diverse and complex issues that could alter the social risk perception of CCTV (Chapter 1.2.1) could be applied. These issues include the level of actually or perceived social control of CCTV and effectiveness of legislation. The community concern over CCTV civil and privacy issues. The professionalism of the security industry (Tate, 1997) and how the industry manages, operates and promotes CCTV. The type and extent of CCTV media coverage and the level of understanding

individuals, groups and communities have of CCTV. Finally, the level of protection CCTV actually provides or is perceived to provide.

### **6.10 Conclusion**

This chapter presented the interpretation of the research data. Key interpretation included the measured risk perception of public street surveillance, that public street surveillance was a socially acceptable risk, that females felt safer with public street surveillance, the changing social risk perception of public street surveillance and why only limited change was demonstrated. Public street surveillance psychometric risk perception was presented, along with the *underlying* MDS dimensions. The ability to measure *intellectual risk* with *physical risk* was also demonstrated. This chapter concluded with the study outcomes, study limitations and areas for further research.

The investigation showed that the social risk perception of public street surveillance was *low dread risk* and *familiarity to risk*. MDS supported this interpretation, but provided additional *underlying* dimensions and presented public street surveillance with its *own* unique characteristics. Public street surveillance had a low sense of *community risk perception* and a low *perceived community exposure to risk*. Females presented a lower social risk perception than males, a unique risk perception outcome. This appeared to indicate that females felt safer when public street surveillance was present. But the factors of age or distance had no significant affect to the sense of risk perception.

The community risk perception of public street surveillance was defined as a low risk to future generations, that exposure was voluntary, the risk was observable, that the community understood the risk, that the risks were known and would be immediate. This resulted in public street surveillance having a perceived low social risk perception, demonstrating a social benefit that outweighed the perceived risk to the community. But it appeared that the community had a social concern over the ability to ensure appropriate public street surveillance control. The risk characteristic of *controllability*

located public street surveillance towards a significantly *higher dread*, but still a *familiarity to risk*. Therefore, it appeared that the community had and maintained a social concern over the ability to ensure appropriate public street surveillance control.

The ability of the psychometric model to measure *intellectual risk* with *physical risk* was also demonstrated. *Intellectual risk* being an activity or technology that does not cause direct personal risk. Previous psychometric studies had only assessed activities and technologies that could be a *physical risk*. It was found that an *intellectual risk* could be measured with perceived *physical risk*.

The study found that increased exposure did not change the social risk perception of lay people towards public street surveillance. Although, increased risk perception between study phases for the risk characteristics of *controllability* and *involuntary exposure* was demonstrated. Also, the factor *familiarity to risk* provided a neutral response, indicating that there may have been little thought given to public street surveillance. These issues could drive and alter the social risk perception of public street surveillance.

This appeared to be indicated within the MDS INDSCAL gender representation. After increased exposure, public street surveillance relocated from a *familiar risk* to an *unfamiliar risk*. This may indicate that like all new technologies, public street surveillance has not yet found its true social risk perception measure and that public street surveillance support is not necessarily defined or robust.

Study limitations included the ability of lay people to provide meaningful response to complex and multidimensional risk issues, that the psychometric model measures risk in the group context, the measure of five activities and technologies reduced the effectiveness of MDS interpretation, only moderate reliability and validity was achieved and the public street surveillance system at the time of study only comprised of two cameras. Areas for further research included psychometric techniques and the need to increase investigations into the domains of CCTV.



CCTV domain of public street surveillance presented a social benefit that outweighed the perceived social risk. Public street surveillance was presented within a socially safe risk domain, accepted and supported by the community and media. But as demonstrated within the study, there were risk characteristics that indicated that there are *underlying* social concerns over public street surveillance. Social concerns could reposition public street surveillance from its current safe social risk position, to a more adverse location. As argued, the community supported public street surveillance but how robust was this support?

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Dear Fellow Resident

The City of Rockingham is in the process of installing street surveillance cameras along Railway Terrace. I am a local resident and also a Master of Science student at Edith Cowan University, presently undertaking a research study on the social attitudes of public street surveillance.

It is my intention to survey people who live or work within 0.5km of Rockingham beachfront. The study involves completing a total of two survey questionnaires. One questionnaire will be completed now, with the other questionnaire completed in approximately 6 months time. The questionnaire only takes about 7 minutes and there are no wrong or right answers to the questionnaire.

Participation in the study is voluntary. All information gathered will be treated in the strictest of confidence, no person will be named or identified within the thesis and information gathered will be destroyed when no longer required. You can withdraw from the study at any time.

Participation in the survey will help further social understanding and effectiveness of public street surveillance, and the use of Closed Circuit Television. The survey contains questions regarding a number of other activities or technologies ie radioactive waste, etc. These items have a known research location and are only used as a measure for public street surveillance.

You can contact me at any time on the telephone numbers listed below to discuss the study and its importance. Please participate in the survey by completing the consent form below, attached questionnaire and returning both, in the self addressed stamped envelope.

Regards

David Brooks

Work phone: 9553 2289

tear off -----  
tear off

I hereby give my consent to participate in the study to assess the social attitude of public street surveillance. I understand that I can withdraw from the study at any time.

Name: ..... Signature: ..... Date:  
.....

Address:  
.....

***Thank you.***

The questionnaire is divided into two parts.

Part 1 gathers some very general information about you.

Part 2 is a psychometric study, or a study that attempts to assess how you currently feel about an activity or technology.

### **PART 1. GENERAL SURVEY**

Please tick **ONLY** one box for each question.

1. Your sex is:                      Male       Female
  
2. Your current age is:
 

16-25     26-35     36-45     46-55     Greater than 56 years
  
3. The distance from your primary place of residence to Rockingham beachfront is:
 

0-1km     2-4km     5-20km     21-30km     Greater than 31km

### **PART 2. PSYCHOMETRIC SURVEY**

Part 2 contains five activities or technologies. Answer how you feel about each statement in regard to that particular activity or technology.

To answer each statement, requires you to place a single mark against each question.

If you Strongly Agree with that statement, mark 1.

If you Strongly Disagree with that statement, mark 7.

Answer each question from your initial feeling about that statement. Do not dwell on each question and please complete ALL questions.

There are no wrong answers.

## Radioactive Waste

Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
Radioactive waste causes me fear.	1	2	3	4	5	6	7	
It is my choice to be exposed to radioactive waste.	1	2	3	4	5	6	7	
The risk of radioactive waste harms my future generations.	1	2	3	4	5	6	7	
If I am exposed to radioactive waste, the risks are known immediately.	1	2	3	4	5	6	7	
I know and understand the risk associated with radioactive waste.	1	2	3	4	5	6	7	
Radioactive waste requires strong government regulation.	1	2	3	4	5	6	7	
Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
I am well accustomed with the risk associated with radioactive waste.	1	2	3	4	5	6	7	
The risk of radioactive waste is not understood or well known by science.	1	2	3	4	5	6	7	
On a gut reaction, the risk of radioactive waste does not cause me dread.	1	2	3	4	5	6	7	
I feel that the high risk with radioactive waste is not visible or transparent.	1	2	3	4	5	6	7	
I know when I am exposed to the risk associated with radioactive waste.	1	2	3	4	5	6	7	
If exposed to radioactive waste, it will affect me and my future generations.	1	2	3	4	5	6	7	

## Drinking Water Chlorination

Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
Drinking water chlorination causes me fear.	1	2	3	4	5	6	7	
It is my choice to be exposed to drinking water chlorination.	1	2	3	4	5	6	7	
The risk of chlorinating drinking water harms my future generations.	1	2	3	4	5	6	7	
If I am exposed to chlorination in drinking water, the risks are known immediately.	1	2	3	4	5	6	7	
I know and understand the risk associated with chlorinating drinking water.	1	2	3	4	5	6	7	
Chlorinating drinking water requires strong government regulation.	1	2	3	4	5	6	7	
Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
I am well accustomed with the risk associated with drinking water chlorination.	1	2	3	4	5	6	7	
The risk of chlorinating drinking water is not understood or well known by science.	1	2	3	4	5	6	7	
On a gut reaction, the risk of drinking water chlorination does not cause me dread.	1	2	3	4	5	6	7	

I feel that the high risk with chlorinating drinking water is not visible or transparent.	1	2	3	4	5	6	7
I know when I am exposed to the risk associated with drinking water chlorination.	1	2	3	4	5	6	7
If exposed to chlorinated drinking water, it will affect me and my future generations.	1	2	3	4	5	6	7

### Home Swimming Pools

	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
Home swimming pools cause me fear.		1	2	3	4	5	6	7	
It is my choice to be exposed to home swimming pools.		1	2	3	4	5	6	7	
The risk of home swimming pools, harms my future generations.		1	2	3	4	5	6	7	
If I am exposed to home swimming pools, the risks are known immediately.		1	2	3	4	5	6	7	
I know and understand the risk associated with home swimming pools.		1	2	3	4	5	6	7	
Home swimming pools require strong government regulation.		1	2	3	4	5	6	7	
	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
I am well accustomed with the risk associated with home swimming pools.		1	2	3	4	5	6	7	
The risk of home swimming pools is not understood or well known by science.		1	2	3	4	5	6	7	
On a gut reaction, the risk of home swimming pools do not cause me dread.		1	2	3	4	5	6	7	
I feel that the high risk with home swimming pools are not visible or transparent.		1	2	3	4	5	6	7	
I know when I am exposed to the risk associated with home swimming pools.		1	2	3	4	5	6	7	
If exposed to home swimming pools, it will affect me and my future generations.		1	2	3	4	5	6	7	

### Coal Mining Disease

	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
Coal mining disease causes me fear.		1	2	3	4	5	6	7	
It is my choice to be exposed to coal mining disease.		1	2	3	4	5	6	7	
The risk of coal mining disease harms my future generations.		1	2	3	4	5	6	7	
If I am exposed to coal mining disease, the risks are known immediately.		1	2	3	4	5	6	7	
I know and understand the risk associated with coal mining disease.		1	2	3	4	5	6	7	
Coal mining disease requires strong government regulation.		1	2	3	4	5	6	7	
	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree

I am well accustomed with the risk associated with coal mining disease.	1	2	3	4	5	6	7
The risk of coal mining disease is not understood or well known by science.	1	2	3	4	5	6	7
On a gut reaction, the risk of coal mining disease does not cause me dread.	1	2	3	4	5	6	7
I feel that the high risk with coal mining disease is not visible or transparent.	1	2	3	4	5	6	7
I know when I am exposed to the risk associated with coal mining disease.	1	2	3	4	5	6	7
If exposed to coal mining disease, it will affect me and my future generations.	1	2	3	4	5	6	7

### Public Street Surveillance

	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
Public street surveillance causes me fear.		1	2	3	4	5	6	7	
It is my choice to be exposed to public street surveillance.		1	2	3	4	5	6	7	
The risk of public street surveillance, harms my future generations.		1	2	3	4	5	6	7	
If I am exposed to public street surveillance, the risks are known immediately.		1	2	3	4	5	6	7	
I know and understand the risk associated with public street surveillance.		1	2	3	4	5	6	7	
Public street surveillance requires strong government regulation.		1	2	3	4	5	6	7	
	Strongly Agree	1	2	3	4	5	6	7	Strongly Disagree
I am well accustomed with the risk associated with public street surveillance.		1	2	3	4	5	6	7	
The risk of public street surveillance is not understood or well known by science.		1	2	3	4	5	6	7	
On a gut reaction, the risk of public street surveillance does not cause me dread.		1	2	3	4	5	6	7	
I feel that the high risk with public street surveillance is not visible or transparent.		1	2	3	4	5	6	7	
I know when I am exposed to the risk associated with public street surveillance.		1	2	3	4	5	6	7	
If exposed to public street surveillance, it will affect me and my future generations.		1	2	3	4	5	6	7	

**Thank you for your time.**



*Figure D.1. Camera 1 Cnr. Railway Tce., Patterson & Kent Streets.*



*Figure D.2. Camera 2 Cnr. Railway Tce., & Rockingham Road.*

Dear

Rockingham City Shire has now installed the public street surveillance system and it has been operating since just after you completed the original survey, six months ago. Can I take another short period of your time to complete this final survey?

As a reminder, I am a local resident and also a Master of Science student at Edith Cowan University, presently undertaking a research study on the social attitudes of public street surveillance or Closed Circuit Television.

Some interesting results were gathered from the original study and this final survey will confirm these findings. If you are interested in receiving a paper on the original results, please complete the attached slip below and return this with your completed survey. I will post this paper to you in September.

Again, as a reminder, participation in the study is totally voluntary. All information gathered will be treated in the strictest of confidence, no person will be named or identified within the thesis and information gathered will be destroyed when no longer required. You can withdraw from the study at any time.

Please feel free to contact me at any time on the telephone numbers listed below to discuss the study and its importance. Again, I thank you for your participation, it is most appreciated.

Regards

*Dave Brooks*

David Brooks

Work phone: 9553 2289

Mobile: XXXXXXXXXX

tear off-----tear off

Please send me a copy of your research findings detailing the original survey results based on our local public street surveillance system.

Name: .....

Address: .....

Thank you.

## **Closed Circuit Television:**

*Legal considerations for the security industry regarding digital processed video images.*

David Brooks

*Department of Defence*

Key words: CCTV, JPEG, admissible evidence, watermarking, digital image

Abstract: Closed Circuit Television (CCTV) digital recorders, using the JPEG algorithm, are becoming increasingly utilised within the security industry. This is due a number of reasons, being an increase in market availability, improved functionality, reduced maintenance, standardisation of equipment and today, increasingly competitive pricing. Today digital video images are admissible evidence in a court of law, but unlike traditional analogue recorded images, these images are digitally processed which will leave them open to future legal interpretation. This leaves the security industry without clear direction regarding the admissibility of digital recorded images.

The digital recording process has a large percentage of image manipulation during compression and reassembly. The intent of the JPEG algorithm is to store and transfer images, not maintain image integrity. Any manipulation questions the image integrity and originality. A current method of digital protection includes watermarking. But the watermarks intent is to show ownership and copyright, not maintain image integrity. Watermarking can also be easily defeated through a number of simple attacks and is weakened through the JPEG compression process.

If a number of criteria can be demonstrated, it is expected that digital image integrity can be maintained within a court of law. These are that the image must be processed with firmware; have a digital signature; integral time/date stamp; that the image has characteristics that shows that it is an original; and that access to the image is restricted, controlled and monitored.

To maintain image integrity requires a holistic approach to image protection. This includes physical security, information and computer security, and management processes. Transparency of process will be the vital aspect and used to demonstrate integrity. Failure, or alluding to fail, in any one of these areas may contribute to the loss of image integrity and therefore admissibility.



## INTRODUCTION

Digital video recorders, using the JPEG algorithm, are becoming increasingly popular within the security industry due to their advantage over magnetic VCR tape recorders. This is due to an increase in availability, non-linear access to images, reduced maintenance, ability to quickly copy or transfer images, playback while recording function, reduced labour in changing tapes, reduced storage space, use of a standard PC and today, increasingly competitive pricing. A digital video recorder can be defined as a recorder that compresses, saves, stores and sorts, into a binary format, visual images from a camera.

But what are the legal considerations within Western Australia when utilising JPEG recorded digital images in CCTV systems? Currently in the UK, the “courts have demonstrated an uncharacteristic willingness to accept visual recordings as evidence in criminal proceedings” (Murphy, 1999, p.401). Today digital video images are admissible evidence in a court of law, but will this remain so? Unlike traditional analogue recording methods, these images are digitally processed, which may leave them open to legal interpretation. As Ainsworth stated “can video evidence be compromised ... or more importantly, can alluding to this possibility raise the issue of reasonable doubt.” (1997, p.101). Rieger further reinforces this issue when he stated that “it is likely that the susceptibility of digital images to manipulation will lead to increasing doubt with respect to the authenticity of photographic images in the era of digital data processing.” (1999, p.262).

With society increasing their understanding of digital image manipulation, this raises concerns for all image presentation. Grundberg raised this issue regarding digital images:

In the future, readers of newspapers and magazines will probably view news pictures more as illustrations than as reportage, since they will be well aware that they can no longer distinguish between a genuine image and one that has been manipulated. Even if news photographers and editors resist the temptations of electronic manipulation ... the credibility of all reproduced images will be diminished by a climate of reduced expectations. In short, photographs will not seem as real as they once did. (Grundberg, cited by Michell, 1994, p.17).

Although this statement is not currently directed towards CCTV digital images, the legal profession will have to be cognizant of the digital imaging issues. This is not an issue with media images, as the validity of an image is generally an ethical issue. But when an image is presented in a court of law, the validity of the image must be demonstrated beyond reasonable doubt. As Murphy stated, “The increasing number of surveillance cameras

Ainsworth's three-point criteria defined the necessary qualifications for the admissibility of video evidence. But to provide sufficient integrity of the image, this has to be expanded to incorporate and protect against the additional issues addressed within this paper. Therefore, to provide a criteria that can show that the image has integrity, the following has to be applied:

1. "Firmware and not software must be used to process the image.
2. The image must contain a secure electronic signature.
3. The Time, Date and other relevant information must form an integral part of the image and NOT be supplied as data or an overlay." (Ainsworth, 1997, p.104).
4. *That the image has demonstrable characteristics that show that it is an original.*
5. *Access to the image is restricted, controlled and monitored to authorised and accountable personnel only.*

It can be argued that if the first four criteria are achieved and the fifth maintained, then digital recorded images will remain admissible as evidence. Although the JPEG image compression process does have flaws, along with watermarking, if access to the image is controlled to a known and demonstrable level, this will negate the possible flaws. Primarily, it allows a demonstration of image originality. "However a number of high profile challenges to digital evidence may enable a clearer picture to emerge. Only when this occurs can the true merits of the concerns expressed .. be evaluated." (Murphy, 1999, p.401).

## **FUTURE DEVELOPMENTS**

What is beyond argument, is the increased utilisation of digital recorders within the security industry. Over the last number of years the availability of systems from manufacturers have substantially increased. With this increase in production, costs are going to continue to reduce, leading to an explosion of digital recording systems. This will lead to an increase in exposure of these systems to not only the security industry, but also to society in general.

Currently in Victoria, the Supreme Court is refurbishing Court 13 to become an electronic court. This will enable the court to be fully computer integrated for audio, video, electronic presentation, electronic management of case information and electronic transcript. (2000, [www.austlii.edu.au](http://www.austlii.edu.au)). This will further increase the legal systems awareness of electronic image presentation, which will also lead to a better understanding and knowledge of its advantages, but also flaws.

throughout the United Kingdom have almost inevitable produced a steadily increasing stream of ... 'video' evidence before the criminal courts. While the use of video evidence is yet in its infancy the development of digital technology promises to further complicate the issues". (1999, p.384). Therefore it is vital for the security industry, that CCTV digital images remain admissible as evidence.

Ainsworth stated that there are three criterion that must be met to ensure that digital images are admissible as evidence. These are that:

1. "Firmware and not software must be used to process the image.
2. The image must contain a secure electronic signature.
3. The Time, Date and other relevant information must form an integral part of the image and NOT be supplied as data or an overlay." (1997, p.104).

Today, these three points have yet to be tested, therefore will these points be sufficient to provide admissibility in a court of law tomorrow? It will be demonstrated that with current technology, that this may not be the case and that current digital recorders lack image integrity. That image integrity can be maintained, but it requires transparency in process. Therefore the intent of this paper is to raise discussions within the security industry on the legal image integrity of digitally recorded images. It will focus wholly on criminal law and not discuss civil issues or attempt to provide legal argument.

## **THE LAW**

Legislation relevant to digital video recording systems and their images, primarily includes the Evidence Act of 1995 and to a lesser extent, the recent assented West Australian Surveillance Devices Act of 1998. The Evidence Act refers to recorded evidence as a "document" and this is defined as "any record of information, and includes: ... anything from which sounds, images or writings can be reproduced" (1995, Section 3, Part 1). To take this further, identification evidence means evidence that is "an assertion by a person to the effect that a defendant was, or resembles (visually, aurally or otherwise) a person who was, present at or near a place where" (1995, Section 3, Part 1) an offence, or in connection to an offence, which the defendant is being prosecuted for.

The Evidence Act (1995. Section 146, (2)) discusses the requirement of evidence that is produced by "processes, machines and other devices ... If it is reasonably open to find that the device or process is one that, ... if properly used ordinarily produces that outcome, it is presumed ... that, in producing the document or thing on the occasion in question, the

device or process produced that outcome.” Therefore if continuity of process can be proven, then recorded images are admissible as evidence. But the Evidence Act goes further, stating that “unless evidence sufficient to raise doubt about the presumption is adduced” (1995, Section 146, (2)) regarding the integrity of the process. It may be argued that if there is any reasonable doubt regarding the process, in either technical integrity or legality, then that evidence then becomes inadmissible.

Beyond those points, for any form of evidence to be admissible, it must “satisfy the general rules of admissibility, namely that it must be relevant to the proof of fact in issue, to the credibility of a witness or to the reliability of other evidence. It also must not be inadmissible due to prejudicial effect nor a particular rule of law such as hearsay.” (Murphy, 1999, p.385). These are complex legal arguments and are beyond the scope of this paper, suffice to say that the rules of admissibility of traditional analogue video evidence has been legally defined and accepted over the years.

But with today’s ability to manipulate digital images, there is an argument that computer stored digital information cannot be truly validated. Ainsworth stated that “The admissibility of computer generated evidence must always be subject to expert analysis of its integrity.” (1997, p.105). This may not be so, as Murphy stated that “it would only be necessary to call a computer expert to perform this task in very rare cases” (1999, p.385). What would decide this requirement is the familiarity of the process by the courts. But unlike accepted known processes, like a photocopier or analogue video, digital image processing may be subjected to the need for continual reassessment of process integrity. This may make future digital image admissibility very transient in nature and its ability to achieve intent, that is to act as evidence, unknown.

“At the time of writing, the writer is unaware of any reported cases in which the courts have differentiated between the admission of visual images recorded on digital as opposed to traditional analogue media as evidence.” (Murphy, 1999, p.385). But it will only take one test case to demonstrate that there may be an issue regarding the integrity of digital images and this will set precedence within the courts. Rieger affirms this argument, when he stated that they are “concerned that this will change dramatically in the future, in view of the susceptibility of digital image manipulation. It is entirely probable that defence attorneys in criminal court proceedings will attempt to challenge the integrity and authenticity of potential images – motion and still pictures alike.” (1999, p.264).

**DIGITAL TECHNOLOGY**

Digital recorders generally utilise the JPEG compression format. This “compression standard is designed for compressing still images.” (Ainsworth, 1997, p.103) and is an industry standard algorithm. JPEG, which stands for the Joint Photographic Expert Group, was selected as the international standard for continuous still image compression in 1991, by the International Standards Organisation (ISO) and CCITT. This accumulated in a number of ISO standards being developed; being Digital Compression and Coding of Continuous Tone Still Images, Part 1: Requirements and Guidelines, and Part 2: Compliance Testing.

The JPEG standard specifies four different modes of operation, depending on picture requirements. These are Sequential Discrete Cosine Transformation (DCT), Progressive DCT, Lossless and Hierarchical. Sequential DCT is the base line, which has to be present in all JPEG implementation. Progressive DCT is similar to the sequential algorithm, but quantised coefficients are partially encoded in multiple scans. Lossless mode decodes the image in an exact reproduction of the original image, apart from predicted values that are combinations of one to three adjacent samples. Hierarchical mode encodes an image as a sequence of increasingly higher resolution frames. The method of image compression involves a number of discrete processes. The simplified process involves an image being placed into a frame store for scanning. It is then colour space converted, forward DCT, quantised and finally, entropy coded to produce the compressed image.

The image is first scanned from the top left to right and top to bottom, breaking the image into 8 x 8 blocks in the frame store. A block of 64 samples are then transformed to a DCT coefficient. The component in the top left corner is called the DC coefficient, because it is “proportional to the average intensity of the block of spatial domain samples” (Netravali, 1995, p.583). The following blocks are AC coefficients, with increasing frequency away from the DC coefficient. The coefficients are then quantised and entropy encoded, producing the final compressed image. Colour space conversion is not part of the JPEG standard, but many compression schemes take advantage of the low sensitivity to chrominance of the human visual system to further reduce data.

Forward DCT coding transform blocks of pixel's into a domain, called the transform domain. This has found to be the most efficient in bit rate reduction per pixel size and is achieved as “not all the transform domain coefficients need to be transmitted in order to maintain good image quality, and second, the coefficients that are coded need not be represented with full accuracy.” (Netravali, 1995, p.388). The type and method of DCT

coefficient used depends on the need and type of image. If the image blocks are similar and large, then the transform statistics between blocks will not change. Therefore the quantisation parameter can be calculated according to the zonal sampling and a non-adaptive transform code will be appropriate. But if the image blocks vary, are small and detailed, then this approach will not be effective. An adaptive approach has to be taken, which requires increased processing, slower data rate, increased data size and greater data sensitivity.

Quantisation of the image is the process where a representation of each pixel is sampled and a finite binary code assigned to that pixel. One of the main problems with quantisation is a noise like error, which is not well understood and depends largely on application. This introduces adversely high or low finite code, which are uncharacteristic of the overall spatial image. In practice quantisation equations must be used with care, the threshold levels determined experimentally, as quantisation design remains an art and somewhat adhoc. (Netravali, 1995, pp.366-433).

Once the image is colour space quantised and DCT coded, it is then Entropy coded. JPEG uses two methods, either Huffman or Arithmetic coding. The ISO standard requires Huffman coding as mandatory when used with Sequential coding, but the other three methods can use either. Entropy coding is a further reduction in the number of data bits necessary to reproduce the image. This is achieved through assigning varying word lengths to probability. Higher probabilities are assigned a lower word length, whereas low probabilities are assigned longer word lengths. This allows a reduction in the data bits required to store the image.

### **IMAGE INTEGRITY**

The question has to be asked; can the integrity of the digital image be maintained beyond reasonable doubt? Unlike photographic images that have traditionally rarely been contested in the past (Rieger, 1999, p.262), this may not be the case with digital images. Murphy affirmed this, when he stated that “the issue of the admissibility of digital images as evidence in legal proceedings is currently, to some extent a matter of speculation.” (1999, p.400). Currently it can be argued that although digital images maintain integrity, this may be through a lack of knowledge or understanding of the process and that the possible flaws in the process have yet to be legally tested. As the introduction remarked, can alluding to this possibility raise the issue of reasonable doubt?

What are some of the issues of image integrity that could be raised? Throughout the JPEG compression process there is large percentage of the image data that is removed during the compression process. This removed data cannot be retrieved and are lost, but is then mathematically reintroduced through algorithms to reassemble the image. For a typically compression ratio of 24:1, 95.8% of the original data is lost and therefore the decompressed image is not the same image as the original image.

Entropy coding reassembles the image through a method of averaging the DC coefficient and then taking the differences between adjacent blocks. This allows an element of error if proceeding data bits are corrupted. Netravali affirmed this when he stated that “Huffman codes in particular generally lose synchronisation ... That is, several code words may be decoded incorrectly before correct decoding is re-established.” (1995, p.163). This raises concern over the validity of the process, under section 146 of the Evidence Act, being that the device produces a known outcome.

It can be argued that JPEG algorithm is not designed to maintain the integrity of the image, but to enable image storage and transfer. Although when using the Lossless mode far less data is lost, typically a compression ratio of 2:1 or 50%. But even during the Lossless mode the only step not included is Forward DCT, but the image is still Colour Converted and Entropy coded. The image still “suffers high degradation via JPEG compression.” (Vidal, 1999, p.296).

The JPEG process is complex, can only be effectively explained and proven through complex mathematics. It could be argued that this may cause confusion and a lack of true understanding when the process is attempted to be proven in court of law. “We are concerned about smoke-screens being raised by cross-examination which focuses in general terms on the fallibility of computers rather than the reliability of the particular evidence.” (Law Commission, cited by Murphy, 1999, p.401). This complexity may be utilised by the defendant to reduce the importance and integrity of digital image evidence.

The Evidence Act (1995, Section 146 (2)) requires that the continuity of the process has to be maintained. Rieger stated that in order to avoid loss of admissibly, that “algorithms and parameters selected are exactly known and the outcome of each step in the modification process can be reproduced. (1999, p.268). This is not necessarily the outcome of the JPEG algorithm, as the previously paragraphs alluded too. Current “Discrete Cosine Technology, the Huffman coder and chipsets. ... ensure that images cannot be decoded by commercially available editing packages, or other illegal means.” (Ainsworth, 1997, p.104). From a

security viewpoint, secure software cannot give the image integrity, as it can be argued that software is difficult to keep secure. Also, any form of image manipulation will have an adverse affect on the image validity.

The consideration that the image may have been manipulated is an issue, as “retroactive detection of manipulations on the basis of image content alone is likely to prove quite difficult” (Rieger, 1999, p.262). It could be presented that unlike a photographic negative or analogue video image, both which could be shown in a physical form as the original, this is not possible with a digital image. This may be more of a concern than the technology itself, as previous UK court rulings have accepted machine technology, but have raised concern when human interaction is involved.

These issues all allude to the possibility that image decoding contains flaws that may alter the image from the original. This may not be difficult to prove theoretically, but the issue will be, has the image changed beyond reasonable doubt? As Lohcheller stated “A carefully designed quantisation matrix will produce high compression ratios while introducing negligible “visible” distortion.” (1984, p.1316). The JPEG process may be very reliable in reassembling a compressed image, but can it be guaranteed that the image is an exact reproduction of the original? The image may appear similar to all but the closest scrutiny, but is this the issue? The very nature of image compression allows a degree of predictive reassemble, unlike a photocopier or photograph that reproduces the original image. The issues discussed above could be used to address the key concern, that the original and reassembled images are not one and the same.

## **WATERMARKING**

Watermarking is currently seen as the method of holistic protection of digital images within the security industry. The watermarking process integrates a unique digital signature within the data that forms the image. This is generally a single mark in all images, used solely to show who owns, or owned, that image. The intent of watermarking is to ensure that there is an unforgeable link between the digital content and principle, it must account for many different types of alternations, withstand careful scrutiny in a court of law and must be acceptable by the public. General techniques of applying watermarks include least significant bit replacement, spread spectrum techniques and perceptual masking techniques. (Ferrill, 1999, p.2).

Watermarking provides a secure signature, but does this maintain image admissibility? There are a number of issues that may make watermarking far from suitable in maintaining



image integrity. First, the intent behind watermarking is to maintain copyright, far different from maintaining image integrity when dealing with documentation evidence. Also, the ability to show ownership of the image may not be the whole issue, as any form of image manipulation may be a concern. Image manipulation changes the image from the original and therefore raises the argument of loss of validity beyond reasonable doubt.

“Bits are considered insignificant if changes in them are not noticeable. This approach does not work ... because JPEG compression throws away those bits and thus destroys the watermark.” (Mateev, 1996, p.1).

Watermarks can be defeated through a variety of attacks. Robustness attack introduces noise into the digital image that garbles the watermark. Presentation attack chops the image into stripes and then reassembles the image, thus destroying the watermark. An Interpretation attack has another watermark inserted over the original, causing confusion over which is the original watermark. Finally, a watermark can be attacked through the courts, in establishing doubt to the authenticity of the watermark. (Ferrill, 1999, p.6).

Craver, (cited in Ferrill, 1999, p.5) stated that “designing a high quality watermarking scheme has been extremely difficult ... many of the digital watermarks that are currently in use either disappear or are significantly weakened by normal image process operations. ... Such operations include filtering, requantization, dithering, scaling, cropping, etc and common image compression like JPEG.” Digimarc affirmed this, stating “compression methods such as JPEG actually remove some image data in order to decrease file size, this can have varying effects on watermark survival.” (1999, p.2). These operations greatly weaken the watermark, which is an issue that may further question the integrity of the image.

Watermarking is seen as a method of protecting digital images. As Ainsworth concludes in his three points for admissibility of digital evidence, one criterion is that the image contains a secure electronic signature. But current watermarking and associated research in digital protection of images is generally focusing on methods of protection for copyright purposes. This may not provide the level of image integrity required for admissible evidence. Most watermarking techniques have to allow a certain amount of data manipulation and are weakened through various simple attack processes, which could be either accidental or premeditated. These issues do question the ability of current digital watermarking, when combined with JPEG compression, to provide the level of image protection perceived by the security industry today.

## **PROTECTION**

Photographic images are rarely contested within a court of law (Rieger, 1999, p.262), due to their ability to demonstrate originality. As demonstrated throughout this paper, this may not be the case with digital images and it is therefore important that originality in the digital process can be shown. The integrity of the digital recording process, when there is a likelihood that it is to be utilised for documentation evidence, has to be maintained at the highest level possible. This includes not only the JPEG algorithm, but also the watermark, physical security, information security and management processes. Failure, or alluding to have failed, in any one of these areas may contribute to the loss of integrity of the digital image within a court of law.

As the previous section discussed, watermarking cannot provide the holistic level of protection most people within the security industry believe. Ferrill reinforces this, when he stated that “digital watermarking in itself is not very useful. Digital watermarking alone is not enough protection against would be attackers, and should not be considered a panacea for protecting” (1999, p.2). Therefore it has to be incorporated as one of a number of integrity guards.

Physical and information security has to be applied in the protection of the image. This is through defence in depth, being sufficient physical barriers, guards, electronic detection, access control, etc. This has to protect not only the physical recorder, but also computer access to the stored images. Ainsworth discussed this issue and stated that “image corruption is equally important” (1997, p.104), but referred to this issue as computer security.

Management processes must also be shown to protect the integrity of the image. These start with a risk assessment process, which has to identify the risks, level of exposure, prioritization and risk treatment methods. Relevant policy and procedures have to be implemented including staff recruitment, training, access to systems, standard operating procedures, etc. These issues have to be considered when developing and implementing a holistic security protection plan. It must be possible to demonstrate transparency in both the digital process and procedures, through audit trails, controls and accountability. This is affirmed by Murphy, when he stated that “In order to ensure that digital images remain potent evidence the watchword is likely to be transparency” (1999, p.401).

Future technical trends will impact on CCTV and how it is socially perceived. Technology can assimilate and become a system multiplier. This is relevant when considered not in isolation, but from a holistic viewpoint. Facial biometrics, data matching and CCTV surveillance provides the capability for an extremely powerful tool. Technology is transferring CCTV into the digital arena, one that may require control through information and privacy legislation. On technology, the Attorney General recommends “Legislation that as far as practical should be technology neutral.” (2000, [www.austlii.edu.au](http://www.austlii.edu.au)). But digital technology will ensure that CCTV becomes more prevalent, as no dedicated transmission lines are required, allowing access to video picture transmission anywhere in the world.

With the expansion of IP addressed CCTV systems operated from remote PC’s, this will only increase the risk exposure of the security industry. Add the consideration of the legal issue of power of seizure, including who owns the system, where images were captured, communication line access, etc., places additional complexity into an already complex issue. Future on-line or Internet legislation may become relevant to this issue, regarding data and information protection, privacy and ownership.

#### **SUMMARY**

Traditional video image integrity has rarely been contested in the past, but this may alter with digital images. With the ever-increasing expansion of CCTV within all parts of our lives, this will only increase the exposure of CCTV. Include the expanding utilisation of digital CCTV technology and this will ensure that digital image integrity will be questioned in the future. The outcome for digital image integrity and therefore how CCTV is utilised in the future, will be decided by a number of test cases that will define and set legal precedence.

The security industry has to be pro-active, by ensuring that integrity guards are put into place that demonstrate transparency of the digital image process. This has to be demonstrated at all stages and be holistic in nature. Ideally, this has to be accomplished before any adverse media coverage that a high profile test case may produce. The onus has to be on the security industry to facilitate this process. Currently, digital images are only accepted and maintained as admissible evidence through the acceptance of traditional analogue video images. But these are not the same and this will raise legal argument in the future.

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## **Is Closed Circuit Television socially acceptable?**

*A proposition for a psychometric study.*

David Brooks

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Key words: CCTV, psychometric, risk, perception

Abstract: Closed Circuit Televisions (CCTV) is often seen as an effective security tool that reduces crime and provides blanket protection to assets and personnel. Although this is supported by research, there is a concern as to the validity of this research, how some types of crimes are not reduced by CCTV and how long crime reduction is sustained. Media coverage of CCTV is generally in a positive nature, reinforcing the subjective validity of CCTV.

Psychometric paradigm is a method that assesses the risk perception and therefore acceptance of risk, into a quantitative two factor analytical representation. This is particularly useful for assessing activities and technologies in a social setting. It has been shown that it is society that defines acceptance to risk, not the industry or its experts.

There are a number of considerations regarding the professionalism of the security industry, how media coverage affects risk perception, social perception to risk and CCTV, how current legislation provides only limited protection, and how future trends and technology will change CCTV. There is a concern that the above issues will lead to a change in the social risk perception of CCTV, relocating CCTV into a more hostile quadrant.

Taking empirical data, CCTV can be placed within a quadrant of No Dread and Unfamiliar Risk. This provides socially unknown system capabilities, little adverse media coverage and therefore a safe social environment for CCTV. But, this leaves CCTV prone to a change in social risk perception and therefore transfer into a more adverse quadrant, of High Dread and Familiar Risk.

## **INTRODUCTION**

There was of course no way of knowing whether you were being watched at any given moment...You had to live ... did live, from habit that became instinct ... in the assumption that ... except in darkness, every movement [*is*] scrutinised. (Orwell, 1954, p.6).

Orwell wrote *Nineteen Eighty Four* long before CCTV became relatively common place within society, but Orwell's novel is as relevant today, as it was then. Why then, if this issue raises such concerns, is CCTV increasing within all parts of society? More importantly, it can be argued that CCTV is currently socially acceptable, but will this acceptance dramatically alter in the future? The intent of this paper is to propose a method to assess where CCTV is currently socially located and whether the perception of risk is likely to dramatically alter in the future.

## **CCTV**

CCTV is often portrayed as an all purpose security tool that will greatly enhanced the level of protection of personnel and assets against risk. The security industry is quick to show the high performance of CCTV, with a typical example being "CCTV continues to be the buzz word around the country, most councils look to the Brisbane experience for arguments to convince ratepayers of the importance of the gadgetry." (Adam, 1998, p.30). It can be argued that today the majority of CCTV media coverage is of a positive nature, with little or virtually no adverse media coverage. This frequent media coverage increases the introduction of CCTV into society.

Research has repeatedly shown that CCTV provides a decrease in levels of crime, (Adam, Horne, Brown), but recent research shows that this may only be for a short period of time. The original research studies failed to account for complementary security measures put into place at the same time. This was a concern to Brown, as he stated that "the effect of cameras on crime may start to fade in the longer term." (1995, p.vi). Only recent research studies have begun to identify these additional measures and how they may attribute to the true crime statistic.

## **PSYCHOMETRIC PARADIGM**

There is a need to accurately assess the level of perceived risk felt by society over CCTV. A suitable tool to provide this assessment is the psychometric paradigm, one of two schools

of thought regarding risk perception, and the primary method discussed and utilised within this paper.

Psychometric paradigm is a method that attempts to assess and understand risk perception, and therefore risk acceptance to certain defined activities and technologies. As Slovic stated “psychometric paradigm, which uses psychophysical scaling and multivariate analysis techniques to produce quantitative representations or cognitive maps of risk attitudes and perceptions.” (1987, p.281). This results in a two factor analytical representation, shown in Figure 1 Psychometric Paradigm, with factor one axis being defined as dread at one extreme, to no dread at the other. Factor two axis is defined as unfamiliar risk to familiar risk.

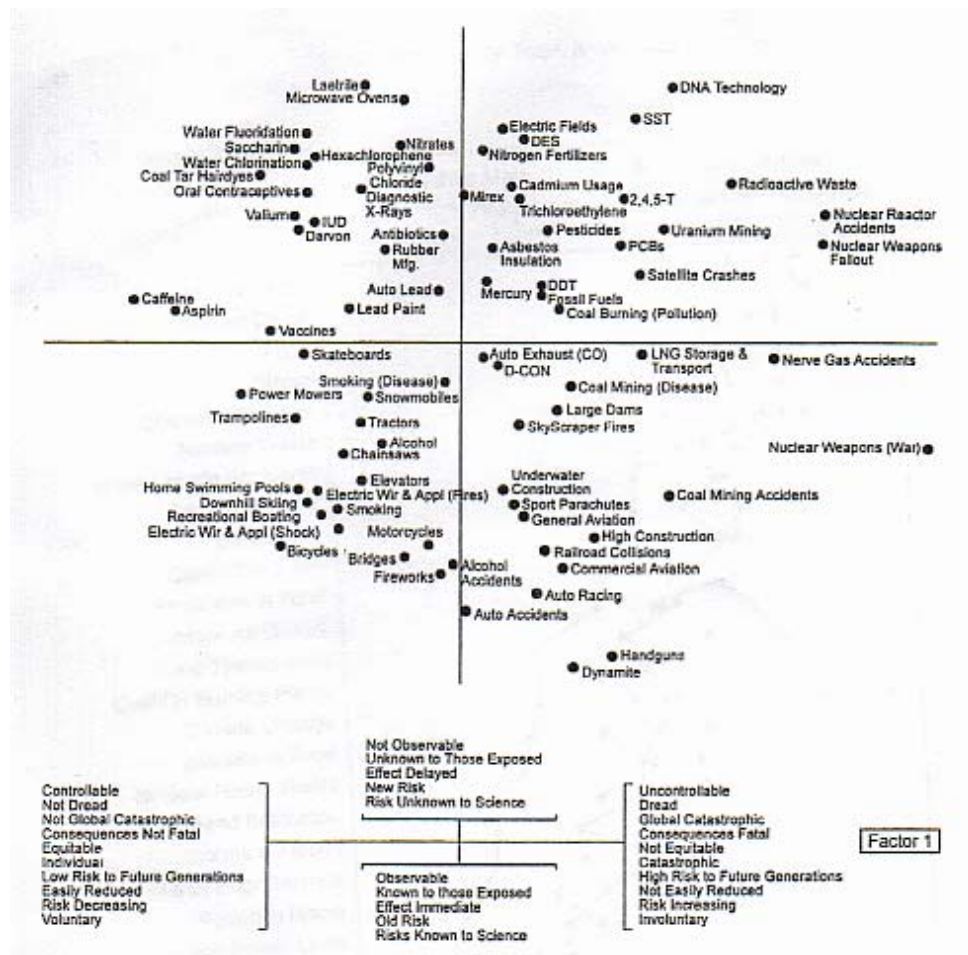


Figure 1. Psychometric Paradigm: Location of 81 hazards. (Slovic, 1997, p.236).

As Thompson discussed, “an individual's perception of ... risk can change. So can the level of risk that they are prepared to accept. These changes, which can be large, sudden and widely spread within a population, can result in the appearance and disappearance of ... problems.” (1982, p.62). Although Thompson is discussing the environment, the society we live in defines its own level of risk. It is not the expert or industry that defines acceptance of risk, but society itself.

### **RISK PERCEPTION ISSUES**

What issues could change the attitude of society towards CCTV? It can be argued that it will not be a single incident or that it will be immediate, but that changes will be slight and extend over a period of time. These changes will come about due to a combination of issues including the professionalism of the industry, media coverage, social perception to risk and CCTV, legislation and how the security industry manages, operates and promotes CCTV.

Does the security industry as a whole lack the professionalism necessary to ensure that it can respond to societies ever changing risk perception? There has for a number of years been a concern regarding the lack of knowledge, experience and qualifications that security practitioners possess, although they are generally portrayed as being the “experts in the field”. Hess and Wroblewski stated that “knowledge and skills beyond those associated with security are clearly needed” (1996, p.694), but it can be argued that for a security practitioner the basic security awareness skills may also be lacking. This is generally not a lack of knowledge of their own product capability, but a holistic knowledge of security. The use of risk assessment has to be a core practice by the security industry, but is arguable lacking. This is confirmed by Blades, when he stated that “One of security's downfalls has been its lack of application of relevant theory.” (n.d. p.3.15).

Although the security industry, at a higher level of management, generally embraces the risk assessment process, the application is generally still limited throughout the industry. Within security risk assessment, there is a large proportion of subjective analysis. This is highlighted by Strutt when developing a risk assessment methodology for security advisers, because “of the need in the present development to take a quantitative approach to security risk assessment and the difficulty of quantifying the terms” (1995, p.226). This introduces bias at one of the primary stages, which it can be argued, is rarely taken into account or understood within the risk assessment cycle. As Aldridge states “It is the responsibility of



the system managers to ensure that security problems are analysed and the contribution of CCTV to security system effectiveness is understood.” (1995, p.437).

It can be argued that this general lack of professionalism may be due to the fact that the “security industry is a still an emerging industry” (Tate, 1997, p.9) and that many new practitioners are entering this field from other related and non-related occupations. Higgins goes further when he stated that “the security industry has a notoriously poor reputation for the quality of its personnel, particularly its most visible representatives, security officers or guards. Everything seems to contribute to the problems, from low pay and high turnover to inadequate or nonexistent training.” (1990, p.75). Adam affirmed this issue, by reporting that “consumer education is important, but so is the need to better educate installers” (1998, p.63). It can be argued that today, the greater risk exposure from the industry to the consumer is not solely through guards, but primarily through the sales representatives within the different security disciplines. These are the people that recommend and promote the products and services within the industry, and therefore set the standards. But currently they do not require formal qualifications and only a minimal understanding of security legislation to obtain a security license and begin operating within the industry.

It can be argued that there is generally little regard or understanding of the effectiveness of CCTV as a risk reducer, by both the industry and consumer. Consumers generally have a poor understanding of their own security requirements and they are acting from a reactive stance when procuring security services. The Hallcrest Report stated that “consumers appear to be generally uninformed ... Potential customers may not have had prior information about the operation or selection of alarm systems prior to a system being ‘recommended’ to them by the alarm company” (Cunningham & Taylor, 1985, p.252). Waters provided criticism on the introduction of CCTV, when he stated that the “justification for introducing new systems needs to stand up to rigorous costs-benefits analysis rather than simple pre-judging the desirability of surveillance as a crime prevention measure.” (1996, p.1).

Social perception can alter, driven by media coverage of high crime levels and their display of the victims. This leads to certain demographic groups being far more afraid of the likelihood of crime, when there may not be the justification. But as Covello, Sandman and Slovic stated, “The media are prime transmitters of information on risks. They play a critical role in setting agendas and in determining outcomes. The media are generally more

interested in politics than in risk; more interested in simplicity than complexity; and more interested in danger than safety.” (1989, p.303). The level of risk acceptance drives public opinion to provide political and social solutions to crime.

What is the public perception of CCTV? Does the public really understand what today’s high-powered PTZ camera can achieve and that this image may be recorded? It can be argued that at the present moment they do not, but why is this belief held? Waters stated that “The chilling effect of surveillance is difficult to quantify, but is clearly recognized by the public.” (1996, p.1). If CCTV is so chilling, why does society continually accept CCTV into their environment? It could be argued that Waters is incorrect and that the public do not understand CCTV. Currently the only time the general public is exposed to CCTV is as a low-resolution image, taken from a budget single camera system and shown on TV when the police are investigating a serious incident. Perhaps the public’s perception may change if they really understood system capabilities?

But currently the general public perception of CCTV is that it improves safety, with little thought to the issues of privacy and civil liberties, both of which it could be argued are being infringed. In Dundee (UK) after CCTV was installed in the city centre, a survey found that 96% of those surveyed thought that CCTV would not infringe on civil liberties (Horne, 1998, p.321). The public views CCTV as a benefit and therefore an acceptable social risk. But it can be argued that with an increasing exposure to CCTV and a growing public awareness, that this view will change. This is reinforced by Slovic, et al., when they stated that “The frequent discovery of new hazards and the widespread publicity they receive is causing more and more individuals to see themselves as the victims, rather than the beneficiaries, of technology.” (1986, p.3).

Blind Camera syndrome is another concern, as public perception of safety may be reinforced by the belief that there is a trained operator behind the camera, ready to react to a situation they view on the monitor. But this may not be the case, as CCTV systems are generally large, utilise multiple cameras and have few operators. This makes a camera virtually blind for a large majority of the time. But the camera still appears the same from street level, as it may even be in a guard tour mode or panning to a preset position. Are these systems providing a perceived level of protection within the public view?

Some may argue that this is a benefit, as the crime perpetrators do not know if they are being watched? But is this a valid argument or an acceptable risk for the likely outcomes? Research has shown that even when CCTV is present, that “the cameras have little effect on overall levels of assaults and wounding, despite being used to prompt many arrests.” (Brown, 1995, p.vi). Brown went further, arguing that this may be put down to the “impulsive nature” of this type of crime. What is a greater concern is the possibility that the camera is blind when an assault is occurring, with the victim anticipating help.

The UK government is currently allocating £153 million pounds to local government, in order to tackle crime in high risk areas using CCTV. But to validate the allocation of these funds “bidders are required to set realistic and achievable crime reduction targets which demonstrate the impact CCTV will have when deployed as part of a wider strategy.” (Home Office, 2000, p.1). Due to the political nature and capital being utilised for these projects, concern must be raised as to the validity of this future data. But on the positive side it is vitally importance that CCTV is subjected to valid research, to ensure that the effectiveness of CCTV in risk reduction strategies is truly understood.

Most people would be surprised to be told that in Australian legislation, there is little protection against CCTV. Relevant legislation being the Privacy Act 1988, Security & Related Activities (Control) Act 1996, Evidence Act 1995 and the most recent, the Surveillance Devices Act 1998. There is a belief that CCTV privacy issues are covered by the Privacy Act 1988. This is not so, as the Act only provides guidelines and protection when Commonwealth government agencies are “collecting, storing, using and disclosing personal information. The Act also gives individuals access ... rights in relation to their own personal information. The Act applies to the wider community (including the private sector and state and local governments) only in relation to specific categories of information: tax file number information and consumer credit information.” (Privacy Commission, 1999). The Privacy Commission Tenth Annual Report highlighted the public misconception over the issue of CCTV, as they reported that Optical Surveillance rated 150 or 6.9% of enquires outside their jurisdiction. (1998, p.45).

“Street surveillance is as much a civil liberties issue as it is a privacy issue. The civil liberties concerns are closely related to prized community values, including freedom of assembly and movement.” (Waters, 1996, p.1). It can be argued that Waters is correct when stating that civil liberty is generally a community or group wide concern over freedom

issues, but this is also closely related to societies perception of risk acceptance. The concern of the community is that they not only have freedom of movement and congregation, but also a socially acceptable level of privacy within this freedom. The majority of society will support CCTV, but only when it is perceived as a benefit. This benefit has to outweigh any disadvantages, as Starr concluded “acceptability of risk appears to be crudely proportional to the third power of the benefits (real or imagined).” (1969, p.1237).

The Surveillance Devices Act 1998 primarily regulates the use of listening devices, optical surveillance and tracking devices in respect to private activities, conversations, location and objects. It was intended to repeal and replace the Listening Devices Act 1978 and amend the Evidence Act 1906 in relation to transcript recording. But the interpretation of an optical surveillance device by the Act is “any instrument, apparatus, equipment, or other device capable of being used to record visually or observe a private activity.” (1998, Part 1, 3.1).

The Surveillance Devices Act 1998 states that “a person shall not install, use or maintain, or cause to be installed, use, or maintain, an optical surveillance device ... (b) to record visually a private activity to which that person is a party.” (1998, p.10). But later states that this does not apply, if “the use of an optical surveillance device resulting in the unintentional recording or observation of a private activity.” (1998, p.11) and/or that it was “reasonable necessary for the protection of the lawful interests of that principle party.” (1998, ii, p.12). But both of these clauses do not remove intentional recording by a security guard who cannot show reasonable cause. This Act only increases the possibility of an adverse risk exposure for CCTV.

The Evidence Act 1995 relates to the admissibility of image evidence. Within this Act, digital images are defined as documents and have to be produced through a process that ordinarily produces that outcome. This is to ensure continuity of process. Documents are not admissible as evidence if there is sufficient doubt regarding their integrity. CCTV digital recorders utilise the JPEG algorithm and watermarking techniques, which are both flawed in their ability to maintain image integrity and originality. These are two vital aspects required to maintain admissibility of digital image. It is expected that with an increase in the use of digital recorded images, that there is a likelihood that digital images will be legally challenged in the future. Currently, this leaves the security industry without clear direction regarding their position with digital recorded video images.

The function of the Security and Related Activities (Control) Act 1996 is to primarily license security operators, sales consultants and installers of security products. It could be argued that this is a method of controlling the security industry to ensure that it maintains some form of credibility, rather than provide protection. But the very fact that the security practitioner has to be licensed, should provide some level of consumer protection. Unfortunately, the Act only requires that security practitioners undergo basic police checks, are of a sound character and have a basic knowledge of the legislation.

It can be argued that legislation generally lags behind social concerns and that society perceives legislation as lacking in its ability to provide sufficient protection. This protection can be either self-regulation or formal legislation. As Slovic, et al., stated “The gap between perceived and desired risk levels suggest that people are not satisfied with the way the market and other regulatory mechanisms have balanced risks and benefits.” (1986, p.5). There is little doubt that CCTV is perceived as an effective security tool. It is also cost effective and as Horne stated “was considered an important measure to deter crime, ranking only second to more police on the beat.” (1998, p.317). But this perception has to be closely scrutinised for validity and until further research studies are completed, questioned.

### **CCTV PSYCHOMETRIC POSITION**

Taking the empirical evidence discussed, a hypotheses can be formed that CCTV is currently located within the “No Dread and Unfamiliar Risk” quadrant of the psychometric paradigm. It could be argued that this places CCTV in an area that would provide little known public knowledge of CCTV capabilities and minimal adverse media coverage, but be prone to social change once the familiarity to the risk alters. Where CCTV relocates too, cannot be defined until further research is completed. But it could be argued that it is likely to relocate to the “High Dread and Familiar Risk” quadrant. This proposition is shown below in Figure 2. Psychometric Paradigm: CCTV Relocation of hazard.

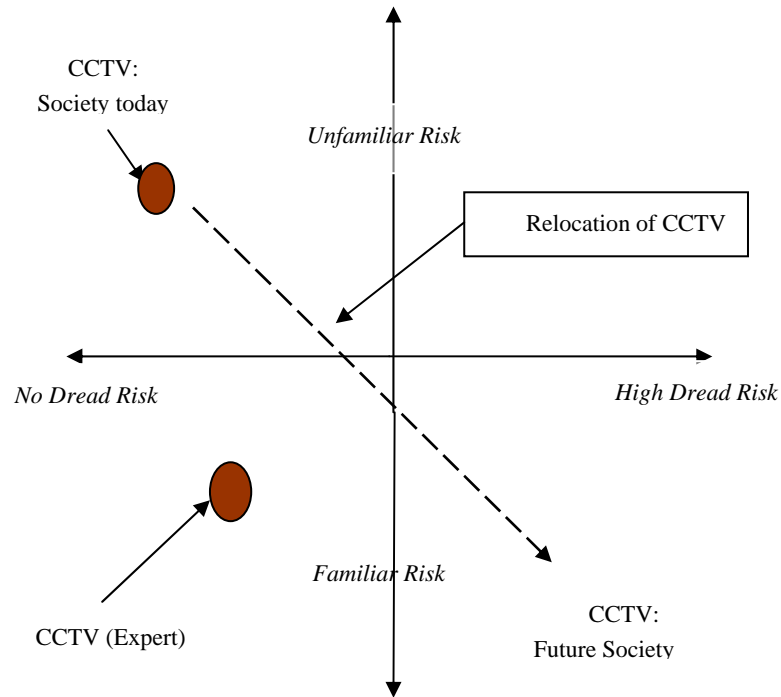


Figure 2. Psychometric Paradigm: CCTV Relocation of hazard.

### **FUTURE TRENDS**

Future trends will impact on CCTV and how it is socially perceived. Technology can assimilate and become a system multiplier. This is relevant when considered not in isolation, but from a holistic viewpoint. Facial biometrics, data matching and CCTV surveillance provides the capability for an extremely powerful tool. Technology is transferring CCTV into the digital arena, one that arguable requires control through information and privacy legislation. On technology, the Attorney General recommended “Legislation that as far as practical should be technology neutral.” (2000, [www.austlii.edu.au](http://www.austlii.edu.au)). But digital technology will ensure that CCTV becomes more prevalent, as no dedicated transmission lines are required, allowing access to video picture transmission anywhere in the world.

One aspect is certain, that in the next five years the increase in the use of CCTV will be exponential, as this has already been the case in the UK and USA. This is shown by Harowitz (2000, p.43) when she stated that “Expenditure for CCTV equipment have tripled during the 1990’s and are expected to increase 13% per year over the coming years, with the growth spurred by falling prices and technological advances.” This increase in CCTV will

increase public exposure to capabilities and therefore alter their risk perception and hence acceptance.

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