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Risk-Based Intervention Profiling in Complex Environments (Impacted by Time-Restricted Conditions)

A dissertation submitted in partial fulfillment of the requirements for the degree of

E58 Bachelor of Security Science (Honours)

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ABSTRACT

Security in the aviation environment is an evolving concept. Security risk profiling is an issue of significant importance in the aviation spectrum. This study examined the profiling undertaken on Australia's bio-security border, with specific attention given to the Australian Quarantine Inspection Service (AQIS) and the officers that use risk-based profiling within the complex environment found on the border—and how effectiveness is impacted by time.

Aviation security is a real and current issue for Australia and the international community as a whole. Given recent outbreaks, and the relative ease of international air travel, of such pests and diseases (SARS, Swine Flu, Avian Influenza, Foot and Mouth Disease) in countries around the globe, the risk assessment process at the border is of vital importance. Failure in this context could result in significant, critical impacts to the Australian environment and economy.

This study examined the efficacy of border-profiling techniques, and how those techniques are impacted by time, behaviour and risk attitude under certain circumstances. The objective was to obtain an accurate empirical understanding of the impact, effectiveness and risk attitude in both officers and clients profiling interactions in the Australian bio-security border under certain circumstances. Those circumstances were placed in context of behaviour altering due to time restrictions. From the literature reviewed, as well as the results of the study, it is clear that there is an impact upon effectiveness given restrictions under certain conditions, such as time. This impact exposed incoming passengers to greater levels of scrutiny during busier months, in order to adequately intercept non-compliant individuals. Clearly, the time-restricted environment impacts the ideal profile. The farther from the perceived ideal, based on statistical profiles or not, the likelier it is that non-ideal objects would be considered for scrutiny. This unnecessary scrutiny is only exacerbated in periods of intense activity within the complex environment.

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Chapter 1 - Introduction

1.1 THE BACKGROUND TO THE STUDY

Australia is an island, and as such, is home to a unique and diverse environment. Due to Australia's isolation, the country is free from a number of biological threats that plague other countries – such as foot and mouth disease (FMD) – resulting in significant detrimental impacts to the environment and economy. It is the role of the Australian Quarantine Inspection Service (AQIS) to manage and regulate what is known as the bio-security border (Dooley, 2007). AQIS administers quarantine controls at sea and airports to minimise the risk of exotic pests and diseases entering the country (AQIS, 2011). This management is undertaken at international airports through the use of risk-based intervention—security profiling.

In an Australian context, aviation risk profiles are developed using cumulative information garnered through statistical data, prior experience on suspicious populations, and criminal history. Border agencies such as Australian Customs (ACBPS), AQIS, and Immigration (DIAC) apply these profiles to their given responsibilities within the environment. Often, these profiles are complemented by surveillance and information technology that expand categories of risk (Weber & Wilson, 2008).

This study, a study on the risk profiles used on the Australian bio-security border, aided in determining the impact and efficacy of such profiling under certain conditions, and if those conditions alter a border officer's use of risk-based profiling. The chosen condition is concerned with the element of time, and how frequency of decision-making processes can be adversely affected. Overall, the study assessed that effectiveness is decayed by time. From this, an understanding of risk attitude and behaviour on the border was applied to better inform decision-making.

1.2 THE SIGNIFICANCE OF THE STUDY

The aviation security environment is one of global importance. Interactions of people within this complex environment, particularly how border officials intervene using risk-based assessment, are of significance to managing the security of the bio-security border. The airports both in Australia and across the planet can be considered critical infrastructure. That is to say, in the context of security, the critical infrastructures of a nation are '*those physical and information technology facilities, networks, services and assets which, if disrupted or destroyed, would have a serious impact on the health, safety, or economic well-being of citizens or the effective functioning of governments*' (Zeng, Chawathe, Huang, & Fei-Yue, 2007). Failure of critical infrastructure would lead to loss in either human or economic terms that would be entirely unacceptable (Egan, 2007). It is therefore necessary to ensure that risk analysis, and thus resource allocation, within aviation is done effectively to manage the security threat landscape (McGill, Ayyub, & Kaminskiy, 2007). Observing the element of decay within the effectiveness of risk-based intervention, given altered conditions, provided the significant foundation for this study.

1.3 THE RESEARCH PROBLEM

This study looked at the current underlying principles of the regulatory framework that argue a risk-based approach should be taken to the Australian Quarantine Inspection Service's intervention at the border. The assessment, or problem, in this framework is reconciling a dynamic, complex security environment with the practicality of long-term operational and legislative planning. That is, looking at the lead-time to introduce effective intervention techniques while ensuring that screening requirements, security risk-based profile assessments, remain appropriate and effective.

Identifying factors and the impact and efficacy of profiling, under certain given conditions as affected by time/behaviour restrictions within the security environment, is the principal research question of this study. Supporting questions were used to assess the problem of

time/behaviour modifications, and the impact of using profiles alone as an indicator for risk-based intervention.

This is the research problem to be explored in this study.

1.4 AIM OF THE STUDY

The aim of this study is to understand the impact and efficacy of profiling techniques on the Australian bio-security border. Secondary to that, a further aim is concerned with how impact and efficacy can be altered by risk attitudes, time restrictions, and behaviour. Time-restrictions, such as the amount of time in which an assessment can be made, allow for risk-based profiling to be implemented more frequently. To reconcile profiling in a dynamic environment, the study assessed if time-restricted decisions are reliant on the statistical probabilities found in risk-based profiling. However, when the element of time is relaxed, and the officer has a greater amount of time to make a decision, the rate of intervention can be lowered while the risk is still managed effectively.

1.5 OBJECTIVE OF THE STUDY

The objective of this study is to obtain an accurate empirical understanding of the impact, effectiveness and risk attitude in both officers and clients profiling interactions in the Australian bio-security border under certain circumstances. Those circumstances are placed in the context of behaviour altering due to time restrictions. That is to say, time impacts the ideal profile—an ideal object (or, in the context of border security, ideal passenger), preferred to certain levels of intervention above all others (Klahr, 1969). The farther from the perceived ideal, based on statistical profiles or not, the more theoretically likely it is that non-ideal objects would be considered for scrutiny.

The study undertaken utilised two key methods of data collection in order to inform the analysis. In order to adequately address the research questions, the study covered a number of objectives:

- To examine how profiling is impacted by risk-based intervention under time-restricted conditions, the study gauged effectiveness under varied time conditions
- To examine how profiling can be reconciled in an environment of varied complexity
- Using a 5-point Likert based survey, examine if current Australian government officers working on the border alter their use of profiling under time-restricted conditions

1.6 RESEARCH QUESTIONS

PRINCIPAL RESEARCH QUESTION

What is the ***efficacy*** of security risk profiling within risk-based intervention on the Australian bio-security border?

SUPPORTING QUESTIONS

1. If time/behaviour inform risk attitudes in officers/clients, does this relationship impact profiling capability?
2. Is there a link between profiling and reconciling a dynamic security environment?

The primary purpose of this research is to understand how the impact and efficiency of risk-based intervention strategies are altered under time-restricted conditions. In researching this problem, it is important to understand that if this method of intervention is influenced, why that influence is occurring and how to reconcile a dynamic security environment.

The principal research question was answered through application of survey data obtained from government officers working in a risk-based environment. The supporting questions were answered using survey data collection techniques, in order to better understand perception of risk-based profiling under certain conditions.

1.7 OVERVIEW OF THE STUDY

The outcome of the study analysis showed that there existed a significant correlation between effectiveness and impact and the use of risk-based intervention on the Australian border, specifically at the Perth International Airport where this study was undertaken. This correlation was inferred through data obtained from AQIS and through 43 responses gained from officers working in the complex environment. To reach this conclusion, the study was designed to collect, analyse and interpret data according to a seven staged research procedure. This was to ensure quality, reliability and integrity in both the research and the results of the analysis (See Figure 1.1).

Seven Stage

Research Procedure

Chapter 1	**Introduction to the Study**
Chapter 2	**Review of the Literature**
Chapter 3	**Theoretical Framework**
Chapter 4	**Materials and Methods**
Chapter 5	**Results**
Chapter 5	**Analysis**
Chapter 6	**Discussion, Limitations and Conclusions**

FIGURE 1.1 SEVEN-STAGE RESEARCH PROCEDURE

1.8 DEFINITIONS OF TERMS OR OPERATIONAL DEFINITIONS

AQIS

The Australian Quarantine Inspection Service. Responsible for the monitoring of pest/disease interception along the Australian border.

ACBPS

The Australian Customs and Border Protection Service. Responsible for the monitoring of customs taxes and the interception of prohibited imports.

DIAC

The Department of Immigration and Citizenship. Responsible for monitoring the immigration status of person/s entering Australia.

Risk-Based Intervention

The use of risk profiles based on likelihood and statistical data to target limited resources towards areas of identified highest risk.

Commonwealth Government

The Federal Government of Australia.

Epidemic

An outbreak or unusually high occurrence of a disease or illness in a population or area.

Declarant

The term applied to an individual who has legally declared an item of either customs or quarantine concern on their incoming passenger card at an international airport.

Non-Declarant

The term applied to an individual who has nothing to declare, or who has failed to declare an item of customs or quarantine concern—either purposefully or accidentally.

K9

The term K9 refers to a method of intervention during the border-crossing process whereby an individual is subjected to inspection by a canine trained to detect items of quarantine concern.

X-Ray

The term x-ray refers to a method of intervention during the border-crossing process whereby an individual's luggage is placed through an x-ray machine. The outcome of this process may result in a manual inspection of the luggage.

Manual Partial

The term manual partial refers to a method of intervention during the border crossing process whereby an individual's luggage is only partially inspected. Such as a single suitcase, or hand luggage.

? Only

The term ? Only refers to a method of assessment whereby an individual is asked questions about what they may have brought into the country. No physical inspection of the luggage/cargo is undertaken.

Overflow

The term overflow refers to a method of assessment whereby an individual crossing the border is not subjected to any type of intervention. The individual is 'overflowed'.

100% Inspection

The term 100% Inspection refers to a method of intervention whereby border officials inspect every article of luggage or cargo being imported into the country.

1.9 CONCLUSION

This introductory chapter has presented the background to the study. An initial overview of the Australian bio-security environment was examined, in context of the border agencies that employ methods of risk-based intervention on the Australian border. As explained in the background, the study determined the impact and efficacy of risk-based profiling under certain conditions, and if those conditions alter a border officer's use of risk-based profiling. The chosen condition is concerned with the element of time, and how frequency of decision-making processes can be alternately affected.

The significance of the study highlighted the environment of operation, international airports, as critical infrastructure. Security is of paramount importance at such facilities, and this study established an advocacy for the use of risk-based profiling, enhanced by experience, in the environment. The research problem developed from this contained a principal research

question and two supporting questions. The questions were designed to explore the realm of profiling as it applied under time-restricted conditions, and also periods of less intense activity.

An overview of the study established a seven-stage research plan in order to ensure data and research integrity, reliability and validity. The final section of this chapter identified key terms and operational definitions used in the complex environment by the border agencies responsible for implementing effected risk-based management and intervention.

Chapter 2 - Review of the Literature

2.1 INTRODUCTION

This chapter examined the literature surrounding the use, advocacy, or condemning of profiling used as a preventative measure on Australia's borders. With particular attention given to the bio-security border, and AQIS, which is the agency responsible for Australia's pest/disease interception (Fullam, 2004) The first section of the literature below examines the history and background of the use of profiling, particularly in the aviation security environment. The use of profiling as negatively impacted via nationality concerns will then be discussed. At the heart of this argument is an understanding that, however morally reprehensible it may be, profiling based on nationality is *statistically* valid. That is to say, evident criminal activities are assumed to be committed more frequently by particular nationalities (Risse & Zeckhauser, 2004) The second half of the review will examine risk-based intervention as positively endorsed.

To address the principal research question proposed in this study, a broad range of literature will be examined to identify areas of similar research, and inversely areas where research is lacking. Key studies in the field of profiling are discussed, which have brought profiling into the light since the terrorist attacks of September 11, 2001. From this, the review will explore theoretical frameworks within profiling (Section 2.5) and how effectiveness is impacted in complex and time-restricted environments. An Australian context will be applied (Sections 2.2.1 & 2.4.1), as the purpose of this study is to examine efficacy on the Australian border.

2.2 A BRIEF HISTORY OF PROFILING

"History doesn't repeat itself… but it does rhyme."
~Attributed to Mark Twain

Profiling has been used by law enforcement agencies across the planet since the late 1880s. In its infancy, informal profiling saw two physicians using crime scene analysis to anticipate the behaviour of serial killer Jack the Ripper (Winerman, 2004). Since that time, profiling has been used primarily to combat crime by law enforcement. In 1974, the Federal Bureau of Investigation founded the Behavioural Science Unit at Quantico, Virginia, which used and developed theories to investigate serious crime—rape and murder. Statistical likelihoods were formed from repeated interviews with people who had committed these crimes (Turvey, 2002; Winerman, 2004). Placed in the simplest terms, law enforcement profiling is a process whereby officers of a given agency consider characteristics including race, gender, religion, age and other contributing factors to make intervention decisions in the course of their duties (Bumgarner, 2004).

To apply profiling to the context of this study, the use of the technique by border security agencies can be deemed 'preventive'. That is to say, it is applied to individuals that have not yet committed any sort of offence. In the aviation environment, it is more commonly referred to as proactive profiling. A modern use of assessment by border officers to make judgements about passengers, concerning possible criminal behaviour, based on a range of subtle and open factors (Fredrickson & Siljander, 2002). The next section of this literature review will define profiling and apply it to an Australian context.

2.3 DEFINING PROFILING

To define it broadly in the context of this study, profiling is the use of such characteristics as behaviour or appearance of internationally arriving passengers to determine adequate levels of risk-based intervention (Reddick, 2004). This method provides an important tool within aviation security, and on the Australian bio-security border, to effectively apply

resources where they are most needed – if used properly, with an informed understanding of risk attitude and behaviour. An aspect of study lacking in the majority of the literature is whether risk attitude can impact the efficacy of risk-based profiling.

Reddick's (2004) definition of profiling is broad, and as such shares similar elements with other definitions. Lever (2011) takes the term profiling and splits it into two distinct categories of use:

1. Preventative and;
2. Post-crime

Preventative profiling is the type used in the aviation security environment across a broad spectrum of security services, including the bio-security border. Preventative profiling uses an understanding gained through statistical evidence of who is most likely to commit an offence, given certain characteristics and behaviours (Lever, 2011) (Gross & Livingston, 2002). Using this developed profile, officers in law enforcement (and on the Australian border) will determine what level of intervention is appropriate. Post-crime profiling is not a real consideration of this study; given that the aviation security environment is concerned with preventing security breaches. Although, an argument can be made that post-crime profiling form the basis of any future preventative efforts (Alison & Canter, 1999).

The key elements in a definition of profiling seem to be observation of behaviour, risk-status, nationality, and appearance, utilised by law enforcement officers to determine levels of intervention in complex environments. Harris (2006) makes a distinction for profiles reliant on racial or ethnic characterisations. This is unique and separate from general preventative profiling.

2.3.1 AUSTRALIAN CONTEXT

In an Australian context, aviation risk profiles are developed using cumulative information garnered through statistical data, prior experience on suspicious populations, and criminal history. Border agencies such as Australian Customs (ACBPS), Australian Quarantine (AQIS), and Immigration (DIAC) apply these profiles to their given responsibilities within the environment (Fullam, 2004). Often, these profiles are complemented by surveillance

and information technology that expand categories of risk (David Lyon, 2008; Weber & Wilson, 2008).

2.4 AVIATION CRITICAL INFRASTRUCTURES AND PROFILING

Critical infrastructure (CI) is a term widely used by academics and governments. Infrastructure such as power, water, public health, emergency services and aviation – airports – are examples of CI. To define CI is to identify infrastructure which provides an essential function, that is without a rapid substitute, that would cause critical, catastrophic harm if destroyed, and can be embedded in a wide array of networked criticalities (Egan, 2007). Failure of critical infrastructure would lead to loss in either human or economic terms that would be entirely unacceptable (Egan, 2007). It is therefore necessary to ensure that risk analysis, and thus resource allocation, within aviation is done effectively to manage the security threat landscape (McGill et al., 2007). As an example, terrorism is not only a problem on the international security threat landscape, but has also affected Australian interests in the decade following the terrorist attacks of September 11, 2001.

After the attack, the public demanded greater protections and defences. This compelled political leaders and security services to organize resources in an efficient and effective manner to areas of greatest risk – particularly the security associated with aviation (D. Lyon, 2007; Salter, 2004; Seidenstat, 2004; Szyliowicz, 2004). The perpetrators of the attacks on 9/11 exploited holes in aviation security that were already known and documented by security professionals. This information, left unused by the leaders of the United States, allowed highlighted weaknesses in aviation security to be abused by enemies of the country (Bazerman & Watkins, 2005). To ensure the utmost chance of stopping any future attacks, of a terrorist nature or not, with a consequence as severe or greater than 9/11, the security protections on the critical infrastructure – airports – on a national and global level must be designed and implemented with the highest efficiency in mind (Feng, Sahin, & Karson, 2009; D. Lyon, 2007). Given the sheer number of people and cargo flying in and out of airports globally everyday, risk-based profiles are employed and used to define threat in an environment that is constantly fast-paced and dynamically changing – security has had to evolve, not simply the technology involved, and it is not always accepted by the society it is there to protect (Singh & Singh, 2003).

2.4.1 AVIATION SECURITY POST 9/11

The world today is often referred to as the 'post-9/11' world, and terrorism has been identified as one of the defining concepts of the twenty-first century (Lynch & Williams, 2007). The September 11 attacks refocused the debate on security risk profiling, particularly in using ethnicity or nationality (racial profiling) as a means of identifying passengers for risk intervention. Proponents of human rights and civil liberties argue that this process is, at the very least, racist, and at worse harmful and dangerous to security (Rabbi Arik & Ehud, 2001).

Preventative security profiling based on characteristics of race will only serve to exacerbate racism within contemporary society and inflict harm upon ethnic minorities (Lever, 2011). However, on the other side of the debate, an argument can be put forward that if racial profiling techniques, such as the targeting of Middle Eastern (Arab) passengers had been undertaken at the levels seen today, then 3,000 people would not have lost their lives and the Worde Trade Centre towers would still feature prominently in the skyline of New York City (Rabbi Arik & Ehud, 2001). This, however, is disputed by a study conducted by Persico and Todd (2005), which shows that better targeting of specific groups does not necessarily decrease deviant behaviour or the overall crime rate. It will simply decrease it in the particularly targeted group. Persico and Todd also make mention that methods of profiling need to allow for the likely possibility that those most likely to do harm, the criminal passenger, may quite easily disguise themselves as a member of a low-crime group.

2.5 RISK-BASED PROFILING USING NATIONALITY INDICATORS

In the wake of September 11, 2001, there was a cataclysmic and undeniable shift toward a public desire for greater security. This alteration crossed many disciplines within the field of security, including the practice of nationality-based profiling. What was once condemned as a clear violation of civil liberties earned practical application (Gross & Livingston, 2002; Harris, 2002; Ramirez, Hoopes, & Quinlan, 2003). Australian authorities have determined mobility, such as across the spectrum of aviation and international air

travel, as a dilemma for security. Issues of effectiveness, of accurate resource application in a fluid and dynamic environment, have risen as a source of principal concern and certainty (Weber & Wilson, 2008).

A utilitarian argument tends to support the case for nationality-based profiling, as it can be declared for the 'greater good'. At the heart of this argument is an understanding that profiling based on nationality is *statistically* valid. That is to say, evident criminal activities are assumed to be committed more frequently by particular nationalities (Ramirez et al., 2003; Risse & Zeckhauser, 2004; Wasserman, 2011). If a case for statistical justification is to be made, then the use of profiling of any group must address utilitarian reform in regard to the health and security of the public. Security must be focused toward risk, and risk is devised through hybridisation of quantitative, qualitative and probability data (Salter, 2008). However, Hart, Larsen, Litton and Sullivan (2003) argue that the long term impact of nationality-based intervention are catastrophic, inasmuch as it stretches the tenuous bond between clients and security officers beyond breaking point (Ramirez et al., 2003; Thomsen, 2011).

Risse and Zeckhauser (2004) defined racial profiling as "*any police-initiated action that relies on the race, ethnicity, or national origin and not merely on the behavior of an individual.*" When implementing profiling as a technique of security assessment, the concern inevitably turns to the use of race or nationality to effectively utilise a profile (Engel, Calnon, & Bernard, 2002). On the Australian border – on any border – whether letting people out or allowing them to enter the country, border agency officers are reliant upon profiling strategies that examine race and/or nationality (Weber, 2007; Wonders, 2006). It is of particular importance to note that, in the context of the aviation security environment, profiling (racial or otherwise) is deemed 'preventative' or 'prospective', which as opposed to 'post-crime profiling' undertaken by law enforcement, is more troubling on moral, legal and political levels (Choudhry & Roach, 2003; Lever, 2011). That is to say, aviation security risk profiling is being performed on the suspicion of possible wrongdoing. No one has actually committed a crime when they are targeted for greater screening or scrutiny. Equality sacrificed for the sake of security (Bou-Habib, 2007).

2.5.1 THE AUSTRALIAN CONTEXT (BIO-SECURITY)

As stated above, in the Australian context, aviation risk profiles are developed using cumulative information garnered through statistical data, prior experience on suspicious populations, and criminal history. Border agencies such as Australian Customs, Australian Quarantine, and Immigration apply these profiles to their given responsibilities within the environment. Often, these profiles are complemented by surveillance and information technology that expand categories of risk (Weber & Wilson, 2008).

Western governments, including Australia, do not endorse policies of racial profiling, for obvious reasons. The use of such strategy contains an element of political disaster, but at the same time a need to provide security and control crime (Garland, 1996, 1997). A study conducted against airports in the United States found that minority groups in particular, such as Blacks or Hispanics, did not endorse and were less likely to accept justifications for profiling as opposed to White travellers (Gabbidon, Penn, Jordan, & Higgins, 2008). However, as an example, to accept Middle Eastern terrorism as a legitimate security concern (9/11, the greatest example of such a threat made real), without assessing passengers based on their possible Middle Eastern origins, presents an interesting contradiction (Spencer, 2006). Border officials are expected to do their job, to serve the goal of achieving greater security, without specifically targeting those of concern based on nationality (Wonders, 2006). Risk-based profiling, therefore, is impacted by individual attitude (both the attitude from the officer and the attitude from the passenger). That is to say, in a complex environment, one of the key concepts that would affect accurate decision-making would be the time available to make the decision weighted against and with behavioural information received, processed and acted upon (Kerstholt, 1994).

2.6 TIME AND BEHAVIOUR IMPACTING UPON PROFILING CAPABILITY

Decision-making logistics and strategy are determined through two means – time allocation and behavioural indicators. Consistent decision-making can be affected by learnt and adaptive conflicts over time in the complex environment (Hogarth & Makridakis,

1981). Different control strategies are employed depending on the horizon of time available, the stability of the utilised model, and the predictability (the profile) of the object being assessed (in this case, the passenger). Consistency in complex environments suffers from the time restrictions placed over the rate the decision can be made. Greater control can and will be gained by the operator as skill at the task is learnt. However, this introduces an element of stress into real-time decision-making (Brehmer, 1992). The singular events that require a decision are repeated on such a frequent basis that real-time dynamic decision-making becomes more of a process than an event. Management of the risk is determined as a whole (such as the risk of a particular flight landing internationally) and objects are processed using a particular methodology that may not work on another.

When it comes to air travel, traffic growth has overwhelmed the capacity for border agencies to deal with the demand in an accurate, timely and relevant manner. A prevalence of just-in-time processing has led to increased congestion (Bonsall, 2004), particularly at airports. In an environment that requires real-time decision-making and risk assessment, an enhanced understanding of risk attitude in an officer may serve to offset variations in consistency. Passengers arriving internationally must clear Customs and Quarantine – they understand that they are assessed as a risk and determined for a level of intervention (Samaan, Patel, Spencer, & Roberts, 2004). Kahneman and Tversky (1979) suggested that in an environment where all things can be deemed equal, people will have a tendency toward risk-averse behaviour when there is a chance of possible gain, and a risk-seeking outlook when a chance of possible loss exists. From this, Prospect Theory was developed. A theory which states decisions are context-dependent and made in sequential ordered assessment of identifiable outcomes, or prospects (Bonsall, 2004). To apply this in context, traveller behaviour, in an unequal complex environment, would stray from a rational assessment of probabilities and into uncertainty – to an assessment of either risk-reducing behaviour or risk-capitalising behaviour (Bonsall, 2004). Prospect Theory would allow for the decision-maker to process this behaviour of a traveller (ideal or otherwise), subjectively weighted against independent attitudes of risk (Brehmer, 1992). This is important because it can aid in determining attitude to risk at the border. Simply put, aid in determining who presents a bio-security risk, who does not, or who has something of consequence to hide.

Understanding this theory aided this study in application and analysis of the data, in order to answer the principal research question.

2.6.1 PREDICTING SIMILARITY IN DECISIONS

Decisions and consistency in high-risk environments, such as the border environment several Australian law enforcement agencies monitor and regulate, are often based on profiles of risk (Weber & Wilson, 2008). However, in any such dynamically, fast-paced setting, decision-makers are presented with alternative dimensions in the space upon which a decision may revolve. That is to say, in the singular environment there is present in the mind of an individual an 'ideal'. An ideal object (or, in the context of border security, ideal passenger), preferred to certain levels of intervention above all others (Klahr, 1969). Klahr (1969) argued that this ideal is the model upon which preference of alternative treatment (or security-based intervention) is based. Thus, the alternative treatment is determined as an inverse to the distance between the ideal object and the other objects in consideration. The farther from the perceived ideal, based on statistical profiles or not, the more theoretically likely it is that non-ideal objects would be considered for scrutiny. Judgements of similarity are made in the time afforded the complex environment (Klahr, 1969). It is important to understand this attitude in dynamic environments, and how it impacts decision making, in order to answer the principal research question posed in this thesis.

2.6.2 DYNAMIC DECISION MAKING IMPACTS ENVIRONMENT

Decisions in the aviation spectrum and on the border are made multiple times, in real-time, and often in an interdependent manner that changes to match circumstance within the environment – an environment that fluctuates to different purpose given varied sequences of action. This is a theory of dynamic decision making (DDM). Broadly, DDM is concerned with the process of decision-making and allowing decision-makers practice at the task to understand causal links (Gonzalez, Lerch, & Lebiere, 2003). It is important to understand DDM as when it comes to inconsistency in the value of decision-making, human inability to apply the profiled rules and judge risk consistently is often misunderstood and becomes subjective (Hogarth & Makridakis, 1981). From this, given the real-time environment within a field (such as the Australian border in this context),

selective time constraints arise and management of risk becomes crucial to avoid negative consequence. Individuals under time pressure must adjust their decision-making ability toward bringing about the best result, or at least the minimal negative consequence (Kerstholt, 1994). Consistent decision-making, therefore, in a complex environment is dependent not just on predicting similarity to the 'ideal' object, but on time and behaviour (risk attitude) within the fast-paced environment.

It becomes important to understand this, in order to apply theoretical constructs of decision-making in complex environments to the research questions asked above. Specifically:

- If time/behaviour inform risk attitudes in officers/clients, does this relationship impact profiling capability?
- Is there a link between profiling and reconciling a dynamic security environment?

2.7 COMPLEXITIES OF RISK ON THE AUSTRALIAN BORDER

People and cargo from all over the world arrive every day through Australia's international airports. A complex environment for that fact alone, the border agencies that enforce and regulate Australian law and international conventions do so in a dynamic and unique state of consequence (Weber & Wilson, 2008). As set forth in the international standard, Annex 17, Australia has a requirement to meet a minimum of aviation security standards – a written aviation security program among the expected standard of security. It was determined in 2006 by a review of the Canadian Air Transport Security Authority (CATSA), that a risk analysis and assessment form a solid foundation for maximising the use of limited and time-restricted resources (Poole, 2009).

Due to the nature and sheer volume of passengers and cargo arriving hour-by-hour, effective time and resource management, based on profiles of risk, are employed by Immigration, Customs, and the Australian Quarantine Inspection Service (Weber & Wilson, 2008). The risk environment varies not only in complexity but severity. For example, in 2003, during the global outbreak of severe acute respiratory syndrome

(SARS), selective and criteria-determined border screening programs were initiated to identify the disease at the border and attempt to limit its spread (Samaan et al., 2004). The complex environment became even more so. Given the amount of information known about the disease at the time, combined with the high public concern, measures in the environment were considered rapidly. The issue of assessment, of determining the level of sensitivity indicators to model intervention upon, was weighed against resource allocation and the logistics of disease control measures. The initial assessment of any traveller arriving internationally fell to the Australian Quarantine Inspection Service. Key indicators such as travel history and symptoms were considered to quickly decide if ill travellers needed to be directed to border nurses (Samaan et al., 2004). From this, it can be argued that, given the constant swell of passengers in need of assessment, that risk-based indicators were the main factor determining intervention in the complex environment. Examining the decision-making process in such a complex environment, limited by stringent time allocation, is the purpose of the second supporting question in this study:

Is there a link between profiling and reconciling a dynamic security environment?

A system of profiling designed to complement security and safety has much to cope with in the contemporary aviation security environment. Stressors inclusive of fast-paced technological advances, a dynamic risk environment (which in itself suffers from increased aggressiveness, or unexpected events such as SARS) and a lack of clarity in legislative and regulatory practice impose a pressure upon the system (Rasmussen, 1997). This pressure is only exemplified in a complex environment. As discussed above, profiling is the system in use to regulate the enormous numbers of people arriving everyday and crossing the bio-security border. Risk-assessments are made on individuals and cargo in real-time.

Risk-assessment is the term often used as a standard of processing in aviation security measures. More narrowly defined as ‘risk-based intervention’. The challenge in coping with the threats presented at the border and in aviation as a whole, is deciding where to allocate limited resources to maximise the benefit (Poole, 2009). In any given dynamic environment, as much in the spectrum of aviation as anywhere else, the decision-making abilities and behaviour of staff is affected to considerable degree by personal and relative factors. This is due to the nature of the environment and, of particular consideration, the time a decision-maker has to make a judgment (Kerstholt, 1994), based on how resources

have been allocated (as stated above, supposedly to maximise benefit). It can be stated that the factor of time influences human decision making, and the amount of time spent deliberating a decision impacts the final choice made (Busemeyer & Townsend, 1993). Thus, it is important to understand what theory influences individual decision-making in the aviation environment. In this case, in a context of the fast-paced passenger assessment undertaken by agencies such as Australian Customs and Quarantine (Samaan et al., 2004).

2.8 CONCLUSION

To address the principal research question proposed in this study, a broad range of literature was examined to identify areas of similar research, and inversely areas where a paucity of research existed. This review explored the vulnerabilities in applying risk-based profiling intervention in the context of the Australian border. Avenues of risk attitudes and behaviour were discussed. It was argued that in a complex environment, one of the key concepts that would affect accurate decision-making would be the time available to make the decision weighted against and with behavioural information received, processed and acted upon. Risk-based profiling, therefore, is impacted by individual attitude (both the attitude from the officer and the attitude from the passenger).

It was discussed that passengers travelling into the country might challenge a law enforcement authority if they felt that their national identity was being scrutinised for propensity to criminal activity, or their freedom restricted, thus exposing themselves to greater intervention. The use of profiles may not always merely identify persons of interest, but also create them. The ‘ideal’ can be dangerous, self-harming. Anticipating vulnerability in this, it can be recommended that greater understanding of risk attitudes and behaviours would minimise human error in the complex environment.

Given the uncertainty in risk attitudes in complex environments, however, this is an area in need of further research, and the aim of this study.

Chapter 3 - Theoretical Framework

3.1 INTRODUCTION

This chapter outlined how the study was structured based on methodology, and discussed how that methodology is supported by theoretical framework. Research methods are explored and placed in context of the methods undertaken in this study. An ontology is selected from an informed epistemology that accepts in the complex environment found at the international airport, the officers are in a constant state of knowledge collection and assessment.

3.2 QUANTITATIVE/QUALITATIVE APPROACH

There are two approaches to measure and test the data obtained in this study. A mixed-methodology approach was used to inform the research and enable the conclusions of this study. The two primary approaches are quantitative and qualitative research:

Quantitative researchers use methods and measures to test hypothetical generalisations. That is to say, in quantitative research the scientific data is emphasised toward facts and causes of action, is readily quantifiable in the form of numbers/statistics, and is summarised in numerical terminology. Simply put, quantitative research is a view of regard to the world as one made of measurable and observable facts (Golafshani, 2003).

Qualitative research is a field of inquiry that cuts across disciplines. The approach of qualitative researchers is to use the method to understand phenomena in context-specific settings (Bashir, Afzal, & Azeem, 2008), such as real world observation. Qualitative research studies environments of natural setting, to make sense of the meanings, broadly, not arrived at through statistical or quantified means (Golafshani, 2003).

Questions of validity and reliability of either method aside, qualitative and quantitative methods are both concerned with trying to reach the same result – one of truth (Bashir et al., 2008). A mixed-methodology approach was used in this study—a hybridisation of qualitative Likert surveys complemented with quantitative data analysis, to aid in ensuring a reliable validation process across the variance of the data (Jick, 1979).

3.2.1 STUDY ANALYSIS

The nature of this study required that a number of data analysis methods were undertaken. Techniques to extract the information from the collected data included calculation of survey sample size, as well as means and standard deviations. This quantitative data, along with the profiling data obtained from AQIS, was placed in the Qualtrics application software and Microsoft Excel spreadsheets respectively, which allowed for further analysis quantitatively. The qualitative survey answers were then used to infer correlations between effective profiling in time-restricted environments and non-time restricted environments.

3.3 EPISTEMOLOGY

Epistemology is a station of philosophical understanding concerned primarily with theories of knowledge. Broadly, epistemology attempts to understand questions of 'how' and 'what' a human being can know. The nature of knowledge itself is examined, concerning such things as scope, validity and reliability (Willig, 2001).

There are certain epistemological stances to be considered when undertaking research. This study examined positivism and constructivism.

3.3.1 POSITIVISM/CONSTRUCTIVISM

In the environment of the international airport – a dynamic, often complex environment – the human beings (passengers, border agency staff, airline staff and so on) are in a constant state of assessing and qualifying information, creating knowledge based on this in response to interaction/intervention and less so due to environment. The nature of the work requires an officer to know and assess risk from within a constant stream of passengers.

Positivism is a paradigm of understanding knowledge that suggests there is a straightforward connection between the world and human ability to perceive it. External factors influence events; understanding is impartial, and based on the outside (external) view (Willig, 2001).

Constructivism is a paradigm in qualitative research that views knowledge as socially constructed – knowledge that may change dependent on context and circumstance. Constructivism in social perspective is defined as the view that all knowledge and, thus, all meaningful reality, is dependent upon human performances, being constructed in and out of interaction between human beings and the world, and developed and transmitted within an essentially social context (Golafshani, 2003). To undertake this research, a constructivist approach is necessary due to the contextual factors that come into play at the airport. Decisions are made on social interpretation, often in real-time, with regard to barriers such as language, culture, and foreign customs. Nationality plays a part in this interpretation.

3.4 ONTOLOGY

Risk-based profiling is employed by risk attitudes in officers on the border. A person constructs their risk attitude based on prior experience, and as such the research needed to view application of the research tool through a similar lens. Ontology is an important emerging discipline that has significant potential to improve information organization, management and understanding (Ding & Foo, 2002). To put it broadly, ontology is the study of 'what is', the structure of objects, properties, processes, events and relations between reality and existence (Welty, 2003). An informed, formal ontology of relativism supported this research – an understanding that reality is constructed. To further this understanding, an ontology of historical realism – an understanding that assumptions, reality, is formed in context and determined in a dynamic environment over time (Cupchik, 2001) and placed in context of the study's methods. This is applied to the study in Chapter 4 (Section 4.3).

3.5 CONCLUSION

This chapter outlined how the theoretical framework supported the materials and methodology used to undertake the study. To best answer the principal research question asked in this study, a mixed-methodology approach was undertaken. Quantitative data collated on passenger statistics to understand the efficacy of profiling, alongside qualitative assessment of interviews/surveys conducted on quarantine officers to understand the impact. The reality of the study is that it is examining an environment under complex strain, and valid/reliable results will be found in diverse methods of data gathering and interpretation.

Given the understanding of the epistemological stance, supported by the ontology discussed, a constructivist approach was used to best answer the research questions. In the environment of the international airport – a dynamic, intricate environment – the human beings (passengers, border agency staff, airline staff and so on) are in a constant state of assessing and qualifying information, creating knowledge based on this in response to interaction/intervention and less so due to environment.

To understand profiling, the constructivist approach is necessary due to the contextual factors that come into play at the airport. Decisions are made on social interpretation, often in real-time, with regard to barriers such as language, culture, and foreign customs. Nationality plays a part in this interpretation. The following results/discussion will identify a model of behaviour – given the context of interpretation at the Perth International airport – that highlights the impact and efficacy of profiling at airports (cause and effect). At its most simplified, the constructivist approach promotes consideration of reality through constructs of individual knowledge and understanding. Given the dynamic, busy environment at the airport, and the accuracy of profiles based on factors such as nationality, it is logical to undertake this research from a position of revising prior understanding based on new information.

Chapter 4 - Materials and Methods

4.1 INTRODUCTION

In order to properly assess and answer the principal question proposed in this research project, a collection of data on passenger flow and basic intervention was undertaken at Perth International Airport. The main bulk of the data was collected through application and approval from AQIS in Canberra.

Alongside that data collection, question-based surveys designed toward understanding risk attitude in officers were sent to staff on the bio-security border at Perth International. Therefore, this procedure involved a hybridisation of data collection techniques.

4.2 THE STUDY'S OVERVIEW

The study was designed to collect, analyse and interpret data according to a seven staged research procedure. This was to ensure quality, reliability and integrity in both the research and the results of the analysis (See Figure 1.1). To achieve an informed result, two core avenues of research were conducted. The first implemented a Likert scale survey in order to assess officer use of profiling on the Australian border. The second was an analysis of data collected from AQIS at Perth International, regarding passenger processing statistics as a result of risk-based profiling being performed. The study was primarily undertaken due to the current lack of Australian research into risk-based assessment usage and effectiveness on the bio-security border.

4.2.1 THE SURVEY

A 5-point Likert scale survey was developed in order to inform the analysis of the research questions (Figure 4.1). The measurement of border agency officers' attitudes to profiling was essential to the principal and supporting questions of this study, and after some consideration the Likert survey was selected. Likert surveys are sometimes referred to as ordinal or ranking scale surveys. This particular method of measurement was developed by psychologist Rensis Likert in 1932 (Likert, 1932). The scale was developed in response to a desire to accurately measure attitude in a quantifiable and scientific matter.

The Likert scale is a uni-dimensional summative rating survey scale which measures each statement made in the survey with the same weight or perception of consequence. Participants within the survey are asked to rate their attitude/belief on a given issue, in this case risk-based profiling in complex environments, and respond using the following response categories (Kumar, 2005):

Question 1: Sample question?				
1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

FIGURE 4.1 - LIKERT SCALE EXAMPLE
(Adapted from Albaum, 1997)

For the purposes of this study, each response is assigned a numerical value from 1-5 to assess and measure a respondent's attitude to the issue of risk-based intervention in complex environments (See Figure 4.1). In the survey (See Figure 4.2) a score of 5 represented 'Strongly Agree' and a score of 1 represented 'Strongly Disagree'. Using this method, each statement can then be ranked and calculated to produce an average of the respondent's attitude to the issue at hand (Nachmias & Nachmias, 2000).

The Likert scale is not without limitations. Particularly, there is a limitation of reliability of truthful or certain responses, as this cannot be verified. The nature of humanity also

presents a particular limiting reminder, inasmuch that according to past evidence the majority of individuals are often unwilling to mark extremes (Strongly Agree/Strongly Disagree), even if that is their preference to the issue being discussed (Mullen, 1995). However, for the purposes of this study the Likert scale's usefulness is more than outweighed by the limitations. It is a tool used broadly and consistently across the world, considered by many researchers to be a reliable measurement and research instrument (Aiken & Groth-Mamat, 2006).

Having developed and implemented the survey into the Qualtrics research suite software, a letter of informed information was provided to all participants (See Appendix A). This letter ensured participants had a clear understanding of the study, and to inform participants of the voluntary and anonymous nature of the survey, as well as its purpose within the study. Further detail within the information letter contained the reason for the study and expected benefits.

AQIS Profiling Survey

Evaluation Scale: (5) strongly agree (1) strongly disagree (0) don't know

General

How long have you been an officer?	0-2 years 2-4 years 4-6 years 6-8 years 8+ years
What is your highest level of qualification (attempted)?	High School TAFE Certificate/Diploma University Degree Post-Graduate Masters/PHD
Age range?	18-25 25-35 35-45 45-55 55+
What state/territory are you from?	QLD ACT WA SA VIC TAS NT NSW

Risk-Based Profiling

I use risk-based profiling when assessing passengers arriving through an international port	5 4 3 2 1 0
Risk-based profiling is an effective measure for assessing risk	5 4 3 2 1 0
Experience enhances indication of non-compliance within risk-based profiles	5 4 3 2 1 0

Time/Behaviour Applications

I rely solely on risk-based profiles during busy periods	5 4 3 2 1 0
I override established risk-based profiles if passenger behaviour suggests non-compliance	5 4 3 2 1 0
I use risk-based profiling as a means of assessing passengers 'out the door' __% of the time	10 20 30 40 50 60 70 80 90 100
How do you feel about the effectiveness of risk-based profiling methods?	Practically Ineffective Not Very Effective Sometimes Effective Very Effective Always Effective

FIGURE 4.2 PROFILING SURVEY

4.2.2 DATA OBTAINED FROM AQIS

The study utilised various methods to achieve the outcomes and answer the principal and supporting questions. To complement the research survey, and to provide a base for judging effectiveness over time, data on passenger flow statistics was requested and obtained with permission from the Australian Quarantine Inspection Service at Perth International Airport.

The research figures presented provide a snapshot of data during an intensive month of travel—January 2011, which saw 174, 971 arrivals—and a snapshot of data from a less intensive month—August 2011, which saw 140,327 arrivals. This is the number of individuals processed by a government agency implementing risk-based profiling in a complex environment. For this reason, the data was requested and received. Alongside the passenger flow statistics, data on the non-compliance rates achieved during these months was also requested. This was to analyse the effectiveness and provide an inference through the snapshot on how the rates differ given a varied element of time in the intensive month of January versus the non-intensive month of August.

4.2.3 QUALTRICS

The Qualtrics survey research suite was used to develop the survey in an online mode, which allowed the responses to the survey to be interpreted using the software. This approach was necessary in order to interpret the qualitative data obtained from the survey. A measure of analysis was required and the in-built mapping functions of Qualtrics afforded a display of the data. As the study is intended to present a snapshot of risk-based intervention at Perth International Airport, the Qualtrics research suite provided a suitable platform for analysing the data from the survey.

4.2.4 DATA VALIDITY (ANALYSIS)

The target population for this study was the officers working the frontline of the Australian bio-security border at Perth International Airport. Of a possible 59 potential officers to survey, this study received responses from 43. This is 72% of the staff. According to the Australian Bureau of Statistic's National Statistical Service's Sample Size Calculator, a

population size of 59 officers would require a minimum of 37 respondents to achieve a confidence level of 95% ($p^{+}/-$ 0.10) (National Statistical Service, n.d.).

4.3 PROCEDURE

Broadly explained, the study procedure adhered to the following format:

1. Request collated data from AQIS Canberra regarding passenger-processing statistics.
2. Conduct a questionnaire-survey with passengers arriving internationally through Perth International Airport.
3. After collection of available data, analyse.
4. Interpret findings.
5. Collate and report results.

4.3.1 DATA ANALYSIS METHODOLOGY

The study developed and implemented research questions using a mixed-methodology approach—both qualitative responses and quantitative analysis.

Question	*Analysis Method*
- ***What is the efficacy of security risk profiling within risk-based intervention on the Australian bio-security border?***	Quantitative, based on data obtained from AQIS Results from two supporting questions will inform this analysis.
- ***If time/behaviour inform risk attitudes in officers/clients, does this relationship impact profiling capability?***	Quantitative assessment of data obtained from AQIS. Survey responses interpreted using Qualtrics software.
- ***Is there a link between profiling and reconciling a dynamic security environment?***	Quantitative assessment of data obtained from AQIS. Survey responses interpreted using Qualtrics software.

TABLE 4.1 ANALYSIS METHODS

4.3.2 RELIABILITY AND VALIDITY

The study was designed and implemented as a snapshot of risk-based intervention strategy at Perth International Airport. Initially, there was an attempt made to issue the survey nationally to all officers working in similar environments at international airports across Australia. However, national implementation was found to be impracticable in the time afforded this study. The limitation of external validity has been acknowledged in this study. For this reason, a strong case can be presented for further research in this risk-based field to verify or contrast conclusions drawn here.

As stated above (Section 4.2.4), of a possible 59 potential officers to survey, this study received responses from 43. This is 72% of the staff. According to the Australian Bureau of Statistic's National Statistical Service's Sample Size Calculator, a population size of 59

officers would require a minimum of 37 respondents to achieve a confidence level of 95% ($p^{+}/-$ 0.10) (National Statistical Service, n.d.). To minimise any potential sampling errors, as great a number as possible of respondents was sought to assist reliability.

4.3.3 ETHICAL CLEARANCE

As with any research study, issues of reliability and validity are endorsed by high standards of professional and ethical conduct. The guidelines of Edith Cowan University states that students undertaking research need ethical clearance from the university's Ethics Committee. This is to ensure integrity of the research undertaken and to protect the reputation and standards of the university. For the purposes of this study, ethical clearance was obtained.

4.4 LIMITATIONS

There are limitations to this study:

1. Initial data collection is dependent upon approval from AQIS in Canberra. Without this approval, other methods would need to be employed. In order to overcome this, the study will anticipate lack of availability of the data and use alternate methods to gather information. This limitation was not realised, as data was obtained through approval of executive level staff at Perth International.
2. Limit on number of participants in survey. The test subject group will make up only a small snapshot of the millions that cross Australia's border every year.
3. Time/budget limitations make it impractical to increase sample size.
4. Perth Airport was the principal centre for data collection, raising an issue of external validity. Given this, an attempt was made to collect similar data at other Australian airports, and possible comparisons made to international comparable agencies. However, this attempt was unrealised within the study.

A holistic approach was undertaken during the progress and implementation of this research thesis. There were minor problems encountered during the proposal and design stage, which helped resolve issues with implementation and barriers on the Australian border. The single most demanding aspect of this research was acquiring the data from the government officers undertaking risk-based intervention strategies on the Australian border. The interesting results obtained in the surveys of frontline staff on the border enabled the conclusions that in intensely busy periods of operation, risk-based profiling was utilised more than in calmer periods.

Once approval was received, after some months of meetings with executive level officials at the Perth International Airport, the officers who responded to the survey were supportive and encouraging to this particular avenue of study.

Further conclusions could have been drawn if the data obtained and the survey had not been limited to a single airport.

4.5 CONCLUSION

This chapter outlined the materials and methodology that were used to undertake the study. A discussion of how the Likert scale survey was presented, alongside the data collection techniques for the risk-based intervention undertaken at Perth International Airport. The study's overview highlighted the implementation used in the design, including the use of the Qualtrics survey suite—a useful tool for survey analysis. The procedure for the study followed, specifically considering data analysis methodology, ethical clearance, and touching on reliability and validity. The limitations section of this chapter discussed acknowledged limitations. Overall, the study was designed and implemented in accordance with the guidelines for ethical research.

Chapter 5 - Results & Analysis

5.1 INTRODUCTION

This chapter presents details of the survey that was undertaken on government border officers implementing risk-based intervention strategies at the Perth International Airport. A brief overview of the environment in which the survey and data was collected is presented, alongside an overview of the data collection procedure and officer demographics.

The results of the survey and data collection are then presented and used to answer the supporting questions of the study, in order to inform first the supporting questions and the principal question. This chapter concludes with a summary of the results and analysis.

5.2 THE COMPLEX ENVIRONMENT

When it comes to air travel, traffic growth has overwhelmed the capacity for border agencies to deal with the demand in an accurate, timely and relevant manner. A prevalence of just-in-time processing has led to increased congestion (Bonsall, 2004), particularly at the airports. In an environment that requires real-time decision-making and risk assessment, an understanding of risk attitude in an officer may serve to offset variations in consistency.

As discussed in Chapter 2 of this study, in an Australian context, aviation risk profiles are developed using cumulative information garnered through statistical data, prior experience on suspicious populations, and criminal history. Border agencies such as Australian Customs, Australian Quarantine, and Immigration apply these profiles to their given responsibilities within the environment. Often, these profiles are complemented by surveillance and information technology that expand categories of risk (Weber & Wilson, 2008).

The target population for this study was the officers working the frontline of the Australian bio-security border at Perth International Airport. Of a possible 59 potential officers to survey, this study received responses from 43. This is 72% of the staff. According to the Australian Bureau of Statistic's National Statistical Service's Sample Size Calculator, a population size of 59 officers would require a minimum of 37 respondents to achieve a confidence level of 95% ($p^{+}/-$ 0.10) (National Statistical Service, n.d.). The study has achieved and exceeded this minimum number.

5.2.1 DATA COLLECTION PROCEDURE

The survey aspect of this study used a Likert template, which asked respondents 11 questions. The survey was undertaken over the space of a week in October, 2011. Given the purpose of the study, the questions were designed to gain an insight into the application of risk-based profiling. Specifically how risk-based profiling was effected and undertaken during busier periods of operation at the airport.

Data on the number of risk-profiling passengers was obtained with permission from executive level public service staff operating at Perth International Airport. This data was for the months of January and August, 2011. It offered the statistical numbers on how many passengers were processed, how they were processed, and whether or not the processing resulted in non-compliance action with relevant legislated quarantine law being implemented.

5.3 OFFICER DEMOGRAPHICS

Participants who completed the survey at Perth International Airport were asked to identify their age, their current education level, and for how long they had been employed by the government agency. This was to allow the structure of the population sample demographic to be broken down. The following cross tabulation compares age range with the length of time a respondent has been an officer working in the complex environment:

		How long have you been a federal officer?					
		0-2 Years	*2-4 Years*	*4-6 Years*	*6-8 Years*	*8+ Years*	*Total*
Age range?	18-25	5	3	2	0	0	10
	25-35	1	5	3	1	0	10
	35-45	4	1	2	1	1	9
	45-55	0	4	5	1	1	11
	55+	0	2	1	0	0	3
	Total	10	15	13	3	2	43

TABLE 5.1 AGE RANGE V. TIME EMPLOYED

		How long have you been a federal officer?					
		0-2 Years	*2-4 Years*	*4-6 Years*	*6-8 Years*	*8+ Years*	*Total*
What is your highest level of qualification (attempted)?	High School	1	2	4	1	0	8
	TAFE Certificate/Diploma	5	7	8	1	1	22
	University Undergraduate Degree	4	5	1	1	1	12
	Post-Graduate Degree / Masters PhD	0	1	0	0	0	1
	Total	10	15	13	3	2	43

TABLE 5.2 TIME EMPLOYED V. EDUCATION LEVEL

Furthermore, in the survey conducted, the following response indicates how often the officers implement risk-based profiling in the complex environment:

I use risk-based profiling when assessing passengers arriving through an international port:

#	Answer	Response	%
1	Strongly Disagree	1	2%
2	Somewhat Disagree	3	7%
3	Neutral	3	7%
4	Somewhat Agree	17	40%
5	Strongly Agree	19	43%
	Total	43	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	4.14
Variance	1.00
Standard Deviation	1.00
Total Responses	43

FIGURE 5.1 RISK-BASED PROFILING USAGE

Of the 43 officers surveyed, 36 (83%) of them use risk-based profiling as part of their regular duties associated with international arrivals.

5.4 TIME/BEHAVIOUR IMPLICATIONS

The purpose of this section is to answer the supporting question:

If time/behaviour inform risk attitudes in officers, does this relationship impact profiling capability?

The survey questions in this section were designed to identify if profiling ability varied in busier time periods in the complex environment, in order to harmonize the principal

question concerning effectiveness of the technique under certain conditions. The priority condition being the time afforded an officer to assess an incoming passenger.

5.4.1 DATA COLLECTED FROM AQIS

Data collected this year on the Australian border at Perth International Airport was undertaken during the busiest time of the year, January 2011, and similarly collected at a significantly less busy time of the year, August 2011.

Figure 5.2, 5.3, 5.4, 5.5, 5.6 and table 5.3, 5.4, 5.5, 5.6 (p. 41 - 49) have been removed as per author's instructions.

5.6.1 PROFILING EFFECTIVENESS

This study has examined the passenger flow statistics of a government agency utilising risk-based intervention strategy on the Australian bio-security border. As well as that, a survey was conducted on the officers that make the daily decisions to employ risk-based profiling in that complex environment. The security risk-based profiling perceptions of the 43 officers surveyed demonstrated that the majority believe risk-based profiling to be an effective measure in assessing risk:

Risk-based profiling is an effective measure for assessing risk:

#	Answer	Response	%
1	Strongly Disagree	0	0%
2	Somewhat Disagree	3	8%
3	Neutral	7	18%
4	Somewhat Agree	24	60%
5	Strongly Agree	6	15%
	Total	40	100%

Statistic	Value
Min Value	2
Max Value	5
Mean	3.83
Variance	0.61
Standard Deviation	0.78
Total Responses	40

FIGURE 5.8 EFFECTIVENESS OF PROFILING

This result was not unexpected, given the nature of the role on the Australian border and the requirement to assess risk as quickly and as effectively as possible, while maintaining operational requirements. The use of risk-based profiling is central to the successful undertaking of border security. However, the majority of officers were also in agreement that risk-based profiling was not the overriding factor in their decision-making, but that it complemented an experience-based approach:

Experience enhances indication of non-compliance within risk-based profiling:

#	Answer	Response	%
1	Strongly Disagree	0	0%
2	Somewhat Disagree	1	2%
3	Neutral	2	5%
4	Somewhat Agree	16	37%
5	Strongly Agree	24	56%
	Total	43	100%

Statistic	Value
Min Value	2
Max Value	5
Mean	4.47
Variance	0.49
Standard Deviation	0.70
Total Responses	43

FIGURE 5.9 EXPERIENCE ENHANCES INDICATION

This result demonstrated that 40 (93%) of officers surveyed believed that experience enhanced the use of risk-based profiling. Concurrently, as discussed above in the supporting question regarding time/behaviour attitudes, a similar 39 (93%) officers agreed that overriding established profiles based on behaviour, on their experience with certain risk groups, was acceptable:

I override established risk-based profiles if passenger behaviour suggests non-compliance:

#	Answer	Response	%
1	Strongly Disagree	0	0%
2	Somewhat Disagree	1	2%
3	Neutral	2	5%
4	Somewhat Agree	14	33%
5	Strongly Agree	25	60%
	Total	42	100%

Statistic	Value
Min Value	2
Max Value	5
Mean	4.50
Variance	0.50
Standard Deviation	0.71
Total Responses	42

FIGURE 5.10 OVERRIDING PROFILES

5.6.2 EFFECTIVENESS BASED ON NON-COMPLIANCE

Effectiveness is seen in the non-compliance statistics obtained from the Australian Quarantine Inspection Service. Of the 43 officers surveyed, the majority (63%) were of a mind that risk-based assessment procedures were 'Sometimes Effective', while 13 (30%) of officers surveyed viewed the procedure as 'Very Effective'. Only 3 (7%) of officers surveyed believed a risk-based approach to profiling was 'Not Very Effective'. As may be expected, given the complex environment, 0 (0%) officers viewed the use of risk-based profiling assessments as 'Always Effective':

Risk-based assessments are performed by organizations and agencies across the planet. How do you feel about the effectiveness of this method?

#	Answer	Response	%
1	Practically Ineffective	0	0%
2	Not Very Effective	3	7%
3	Sometimes Effective	27	63%
4	Very Effective	13	30%
5	Always Effective	0	0%
	Total	43	100%

Statistic	Value
Min Value	2
Max Value	4
Mean	3.23
Variance	0.33
Standard Deviation	0.57
Total Responses	43

FIGURE 5.11 OFFICER EFFECTIVENESS BELIEF

As displayed above in the results to the supporting questions, to reconcile the use of profiling a comparison was made between effectiveness (based on non-compliance incidents) in a busy period against a relatively less busy period. Effectiveness was shown to be determined by time available to make a decision in the complex environment. This can be inferred from the supporting questions, where it was reasoned that as there was no statistically significant difference between non-compliance rates in the two unique months, the survey responses and, ultimately, the use of risk-based profiling, could give an accurate comparison of how time constraints impact effectiveness.

As discussed in Chapter 2, current literature argued that risk-based assessment is a process of real-time decision making in a dynamic, complex environment. The findings of this study supported that effectiveness is impacted under certain conditions, specifically that of time-restricted environments. The use of risk-based profiling, however, allowed for officers on the border to maintain effectiveness levels in uncovering non-compliant behaviour, despite an increase in workload/passenger flow and a decrease in time available to assess each passenger.

5.7 CONCLUSION

This chapter presented a detailed interpretation of the study's results, based on the established survey and data collected from the complex environment at Perth International Airport. Risk-based intervention profiling was explored and placed in context of the given environment, and analysis of the results inferred certain perceptions of the profiling strategy in the officers at work on the border.

A brief overview of the environment in which the survey and data was collected was presented, alongside an overview of the data collection procedure and officer demographics. The results of the survey and data collection were then presented and used to answer the supporting questions of the study, in order to inform the principal question.

The first supporting question was concerned with time/behaviour applications and how profiling was effected by that under certain conditions. The condition chosen to display variance in application was a comparison of activity in a time-restricted month of intense passenger flow (in this case, January, 2011) against a month of significantly less intensive passenger flow (August, 2011). The data was analysed to show that, despite the lighter workload in August, the officers were able to overflow and intervene with 72, 854 passengers. This is 51.91% of all passengers for the month. However, in the busier month, only 43, 599 passengers were released with zero intervention. A rate of 24.91%. This was inferred that due to the loosening of time restraints, the higher non-intervention rate in August could be attributed to greater assessment being conducted by officers as time allowed. Profiles were relied upon less, as a more experienced-based assessment could be made of the individual passenger given more time to do so. Further questions could be asked, and decisions made not just on the statistical likelihood of non-compliance (profiling).

The study also illustrated how profiling could be reconciled in this environment, given the varied conditions and time-restricted months. The data showed that, despite the drop in passengers for the month of August, and the greater instance of overflow and zero intervention strategies, the rate of non-compliance incidents stayed relatively the same

from the busier month of January. Non-compliance incidents for January amounted to 0.35034% of passengers, whereas non-compliance incidents for August amounted to 0.32638%. A difference of 0.02396%. This infers that time-restrictions, such as the amount of time in which an assessment can be made, allow for risk-based profiling to be implemented more frequently. To reconcile profiling in a dynamic environment, these figures are indicative of time-restricted decisions being reliant on the statistical probabilities found in risk-based profiling. However, when the element of time is relaxed, and the officer has a greater amount of time to make a decision, the rate of intervention can be lowered while the risk is still managed effectively.

Lastly, this chapter looked at the principal research question, as informed by the two supporting questions. The effectiveness of profiling in this environment, under certain conditions, was examined and contrasted against the responses the officers working in the complex environment gave to the survey. It was concluded that profiling was effected by time-restrictions placed on the environment, for the sample and snapshot taken at Perth International Airport.

Chapter 6 - Discussion, Limitations and Conclusion

6.1 INTRODUCTION

This chapter reviewed the outcomes of the study and demonstrated the key findings. The key outcomes of the study found that the ability to apply risk-based profiling strategy is impacted by time in the complex environment. Limitations and future research are also discussed, such as issues of external validity concerning national implementation. Recommendations are made, based on the outcome of the study, for further research within the field. Discussing the results of the research findings in relation to the supporting questions and the principal research question, it was concluded there is an adverse impact upon effectiveness given restrictions under certain conditions, such as time.

6.2 IMPLEMENTATION AND LIMITATIONS OF THE RESEARCH

A holistic approach was undertaken during the progress and implementation of this research thesis. There were minor problems encountered during the proposal and design stage, which helped resolve issues with implementation and barriers on the Australian border. This enabled acquisition of the data from the government officers undertaking risk-based intervention strategies on the Australian border. The results obtained in the surveys of frontline staff on the border permitted the conclusions that risk-based profiling was utilised more, and to no significantly greater effect, in months of increased activity as opposed to calmer periods.

Once approval was received, after some months of meetings with executive level officials at the Perth International Airport, the officers who responded to the survey were supportive and encouraging to this particular avenue of study. This survey was limited to a single airport. However, national implementation was found to be beyond the scope of the time

afforded this study. The limitation of external validity has been acknowledged in this study. For this reason, further research is necessary in this risk-based field to verify or contrast conclusions drawn here.

6.3 FUTURE RESEARCH

An understanding of the risk attitude in government officers on the Australian border, during both time-restricted and less complex environments (as presented in the data obtained from the Australian Quarantine Inspection Service) (See Chapter 5), did present a useful foundation for future research. The data collection and interpretation serve to complement the effectiveness of risk-based intervention prescribed in the literature review. International passenger arrivals are increasing month by month, and the complex environment of the border is becoming ever more intricate. Further research aimed at understanding how profiling is altered under these conditions would assist in maintaining both positive impact and effectiveness.

6.4 STUDY OUTCOMES

6.4.1 SUPPORTING RESEARCH QUESTION 1

If time/behaviour inform risk attitudes in officers, does this relationship impact profiling capability?

The two data sets obtained from AQIS were snapshots of the bio-security border during a busy period, in January 2011, where resources are employed to capacity, and a relatively calm period of August 2011, where resources are somewhat relaxed. This supporting question was of primary importance in answering the principal question.

Time (in which to make a decision) was clearly identified as the most demanding aspect of the relationship between risk attitude and the complex environment. Profiling capability was impacted, as shown in the effectiveness results. Constraints on time inform the

officer's risk attitude in such a way that, during busier periods, a greater number of passengers are exposed to intervention methods with a very negligible effect on non-compliance incidents.

The results to this question demonstrated that an officer operating in time-restricted conditions is more likely to rely solely upon risk-based profiles, as established by statistical likelihoods of previous assessments. However, one link within the study identified that, if presented with passenger behaviour indicative of non-compliance with border-crossing law, the majority of officers (93% - See Figure 5.7) would override established profiles regardless of time constraints.

6.4.2 SUPPORTING RESEARCH QUESTION 2

Is there a link between profiling and reconciling a dynamic security environment?

Profiling in this environment, at Perth International Airport, is undertaken under complex and dynamic conditions. Complex due to the nature of human risk assessment, and dynamic due to the constant changing influx of people from unique and varied cultural/socio-economic backgrounds. The bio-security of Australia and its people is the goal of the operation. The survey respondents valued the process of profiling, based on established understanding of risk-based intervention (gained from statistical data over time), and clearly showed that a link existed between profiling and reconciling the dynamic security environment at the Perth airport.

The security environment for this avenue of study is linked to profiling. Government officers, from various agencies, make assessment and interpretation of risk in real time within the international arrivals hall. The findings of the research advocate the use of profiling as an effective measure for ensuring risk-based intervention, particularly in an environment of increasing complexity – affected by time constraints.

The results to this question demonstrated that analysis of the data from Perth International showed that during the less time-restricted month of August, 2011, a greater number of passengers received no intervention, as opposed to the time-restricted month of January,

2011. To reconcile profiling in a dynamic environment, these figures are indicative of time-restricted decisions being reliant on the statistical probabilities found in risk-based profiling. From this, it is clearly seen that when time becomes a significant factor in decision-making, the likelihood of unnecessary intervention will increase.

6.4.3 PRINCIPAL RESEARCH QUESTION

The principal research question was similar in nature and yet varied in form from the two supporting questions, presenting a holistic view to risk-based profiling in the aviation bio-security environment.

What is the ***efficacy*** of security risk profiling within risk-based intervention on the Australian bio-security border?

This study demonstrated that an officer's perception of risk is often paramount in determining a decision. When the element of time is relaxed, and the officer has a greater amount of time to make a decision, the rate of intervention when lowered does allow the risk to still be managed effectively. During peak periods of activity on the border at Perth International Airport, the study has shown through effectiveness measurements and comparisons between peak and non-peak times that risk-based profiling is used more than experience-based assessment, given the greater rate of intervention in the busier month of January. However, during less time-restricted circumstances, the effectiveness of risk-based profiling is clearly more significant, given that the data reflected a picture of less intervention in quieter months, while maintaining similar levels of non-compliance incident discovery.

Time-restrictions, such as the amount of time in which an assessment can be made, allow for risk-based profiling to be implemented more frequently. To reconcile profiling in a dynamic environment, these figures are indicative of time-restricted decisions being reliant on the statistical probabilities found in risk-based profiling.

The efficacy of security risk profiling, within risk-based intervention strategy, as studied upon the Australian bio-security border at Perth International Airport, is dependant upon the risk attitudes in officers, as well as the time afforded any given officer in the environment.

6.5 RECOMMENDATIONS BASED ON STUDY RESULTS

The study presented that dynamic decision-making is impacted by time in complex environments, and that security risk-based profiling based on statistical likelihood can be of use during periods of significant time-restricted operation. However, given proper allocation of time for an officer to assess and make a decision based more on experience as opposed to the statistical likelihoods of probability found in risk-based profiling, does enhance and streamline the process, resulting in significantly less intervention while maintaining effective hit-rates resulting in non-compliance action.

An understanding of risk-based profiling effectiveness, as impacted by time constraints, must be built into organisational operational requirements, in order to limit the impact of unnecessary intervention. A reliance more on experience over the stringent application of statistically based profiles does inform an officer's performance across several complex environments, limited by time or not. Further research needs to be performed to explore the potential effectiveness of profiling based more on individual experience than risk-based profiling based on statistical likelihood, when time constraints are in effect.

6.6 CONCLUSION

This study examined the efficacy of risk-based profiling on the Australian bio-security border, and how effectiveness is varied under certain conditions. The chosen condition was a complex environment restrained by time available to assess incoming passengers.

The interpretations of the analysed results, obtained from the data in the previous chapter showed the following: The correlation between time restrictions and effectiveness was presented, both through the survey responses from the officers working on the border and

the data reflecting actual processing during periods of varied time restriction at Perth International Airport—January and August, 2011. Profiling reconciliation was examined against the non-compliance incidents found through the use of risk-based intervention in the two varied months. From this, the study answered the principal research question regarding effectiveness of the method.

Limitations of the study included a single airport simple, a snapshot data sample and acquiring the data from the government officers undertaking risk-based intervention strategies on the Australian border. The results obtained in the surveys of frontline staff on the border enabled the conclusions found in Chapter 5.

From the literature reviewed, as well as the results of the study, it is clear that there is an impact upon effectiveness given restrictions under certain conditions, such as time. This impact exposed incoming passengers to greater levels of scrutiny during busier months, in order to adequately intercept non-compliant individuals. The objective of this study was to obtain an understanding of the impact, effectiveness and risk attitude in both the officers and passengers' interactions on the Australian bio-security border. The interactions were based on risk-based assessment, and placed in the context of behaviour altered due to time restrictions. In conclusion, the study found that the time-restricted environment impacts the ideal profile. The farther from the perceived ideal, based on statistical profiles or not, the more theoretically likely it is that non-ideal objects would be considered for scrutiny. Under certain conditions, a quantity of passengers will be exposed to unnecessary intervention.

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Appendices

APPENDIX A - INFORMATION LETTER TO PARTICIPANTS

A STUDY INTO THE USE OF RISK-BASED INTERVENTION POLICY ON THE AUSTRALIAN BIO-SECURITY BORDER

My name is Joseph Ducie and I am conducting research towards my Honours Degree at Edith Cowan University in the Faculty of Computing Health and Science. I would be grateful if you would assist me by consenting to participate in my research survey as outlined herein.

You are invited to participate in this survey, which is being conducted as part of the requirements for the completion of my BSc (Security) Honours. Contact details about the researchers are given below:

Research Student/ Chief Investigator: Joe Ducie
Student Number: 10094681
Contact details: 0413 991 411 or jducie@our.ecu.edu.au

Research Supervisor: David Cook
Lecturer in Security
School of Computer and Security Science
Faculty of Computing, Health and Science
Contact details: 08 6304 5104 or d.cook@ecu.edu.au

The aim of this research project is to determine the impact of risk-based intervention strategies, and how effectiveness is altered under certain conditions, such as time. This is placed in context of aviation critical infrastructure, and the Australian border.

If you choose to participate in this project you will be asked to:
participate in an online survey of approximately 3 - 5 minutes.

The information will be used to complete the requirements for the research project noted above, and only the research student (Chief Investigator) and the research supervisor will have access to the information. Any information or details given for this survey will be kept confidential and will only be used for the purposes of this research. You will not be identified in any written assignment or presentation of the results of this research project.

Participation in this project is voluntary. If you choose to participate, you are free to withdraw from further participation at any time without giving a reason and with no negative consequences. You are also free to ask for any information which identifies you to be withdrawn from the study (Note: there is no such information in this instance).

If you have any questions or require any further information about the research project, please feel free to contact me (Joseph Ducie) for further assistance.

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Name: Sandra Green
Title: The Faculty of Computing Health and Science Ethics Sub-Committee

Address: Edith Cowan University, 270 Joondalup Drive, Joondalup
Phone: 08 6304 3450
Email: sandra.green@ecu.edu.au

LETTER OF PERMISSION TO

CONDUCT SURVEY

My name is Joseph Ducie and I am conducting research towards my Honours Degree at Edith Cowan University in the School of Computer and Security Science. I would like to request permission to conduct anonymous and voluntary surveys on border officers working in the complex environment.

Contact details about the researchers are given below:

Research Student/ Chief Investigator: Joe Ducie
Student Number: 10094681
Contact details: 0413 991 411 or jducie@our.ecu.edu.au

Research Supervisor: David Cook
Lecturer in Security
School of Computer and Security Science
Faculty of Computing, Health and Science
Contact details: 08 6304 5104 or d.cook@ecu.edu.au

The aim of this research project is to determine the impact of risk-based intervention strategies, and how effectiveness is altered under certain conditions, such as time. This is placed in context of aviation critical infrastructure, and the Australian border.

The information collected will be used to complete the requirements for the research project noted above, and only the research student (Chief Investigator) and the research supervisor will have access to the information. Any information or details given for this survey will be kept confidential and will only be used for the purposes of this research.

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Name: Sandra Green
Title: The Faculty of Computing Health and Science Ethics Sub-Committee
Address: Edith Cowan University, 270 Joondalup Drive, Joondalup
Phone: 08 6304 3450
Email: sandra.green@ecu.edu.au

Thank you for you consideration and assistance with this study enquiry.

APPENDIX C – PROFILING SURVEY

AQIS Profiling Survey

Evaluation Scale: (5) strongly agree (1) strongly disagree (0) don't know

General

How long have you been an officer?	0-2 years 2-4 years 4-6 years 6-8 years 8+ years
What is your highest level of qualification (attempted)?	High School TAFE Certificate/Diploma University Degree Post-Graduate Masters/PHD
Age range?	18-25 25-35 35-45 45-55 55+
What state/territory are you from?	QLD ACT WA SA VIC TAS NT NSW

Risk-Based Profiling

I use risk-based profiling when assessing passengers arriving through an international port	5 4 3 2 1 0
Risk-based profiling is an effective measure for assessing risk	5 4 3 2 1 0
Experience enhances indication of non-compliance within risk-based profiles	5 4 3 2 1 0

Time/Behaviour Applications

I rely solely on risk-based profiles during busy periods	5 4 3 2 1 0
I override established risk-based profiles if passenger behaviour suggests non-compliance	5 4 3 2 1 0
I use risk-based profiling as a means of assessing passengers 'out the door' __% of the time	10 20 30 4050 60 70 80 90 100
How do you feel about the effectiveness of risk-based profiling methods?	Practically Ineffective Not Very Effective Sometimes Effective Very Effective Always Effective