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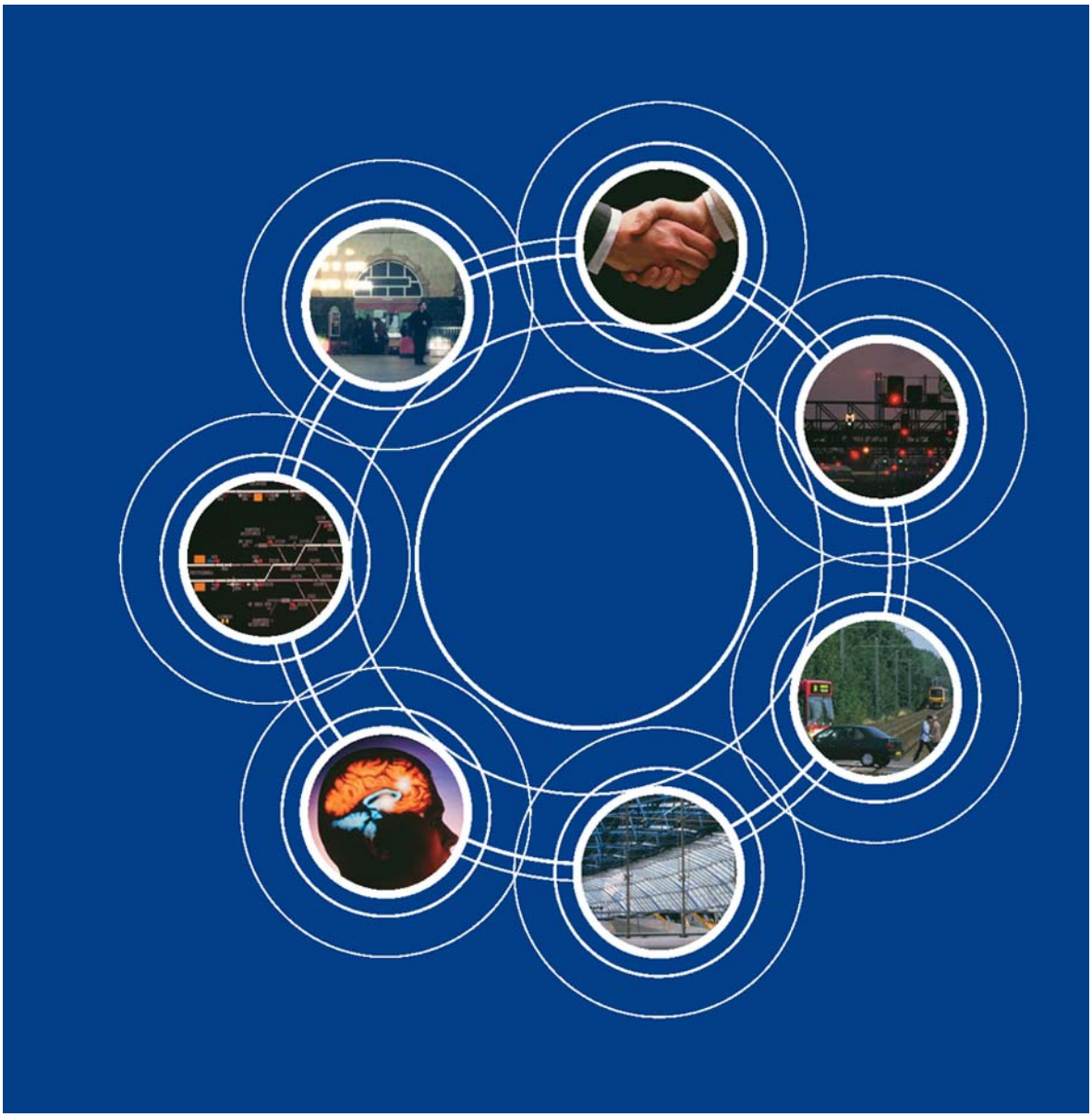
Research Programme

Operations and Management

Evaluating measures to improve personal security and the value of their benefits



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Evaluating measures to improve personal security and the value of their benefits (T954)

1 Executive Summary

Overview

The purpose of this study was to evaluate two specific interventions designed to reduce personal security risk at railway stations and railway station car parks, namely the Secure Stations and Safer Parking schemes. Secure Stations is a scheme for rewarding station operators, through accreditation by the British Transport Police (BTP), for managing security and demonstrating to customers their desire to reduce crime. The scheme was launched in 1998 and by March 2011 there were 1245 stations accredited under the scheme of which 345 were first time accredited stations, 893 were re-accreditations and seven were working towards accreditation. Safer Parking is a similar scheme, managed by the British Parking Association on behalf of the Association of Chief Police Officers (ACPO). Approximately 400 stations have gained accreditation for their car parks. Both the Secure Stations and Safer Parking schemes have clear guidelines for accreditation which include the requirement for crime to be beneath a given threshold. In addition, the station or car park must successfully pass an assessment of the station/car park environment.

Objectives

The two primary objectives of this study were to:

i. Evaluate the Secure Stations and Safer Parking schemes, ensuring that part of the evaluation includes a quantification of the costs and the benefits (actual and perceived) accrued by the public, passengers, industry and the wider society through their implementation.

ii. Through the evaluation of the two schemes, and using other techniques/methods as necessary, develop a methodology (and framework) and use it to provide a quantifiable assessment (quantifiable in terms of both monetary and risk impact and societal measures) of the Secure Stations and Safer Parking schemes/measures to improve personal security.

Method

The evaluation consisted of two principal strands, one concerned with **crime-based evaluation**, and a second concerned with **economic-based evaluation**. In broad terms, the study evaluated the effects of Secure Stations and Safer Parking on the prevalence of crime, and the associated costs and benefits to the industry and society more generally.

In undertaking this evaluation, the study developed, and integrated, analyses at two distinct levels of detail; **aggregate** and **detailed**. The role of the aggregate analysis was to elicit general trends in the crime-reducing effects (and the consequent net social benefits) of Secure Stations/Safer Parking from a large sample of stations/car parks. The role of the detailed analysis was to develop a deeper understanding of the relationships between the interventions and the effects, with reference to a small number of specific station/car park sites.

The specific research methods included the following:

Aggregate sample: for a representative sample of 322 stations (and station car parks where applicable) for period 2006/7 to 2011/12, the study developed a:

- **Crime model:** this is a statistical model that seeks to draw relationships between the incidence of crime by crime type and drivers of crime. The model was informed by an on-line survey of station managers.
- **Patronage model:** this is a statistical model that seeks to draw relationships between the incidence of crime by crime type and rail patronage, defined in terms of sales of rail tickets.

Detailed sample: for a selective sample of seven stations and four station car parks, the study carried out:

- **Visual audits:** site visits to inspect and document features of the station environment that may be associated with facilitating or preventing crime.
- **Valuation surveys:** Willingness-To-Pay (WTP) passenger surveys to value reductions in crime risk that might be associated with Secure Stations/Safer Parking.

Key findings

The key **drivers for reducing crime** at railway stations/railway station car parks include the following:

- Guardianship - the presence of station/car park staff.
- Surveillance - the presence of CCTV or informal surveillance.
- Defensible space and access control: ie the presence of ticket barriers, and the ability to secure station property and spaces.
- Activity support - the extent of routine activity associated with the presence of shops and cafes etc.

Secure Stations and Safer Parking have the following **effects on crime**:

- Secure Station accreditation is associated with lower levels of theft from a person, criminal damage and vehicle crime.
- In the absence of Secure Station accreditation, Safer Parking accreditation has no discernible influence upon vehicle crime, but does bring additional benefit when combined with Secure Station.

Secure Stations/Safer Parking generate **benefits to existing rail users** in the following ways:

- Benefits arise from reductions in the frequency of actual crime incidents.
- Quite aside from the effects of Secure Stations/Safer Parking on actual crime, station/car park users place significant value upon specific personal security interventions at stations/car parks (eg CCTV), since these contribute to improvements in perceptions of crime risk more generally.
- Whilst placing significant value upon such interventions, existing rail users are however reluctant to pay for them through the fare box/car park charges.

Secure Stations/Safer Parking generate **benefits to new rail users** (and/or existing users making additional trips) in the following ways:

- Secure Stations and Safer Parking have a significant effect on rail demand (7% for seasons, 1% for non seasons).

- This increase in demand implies the existence of benefits to 'new' users, and increased revenue to train operating companies from increased patronage.

It is worth noting that the demand impact reported is largely driven by the Secure Stations scheme. The specific contribution of Safer Parking was difficult to discern statistically.

Deliverables

In addition to this final report, the study has developed a Planning Tool, which features the following key elements:

- It records background data for a user-defined personal security intervention (Secure Stations, Safer Parking, specific physical interventions, or some combination thereof) at a railway station/railway station car park.
- It incorporates a crime model, to provide a first estimate of the crime reduction impact of the intervention.
- It estimates the rail demand impact, based on a patronage model.
- It values the social benefits of the intervention.
- It aggregates the benefits and costs to a Net Present Value (NPV) and Benefit : Cost Ratio (BCR) using methods and parameters consistent with industry and DfT practice.
- It conducts sensitivity analysis for key parameters.

Main recommendations

R1. This study has found clear and convincing evidence that:

a. Secure Stations and Safer Parking interventions reduce crime

b. Reduced crime yields benefits to existing rail users

c. Reduced crime encourages greater patronage of rail

Against this background, there is a good case for formalising the evaluation of Secure Stations/Safer Parking interventions in line with the evaluation of other comparative interventions such as station/service quality and railway safety improvements.

R2. RSSB is encouraged to promote the findings of this study, and the existence of the Planning Tool, to relevant industry stakeholders. There is a good case for inclusion of the findings in PDFH. DfT may also wish to consider the case for commissioning associated WebTAG guidance.

R3. The Tool is designed to represent general relationships between personal security interventions, crime and rail patronage. It is recommended that, in assembling a business case for investment, the Planning Tool should be combined with a visual audit of the local site by a practitioner skilled in such analysis. Such an audit could provide a justification for any deviation from the Tool's default assumptions on the basis of local conditions.

R5. In order to encourage take-up of the Planning Tool, the design and implementation of a 'front end' interface should be commissioned.

R6. The study has identified significant problems with awareness of Secure Stations/Safer Parking, on the part of both staff and customers. The rail industry may wish to consider mechanisms for better communicating not only accreditation, but security enhancements more generally. This would help to motivate staff, deter criminals, and improve customer perceptions.

R8. The research identified that workplace assaults were inconsistently recorded, with high levels of under-reporting. As a consequence, it was not possible to ascertain the effects of Secure Stations and Safer Parking on staff incidents specifically. It is recommended that RSSB continues to reinforce guidance provided to the industry on the nature of incidents that should be recorded.

R10. Reaccreditation for the Secure Stations scheme takes place every two years, and involves the station self-reporting changes and developments occurring since the last accreditation. Stations overwhelmingly report 'no change'; the study found that this description was often inaccurate, and that significant changes went unreported. It is recommended that the future administration of the scheme identifies a mechanism whereby station intervention and management data can be systematically updated on a regular basis, perhaps through the use of online reporting forms, and to explore options to ensure that such data are audited at regular intervals (eg each financial year).

R11. Stations applying for Secure Stations accreditation are judged against three criteria areas, the ratio of crimes to passengers, an audit score derived from an assessment of the station environment, and management processes and passenger perceptions of the station.

a. The crime ratio threshold does not test the largest stations and although flexibility is currently given for stations with very low throughput they report that the crime ratio is still too stringent. Consideration should be given to the development of a tiered scheme, with adjusted crime ratio criteria for stations with different levels of throughput.

b. The current accreditation audit and related score assigns an equal weighting to all questions. It is recommended that the accreditation form be redesigned to provide greater weighting to those items that have greater influence on crime and/or are harder to achieve.

Please note that there are a number of other recommendations made and documented further in the report that have not been presented in this list of 'main recommendations'; hence some missing recommendation numbers in the list above.

Contents

Acronyms Used

ACPO - Association of Chief Police Officers

ATOC - Association of Train Operating Companies

BCS - British Crime Survey

BPA - British Parking Association

BTP - British Transport Police

CV - Contingent Valuation

CBA - Cost-Benefit Analysis

CPTED - Crime Prevention through Environmental Design

CPO - Crime Prevention Officer

CRASBO - Criminally Related Anti-Social Behaviour Order

GJT - Generalised Journey Time

GDP - Gross Domestic Product

GVA - Gross Valued Added

HEN - Highways Economic Note

MRS - Marginal Rate of Substitution

MNL - Multinomial logit

NPV - Net Present Value

NSB - Net Social Benefit

PDFH - Passenger Demand Forecasting Handbook

QALY - Quality of Life Year

PCSOs - Police Community Support Officers

RPSG - Rail Personal Security Group

RP - Risk Premium

RUM - Random Utility Model

SCPs - Safer Parking; we refer to accredited sites as Safer Car Parks

SS - Secure Stations

SBD - Secured By Design

SMIS - Staff Management Information System

SP - Stated Preference

TOC - Train Operating Company

VPF - Value of Preventing a Fatality

VPI - Value of Preventing an Injury

WebTAG - Web Transport Analysis Guidance

WTA - Willingness-To-Accept

WTP - Willingness-To-Pay

FINAL REPORT

2 Final Report

2.1 Introduction

The **Institute for Transport Studies (ITS) at the University of Leeds** produced this report, in partnership with the **Applied Criminology Centre (ACC) at the University of Huddersfield**. The report describes a study undertaken to evaluate the impacts of personal security measures at railway stations and railway station car parks. The full technical detail is captured in Annex A.

The study was motivated by the need of the Rail Personal Security Group (RPSG) to understand how personal security improvements impact upon changes in personal security risk, rail demand, and passenger satisfaction. Although there is an increasing obligation on the part of the railway industry to justify the business case for investment in personal security measures (eg through the franchising process), the industry presently has no standardised method or valuations to support such a business case. This dearth of evidence contrasts with the comprehensive evidence base (eg Passenger Demand Forecasting Handbook (PDFH)) concerning valuations of many other features of rail travel, such as journey time and service quality.

Crime at train stations is a rare event compared to the number of passenger journeys on the rail network each year. A total of 95,103 crimes were recorded on the British rail network in the financial year 2010/11; this is compared to over 2 billion passenger journeys (British Transport Police, 2011). However, previous research has found that concerns about crime can act as deterrent to taking the train. Repeated studies have consistently found that around 10% of people have concerns about travel on public transport during the daytime; this proportion rises to around 30% after dark.

The purpose of this study was to evaluate two specific interventions designed to reduce personal security risk, namely the Secure Stations and Safer Parking schemes.

2.2 Overview of the Secure Stations and Safer Parking schemes

Secure Stations is a scheme for rewarding station operators, through accreditation by the British Transport Police (BTP), for managing security and demonstrating to customers their desire to reduce crime. The scheme was launched in 1998 and by March 2011 there were 1245 stations accredited under the scheme of which 345 were first time accredited stations, 893 were re-accreditations and seven were working towards accreditation. Safer Parking is a similar scheme, managed by the British Parking Association on behalf of the Association of Chief Police Officers (ACPO). The scheme is intended to encourage car park providers to improve security standards as a means of reducing criminal activity, the fear of crime and the perception of crime in car parks. This scheme was launched in an earlier form in 1992, and has a comprehensive national coverage. Approximately 400 stations have gained accreditation for their car parks.

Both the Secure Stations and Safer Parking schemes have clear guidelines for accreditation which include the requirement for crime to be beneath a given threshold. In addition, the station or car park must successfully pass an assessment of the station/car park environment. The assessment determines whether the security measures and management procedures in place are commensurate with the prevailing crime risks. Consequently there is no prescription of a ‘one size fits all solution’. This flexibility is necessary given the disparate nature of stations, car parks and the contexts in which they are situated, but provokes a significant complication for the present evaluation as neither scheme can be articulated in terms of a clear

and definitive set of criteria. Accreditation is as much about the station/station car park management's culture towards personal security, as about the extent of physical crime prevention measures, such as CCTV. This point will be considered in more detail subsequently. Conscious of the fact that a range of different car parks might serve a given railway station, a definition was agreed for station car parks that would fall within the scope of the evaluation; these were **car parks that a Train Operating Company (TOC) or Network Rail own and manage, or pay a contractor to manage on their behalf**.

2.3 Research Objectives

The two primary objectives of this project were to:

i. Evaluate the Secure Stations and Safer Parking schemes, ensuring that part of the evaluation includes a quantification of the costs and the benefits (actual and perceived) accrued by the public, passengers, industry and the wider society through their implementation.

ii. Through the evaluation of the two schemes, and using other techniques/methods as necessary, develop a methodology (and framework) and use it to provide a quantifiable assessment (quantifiable terms of both monetary and risk impact and societal measures) of the Secure Stations and Safer Parking schemes/measures to improve personal security.

2.4 Methodology

The methodology consists of two principal strands; one concerned with **crime-based evaluation**, and a second concerned with **economic-based evaluation**. In broad terms, the effects of Secure Stations and Safer Parking on the prevalence of crime, and the associated costs and benefits to the industry and society more generally, are analysed.

Table 2.1: Primary research tasks and methods

Crime-based evaluation		**Economic-based evaluation**	
Research Task	Research method	Research Task	Research method
Review of evidence on the effects of personal security interventions on crime/fear of crime	Literature search	Review of evidence on the costs and benefits of crime/personal security interventions	Literature search
Profiling crime prevention (security measures in place at stations across the sample)	On-line survey of station managers	Estimating the willingness-to-pay of existing users for station/car park improvements	Station user/car park user surveys
Understanding the implementation of crime prevention at stations/car parks	Visual audits	Estimating the willingness-to-pay of existing users to reduce the objective risk of crime	Station user/car park user surveys
Estimating the impacts of interventions on crime	Crime model	Estimating the effects of crime on rail demand	Patronage model
Understanding the perceptions of station/car park users regarding fear of crime	Station user/car park users surveys		

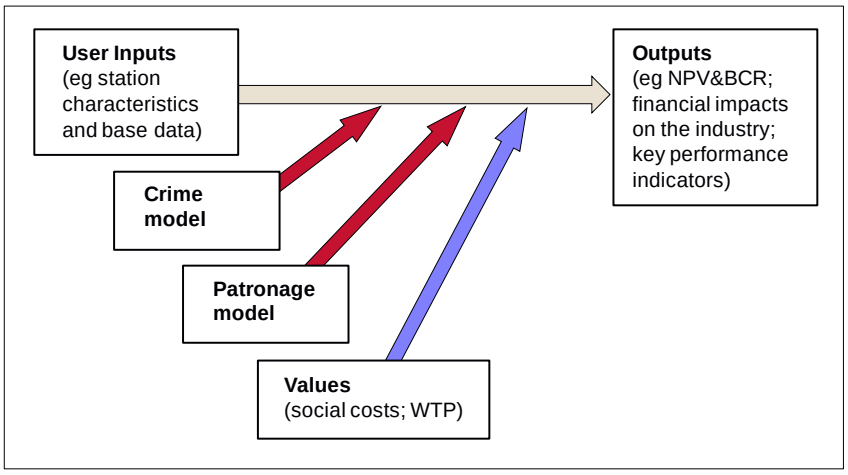
Whilst the methodology has, where appropriate, sought to adhere to best-practice conventions (eg as laid down in WebTAG and the Passenger Demand Forecasting Handbook (PDFH)), the evaluation has proved challenging, and certain methodological innovations have had to be developed and implemented in the course of the work. Areas of innovation include the following:

1. This study includes the first systematic attempt to model the impact of personal security interventions at stations/station car parks on crime.
2. This study includes the first systematic attempt to model the impact of crime on railway demand.
3. Previous Willingness-To-Pay (WTP) studies have looked at isolated personal security interventions (for example in the context of station improvements generally), but not specifically in a crime context, and not as part of a package. This study includes the first attempt to value a package of personal security interventions.
4. This study includes the first attempt to value the perceived benefits of crime prevention as a multiplier of established evidence on the value of preventing a fatality (VPF).

2.5 Planning Tool

The evaluation culminated in the development of an Excel-based Planning Tool (section 6), which integrates key research methods (especially the **crime model** and the **patronage model**) from the crime and economic evaluations respectively. It was not within the scope of the study to develop a full commercial software implementation of the Planning Tool, rather the goal at this stage was to develop the mechanisms which could underpin such software. The intention of the Planning Tool is to provide the industry with a systematic method – grounded in theory and evidence – for assembling business cases for investment in personal security interventions at railway stations and railway station car parks.

Figure 2.1: Basic structure of the Planning Tool



With reference to Figure 2.1, the key components of the Planning Tool include:

User inputs: key information is entered concerning the scheme to be appraised, including planned changes in accreditation status and specific security measures, as well as base data on the station characteristics, crime rates and annual throughput

Crime model: this is a statistical model that seeks to draw relationships between the incidence of crime by crime type and drivers of crime.

Patronage model: this is a statistical model that seeks to draw relationships between the incidence of crime by crime type and rail patronage, defined in terms of sales of rail tickets.

Values: social benefits of the intervention are calculated, based upon Home Office costs of crime data (associated with each incidence of crime), combined with the study's own estimates of the value of crime risk reduction (associated with the fear of crime more generally).

Outputs: the Planning Tool summarises the outcomes of the scheme in terms of changes in crime, changes in patronage, and three economic/financial measures, namely Net Present Value (NPV), Benefit Cost Ratio (BCR), and Financial Internal Rate of Return (IRR).

2.6 Findings

The main findings from the study are as follows.

2.6.1 Crime impacts of the scheme

Table 2.3 summarises the predicted reductions in crime rate associated with all significant drivers of crime that arise from the **crime model** (section 4.7). The reported percentages represent the influence of each driver on crime. Percentage changes should be compared to the base category specified in the left hand column. Each crime type model contains only those drivers that were found to be statistically significant (ie the model gives a high level of confidence that the impact on crime is real). It should be remembered that the percentage changes relate to the number of crimes per passenger; the latter is normally an extremely low value, which explains some of the extremely high percentages

To illustrate a few examples:

- **Secure Station accreditation is associated with 24% fewer incidences of theft from a person, relative to non-accreditation, all else equal**.
- **Automatic ticket barriers were associated with 32% more incidences of commercial theft, relative to the absence of such barriers.**
- **The presence of self-service ticket machines were associated with 61% fewer incidences of commercial theft, relative to the absence of such machines.**
- **Stations staffed on a part-time basis experienced an estimated 1044% more incidences of theft from a person relative to unmanned stations. This figure seems dramatic but compared to the mean crime ratio for unmanned stations of 0.1 it amounts to an increase of approximately one incident per 100,000 throughput.**

Table 2.3: Summary of forecasted reductions in crime rate from the crime model

Explanatory Variable		Violence against a person	Sexual assault	Theft from a person	Criminal damage	Commercial theft	Vehicle crime
		Predicted % change compared to base category					
Criminal Damage Levels in Local Authority Area		15.26	25.11	33.24	31.92	10.96	16.88
Country (Compared to England)	Scotland	-35.73	-52.81	-56.04	ns	-62.36	-91.6
	Wales	64.87	ns	ns	86.08	121.67	-55.47
Output Area Classification	Blue Collar Communities			ns		-65.32	
(Compared to Constrained by Circumstances)	City Living			ns		-49.54	
	Countryside			ns		ns	
	Multicultural			51.74		-50.04	
	Prospering Suburbs			ns		ns	
	Typical Traits			ns		-41.84	
Station Category (Compared to A)	B		ns	-54.52	ns	ns	104.01
	C		-41.78	-66.24	ns	-56.22	249.73
	D		ns	-71.06	178.71	-57.94	276.97
	E		ns	-66.11	319.54	ns	524.64
	F		ns	ns	ns	ns	1639.18
Staffing (Compared to Unmanned)	Part-time	-64.16		1043.87	ns	923.69	
	Full-time	ns		1077.53	-65.39	1276.32	
Secure Station (Compared to No)	Yes			-24.04	-34.88		see below
Automated ticket barriers (Compared to No)	Yes			-26.95		32.31	
Proportion of tickets checked	25-50%				-64.013		
(Compared to less than 25% of passengers)	50-75%				ns		
	75+%				50.441		
Self-service ticket machines (Compared to No)	Yes						-60.82
Lighting (Compared to Poor)	Needs improvement		-51.13		-26.07		
	Good and consistent		-37.19		ns		

Work to improve lines of sight (Compared to No)	Yes	-15.89		-17.47		-24.65	
CCTV installed at station (Base No)	Yes				-48.57		
Monitoring of CCTV (Compared to Not monitored)	Monitored	-33.03					
CCTV Upgrade (Compared to No)	Yes					31.52	
Car Park Accreditation Status	Not SS/ SCP						ns
(Compared to not SS and not SCP)	SS /Not SCP						-36.24
	SS/ SCP						-48.31
Car Park Payment Type	Free						-54.21
(Compared to Pay and Display)	Pay on Exit						-42.71

An important practical issue is the extent to which there could be a 'package effect' from making one or more interventions in combination. The crime model was unable to identify clear relationships on this issue, but intuition and qualitative evidence from the likes of the visual audits suggests that such relationships exist. In particular, intuition suggests that the crime-preventing effects of two or more interventions in combination will not be the sum of the independent effects of each individual intervention.

2.6.2 Patronage impacts of the scheme

Whilst the term 'new users' is common parlance in travel demand modelling, it is appropriate to clarify that – strictly speaking – the study interests are broader, encompassing the generation of any new rail journeys, whether these are additional journeys undertaken by existing rail users, or are journeys undertaken by new customers.

Guided by PDFH modelling conventions, a demand model was developed which estimates the specific influence of Secure Stations/Safer Parking, in combination with a range of physical interventions (eg CCTV), on ticket sales, whilst controlling for other background drivers of rail patronage (such as levels of fares, GJT, service quality incomes, car ownership and population). The conclusions from this exercise are that:

- **Secure Stations and Safer Parking have a significant effect on rail demand, all other things being equal.**
- **For season tickets, the demand response is approximately 7%.**
- **For non-seasons, the demand response is somewhat weaker, at around 1%.**

It is worth noting that the demand impact reported is largely driven by the Secure Stations scheme (although it is possible that this impact is - to some extent - confounded with various aspects of physical personal security interventions). The specific contribution of Safer Parking was difficult to discern statistically. However, this increase in demand implies the existence of benefits to new users, and increased revenue to TOCs from increased patronage.

This study has assembled one of the largest data sets ever used in rail demand analysis in Great Britain and this has been critical in being able to obtain statistically robust estimates of what might be expected to be relatively small effects. These demand impacts have been found whilst controlling for all other factors included in standard demand management analysis as per the current Passenger Demand Forecasting Handbook. Comparing the demand responses for Season and Non-Seasons, it should be acknowledged that commuting trips are made more frequently and hence there will be greater awareness of changes in crime levels. There will also be more exposure to crime since trips are made more frequently. Another point to countenance, in comparing the demand responses of Season and Non-Season tickets, is that in dense networks where commuting/season ticket purchase high, there is the scope to switch stations. Thus there is the possibility that after crime variations, some of the change in demand is attributable to switching between stations, rather than new demand per se. That said, the magnitude of the apparent demand response to changes in crime levels, and the discrepancy between Seasons and Non-Seasons, is consistent with existing evidence on demand responses to service and station improvements generally.

2.6.3 Social costs

Within the Planning Tool, valuation of social benefits is based primarily on the Home Office unit costs of crime data, adjusted for the rail context (see Table 2.8). An important question considered by the current project was the extent to which there is evidence of benefit over and above the unit costs of crime, **associated with reductions in crime risk (as might arise from the intervention) that benefit all passengers using railway stations and railway station car parks, as opposed to simply those passengers who had been victims of crime**.

This study sought to develop estimates of this benefit via an analogy to the Value of Preventing a Fatality (VPF). There exists a reasonably robust evidence base on VPF, eg RSSB (2006), RSSB (2008). Evidence on VPF has been used previously to infer estimates of the Value of Preventing Injury (VPI) short of fatality, through a method of calculating multipliers of VPF for different types of injury. A similar method was adopted in the context of the present project, developing an experimental game, to seek validation for the method of inferring the value of objective risk via an analogy to the VPF, and to elicit empirical evidence on the relevant multipliers.

This experimental game was implemented on passengers and car parks users at eight specific sites drawn from the large sample of 322 stations, namely: London Euston, Manchester Victoria, Paisley Gilmour Street, Willesden Junction, Bathgate, Bedford, Manchester Piccadilly and Peterborough. These sites were chosen to reflect a good range of station and station car park conditions, and variety in terms of background crime rates (Table 3.2). Analysis of the data emanating from the experimental game allowed estimation of multipliers reflecting the station/car park users' valuations of crime incidents relative to the value of the specified railway accident. Since evidence on the latter is well-established in the form of the VPF, it provided a basis for inferring social valuations of crime as a multiple of the VPF. For example, it was found that 'violence against a person' is valued around 3.7 times the specified railway accident (Table 2.4).

Table 2.4: Estimated multipliers for value of a crime relative to value of an accident

	Multiplier between crime incident and minor accident	
Crime type	**Station**	**Station Car Park**
Violence against a person	3.72	3.65
Sex attacks	1.12	0.97
Theft from a person	0.13	0.10
Criminal damage	0.03	0.06
Theft from a vehicle	0.01	0.02

Reconciling these results with evidence from other sources, a judgement was made that the case for additional benefit **associated with reductions in crime risk**, was convincing in only one specific case. That was the case of social valuations of 'violence against a person', where the multiplier in Table 2.4 implied a social valuation considerably in excess of the Home Office unit costs of crime. This potential additionality has been represented as a sensitivity test in the Planning Tool, thereby

clearly showing the incremental contribution of the objective risk of 'violence against a person' over and above the Home Office's unit costs of crime.

2.7 Discussion

2.7.1 Crime Evaluation: does Secure Stations/Safer Parking reduce crime?

What are the practical features of Secure Stations/Safer Parking?

As was noted in the introduction to this report, a significant complication for the evaluation was that neither Secure Stations nor Safer Parking can be articulated in terms of a clear and definitive set of criteria. Accreditation is as much about the station/station car park management's culture towards personal security, as about the extent of physical crime prevention measures, such as CCTV. Having now completed the evaluation, the study has discerned a clearer description of what practical features embody a Secure Station and/or Safer Car Park.

Analysis of the intervention dataset revealed that, although accreditation allows for flexibility in approaches to crime prevention, several attributes were common to Secure Stations and Safer Parking but significantly different from their non-accredited counterparts, notably:

- Features of CCTV provision
- Presence of automated ticket barriers
- Seclusion of entrance routes
- Installation of emergency help points
- Extent of informal surveillance and guardianship

Overall, these differences suggest that Secure Stations offer a higher standard of crime prevention, with a greater provision of facilities that are likely to facilitate crime prevention. In the case of SCP, the analysis did not identify as many significant differences between SCP car parks and non-accredited car parks (although the data was less complete for station car parks with a larger proportion of missing data). The main distinction identified was a greater likelihood that SCP car parks would be patrolled.

What are the key drivers of crime at railway stations/railway station car parks?

Having accounted for external influences on crime (such as crime in the locality of the station/station car park), key drivers of crime at railway stations/station car parks that could potentially be controlled through Secure Station/Safer Parking and/or physical interventions include the following.

Guardianship

- Unmanned stations experienced significantly higher levels of **violence against a person** and **criminal damage**[1] (although the crime-reducing effect of full-time vs. part-time staffing was not consistent across these crimes).
- Manned stations experienced significantly higher levels of **theft from a person** and **commercial theft** compared to unmanned stations.
- Staffing and patrols of station car parks did not significantly affect levels of **vehicle crime**.

[1]This difference is likely to be a consequence of greater opportunities to detect and report crime at manned stations and the greater volume of passengers providing more opportunities for theft from a person.

Surveillance

Formal surveillance in the form of CCTV was prevalent across the sample. However, it was still possible to discern the following findings:

- Stations with CCTV experience significantly lower levels of **criminal damage** - this was the only crime type that was significantly associated with the presence of CCTV.
- The presence of CCTV in car parks was not significantly associated with **vehicle crime**.
- An upgrade to the CCTV system over the last five years was significantly associated with **commercial theft**; this may reflect an enhanced ability to detect crimes, or that stations with more entrenched theft problems are being prioritised for an upgrade.
- Stations that had the ability to monitor live CCTV feed experienced significantly lower levels of **violence against a person**; this may reflect the ability to identify and respond to violent incidents that may not otherwise be reported, such as fights breaking out between passengers.
- The quality and extent of CCTV coverage were not significant predictors of any of the crime types analysed.
- However, key differences were identified in the extent and nature of CCTV monitoring, which varied from no monitoring at all to centralised control rooms with dedicated staff.

In addition to formal surveillance through CCTV, informal surveillance can be enhanced by improving lines of sight and ensuring that passengers and staff can see around corners and into waiting areas.

- Stations that had undertaken work to improve lines of sight experienced significantly **less violence against a person**, **theft from a person** and **commercial theft**.
- Waiting rooms with enhanced informal surveillance were not significantly associated with any of the crime types analysed.

Lighting quality, which can help passengers be seen and see others, was significantly associated with some crimes. It was found that:

- Stations with poor lighting experienced more incidences of **sexual assault** and **criminal damage** than stations where lighting was 'in need of improvement'.
- However, the relationship between the quality of artificial lighting and the frequency of these crimes was not linear, and may be moderated by other factors such as careful design to maximise natural light.

Defensible space and access control

The visual audits identified a number of stations with issues relating to the control of space, especially the presence of multiple entrances/exits to the station. As regards the crime model, the following specific relationships were detected:

- The control of access to the station through automatic ticket barriers was associated with lower levels of **theft from a person** and higher levels of **commercial theft**. In the case of theft from a person, it is likely that barriers prevent access to the station to those who are attracted by criminal opportunities. In the case of commercial theft, it is likely that ticket barriers aid the detection of crimes such as fare evasion.
- 'Pay on exit' car parks experienced significantly less **vehicle crime** than 'pay and display' car parks. Interviews suggested that this finding may also be an effect of the absence of 'pay and display' tickets which advertise the time period for which a car will be left. Free car parks also experienced less **vehicle crime** than 'pay and display' car parks; again this could also be explained by the absence of timed tickets.

Activity support

The principle of activity support ensures that there are sufficient numbers of people in, or passing through, a particular place, conducting routine, honest activities like shopping or dining; in so doing, their presence prevents or discourages offenders from committing crime.

- No empirical support for this relationship was found in the crime model.
- As an aside, the presence of self-service ticket machines was associated with a significant reduction in commercial theft. This may suggest that where passengers are provided with sufficient opportunities to purchase tickets, they are less inclined to evade their fare.

What is the effect of Secure Stations and Safer Parking on crime?

Having identified a comprehensive range of drivers of crime, the focus of the crime evaluation was to consider the effect of Secure Stations and Safer Parking on crime. It was found that:

- Secure Station accreditation was associated with lower levels of **theft from a person**, **criminal damage** and **vehicle crime**. That is to say, even when the data is controlled for pre-existing levels of crime, Secure Stations has a distinct effect upon crime rates for these crime types.
- In the absence of Secure Station accreditation, SCP accreditation has no discernible influence upon **vehicle crime**.
- However, if the two schemes are combined, then the collective impact on crime is greater than that of Secure Stations in isolation. On the basis of this finding, the crime reducing effects of Secure Stations and SCP cannot be treated as additive.

What is the effect of Secure Stations and Safer Parking on crime?

It was found that passenger awareness of station and car park accreditation was extremely low. This is not surprising given the findings from the evidence review and interviews with station staff that the schemes are not widely publicised. However, this finding is unfortunate, given that publicity can support crime prevention by influencing the perceptions of offenders.

Despite the lack of awareness regarding station accreditation, the passenger survey identified that passengers at Secure Stations were significantly less likely to report concerns about crime than passengers at non-accredited stations. No significant differences in feelings of safety were identified between users of Safer Car Parks and users of non-accredited car parks.

2.7.2 Economic Evaluation: does Secure Stations/Safer Parking generate net social benefit?

What are the benefits of Secure Stations/Safer Parking to existing users?

As a result of Secure Stations and Safer Parking interventions, there is evidence of benefits to existing rail users from two sources, namely reductions in the frequency of crime incidents and improvements in perceptions of crime risk.

Reductions in the frequency of crime incidents

The crime model gives a basis for predicting specific reductions in crime rate by crime type associated with accreditations in combination with other drivers of crime (notably physical crime prevention interventions). For example, it was found that **Secure Station accreditation is associated with 24%**

fewer incidences of theft from a person, relative to non-accreditation, all other things being equal. Equipped with these predictions, it is a reasonably straightforward procedure to apply the Home Office's (2005) unit costs of crime, and to thereby calculate the social benefit from reduced incidence of crime at stations/station car parks.

Improvements in perceptions of crime risk

Quite aside from the reduction in incidents and associated unit cost savings, there is a question as to whether rail users who have not themselves been the victims of crime but may have witnessed crime or be aware of general levels of criminality, place a value on the perceived reduction in crime risk that arises from Secure Stations/Safer Parking interventions. This question was investigated through two alternative Willingness-To-Pay (WTP) games - one based upon valuation of station/car improvements and a second based upon valuation of different crime types - finding that:

- **Station/car park users place significant value upon personal security interventions at stations/car parks, but are reluctant to pay for them through the fare box/car park charges**. There is some evidence (albeit inconsistent) that car park users may be willing to pay a premium for improved security; this perhaps reflects the fact that car park usage implies that personal property will be left in the custody of the car park. By contrast, station users are clear and definitive in their unwillingness to pay; we interpret this to be a protest response.
- Crime risk exhibits a highly significant effect. Since crime risk is perfectly correlated with the expected social costs of crime, **it can be concluded that passengers/car park users demonstrate classic public good behaviour in relation to personal security interventions; they believe that personal security is good for society, but are unwilling to pay for such interventions on a private basis**.
- Relative to the Home Office unit costs of crime, **station/car park users substantially over-valued (by more than four times) the social costs of violence against a person**, and undervalued sex attacks (by half). The latter discrepancy could be due to respondents' interpretation of the term 'sex attack'. As regards the former discrepancy, this gives credence to the proposition that the perceived reduction in risk associated with Secure Stations/Safer Parking could give rise to additional benefit above and beyond the Home Office's unit costs of crime.

What are the benefits of Secure Stations/Safer Parking to new users?

Whilst the term 'new users' is common parlance in travel demand modelling, it is appropriate to clarify that – strictly speaking – the study interests are broader, encompassing the generation of any new rail journeys, whether these are additional journeys undertaken by existing rail users, or are journeys undertaken by new customers.

Guided by PDFH modelling conventions, a demand model was developed which estimates the specific influence of Secure Stations/Safer Parking, in combination with a range of physical interventions (eg CCTV), on ticket sales, whilst controlling for other background drivers of rail patronage (such as levels of fares, GJT, service quality incomes, car ownership and population). The conclusions from this exercise are that:

- Secure Stations and Safer Parking have a significant effect on rail demand.
- For season tickets, the demand response is approximately 7%.
- For non-seasons, the demand response is somewhat weaker, at around 1%.

It is worth noting that the demand impact reported is largely driven by the Secure Stations scheme. The specific contribution of Safer Parking was difficult to discern statistically. This increase in demand implies the existence of benefits to new users, and increased revenue to TOCs from increased patronage.

2.7.3 Planning Tool: how should Secure Stations/Safer Parking interventions be evaluated?

Synthesising and reconciling the outcomes from the Crime and Economic Evaluations, an Excel-based Planning Tool was developed, which could potentially be used by the industry to support cases for investment in personal security interventions at stations. Such interventions could include Secure Station accreditation, Safer Parking accreditation, and/or specific physical measures such as CCTV.

It was not within the scope of the study to develop a full commercial software implementation of the Planning Tool; the goal at this stage was to develop the mechanisms which could underpin such software. Should the industry wish to progress the Tool to full implementation, then some enhancements to its functionality would be advisable (see section 8, recommendation R5).

Through two case studies, the basic workings of the Tool were demonstrated, and it was shown that the Tool embodies intuitive evidence-based relationships in terms of:

- The effects of personal security interventions on crime rates
- The effects of crime rates on rail patronage
- The net social benefits that follow

2.7.4 Follow-on research

This study has delivered evidence on willingness-to-pay (WTP) for personal security improvements, methods to support the evaluation of Secure Stations/Safer Parking/security measures, an Excel-based Planning Tool, and two case studies showing how the Tool could be applied in practice.

Following on from the study, a number of additional research activities can be identified which could support adoption of the Planning Tool, and further evaluation of Secure Stations/Safer Parking:

1. Real case studies – involving significant input from TOC/Network Rail partners on the scheme design and costing side.
2. Software – a fully developed software implementation.
3. An evaluation of the Secure Stations/Safer Parking programmes as a whole – this would require the partners (BTP, TOCs, Network Rail and perhaps RSSB themselves) to gather a significant amount of information on resources allocated to these programmes over the years.

2.8 Main Recommendations

Arising from this evaluation, the **main** recommendations (the full set of recommendations is presented in section 8) are as follows:

R1. This study has found clear and convincing evidence that:

a. Secure Stations and Safer Parking interventions reduce crime

b. Reduced crime yields benefits to existing rail users

c. Reduced crime encourages greater patronage of rail

Against this background, there is a good case for formalising the evaluation of Secure Stations/Safer Parking interventions in line with the evaluation of other comparative interventions such as station/service quality and railway safety improvements.

R2. RSSB is encouraged to promote the findings of this study, and the existence of the Planning Tool, to relevant industry stakeholders. There is a good case for inclusion of the findings in PDFH. DfT may also wish to consider the case for commissioning associated WebTAG guidance.

R3. The Tool is designed to represent general relationships between personal security interventions, crime and rail patronage. It is recommended that, in assembling a business case for investment, the Planning Tool should be combined with a visual audit of the local site by a practitioner skilled in such analysis. Such an audit could provide a justification for any deviation from the Tool's default assumptions on the basis of local conditions.

R5. In order to encourage take-up of the Planning Tool, the design and implementation of a 'front end' interface should be commissioned.

R6. The study has identified significant problems with awareness of Secure Stations/Safer Parking, on the part of both staff and customers. The rail industry may wish to consider mechanisms for better communicating not only accreditation, but security enhancements more generally. This would help to motivate staff, deter criminals, and improve customer perceptions.

R8. The research identified that workplace assaults were inconsistently recorded, with high levels of under-reporting. As a consequence, it was not possible to ascertain the effects of Secure Stations and Safer Parking on staff incidents specifically. It is recommended that RSSB continues to reinforce guidance provided to the industry on the nature of incidents that should be recorded.

R10. Reaccreditation for the Secure Stations scheme takes place every two years, and involves the station self-reporting changes and developments occurring since the last accreditation. Stations overwhelmingly report 'no change'; the study found that this description was often inaccurate, and that significant changes went unreported. It is recommended that the future administration of the scheme identifies a mechanism whereby station intervention and management data can be systematically updated on a regular basis, perhaps through the use of online reporting forms, and to explore options to ensure that such data are audited at regular intervals (eg each financial year).

R11 Stations applying for Secure Stations accreditation are judged against three criteria areas, the ratio of crimes to passengers, an audit score derived from an assessment of the station environment, and management processes and passenger perceptions of the station.

a. The crime ratio threshold does not test the largest stations and although flexibility is currently given for stations with very low throughput they report that the crime ratio is still too stringent. Consideration should be given to the development of a tiered scheme, with adjusted crime ratio criteria for stations with different levels of throughput.

b. The current accreditation audit and related score assigns an equal weighting to all questions. It is recommended that the accreditation form be redesigned to provide greater weighting to those items that have greater influence on crime and/or are harder to achieve.

References

Home Office (2005) ‘The economic and social costs of crime against individuals and households 2003/04’. Home Office Online Report 30/05.

RSSB (2006) ‘Assessment of the Value for Preventing a Fatality (VPF) Phase 1’. Report T430: the definition of VPF and the impact of societal concerns.

RSSB (2008) ‘Assessment of the Value for Preventing a Fatality (VPF)’. Report T616: Report and results.

RSSB (2008) ‘Making the most of data associated with railway crime’. Report T723.

ANNEX A - FULL TECHNICAL REPORT

3 Introduction

The **Institute for Transport Studies (ITS) at the University of Leeds** is pleased to submit this report, in partnership with the **Applied Criminology Centre (ACC) at the University of Huddersfield**. The report describes a study undertaken to evaluate the impacts of personal security measures at railway stations and railway station car parks.

The study was motivated by the interest of the Rail Personal Security Group (RPSG) in how personal security improvements impact upon changes in personal security risk, rail demand, and passenger satisfaction. Although there is an increasing obligation on the part of the railway industry to justify the business case for investment in personal security measures (eg through the franchising process), the industry presently has no standardised method or valuations to support such a business case. This dearth of evidence contrasts with the comprehensive evidence base (eg. Passenger Demand Forecasting Handbook (PDFH)) concerning valuations of many other features of rail travel, such as journey time and service quality.

Crime at train stations is a rare event compared to the millions of passengers who use the rail network each year. A total of 95,103 offences were reported on the British rail network in the financial year 2010/11; this is compared to over 2 billion passenger journeys (British Transport Police, 2011). However, research has found that concerns about crime can act as deterrent to taking the train. Repeated studies have consistently found that around 10% of people have concerns about travel on public transport during the daytime; this proportion rises to around 30% after dark.

The purpose of this study was to evaluate two specific interventions designed to reduce personal security risk, namely the Secure Stations and Safer Parking schemes. Secure Stations is a scheme for rewarding station operators, through accreditation by the British Transport Police (BTP), for managing security and demonstrating to customers their desire to reduce crime. The scheme was launched in 1998 and by March 2011 there were 1245 stations accredited under the scheme of which 345 were first time accredited stations, 893 were re-accreditations and seven were working towards accreditation. Safer Parking is a similar scheme, managed by the British Parking Association on behalf of the Association of Chief Police Officers (ACPO). The scheme is intended to encourage car park providers to improve security standards as a means of reducing criminal activity, the fear of crime and the perception of crime in car parks. This scheme was launched in an earlier guise in 1992, and has a comprehensive national coverage. Approximately 400 stations have gained accreditation for their car parks. Both the Secure Stations and Safer Parking schemes have clear guidelines for accreditation which include the requirement for crime to be beneath a given threshold. In addition, the station or car park must successfully pass an assessment of the station/car park environment. The assessment determines whether the security measures and management procedures in place are commensurate with the prevailing crime risks. Consequently there is no prescription of a ‘one size fits all solution’. This flexibility is necessary given the disparate nature of stations, car parks and the contexts in which they are situated, but provokes a significant complication for the evaluation as neither scheme can be articulated in terms of a clear and definitive set of criteria. Accreditation is as much about the station/station car park management’s culture towards personal security, as about the extent of physical crime prevention measures, such as CCTV. This point will be discussed in more detail subsequently. Conscious of the fact that a range of different car parks might serve a given railway station, a definition was agreed for station car parks that would fall within the scope of the

evaluation; these were car parks that a Train Operating Company (TOC) or Network Rail own and manage, or pay a contractor to manage on their behalf.

3.1 Research Objectives

The two primary objectives of this project were to:

i. Evaluate the Secure Stations and Safer Parking schemes, ensuring that part of the evaluation includes a quantification of the costs and the benefits (actual and perceived) accrued by the public, passengers, industry and the wider society through their implementation.

ii. Through the evaluation of the two schemes, and using other techniques/methods as necessary, develop a methodology (and framework) and use it to provide a quantifiable assessment (quantifiable terms of both monetary and risk impact and societal measures) of the Secure Stations and Safer Parking schemes/measures to improve personal security.

3.2 Key Research Strands

The evaluation consisted of two principal strands, one concerned with a **crime-based evaluation**, and a second concerned with an **economic-based evaluation**. In broad terms, the study considered the effects of Secure Stations and Safer Parking on the prevalence of crime, and the associated costs and benefits to the industry and society more generally.

Table 3.1: Primary research tasks and methods

Crime-based evaluation		**Economic-based evaluation**	
Research Task	Research method	Research Task	Research method
Review of evidence on the effects of personal security interventions on crime/fear of crime	Literature search	Review of evidence on the costs and benefits of crime/personal security interventions	Literature search
Profiling crime prevention	On-line survey of station managers	Estimating the willingness-to-pay of existing users for station/car park improvements	Station user/car park user surveys
Understanding the implementation of crime prevention at stations/car parks	Visual audits	Estimating the willingness-to-pay of existing users to reduce the objective risk of crime	Station user/car park user surveys
Estimating the impacts of interventions on crime	Crime model	Estimating the effects of crime on rail demand	Patronage model
Understanding the perceptions of station/car park users regarding fear of crime	Station user/car park users surveys		

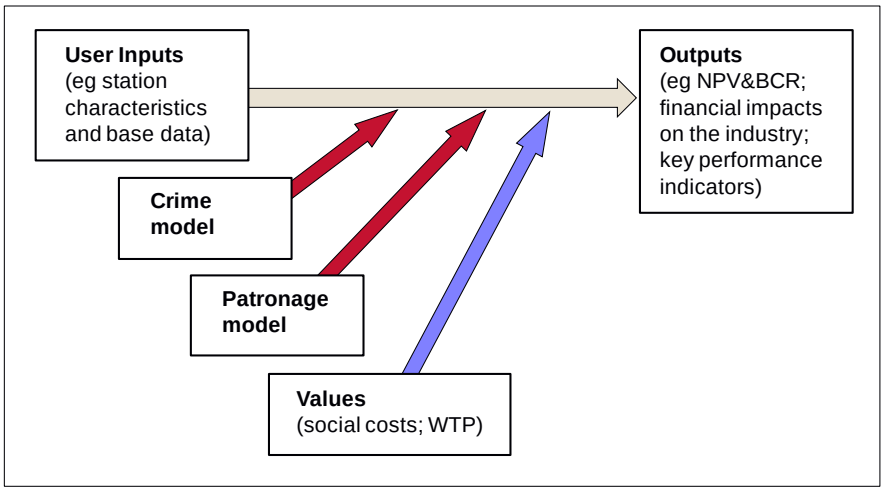
Whilst the methodology has, where appropriate, sought to adhere to best-practice conventions (eg as laid down in WebTAG and the Passenger Demand Forecasting Handbook (PDFH)), the evaluation

has proved challenging, and certain methodological innovations have had to be developed and implemented in the course of the work. Areas of innovation include the following:

1. This study includes the first systematic attempt to model the impact of personal security interventions at stations/station car parks on crime.
2. This study includes the first systematic attempt to model the impact of crime on railway demand.
3. Previous Willingness-To-Pay (WTP) studies have looked at isolated personal security interventions (for example in the context of station improvements generally), but not specifically in a crime context, and not as part of a package. This study includes the first attempt to value a package of personal security interventions.
4. This study includes the first attempt to value the perceived benefits of crime prevention as a multiplier of established evidence on the value of preventing a fatality (VPF).

The evaluation culminated in the development of a Planning Tool, which integrates key research methods (especially the Crime Model and the Patronage Model) from the Crime and Economic Evaluations respectively.

Figure 3.1: Basic structure of the Planning Tool



3.3 Scope and Dimensions of the Data

The evaluation draws upon several disparate research strands and methods (Table 3.1), intended to yield different (but complementary) insights on the headline research objectives. These methods involved a plethora of secondary data sources, as well as a number of bespoke primary data collection commissioned as part of this study.

Data collection - and synthesis – for this study has proved to be a complex and time-consuming exercise, for a variety of reasons:

- The sheer volume of data collected, as well as the variety in its focus and scope.
- The large number of data providers who have been called upon (DfT, BTP, individual station managers, ATOC, individual TOCs, RSSB, to name just a few).

- The lack of consistency in the scope and units of aggregation employed in each dataset (eg differences between the temporal reporting periods for crimes and ticket sales); this is partly provoked by the complex nature of the research problem at hand.

The intention throughout the study has been to conduct the crime and economic evaluations using common 'subjects'; that is to say, the study was interested in establishing - for a common set of railway stations and railway station car parks - the impact of the Secure Stations and Safer Parking accreditations on crime, rail demand and social welfare more generally. With this principle in place, research was conducted at essentially two levels of detail - **aggregate** and **detailed**. The purpose of the aggregate study was to discern general relationships between the accreditations and crime/rail demand for a large sample of stations/car parks across Great Britain. The purpose of the detailed sample was to investigate - in more depth - the general relationships emerging from the aggregate sample.

Aggregate sample

An aggregate sample of 322 stations was established, through a careful and systematic process based upon the following steps.

1. A core database of station information was created by taking a complete list of GB stations and matching to a database of stations which have been or are working towards Secure Stations.
2. Data on station throughput and footfall was added.
3. The same tasks were performed in respect of Secure Parking.
4. Stations were segmented by the A-F classification scheme.
5. Data from BTP CRIME was introduced, matching by each station/station car park.
6. The data were sorted by crime rate.
7. From the listing of GB stations a sample was drawn, stratifying by the A-F classification and accredited/unaccredited status, but under-sampling E and F stations (since the sample would otherwise be skewed towards smaller stations with a low incidence of crime).
8. The Steering Group was invited to boost the sample with specific suggestions, especially Scottish stations[2], and stations of particular interest due to known security improvements/problems.
9. A final sample of 322 stations was agreed.

The temporal scope of the aggregate dataset was ultimately dictated by the availability of crime and ticket sales data; a scope of 62 four weekly periods from period 10 2006/7 through to period 6 2011/12 was eventually settled upon.

[2] To date ScotRail, Scotland's principal operator, have not participated in the Secure Stations scheme although many of their stations have good standards of crime prevention. Therefore in addition to ensuring a UK representative sample, the inclusion of Scottish stations provided a booster sample of stations that have implemented crime prevention measures good levels but do not have station accreditation.

Table 3.2: Detailed sample

	Station user survey	Car Park user survey	Visual audit	Safer Parking	Secure Stations	A-F Classification
London Euston	Y	N	Y	Y	Y	A
Manchester Victoria	Y	N	Y	Y	N	B
Paisley Gilmour Street	Y	N	Y	N	N	C
Willesden Junction	Y	N	Y	N	Y	D
Bathgate	N	Y	Y	N	N	F
Bedford	N	Y	Y	N	Y	C
Manchester Piccadilly	N	Y	Y	Y	Y	A
Peterborough	N	Y	Y	Y	Y	B
Dewsbury	N	N	Y	Y	N	D
Garforth	N	N	Y	N	Y	E
Honley	N	N	Y	N	N	F

Detailed sample

The detailed sample was comprised of a small subset of the large 322 sample. At the outset of the study, a detailed sample of eight sites was budgeted for; four stations and four station car parks. These sites were the focus of the main primary data analysis, namely the visual audits and station user/car park user surveys. At a late stage in the study, additional funds were secured by RSSB which supported visual audits at three additional stations. The full set of 11 sites (Table 3.2) was selected through discussion with RSSB and the Steering Group, and was intended to provide good variety in terms of accreditation (with and without) and the broader characteristics of the site, especially in terms of the A-F station classification employed by the GB railway industry.

3.4 Governance of the Project

As was alluded to in the previous section, this project has been conducted through a process of ongoing dialogue with RSSB and the Steering Group. This process has engendered positive and constructive two-way working relationships which have helped to support the successful delivery of the key outcomes.

3.5 Structure of the Report

The report is organised as follows:

- Section 4 outlines the crime evaluation of Secure Stations and Safer Parking.
- Section 5 does likewise for the economic evaluation.
- Section 6 combines the crime and economic evaluations in the form of the Planning Tool, and applies the Tool to two case studies.
- Section 7 presents the findings.
- Section 8 presents the recommendations.

4 Crime Evaluation of Secure Stations and Safer Parking

The purpose of this section is to describe the Crime Evaluation of Secure Stations and Safer Parking.

There were several key components to the Crime Evaluation, as follows:

- To conduct a review of existing research evidence.
- To produce a profile of crime prevention across Secure Stations and SCPs.
- To understand the processes of implementing crime prevention.
- To identify the impact of Secure Stations, Safer Parking and individual interventions on crime and passenger perceptions of crime.

Following a summary of research evidence, the following sections will describe the methods by which the work was undertaken, and present the results of the data collection and analysis.

4.1 Review of the Literature

Drawing upon the review of evidence, this section provides a brief commentary on patterns of crime in relation to public transport, and research that has explored passengers' experiences of actual crime incidents, experiences regarding personal safety more generally, and perceptions in relation to the fear of crime.

4.1.1 Patterns of crime on and around public transport

Crime on public transport is relatively rare. A total of 95,103 crimes were recorded on the British rail network in the financial year 2010/11 (British Transport Police, 2011). This can be compared to over 2 billion passenger journeys, resulting in a crime ratio of less than 0.05 crimes per passenger. Although crime on public transport is rare, research has shown that public transport stations and stops can act as crime generators and/or crime attractors (Brantingham and Brantingham, 1993; Burrell, 2007; SRG, 2000). The number of people congregating and passing through stations and stops may produce greater opportunities for crime to occur (ie crime generator). In addition, stations which gain reputations for their ample supply of crime opportunities will encourage offenders to travel to the stations on the basis of a specific intention to offend. In reality, most crime at stations will result from a mixture of generated crime opportunities and the attraction of motivated offenders.

Research exploring the patterns of crime on public transport and surrounding public transport hubs has generated the following key findings, the majority of which have been replicated across international studies.

- Crime is unevenly distributed across transport networks, with concentration upon a minority of routes and stations/stops (Chaiken, Lawless and Stevenson, 1974, New York; Wilson and Healey, 1987, New South Wales, Australia; Pearlstein and Wachs, 1982, California; Newton, 2004, Merseyside; Burrell, 2007, West Midlands).

- Crime rates are higher on those routes/stops that traverse or are located within areas that experience high crime rates in general (Chaiken, Lawless and Stevenson, 1974, New York; Pearlstein and Wachs, 1982, California; Newton, 2004, Merseyside).
- Crime is higher at key interchange stations (London Assembly, 2006); this may be because passengers wait longer at interchanges, and these stations are often 'pinch points' within the system.
- Patterns of crime are specific to different crime types, for example:
    - Crimes of thefts from the person are most frequent when passenger volumes are highest (Pearlstein and Wachs, 1982, California).
    - Violent crime rates are disproportionately high during the evenings when passenger density is lower (Pearlstein and Wachs, 1982, California; Clarke et al., 1996, New York).
    - Graffiti and vandalism are prominent in unsupervised areas during off peak hours (Wilson and Healey, 1987, New South Wales).
- Areas surrounding stations and transport stops can experience higher rates of crime (Block and Davis, 1996, Chicago; Robinson, 1998, Vancouver). However, SRG (2000) suggested that statistics on public transport crime should be treated with some caution, as apparent crime concentrations around stations may, in part, be due to the use of stations as landmarks to locate crimes that happen close to, but not at, the stations themselves. Thus the perception of stations as problematic may be based on inaccurate data.

4.1.2 Perceptions and experiences of travellers

A number of studies have been conducted to investigate passenger perceptions of personal security. Findings have been consistent across different methodologies and international studies. A variety of methodologies have been applied to explore the issue of perceptions of safety on public transport. These include large scale surveys, focus groups, escorted journeys and ethnographic observations. Despite the range of methods applied, research findings have been remarkably similar.

Research has identified that a small proportion of people (consistently around 10%) feel unsafe on public transport during daylight hours. These concerns become more prevalent during night-time travel, when the proportion of those who feel unsafe rises to between 30-50%, (Kennedy, 2008; Stafford and Petterson, 2004; Booz Allen and Hamilton, 2003; Symonds, Travers and Morgan, 1996). The relative importance of personal security as a factor discouraging public transport use varies across different surveys, although it generally rates relatively low against other concerns such as cost, convenience and reliability. Given the increased concerns about personal safety after dark, it is not surprising that personal security concerns become a more significant barrier to night-time public transport use (Cheng, 2010; Kennedy, 2008; Kennedy, 2006; Booz Allen Hamilton, 2005; Cozens et al., 2004; Stafford and Petterson, 2004; Transport and Travel Research, 2001; Pinnacle Research and Capital Research, 2001).

Women are more likely to experience feelings of insecurity on public transport, and the differences between men and women become amplified after dark (eg Kennedy, 2008; Stafford and Petterson, 2004; Smith, 2008; Lynch and Atkins, 2008). Despite being the focus of many people's concerns when travelling, young people are amongst the groups who are most likely to express concerns (Cooper, Love and Donovan, 2007; Stafford and Petterson, 2004; Tulloch, 2000). Young people have fewer alternative forms of transport available, and travelling as a group is a strategy often adopted to combat concerns about safety.

Waiting at the station after dark has been consistently identified as the time when people feel least safe (Kennedy, 2008; Stafford and Petterson, 2004; Cozens et al., 2004; Booze Allen Hamilton, 2003; Wallace et al., 1999; Lynch and Atkins, 2008). Densai et al. (2009) found that entering stations could also feel risky, because of groups of youths congregating, and because of uninviting aspects of station and car park architecture. In line with Densai et al.'s findings, Kennedy's respondents reported that feelings of insecurity were related to people hanging around in groups, feeling isolated and the presence of alleyways and secluded passageways. Passengers also reported concerns relating to the security of parked cars and cycles left at stations (Kennedy 2008, Cozens et al., 2004).

Passengers reported feeling less secure in isolated locations where there were few opportunities for natural surveillance from passers-by or neighbouring premises, and in areas that were poorly lit or lit in such a way as to produce dark shadows (Kennedy, 2008; Stafford and Petterson, 2004; Lynch and Atkins, 2008). Subways, long flights of stairs, and places near to recesses and concealed corners were all cited as problem areas (Kennedy, 2008, Stafford and Petterson, 2004, Symonds Travers and Morgan, 1996; Lynch and Atkins, 2008). Lack of familiarity with a location has also been found to be associated with greater feelings of insecurity (Stafford and Petterson, 2004).

Aspects of night-time travel that were a cause for concern included the infrequency of services and lower passenger numbers, and the presence of noisy, drunk or anti-social fellow passengers, particularly associated with groups of young people, individuals under the influence of drugs or alcohol, and aggressive beggars (all of whom the respondents found unpredictable with the potential to escalate into criminal incidents) (Kennedy, 2008; Symonds Travers and Morgan, 1996; Stafford and Petterson, 2004). Although crowds were associated with raising anxiety, the presence of other passengers generally lead to increased feelings of safety. Stafford and Petterson (2004) found that women were most concerned when they were waiting with one other person, particularly if that person was a male. Male respondents were less concerned about individuals, and more likely to be anxious about the presence of groups.

Across the studies that were reviewed, respondents consistently reported that that the personal safety improvement most likely to increase their feelings of safety was an increase in personnel over technological solutions such as CCTV (Kennedy, 2008; Stafford and Petterson, 2004; Thomas et al., 2006; Symonds Travers and Morgan, 1996). Focus group participants in Kennedy's New Zealand study stated that an increase in the number of cafes and kiosks would enhance their feelings of safety while waiting for trains. These retail and catering activities increase the presence of staff at stations and enhance the opportunities for informal surveillance. Similarly Cozens et al. (2004) found that more passengers at stations helped to increase feelings of safety.

Other preferred improvements included improved visibility and lighting at stops and shelters, increased presence of security personnel and the installation of CCTV (Kennedy, 2008; Stafford and Petterson, 2004; Cozens et al., 2004). Infrastructure projects (Densai et al., 2009), reliable information systems (Cozens et al., 2004) and the provision of safe onward travel (Stafford and Petterson, 2004) have also been associated with increasing passengers' feelings of security.

Studies have identified a degree of uncertainty amongst passengers regarding the effectiveness of technological interventions. Stafford and Petterson's research revealed that passengers felt that emergency alarms would be more useful if passengers were more aware of the circumstances under which they should be used and what the response would be if activated. Both Kennedy (2008) and Stafford and Petterson (2004) found that research participants were unsure as to how well CCTV would be monitored and thought the deterrent effect for offenders, particularly those who were drunk, was minimal. Importantly, Densai et al. (2009) argued that the potential of personal security initiatives to reassure passengers was not currently maximised; they attribute this to a failure of communications on the part of transport operators.

Stafford and Petterson's survey (2004) included questions on victimisation. Just under a quarter of respondents in their 2002 survey had experienced an incident of crime or anti-social behaviour on public transport (it was unclear over what period); a third of young people had experienced one or more incident on public transport. The most common incidents experienced or witnessed were being stared at in a hostile or threatening way, threats of violence, being deliberately pushed and physical assault. The severity of these incidents is unclear. Men experienced and witnessed more violence and physical assault, while women were more likely to experience sexual assault or indecent exposure. Young people were more likely to have been deliberately pushed or stared at in a hostile way. Around 16 of every 100 Black and Minority Ethnic respondents had been harassed as a result of their colour, race or religion compared to 1 in 100 white respondents. This type of incident had increased between 1996 and 2001. Respondents who had experienced crime or anti-social behaviour were less likely to rate personal security on public transport as 'good or very good'. Nearly 80% of respondents said they had not reported the last incident they had experienced. The equivalent 2001/2 British Crime Survey estimated that 68% of respondents did not report incidents to the police. The most frequently cited reasons for not reporting incidents were the perception that they were not important and the belief that the incident would not be taken seriously.

Several studies have identified that personal security concerns can act as a deterrent to the use of public transport (Kennedy, 2008; Stafford and Petterson, 2002; Symonds, Travers and Morgan, 1996; Morris et al., 2003; Kennedy, 2008). Kennedy found that amongst those who do not currently use public transport, the safety of bikes or cars parked at stations was the most serious barrier to the take up of day-time train travel, (28% of the 99 non-users rated this as a strong influence). Other important barriers related to cost, accessibility, reliability and frequency of service. A minority (11%) of non-users rated personal security concerns at the station or walking to the station as a strong barrier to day time train travel. Concern about bikes and cars remained the most frequently reported barrier to night-time train travel (47% of non-users rated this as a strong influence), while concerns relating to waiting in and walking to the station rose to the second and third highest rated barriers (42% and 37% respectively rating these issues having a strong effect). Overall, females were three times more likely than males to be discouraged from using trains through security concerns. Respondents aged between 15-24 were the most likely age group to be strongly discouraged from train use by personal security concerns, followed by the over 50s (Kennedy 2008). The impact of personal security concerns on public transport can create a downward spiral as low ridership reduces the amount of capable guardianship on the network, thereby creating more opportunities for crime (Cozens et al., 2004; Cozens et al., 2003; Smith, 2008). Across a sample of 95 train users, Kennedy (2008) estimated that improvements to security could lead to an average increase of 1 day-time train journey per week and 0.8 night-time train journeys per week. Across the 99 respondents who did not use public transport, improvements to security could lead to 0.3 additional day-time train journeys per week, and 0.2 additional night time train journeys per week.

Summary

This research clearly demonstrates that personal security concerns discourage people from using public transport generally, and trains specifically, although these concerns are not the most important disincentive. Concerns are considerably more prevalent after dark and more likely to be experienced by women (although research has suggests that males may have been reluctant to reveal their concerns). Aspects of travel that created personal safety concerns included feeling isolated and the presence of rowdy or noisy groups. Women were concerned about the presence of individual male passengers, while men were concerned about the presence of groups. The impact of personal security concerns on public transport can create a downward spiral as low ridership reduces the amount of capable guardianship on the network thereby creating more opportunities for crime and

increase passengers feeling of insecurity. The research shows that improvements have the potential to improve the take up of train travel, but this is more likely to impact on the frequency of travel of existing users rather than on mode shift by non-users of public transport. Respondents expressed a preference for security measures that relied on the presence of personnel rather than the installation of cameras.

4.1.3 Crime Prevention through Environmental Design

The recognition that the environment can influence criminal behaviour emerged in the 1960s. The phrase Crime Prevention through Environmental Design (CPTED) was coined by Jeffrey (1971). Subsequently, Newman (1973) was influential in the development of designing out crime and his central concept of defensible space remains fundamental to the most recent iterations of CPTED theory and practice. These approaches to crime prevention represent a departure from 'traditional' criminological approaches which aimed to identify the factors predisposing individuals to offend and aimed to reduce crime through the modification of the motivation of offenders in the long term. The CPTED approach also represents a broadening out of responsibility for crime prevention from the traditional agencies of the criminal justice system to non-statutory stakeholders including designers, planners and facility managers who may not previously have had the responsibility or the opportunity to reduce crime.

Ekblom (2011) asserts that, when properly applied, CPTED entails reducing the possibility, probability and degree of harm from criminal and related events through the processes of planning and design of the environment. The process can be applied on a range of scales and types of place, from individual buildings and interiors to wider landscapes, neighbourhoods and cities. Cozens, Saville and Hillier (2005, in Ekblom, 2011) present the most recent and comprehensive outline of the key principles underpinning the CPTED approach:

- The creation of **Defensible space** aims to design buildings/enclosures to help occupants, owners and users keep criminals out.
- **Access control** aims to actively keep certain people out of buildings/enclosures and structures (or from procedures and technologies), whilst admitting those people with a right to be there. Natural access control aims to seamlessly guide users in entering and exiting a space through the careful placement of signs, entrances, exits, fencing, landscaping and placement of features in the environment. More formal measures aim to physically prevent users from entering spaces that are out of bounds.
- **Territoriality** facilitates the human motivation to control space. Physical attributes of a space can be designed to communicate ownership, and to distinguish between public, private and semi-private space, for example through the use of fences, pavement treatments, artwork, signage and landscaping. Design can also communicate the intended use of space. Good designs increase the motivation of those responsible for, or using, a space to ensure control over it (poor design can also encourage negative territoriality such as turf wars between gangs).
- **Surveillance** involves using design to assist people to act as crime preventers, ensuring that they will see or hear suspicious people or criminal behaviour, and take appropriate action. Those assisting may have formal roles such as police or security staff or informal roles such as employees or the general public. Surveillance can be assisted with technology, most commonly with CCTV, but also through natural surveillance, which ensures that placement of

features provides clear sight lines to maximise visibility and ensure that people are able to see and be seen by others.

- **Target hardening** ensures that physical structures such as walls, windows and doors are resistant to attack and/or penetration by criminals.
- **Image** is concerned with maintaining the aesthetic appearance and social reputation of a building, place or neighbourhood. These factors can influence crime levels and feelings of insecurity.
- **Maintenance** contributes to the appearance and reputation of a location but also ensures the effectiveness of security systems. Maintenance ensures the continued use of space for its intended purpose and serves as an additional expression of ownership.
- **Activity support** ensures that there are sufficient numbers of people in, or passing through, a particular place, conducting routine, honest activities like shopping or dining; in so doing, their presence prevents or discourages offenders from committing crime. Increasing the number of people passing through or working within a location helps to increase the supply of potential guardians. Guardians are people who can interrupt the actions of offenders either directly or indirectly.

The terms CPTED and situational crime prevention are frequently used interchangeably and the distinction between the two is increasingly blurred. Clarke (2002) highlights two key differences. Firstly, CPTED is focused predominantly on design while situational prevention can include approaches such as policing and place management. Secondly, CPTED manipulates the built environment with the aim of preventing a broad range of crime problems together, whereas situational crime prevention tends to address one crime problem at a time. Recent studies have highlighted the effectiveness of the manipulation of the built environment on levels of crime, a prominent UK example being the Secured by Design (SBD) scheme which applies the principles of CPTED to housing design. Five published evaluations have concluded that SBD contributes to crime reductions (Brown, 1999; Pascoe, 1999; Armitage, 2000; Armitage and Monchuk, 2009; Teedon and Reid, 2009). It has been argued that by not attending to the long term motivations of offenders, CPTED and situational crime prevention approaches simply displace crimes to other locations, times or targets. However, research has demonstrated (Felson and Clarke, 1998; Town, 2001) that displacement is not an inevitable result of situational crime prevention, since it is often limited or does not occur at all. Another possibility is for a diffusion of benefit to occur whereby the positive effects of intervention extend beyond the operational boundary of the scheme (Bowers and Johnson, 2003).

4.1.4 Applications of CPTED and situational crime prevention to public transport

Smith (2008) has demonstrated how Cornish and Clarke's (2003) typology of 25 techniques of situational crime prevention can be applied to crimes against passengers on public transport. A wealth of research has demonstrated the potential of CPTED and situational crime prevention measures within public transport and specifically railway environments, as will now be shown through the following project descriptions.

Secure Stations

Although there has been no formal evaluation of the Secure Stations scheme, Stafford and Petterson (2004) undertook escorted journeys with passengers which included trips to two stations accredited by the initiative. The participants were unaware of the stations' accredited status but did perceive the

two stations as relatively safe environments. A 2002 DfT review (cited in Stafford et al., 2006) found that seeking accreditation can be an important stimulus to station improvements. A survey of operators taking part in the scheme (Stafford et al., 2006) reported that views on the process of accreditation were mixed, but several operators stated that process of accreditation was more valuable than the certificate itself.

As part of a review of crime and safety at suburban London train stations, the London Assembly Transport Committee (2006) considered the Secure Stations scheme. This review suggested that the crime ratio threshold for scheme entry was too low for many London stations, as the significant volume of passengers particularly at large mainline stations would always ensure that ratios of crimes to passengers would fall beneath the qualifying threshold. The review argued that Secure Stations is overly focused on threats to corporate security compared to passenger safety. Furthermore, the review criticised the accreditation form for its lack of weighting, with all elements contributing equally to the overall score. This same point was also made by Stafford et al. (2006), who argued that factors relating to staffing should receive a higher weighting.

Secure Car Parks

Smith, Gregson and Morgan (2003) evaluated the Safer Car Park (SCP) award scheme as it operated in 2001; it should be acknowledged that, partly in response to the findings of this evaluation, the principles and operation of the scheme have since been refined. The study included interviews with practitioners responsible for car parks, a survey of car park users and an examination of recorded crime data. Although the evaluation focused on town centre car parks, the findings are relevant to the application of the scheme to rail station car parks.

The report noted that take up of the scheme had been limited by the costs involved in upgrading car parks, and in gaining and maintaining accreditation. The practitioners interviewed for the research suggested that many of the car parks that had been put forward for the scheme were those that required little or no modification to meet the standards. The evaluation noted that take up of the scheme had been noticeably lower in some high crime urban areas; these being areas that present the greatest challenges to preventing car park crime. The evaluation identified a lack of public awareness of the scheme, even amongst those using SCP car parks. Only 18% of all respondents and 22% of SCP users had heard of the scheme. The majority of car park users interviewed did not know whether the car park they had parked in that day had SCP accreditation; 16% of those parking in a SCP were aware of the fact, whilst 11% of those parking in non-SCP car parks erroneously thought they were parked in a scheme car park.

The SCPs in the sample generally had amongst the lowest levels of crime compared to other car parks in their town or city centre. Where it was possible to undertake a before and after comparison, the evaluation found evidence that the SCP scheme helped to reduce the level of vehicle crime and fear of crime when implemented at high crime car parks. The study also identified that new car parks designed to meet the accreditation requirements experienced low levels of crime. The authors ruled out the possibility that crime reductions in SCP car parks was the result of publicity surrounding the granting of the awards, due to the low level of public awareness and the fact that the observed reductions were sustained for a considerable period of time. It was not possible to isolate the impact of individual elements of the scheme, although the authors pointed to evidence relating to the effectiveness of CCTV in car parks (Poyner, 1997; Tilley, 1993; Welsh and Farrington, 2002).

The key measures that appeared to influence fear of car park crime were surveillance, lighting, access control and the physical appearance of the car park. The research identified a small but statistically significant improvement in user satisfaction in SCPs compared to non-SCPs. Car park users who expressed higher satisfaction levels tended to be less worried about car park crime. The

features of car parks that were most frequently cited by respondents as making a car park safe from crime were regular patrols, CCTV and good lighting. Overall, the factors that were rated as important to respondents' choice of parking location were proximity to destination, car safety, personal safety and availability of spaces.

The practitioners interviewed revealed that, at the time of the evaluation, there were a number of inconsistencies in the application of the scheme across the country. The reasons for this were often practical and pragmatic, but resulted in variation in the standard of SCPs across the scheme as a whole. The report suggested that there could be a national trend towards new car parks being built with higher parking standards, although these may not necessarily have participated in the scheme.

CPTED and station design

Diec, Coxon and Bono (2010) describe how the principles of CPTED should be applied to the design of a station redevelopment. Based on the evidence from a literature review, the authors concluded that a combination of good regulations, policing, security measures, and management together with a well-designed environment contribute to a safe and successful railway system (see also Diec et al., 2009). Diec et al. (2010) suggest that remedies to counter crime and passengers' fear of crime based on the principles of CPTED should include integrated security technology, including CCTV, emergency alarms and ticket barriers. High quality environments are required to bolster passenger confidence in the railway environment; these should include provision of clear sightlines and effective lighting. Asset management and protection of the built environment should ensure that stations are clean and well maintained. The authors note that across Melbourne (the location of interest to them), stations that were undergoing improvements tended to be larger high profile stations while smaller and unstaffed stations were being overlooked. To support suggested designs for station improvements in Melbourne, a literature review was conducted to investigate the application of CPTED principles to stations internationally. The review highlights a number of train networks that included CPTED principles in their design from the outset, as follows.

The ***Washington Metro System*** has relatively low levels of crime compared to other transport systems in the US. LaVigne (1997) describes elements of the system's design that have contributed to lower crime. The high arched ceilings to all stations create a sense of openness and light, stations are designed to provide clear views for passengers, lighting is maximised, and alcoves and obstructions are minimised to provide little opportunity for criminals to hide. As far as possible, station layouts are identical across the network to achieve a sense of familiarity while aiding navigation. Access to the platforms is restricted to those who have a ticket, and the ticket is required to exit the station. Stations are continually staffed during operating hours and covered by CCTV cameras. LaVigne recognised the difficulties of attributing crime levels to these measures but asserts that the Metro's design characteristics and operating policies have contributed to its low crime rates.

Although Hong Kong culture is generally associated with low crime rates, ***Hong Kong's Mass Transit Railway (MTR) network*** has been highlighted as another good example of the application of CPTED to public transport (Gaylord and Gallihe, 1990). As with the Washington Metro, a 'designing out crime' approach was incorporated from the earliest stages of planning. The station designs avoided the inclusion of alcoves, dog-leg passageways, and columns that can provide hiding places for offenders. Where this was not possible, mirrors and CCTV were installed. There are no chairs or public toilets, so as to discourage loitering. Areas of the station are designed so as to enable them to be closed off, confining an offender until the police arrive if a serious offence has been committed. Stations have a limited number of entrances to control the access and movement of people. A cashless payment system reduces opportunities for bag snatchings, wallet thefts and similar crimes. The MTR also uses platform screen doors situated between the edge of a platform and the train tracks which only open when it is safe to enter or exit the train. These barriers prevent deliberate or accidental access to the

rail tracks. The network also ensures a rapid police response to all incidents, with police talking an average of 90 seconds to reach the scene.

Line 14 of the Paris Métro has been presented as another successful application of CPTED to rail systems (Myhre and Rosso, 1996). Many of the measures on this line were inspired by the Washington Metro and Hong Kong MTR. However, a number of additional innovations have been implemented on Line 14. The abundant use of glass in the overall design allows natural light into the platforms and station entrances. This includes the use of clear glass for the platform screen doors (other systems have used tinted glass). The transparency of the doors allows passengers to see through to the next platform and helps minimise the feeling of being 'trapped' in an enclosed space.

It is clear that elements of station design can present potential conflicts or tradeoffs between different user needs, which do not appear to have been acknowledged by the above authors in their reviews of CPTED. For example, stations without toilets and seating, and which prohibit food consumption, might negatively impact upon other aspects of passenger comfort and satisfaction, and would not be appropriate for all public transport networks.

Finally, and drawing upon a few remaining studies, it is useful to highlight some of the evidence relating to the application of situational crime prevention to station environments. An evaluation of CCTV installed in London Underground car parks (Gill and Spriggs, 2005) found a statistically significant reduction in vehicle crime compared to national trends. The evaluation found that reductions were greatest in those car parks that had had the highest ratio of crimes to parking space before cameras were installed. The evaluation also highlighted problems with the implementation of CCTV that limited effectiveness, including poor lighting, cameras that were affected by high winds and rain, and failure to retain CCTV evidence for 14 days or more. Analysis by ATOC (2006, cited in Stafford et al., 2006) has identified that crime is higher at stations with real-time monitoring. However, this may be the result of greater investment in stations with crime problems, or the result of improved identification and recording of criminal activity as stations with real-time monitoring of CCTV. Train operators surveyed by Stafford et al. reported that CCTV can act as a useful tool within a wider package of interventions, but that its benefits were seen to lie more in the detection of incidents and provision of evidence than the prevention of crime.

Cozens et al. (2004) found that the replacement of traditional brick waiting shelters with modern transparent shelters across the Valley Lines network resulted in improvements to passengers' perceptions of safety. In a survey, 93% of respondents at these stations stated that they had noticed the improvements, and of those 71% stated that the transparent shelters reduced their fear of crime due to improved visibility.

One of the more high profile applications of situational crime prevention to a rail network was the New York rapid graffiti removal initiative during the mid 1980s (Sloan-Howitt and Kelling, 1997). This intervention was based on the underlying principle that offenders' motivation for graffiti was for their 'work' to be seen in public. The network's response was to ensure that graffiti on carriages was cleaned within two hours, or the carriages were removed from service. This measure has generally been seen as successful, but it is unclear whether this assessment is based upon reduced activity of offenders or more efficient cleaning of carriages. The intervention was certainly difficult to implement and sometimes resulted in delayed or cancelled services.

One of the most comprehensive attempts to tackle crime and disorder in a public transport environment occurred at the New York Port Authority bus terminal in 1991 and 1992, and involved 63 measures of situational prevention and CPTED (Felson et al., 1996). Statistical analysis of crime showed that the measures were effective in reducing crime, and qualitative analysis suggested that

fear of crime was also reduced as a result of these combined measures. These approaches could not be isolated so the impact of individual interventions could not be assessed.

Wallace et al. (1999) demonstrated that security measures vary in their visibility to passengers. They found that emergency phones were not as effective as more visible crime prevention measures, as they were less likely to be noticed. This research also showed that women were more likely to notice increases in lighting. Symonds Travers and Morgan (1996) also noted that passengers were often unaware of security improvements. Stafford and Petterson (2004) noted that increases in the number of staff are likely to be noticed, and appreciated by passengers. Johnson and Bowers (2003) demonstrated that the effectiveness of crime prevention interventions can be significantly enhanced by publicity; publicity can act to inform offenders of crime prevention measures in place thereby acting as a deterrent to offending.

Summary

The security measures that appear to have been the most successful in evaluated studies include increased police or security patrols/the presence of staff at the station, increased use of monitored CCTV and improved lighting (Audit Office of New South Wales, 2003; Ramsey, 1991; Stafford and Petterson, 2004; and Wallace et al., 1999). The research evidence also demonstrates the difficulty of isolating effects of individual interventions when they are commonly implemented as a package.

4.1.5 Crime data

The crime evaluation that follows (especially sections 4.5 and 4.7) is based largely upon an analysis of recorded data on railway crime. This section highlights the considerations that must be taken into account in the interpretation of this data. These considerations are drawn from the RSSB report 'Report T723: Making the most of data associated with railway crime'. (RSSB 2008)

This report draws together the research findings from four sources, namely:

1. Interviews with UK crime and safety data collectors, analysts and users.
2. A small scale survey with those responsible for collecting and analysing crime data outside the UK.
3. Matching of a month's British Transport Police (BTP) CRIME and the Rail Safety and Standards Board Safety Management Information System (SMIS) data.
4. A comparative analysis of crime and safety data sources in the UK, including not only the specific databases mentioned above, but also BTP incident logs, RIDDOR, and TOC and Network Rail databases.

A particular feature of the report is an assessment of which databases are the best source of statistics for different categories of crime. The table below, reproduced directly from the report, compares BTP CRIME and SMIS specifically, based upon a matching exercise for the month of April 2007. The multipliers offer an insight into the degree of under-reporting. Those multipliers coloured green are deemed to be reasonably reliable, whereas those coloured amber are recommended to be used with caution.

As can be seen from the table in Figure 4.1, the report recommends use of BTP CRIME over SMIS in most instances, the exceptions being violence against staff, track trespass, and vandalism – line of route.

The report issues the following recommendations:

Reporting and recording

The authors remark that under-reporting is a key concern, both at individual and corporate level. It is suggested that reporting into SMIS should be incentivised, by linking SMIS to DfT funding and benchmarking exercises. It is recommended that RSSB should communicate the message that non-reporting into SMIS may cause stakeholders to be non-compliant with the requirements for Railway Group Standards. The report also proposes and advocates initiatives for RSSB to encourage stakeholders to use SMIS constructively, for example through health check visits. It is noted that passenger assaults and other crimes where the passenger is the victim and the safety of staff is not involved are poorly documented in SMIS; it is suggested that these should be excluded from SMIS.

As regards correspondence between BTP and SMIS, it is noted that attention should be devoted to the conventions for accurate recording of crime location in each. It is also suggested that the provision of BTP incident data would support better matching with SMIS.

Further research and development

The study recommends that RSSB should consider further research into levels of under-reporting of specific crime types. In particular, line of route offences and theft of railway property are identified, on the basis that the British Crime Survey offers a poor indication of these crime types.

Figure 4.1: Recommended sources of data for different incident categories

Table 2: Recommended Sources for Different Incident Categories

Crime Categories	Percentage of reported incidents recorded in each dataset		Recommended source	2003/04 Multipliers for Rail Crime data [Note]
	BTP CRIME	SMIS		
Violence against passengers	98%	Only 3%	BTP CRIME	Common Assault – 7.7 More serious – 1.8
Violence against Staff	43%	90%	SMIS	1.52
Sexual Offences	100%	Less than 1%	BTP CRIME	5.2
Robbery	100%	Less than 1%	BTP CRIME	3.7
Track trespass	60%	62%	SMIS	Not known
Vandalism – line of route	45%	76%	SMIS	Not known
Graffiti – line of route	98%	Only 8%	BTP CRIME	Not known
Theft of passenger property	100%	None	BTP CRIME	4.6
Motor vehicle and cycle offences	100%	None	BTP CRIME	For vehicle – 2.1 For cycle – 1.43
Theft of railway property (excluding cable theft)	100%	None	BTP CRIME	Not known
Cable theft	93%	41%	BTP CRIME	Not known
Criminal damage including Graffiti (not line of route)	94%	Only 16%	BTP CRIME	4.3
Public Disorder	100%	Less than 1%	BTP CRIME	Not known

4.1.6 Understanding and measuring perceptions of safety

This section summarises the key conceptual and methodological challenges encountered in the study of perceptions and concerns about crime. These issues are important in the consideration of the influence of crime and personal safety concerns on the level and patterns of train use.

Surveys have demonstrated that fear of crime as measured in surveys correlates with experience of crime, but this relationship is not as strong as might be expected. Women and older people are frequently characterised as being more afraid of crime despite experiencing lower levels of crime. On the other hand, young males experience higher rates of crime while expressing comparatively low levels of fear and concern. This apparent mismatch between worry about crime and risk of victimisation should not be considered irrational. Rather it reveals the problems that have been encountered in trying to define and measure what are in reality complex and changing perceptions, and a reflection of the as yet poorly understood ways in which crime concerns shape behaviour.

Research has demonstrated that people are not always able, or even willing, to recognise and describe their concerns about crime. It has been long recognised that men admit to certain fears only with difficulty (Sutton and Farrall, 2005). Survey questions have also failed to refer to specific time periods or behaviour settings, resulting in the impression that people are afraid all of the time, rather than at specific times or in specific locations or circumstances (Fattah and Sacco, 1996). Farrell and Gadd (2004) found asking survey respondents about the frequency of fear demonstrated that those who are afraid of crime are not afraid very often.

Researchers and policy makers have frequently conflated estimations, judgements, emotions and reactions to (and even the direct experience of) crime under the concept of ‘fear’ (Tulloch, 1998). Feelings about crime are not limited to fear of direct individual victimisation but include worry for others who may be victimised and wider concerns about the impact of crime on the community (Christmann, Rogerson and Walters, 2004). Innes (2003) argued that fear of crime needs to be understood as a component part of a much more widespread and diffuse sense of ‘insecurity’, and it should be recognised that these insecurities are felt to some degree at some time by most members of modern society.

The most frequently used survey questions tend to ask indirect questions about ‘feelings of safety’ in order to avoid any automatic fear response triggered by the word ‘crime’. This tactic risks encouraging respondents to channel a range of anxieties and worries through their crime talk (Lupton and Tulloch, 1999). Thus fear of crime has become a ‘dump concept’ where fear of victimisation is elided with more nebulous anxieties concerning the general state of society.

Despite the difficulties of definition and measurement, it is clear that perceptions of the environment have an impact on individuals and communities and behaviour. Innes and Fielding (2002) argue that signs of disorder can be a powerful communicator of an area’s state of communal health, and the cumulative impact of a succession of apparently ‘trivial’ occurrences may have significant impact upon the local community. These signs influence individuals’ feelings of concern and unease. Incidents and their physical traces carry ‘signal values’ which provoke different reactions from different individuals/communities.

Interpretations of signal vary not as a result of irrational fears or miscalculation of risks, but because of selective attentions to risk. The British Crime Survey revealed that people who live in an area with high physical disorder are more likely to think that the local crime rate had increased (Flatley et al., 2010). Because people take cues about safety from the environment, it should be noted that crime prevention measures, however successful, may not influence perceptions of security. Interventions tackling these problems should provide visible and demonstrable signs of improvement, signalling that

the area's problems are under control, and increasing public confidence in the authorities' ability to deal with crime (Innes and Fielding, 2002).

However, there are dangers in improving cues of safety without addressing underlying risks. The apparent imbalance between individuals' concerns about crime and their 'true' level of risk may be a by-product of risk-averse behaviours and protective practices implemented as a consequence of their concerns. For example, women are less likely than men to suffer a violent assault after dark, partly because concern about attacks leads many women to modify their behaviour and lifestyle. In recognition of the potentially protective role that crime concerns may have, Rogerson and Christmann (2007) caution that crime preventers should not attempt to reduce concerns about crime without also attending to the prevailing risks of crime.

In summary, academic research highlights the dangers of oversimplifying the perceptions, emotions and reactions to crime. As the examples in the following section show, public transport research has dealt with some of the methodological challenges better than research that explores fear of crime at a neighbourhood level, particularly by asking about concerns experienced in specific places at specific times. The research evidence demonstrates the importance of environmental cues as signals of the safety of a location. Consequently, signs of disorder and neglect can cause people to feel insecure. Correspondingly, attempts to reduce crime risk, however successful, need to be visible in order for successes to translate into increased feelings of safety and security.

4.2 The Crime Evaluation: Explaining the Key Strands

4.2.1 Profiling crime prevention

The evaluation of the Secure Station and Safer Parking awards is complicated by the fact that the nature of the schemes means that the characteristics of a 'Secure Station' or 'Safer Car Park' will vary considerably from one location to another. A central task of the evaluation will be to consider what constitutes a Secure Station/Safer Parking car park and to determine the most prevalent features of each of the two schemes.

Both the Secure Station and Safer Parking schemes have clear guidelines for accreditation; however these guidelines are not definitive and are not treated as hard and fast rules. In the case of Secure Stations accreditation requires:

- The ratio of crimes to passenger footfall to be below a given threshold.
- Positive passenger perceptions of station security, as identified through passenger surveys.
- An assessment of the station environment and security measures in place. An initial assessment is made by a BTP Crime Prevention Officer (CPO)[3], with the final assessment made by the BTP Secure Stations Manager.
- A review of station management practices, which stations are asked to evidence, also undertaken by the Secure Stations Manager.

Similarly Safer Parking accreditation requires:

- The ratio of crimes to car park usages (vehicles entering and exiting) to be below a given threshold. This threshold has been adapted from the national Safer Parking scheme; station car

[3] BTP Crime Prevention Officers offer crime prevention advice to transport operators and passengers. They receive training in Crime Prevention through Environmental Design and in Architectural Liaison.

parks are dominated by long stay users resulting in considerably lower numbers of vehicles entering/exiting the car park.

- An assessment of the car park environment and security measures in place. The assessment is conducted, on behalf of the British Parking Association, by the BTP Secure Station Manager.
- A review of car park management practices, again undertaken by the BTP Secure Stations Manager.

For both the station and car park schemes, the assessment of the environment, security measures and management procedures is conducted in relation to the existing crime risks. Neither scheme prescribes a 'one size fits all solution'. Therefore the measures included on the pro-forma used to make the assessments are regarded as potential interventions that are available to owners/operators, not elements that must be incorporated to achieve an award. Successful stations/car parks are regarded as those that have implemented measures that are appropriate to the crime problems experienced and the nature of their locations. The approach allows for flexibility, which is essential when the disparate nature of stations and their locations is considered. For example, many train stations are located within listing buildings which can restrict the application of physical measures to address crime and security problems. Consequently, a station or car park with a low rate of crime per passenger will not be expected to have implemented the same level of security measures as a station with a more serious crime problem. Furthermore, two stations with similar crime levels may have adopted very different strategies to address their problems, but both receiving awards for their approaches.

The evaluation also needs to accommodate the fact that for some locations the acquisition of Secure Station/Safer Parking accreditation is an acknowledgement of security measures and procedures that have been in place for considerable time. For other locations, accreditation marks the culmination of a significant programme of improvements. Those involved in the scheme have commented that the latter scenario is now more frequent as operators initially sought accreditation for their strongest and most secure locations, but have now moved on, with the additional incentive of franchise conditions, to address crime at some of their more problematic stations. A further complication arises from the fact that some stations and car parks which have not applied for accreditation may have security measures and management practices that are equivalent to those accredited as Secure Stations or Safer Car Parks.

In addition to the assessment of crime prevention measures in place at stations, a key element to both schemes is the ongoing monitoring of crime by BTP Crime Prevention Officers (CPOs). Should crime levels increase, the CPOs work with the station managers to identify the likely causes and help devise appropriate prevention strategies. Stations that ignore emerging crime problems and/or fail to implement the action recommended run the risk of being removed from the scheme. Where crime remains high but it is recognised that all possible steps are being taken to tackle it, the station may remain on the scheme. Consequently there are a small number of stations that remain on the scheme despite temporarily exceeding the crime ratio threshold. This issue serves to highlight that the ongoing monitoring and support provided by BTP is as much a part of the scheme as the measures implemented at individual stations. The CPO role is not restricted to Secure Stations, but the existence of the award places additional responsibilities on the CPO to monitor crime at that station.

The challenge then is that, given the high probability that no two Secure Stations or Safer Car Parks will be the same, the evaluation must identify what distinguishes an accredited station or car park from non-accredited, and which elements of the schemes (if any) are responsible for the associated crime outcomes. For this reason, the evaluation will assess the schemes as a whole and the component elements that are implemented by stations. To address these questions, the research

team implemented an online survey of the sample of 322 stations. This is described in section 4.2 below.

4.2.2 Understanding the implementation of crime prevention at stations

This strand of the research aimed to understand the processes involved in implementing personal security measures within stations and car parks. This element of the research provided an insight into the crime problems experienced at stations and the strategies in place to tackle them. The interviews conducted gathered the perceptions of station staff towards the Secure Stations and Safer Parking awards and explored the factors which encourage or discourage operators from submitting stations/car parks for accreditation. This strand of the research supplements the profiles of interventions generated through the online survey, by further exploring the differences between accredited and non accredited stations/car parks. This strand also considers the extent to which the environment at accredited stations and car parks is one that feels safe and secure.

4.2.3 Estimating the impact of interventions on crime

This strand of the research aimed to estimate the impact of accreditation and individual interventions on crime, especially in terms of police-recorded crime data. This strand considered the crime outcomes for Secure Stations and Safer Car Parks relative to their non-accredited equivalents, and in terms of the presence/absence of specific individual interventions. In addition, passenger perceptions and fear of crime were measured using the passenger survey will be compared for Secure Stations and their non accredited equivalents. The analysis also explored the influence of passengers' awareness of Secure Station status on their perceptions of crime and fear of crime.

4.3 Primary Data Collection

4.3.1 Format of the online survey of stations

An online survey was distributed to the 322 stations in the aggregate sample. This sample is consistent with the sample used for the valuation of changes in behaviour as described in section 3.3. The survey included two modules. The first module contained questions relating to the station (Appendix 3) and the second, for stations where it is applicable, contained questions relating to the car park (Appendix 4). The survey was designed to answer the following research questions.

- What is the level and nature of security measures and practices across the sample?
- To what extent are there consistent differences between Secure Stations and non-accredited stations in terms of the security measures/practices implemented?
- To what extent are there consistent differences between Safer Parking car parks and non-accredited car parks in terms of the security measures/practices implemented?

The results of the online survey also feed into the analysis of crime outcomes (section 4.7).

The station and car park modules both asked questions that help to determine the extent to which station environments and crime prevention practices relate to the key principles of CPTED. Consequently the questionnaires covered the following themes:

- Monitoring and responding to personal security and crime.
- Staffing and procedures (including provision of training).
- Formal surveillance (including CCTV).
- Informal surveillance.
- Station design and layout.
- Access control.
- Partnership working.

The questionnaire was designed to include elements that are assessed during the Secure Stations and Safer Parking accreditation process. This allowed us to compare the features of accredited and non accredited stations, and to determine whether there are any notable differences in the level and nature of security. The survey asks about the improvements that have been made to the station and car park over the last five years, and prompts respondents to provide the approximate dates on which these improvements were made. This is essential information to enable the analysis of change before and after implementation.

Prior to going live, the survey was reviewed by the Steering Group and the Secure Stations Manager. This was particularly useful in devising the strategy for distributing the questionnaires, which was conducted through a central contract at each TOC. Contacts for each TOC in the sample were provided by the Steering Group. An email request was sent to each of these contacts asking them to identify and provide contract details for the relevant individuals with responsibility for the stations in the sample. These station level contacts were normally either a station manager or a customer service manager. An invitation to participate in the survey was then emailed to each station contact. Respondents were invited to complete the survey via a web-based questionnaire. The web-based questionnaire has two key advantages over a traditional postal survey. Firstly, automatic routing ensures that respondents only need to read and respond to those questions of relevance to their station. Secondly, responses are automatically entered into a database, reducing the need for data entry and cleaning.

An issue that had not been anticipated at the inception of the online survey was the number of instances where a group station manager was responsible for several neighbouring stations. This meant that in some cases respondents were requested to complete surveys for multiple stations, in one case this amounted to over 20 stations. This placed a considerable response burden on these individuals and may have influenced the response rate.

It also became clear that many station managers had limited access to the Internet and that at some stations the Internet connection was poor. To overcome these problems, station managers were provided with alternative means of responding. A PDF version of the questionnaire enabled respondents to email, post or fax through their survey returns.

Survey returns and missing data

A total of 211 (65%) of survey forms were returned. To produce a comprehensive database of station environments and interventions, the online survey data was supplemented from secondary sources. For Secure Stations, accreditation forms were requested from DfT. These provided an overview of interventions in place at the time of accreditation and should report key changes that have occurred since then. For all stations in the sample, a number of websites were used to supplement the survey data. For the stations themselves, the resources included the station information pages at the National Rail Enquiries website and TOC websites. For car parks, Parkopedia.com and websites for car park contractors including ACPOA, NCP and Meteor were consulted.

Analysis of the survey returns reveals a bias in responses, with a more favourable response from Secure Stations compared to non-accredited stations. Whilst ex post desk-based research helped to fill gaps in the data, the required information was generally more readily available for Secure Stations, meaning that this bias remains in the database. In addition to non-response, inspection of the survey returns revealed a high level of missing information for individual questions. This is most apparent for questions relating to historical information on the implementation of interventions. Many respondents answered that they did not know when interventions had been implemented. It is suspected that this is due to turnover of staff with station respondents only being in post for a relatively short period of time. This has also been a problem encountered when interviewing station staff (section 4.6). It was anticipated that the forms completed for the bi-annual re-accreditation of Secure Stations would provide information on the dates of interventions, however this proved not to be the case, as the overwhelming majority of re-accreditation forms report that no significant changes have been implemented at the station since the last accreditation. Interviews conducted with station staff provided an opportunity to validate these claims, which often proved to be false. For example the forms for one station repeatedly reported 'no change', and yet changes over the period of accreditation have been extensive and include the installation of a new CCTV control room. Appendix 6 presents an analysis of missing data for the variables in the dataset.

4.3.2 Detailed sample, site visual audits and interviews

The site visits were conducted at 11 locations; Table 4.1 provides a breakdown of the Secure Station and Secure Car Park status of the 11 stations in the detailed sample.

Table 4.1: Sites chosen for visual audits and interviews

	Safer Parking	Secure Stations	Category	Staffed	OAC Classification
London Euston	Y	Y	A	Full-time	Multicultural
Manchester Victoria	Y	N	B	Full-time	City Living
Paisley Gilmour Street	N	N	C	Full-time	City Living
Willesden Junction	N	Y	D	Full-time	Multicultural
Bathgate	N	N	F	Part-time	Constrained by Circumstances
Bedford	N	Y	C	Full-time	Multicultural
Manchester Piccadilly	Y	Y	A	Full-time	City Living
Peterborough	Y	Y	B	Full-time	Multicultural
Dewsbury	Y	N	D	Part-time	Multicultural
Garforth	N	Y	E	Part-time	Typical Traits
Honley	N	N	F	Unmanned	Prospering Suburbs

Prior to the fieldwork, a pilot of the research tools was undertaken at Leeds Station. The researchers conducted visual audits of the station and station car parks, and conducted an interview and accompanied walkabout with station staff (Station Manager, BTP, CPO based at the station and a car park attendant). The pilot demonstrated that the research tools generally worked well, but highlighted some areas for improvement. The station staff participating in the interviews suggested some revisions to the interview questions, and some additional themes that should be included in the research. The visual audit pilot highlighted a number of additional factors to include on the checklist:

- The types of materials used across the station. For example, the pilot station maximises the use of glass and transparent materials while at other stations the structures are predominantly brick or concrete.
- Whether the researchers observe any acts of disorder or crime during their visit.
- Whether the station design/layouts produces 'bottlenecks' as passengers attempt to move around the station at busy times.

The site visits were conducted between December 2011 and January 2012. The research team spent a whole day at each of the stations, to observe the stations at both peak and quiet times. At each site the research team inspected and documented features of the station environment that research has suggested may be associated with facilitating or preventing crime. This audit was undertaken during daylight hours and then revisited after dark. The visual audits covered key areas of CPTED and although not a quantitative exercise, a detailed checklist was been devised to ensure consistency across the sample and to provide transparency of the factors being considered by the researchers.

In addition to the visual audit, researchers conducted a group interview with key staff at each station. Participants in the group interviews included station managers and supervisors, customer service advisers, gate line staff, car park managers, security staff and BTP officers.. The interviews with station and car park staff covered:

- Current and previous crime and anti-social behaviour problems on the station.
- The management of crime and personal security at the station/car park including:
    - Staff roles and responsibilities.
    - Provision of training.
- Procedures for recording crime incidents.
- Crime prevention measures implemented at the station.
    - Views on the effectiveness of different strategies.
- Partnership working arrangements.
- Experiences and views of the Secure Station and Safer Parking schemes.

It was found that, at the majority of stations, staff had been in place for only a short period of time; they were therefore unable to answer questions relating to the station's recent history. It had been intended to undertake a walkabout accompanied by staff at each of the stations. The aim of the walkabouts was to allow participants to point out specific problem areas or solutions they have implemented. However at smaller stations this was not possible as staff were required to man ticket offices etc. It should be noted that the fieldworkers were female; this may influence the teams' reports of feelings of safety. It should also be noted that at the time of the visual audits, refurbishment works were underway at Peterborough, Paisley Gilmour Street and Manchester Victoria.

4.4 Estimating the Influence of Interventions on Crime: Fitting the Models

The models constructed for the crime analysis explored the impact of station accreditation and crime prevention interventions on crime. The analysis was conducted on the full sample of 322 stations. The method for selecting sample developments was discussed in section 3.3.

The analysis employed a series of log linear regression models. The majority of models utilised an extra negative binomial distribution. This is appropriate for the prediction of count data that is heavily dispersed and where the majority of cases are concentrated around zero events. The exception to this was vehicle crime which more closely fitted an extra Poisson distribution. This is also suitable for modelling of counts of events, but this distribution is less dispersed than negative binomial. These methods are particularly suited to studies of crime as they assume that the event of interest is rare. Examples of research adopting Poisson and negative binomial distributions to model crime counts include Johnson and Bowers (2009), Tseloni (2006) and Armitage, Rogerson and Monchuk (2011).

As will be shown in section 4.5, crime levels have decreased across the sample stations during the period of analysis. In order to distinguish between the trends over time and variation in crimes resulting from differences between stations, a repeated measures approach was applied. In other words, the results give the effect of the explanatory variables on stations once the differences over time have been accounted for. This required a two-level hierarchical structure to the data with the count of crime in each of the financial years (Level 1) was nested within each of the stations (Level 2), see Table 4.2. The analysis was conducted via the software package *MLwiN* (Rasbash et al., 1988).

Table 4.2: Data structure for crime models

Level 2	Level 1	Crime Count	Secure Station
Station 1	Year 1	xxx	Yes
Station 1	Year 2	xxx	Yes
Station 1	Year 3	xxx	Yes
Station 1	Year 4	xxx	Yes
Station 1	Year 5	xxx	Yes
Station 2	Year 1	xxx	No
Station 2	Year 2	xxx	No
Station 2	Year 3	xxx	No
Station 2	Year 4	xxx	Yes
Station 2	Year 5	xxx	Yes
Station 3	Year 1	xxx	Yes
.....	.....	.....	.....

An advantage of this multi-level approach is that is allows the model to account for variables which change over time. This includes the outcome variable of crime count, which is modelled as a repeated observation over time, in this case five observations, one each financial year. In addition, the model is also able to account for changes in predictor variables and contextual variables over time. For example, the analysis can distinguish between stations which have had Secure Station accreditation throughout the five year period (Station 1 in Table 4.2 above) and stations that received their accreditation part way through the analysis period (Station 2 in Table 4.2 above).

Each of the crime models (one per crime type) includes variables that indicate the presence/absence of Secure Station/Safer Car Park accreditation and/or crime prevention measures at a given time during the analysis period. By comparing the impact of various combinations of accreditation status

and crime prevention measures, the models provide an estimate of the impact which accreditation has over and above the impact of any individual measures.

The estimated effects of the explanatory variables on each crime type are presented in Tables 4.20 to 4.25 of the crime analysis section below. To aid interpretation, coefficients have been converted into the predicted percentage change in crimes per passenger. These percentages are interpreted in different ways depending on whether the variables are continuous (eg Local Authority Criminal Damage levels) or categorical (eg 'prosperous suburbs' versus 'blue collar communities'). For continuous variables, the size of the effect on crime is multiplicative, and the coefficient shows by how much crime increases for every 'unit increase' in that variable, assuming all other factors are constant. Coefficients have been converted into the predicted percentage increase to aid interpretation. For example a coefficient given as 50% relates to a 50% increase in crime when the value of that variable increases by 1 (assuming all other factors remain equal). With categorical variables, a 'base category' (eg 'Prosperous Suburbs') is chosen, and the estimated relative increase (or decrease) in crime rate associated with a switch to another category (eg 'Typical Traits') is reported. For example, in the first of these tables (Table 4.20 for violence against the person) the base category for country is given as 'England'; it can therefore be discerned that a station in Scotland will have 35.7 per cent less crime than a station in England (all other things being equal).

Variables

The models produced estimates of the counts of crime at each station. To account for variation in the throughput of passengers across the sample, an offset variable was included to control for throughput (total entrances + total exits + total interchanges). The model therefore predicts the underlying rate of station crimes. For the vehicle crime model, the offset variable remained number of passengers with number of car park spaces included as an explanatory variable. Ideally car park visits/usage would have provided a more appropriate offset, however this data was not available.

The analysis was repeated for the six key crime types of:

- Violence against a Person
- Sexual Assault
- Theft from a person
- Criminal Damage
- Vehicle Crime (including cycle crimes)
- Commercial theft

The crime counts included both notifiable and non-notifiable offences. This data was obtained from BTP for five financial years 2006/7 to 2010/11. The crime counts include all crimes of the relevant type committed within the station or car park. The potential to use SMIS data to examine the impact of interventions on workplace assaults was investigated. As noted in Report T723 (RSSB 2008), SMIS data provides a more reliable source of information on workforce assaults than BTP crime data. However it was clear that for the sampled stations, the number of reported incidents per station was too small to enable workplace assaults to be modelled in isolation. This reflects known issues with under-reporting of these incidents. The BTP data requested did not enable a distinction to be made between assaults against staff and assaults against passengers. Had this distinction been possible, the problem of under-reporting of staff assaults would have been more apparent. In the event, the most appropriate way forward was to model staff and passenger assaults together using BTP data.

As described in section 4.3.1, the independent variables were obtained through the online survey and secondary data sources. These variables are generally modifiable variables, which have the potential to be manipulated by stakeholders within the railway industry. The crime models also included

contextual variables, these are variables that cannot be manipulated by industry stakeholders but their inclusion in the model improves the estimate of the impact of modifiable variables. Contextual variables were collected from secondary sources; these included:

- **Station category:** Stations are classified by Network Rail into six categories (A-F) based on a combination of passenger footfall and annual income from ticket sales. Table 4.3 provides the Network Rail definition of each category.
- **Crime in the wider Local Authority area**: This data is published by the Home Office and was linked to the station data using the geo-coded locations of stations, supplied by BTP. These variables were standardised before entering them into the model; therefore coefficients should be interpreted as the impact of a one standard deviation change in Local Authority crime levels. The following measures of crime in the Local Authority area were considered:
    - Total Crime
    - Acquisitive Crime
    - Violence against a Person
    - Criminal Damage
- **Output area classification**: As above, geo-coded locations of stations were used to link each station the Office of National Statistics Output Area Classification which provide a demographic profile of each output area in England and Wales.
- **A country variable** (ie England, Scotland and Wales): This was included in the analysis because there are no Scottish Secure Stations and because crime recording conventions differ in different parts of Great Britain.

All explanatory variables were tested within the crime models; however only those that proved significant are included in the models discussed in section 4.7 below.

Table 4.3: Network Rail station categorisations

Category	Category Definition
A – National Hub	Major station providing a gateway to the rail network from a large area, and acts as a significant interchange hub
B – Regional Hub	Large station providing a gateway to the rail network from a large area. Often served by more than one TOC with a mix of service types. May be a terminus for some services
C – Important Feeder	Significant 'feeder' station, on a busy trunk route or as a subsidiary hub station. Often with services from more than one TOC and a regular long-distance service
D – Medium Staffed	Medium-sized, staffed station, with a core inter-urban business or high-volume inner suburban business
E – Small Staffed	Small, staffed station often with just one member of staff at any one time, or for only part of the day
F – Small Unstaffed	Small, unstaffed station

Note: Reproduced from Network Rail (2011)

4.5 Results Strand 1: Profiling Crime Prevention

The following section outlines the results from the online survey and desk based research. An overview will be provided of the nature of the stations in the sample and the presence or absence of key environmental features that have the potential to influence personal security and perceptions of safety. This will be followed by a description of the interventions that have been undertaken at the sample stations with the aim of preventing crime. The analysis draws comparisons between the station environments and interventions that are implemented at Secure Stations vs. non-accredited stations.

4.5.1 Sample characteristics

Table 4.4 shows the Secure Station and Safer Parking status of the stations in sample. Of the 322 stations, 93 (28.9%) have both Secure Station and Safer Parking accreditation, 110 (34.2%) are Secure Stations but do not have Safer Parking status, 20 stations (6.2%) have Safer Parking but not Secure Station status. This leaves 99 stations (30.7%) that have neither Secure Station nor Safer Parking status.

Table 4.4: Secure Station and Safer Parking status of sample stations

		Secure Station				Total	
		Yes		No			
		N	%	N	%	N	%
Safer Parking	**Yes**	93	28.9	20	6.2	113	35
	No	110	34.2	99	30.7	209	64.9
Total		**203**	**63**	**119**	**37**	**322**	**100**

Across the GB network as a whole, the proportion of stations with Secure Station and Safer Parking accreditation is smaller: 56% of stations have neither award, 26% have Secure Station status, 3% have Safer Parking accreditation and 14% have both awards. Although efforts were made to assemble a representative sample for analysis, the difference in the level of accreditation between the sample and the population is partly due to the under-sampling of smaller stations which are less likely to participate in the two schemes. This under-sampling is apparent in Table 4.5 which gives the industry classification, A-F, of stations in the sample compared to the distribution of these classifications across England and Wales (station A-F classifications were not available for Scotland). This sampling strategy was adopted to avoid skewing the sample towards stations with very low passenger throughput and low crime levels.

Table 4.5: Classification A-F of stations in the sample

	Sample		National Network
Category	**N**	**%**	**%**
A	13	4.08	1.1
B	34	10.6	2.7
C	103	32.0	9.8
D	83	25.8	15.7
E	52	16.1	26.9
F	37	11.5	47.6
Total	**291**	**100**	**100**

Table 4.6: Dates of Secure Station and Safer Parking accreditation

Year of Secure Station Accreditation	N	N
Prior to 2006/7	78	19
2006/7	21	21
2007/8	23	16
2008/9	50	17
2009/10	25	24
2010/11	4	14
2011/12	2	1
Not Accredited	119	210
Total	322	322

Table 4.7: Train operators included in the sample

	Sample		GB Stations
	N	%	%
Arrival Trains Wales	21	6.5	9.3
c2c	6	1.9	1
Chiltern Railways	7	2.2	1.2
East Coast Main Line	8	2.5	0.5
East Midlands	6	1.9	3.5
Capital Connect	12	3.7	2.9
First Great Western	23	7.1	8.3
First ScotRail	27	8.4	13.3
First Transpennine Express	6	1.9	1.2
Highspeed1	1	0.3	0
London Midland	14	4.3	5.9
London Overground	12	3.4	1.4
Merseyrail	8	2.5	2.5
National Express East Anglia	29	9	6.6
Network Rail	9	2.8	0.7
Northern Rail	40	12.4	18.6
South West Trains	24	7.5	7
Southeastern	39	12.1	7
Southern	22	6.8	6.3
Virgin West Coast	8	2.5	0.7
Total	**322**	**100**	**100**

Table 4.6 details the dates of accreditation for the Secure Stations and Safer Car Parks in the sample. A total of 78 Secure Stations received accreditation prior to the period analysed in this research, whilst 125 stations were accredited during the period. 19 stations car parks received accreditation prior to the analysis period, and 131 received accreditation during the analysis period. These 125 Secure Stations and 131 SCPs allow for the consideration of change in accreditation in the analysis of crime outcomes. Table 4.7 lists the TOCs that are included in the sample. The majority of the principal train operators that cover England, Wales and Scotland are included in the sample.

Table 4.8 shows that the areas in which the sampled stations are located are fairly diverse. Just over a quarter of the sampled stations are located in areas that were classified by OACs as 'City Living'; a similar proportion of the stations (25%) were located in areas classified as 'Typical Traits'; 18% are located in areas described as 'Multi-Cultural'; 12% are located in deprived areas classified as 'Constrained by Circumstances'; 6% are located in rural 'Countryside' areas and 8% are in 'Prosperous Suburbs'. These classifications are important because, as noted in the evidence review, the area in which a station is located will influence not only the level of crime but the nature of crime experienced. It is important that the sample includes a cross section of area types to ensure that the impact of station context on the effectiveness of personal security interventions is accounted for in the analysis.

Table 4.8: Output Area Classifications of the locations of stations in the sample

OAC Classification	N of Stations	% of Stations
Blue Collar Communities	15	4.7
City Living	87	27
Countryside	19	5.9
Prosperous Suburbs	25	7.8
Constrained by Circumstances	38	11.8
Typical Traits	80	24.8
Multi Cultural	58	18
Total	**322**	**100**

4.5.2 Secure Stations and non-accredited stations compared

The following section compares the station environments, facilities and security at Secure and non-accredited stations. This section does not attempt to explain the factors that make one station 'more secure than another, rather it aims to highlight the key differences between the two groups of stations. The influence of these factors on crime will be explored in section 4.7 below.

Figure 4.2: Station categorisation by Secure Station status (N=322)

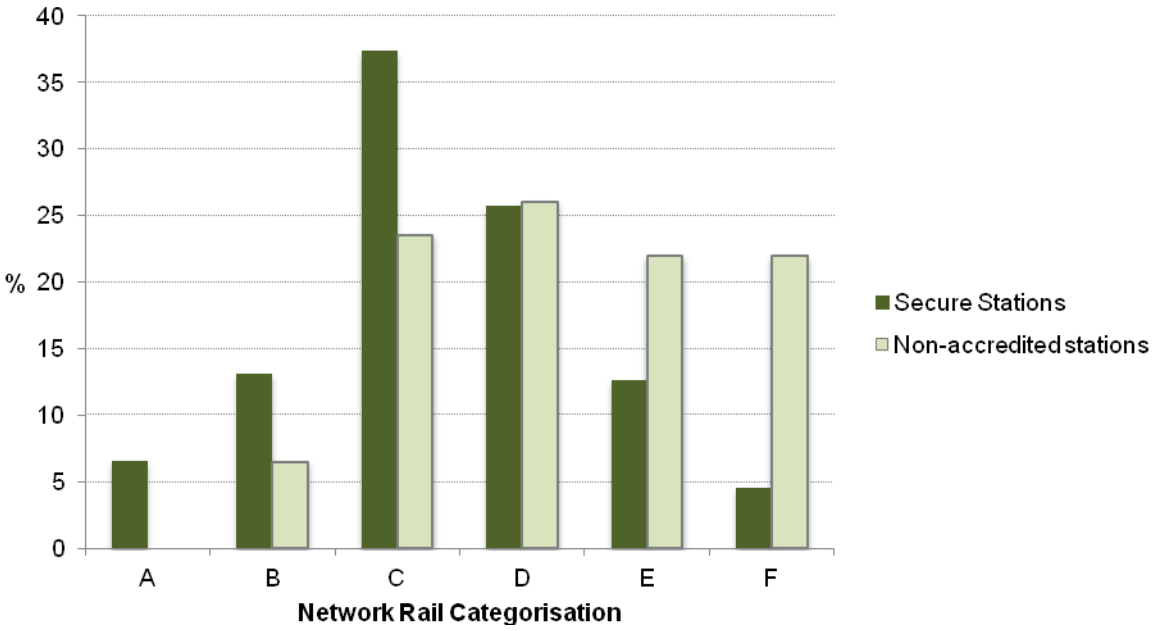
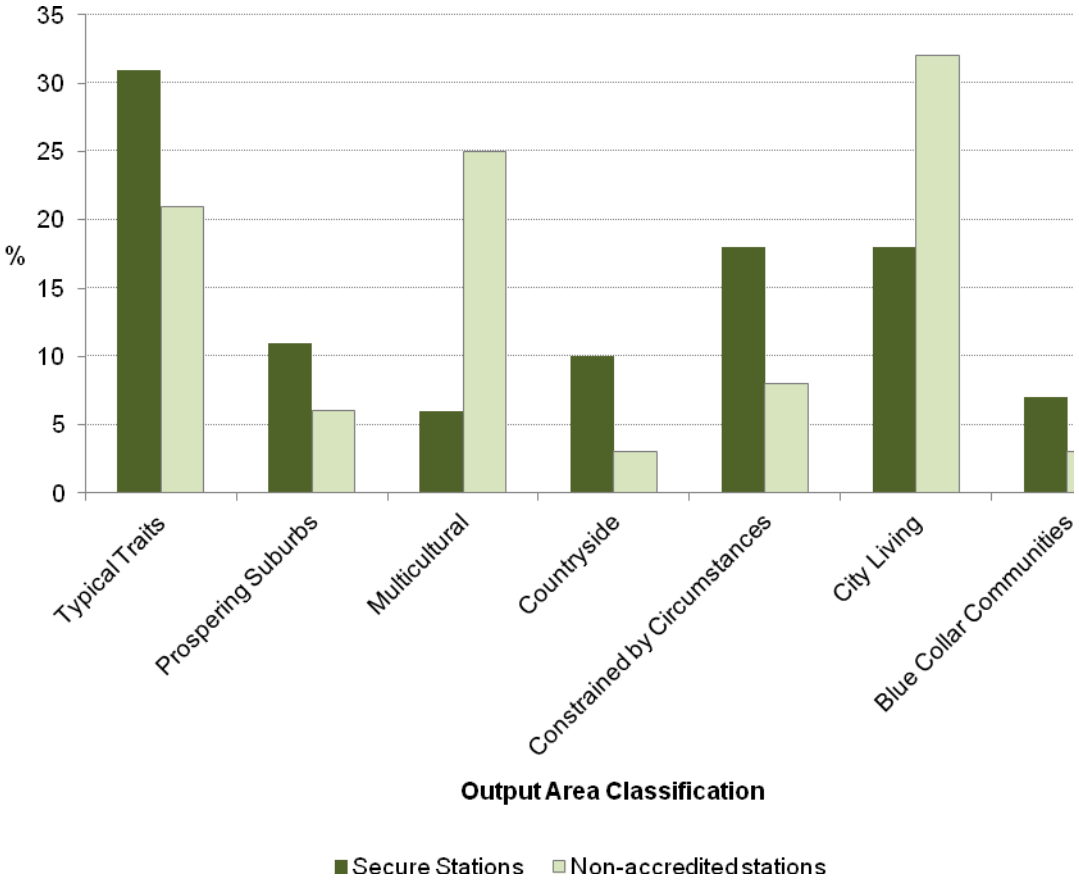


Figure 4.3: Output Area Classification by Secure Station status (N=322)



Station Categorisation

Figure 4.2 displays the Network Rail categorisation of stations in the aggregate sample by Secure Station status. All Network Rail Category A stations are Secure Stations; therefore there are no non-accredited Category A stations in the sample. There was a greater proportion of Secure Stations in Categories B and C, and a greater proportion of non-accredited stations in categories E and F. This reflects the nature of the Secure Station scheme, in that a greater proportion of larger stations have been accredited.

Output Area Classification

Figure 4.3 presents the OAC grouping of the areas in which stations were located by Secure Station status. The modal classification of the areas in which the Secure Stations were located was 'Typical Traits'. The next most frequent categories for Secure Stations were 'City Living' and 'Constrained by Circumstances'. In contrast the most frequent classifications of the locations of non-accredited stations were 'City Living' and 'Multicultural'.

The following analysis considers the facilities, station environments, and crime prevention interventions implemented at the sample stations. The analysis considers these factors by Secure Station status and Station Category. It should be remembered that the Network Rail classifications reflect the size, throughout and facilities available at a station. Therefore it should be expected that stations with a classification of A or B would host a greater range of facilities than stations grouped E or F. The tables and discussion that follows aim to identify whether the station environments and crime prevention interventions at Secure Stations are different to non-accredited stations within the same category.

Staffing

Information on staffing levels was available for the entire sample. This was derived from the online survey and from the station information on the National Rail Enquiries website. Across the sample, 10% of stations were unmanned, 42% were staffed part-time and 48% were staffed full-time. Compared to non-accredited stations, Secure Stations were more likely to be manned full-time and less likely to be unmanned. This difference in staffing levels was statistically significant.

Table 4.9 shows the staffing levels of the sample broken down by Secure Station status and station category. All Category A stations which, as noted above, are all also accredited with Secure Station status, are manned full-time. Stations in categories B to E are manned, but possibly only part-time. A greater proportion of Category B Secure Stations were manned full-time, 92% compared with 75% of non-accredited stations, however this difference was not statistically significant. The staffing of Category C stations was broadly similar for both accredited and non-accredited stations, with a little over half of the category being manned full-time. Within Category D, 68% of Secure Stations were manned part-time compared to 53% of non-accredited stations. Category E stations were significantly more likely to be manned full-time compared to the non-accredited stations in this category (60% and 26% respectively). The only unmanned stations in the sample were Category F; although the Network Rail definition of a Category F station is a 'small unmanned station', only 10% of this category was manned in the sample. Secure Station accredited Category F stations were significantly less likely to be unmanned compared to non-accredited stations (70% and 93% respectively).

Table 4.9: Staffing levels by Secure Station status and station category

		Secure Station Accreditation		Significance
		Yes	**No**	
Category	**Staffing**	%	%	
A	Unmanned			n/a
	Part-time			
	Full-time	100		
	N	**13**		
B	Unmanned			ns
	Part-time	8	25	
	Full-time	92	75	
	N	**26**	**8**	
C	Unmanned			ns
	Part-time	45	43	
	Full-time	55	57	
	N	**75**	**28**	
D	Unmanned			ns
	Part-time	68	53	
	Full-time	32	47	
	N	**53**	**30**	
E	Unmanned			*
	Part-time	40	74	
	Full-time	60	26	
	N	**25**	**27**	
F	Unmanned	70	93	*
	Part-time	10	7	
	Full-time	20	0	
	N	**10**	**27**	
All categories	Unmanned	4	21	**
	Part-time	41	43	
	Full-time	55	36	
	N	**202**	**120**	

* Statistically Significant Chi Square P<0.05
** Statistically Significant Chi Square P<0.01
ns non significant
n/a not applicable

Automatic help points

Automatic help points provide passengers with a direct link to an operator; help points can be used to request information or to receive assistance in an emergency. Data on the availability of automated help points on stations was collected from the online survey. Where data was missing, Secure Station accreditation forms and online data were used to supplement the primary data collection. This information was available for 319 stations. Help points were available at 57% of stations in the sample. Secure Stations were significantly more likely to provide help points when compared to non-accredited stations (62% compared to 50% respectively). Table 4.10 provides a breakdown of the provision of help points at stations by Secure Station status and station category. The most substantial differences between Secure Stations and non-accredited stations were found within station categories C and F. Amongst Category C stations, 65% of Secure Stations provided help points compared to 37% of non-accredited stations. In Category F, 90% of Secure Stations provided help points compared to 52% of non-accredited stations.

Table 4.10: Proportion of stations with help points by Secure Station status and station category

	Stations with Help Points		
	Secure Station Accreditation		
Station Category	**Yes**	**No**	**Significance**
	% (N)	% (N)	
A	38 (13)		n/a
B	38 (26)	25 (8)	ns
C	65 (74)	37 (27)	*
D	73 (52)	60 (30)	ns
E	60 (25)	56 (27)	ns
F	90 (10)	52 (27)	*
All categories	62 (200)	50 (119)	*
* Statistically Significant Chi Square P<0.05 **ns** non significant **n/a** not applicable			

Automated help points by Secure Station status and staffing

As help points aim to provide an alternative form of assistance where staff may not be readily available, it might be expected that they would be more prevalent on unmanned and part-time staffed stations. As illustrated in Table 4.11, this proved to be the case in the sample. Stations staffed on a part-time basis were most likely to provide automated help points (75%), followed by unmanned stations (60%); 43% of stations staffed full-time also provided help points. Secure Stations were more likely to provided help points at non-full-time stations than non-accredited stations; 100% of unstaffed Secure Stations provided help points compared to 48% of non-accredited stations. Similarly, 93% of part-time staffed Secure Stations had help points compared to 61% of part-time staffed non-accredited stations. Note that, as discussed above, there were considerably more unstaffed stations amongst non-accredited stations.

Table 4.11: Stations with automated help points by Secure Station status and staffing levels

	Station staffed:			
	Unstaffed	**Part-time**	**Full-time**	**Significant Difference Secure vs Non-Accredited**
	%	%	%	
Secure Station	100 (7)	93 (83)	35 (112)	ns
Non Accredited Stations	48 (25)	61 (52)	37 (43)	ns
All categories	59 (32)	75 (135)	43 (155)	**
* *Statistically Significant Chi Square P<0.01 **ns** non significant **n/a** not applicable				

Access to the station

The number of pedestrian entrances into a station has been linked to an increase in personal security risks. Stations had a mean of 2.6 entrances, although 9% of stations had five or more exits/entrances. Using station plans and photographs of stations that are available online, the research team assessed whether each station had at least one pedestrian approach or entrance that was secluded or provided poor natural surveillance. This might include a long footpath or alleyway. Secluded station approaches may increase personal security risks and/or negatively influence passenger and staff perceptions of security. This assessment did not consider whether any lighting, CCTV or other measures had been employed to improve natural surveillance and thereby counter these problems. This data was available for all 322 stations and is summarised by Secure Station status and station category in Table 4.12.

Table 4.12: Entrances with poor natural surveillance at stations by Secure Station status and station category

Entrances with poor natural surveillance			
	Secure Station Accreditation		
Station Category	**Yes**	**No**	**Significance**
	% (N)	% (N)	
A	31 (13)		n/a
B	23 (26)	38 (8)	ns
C	27 (74)	44 (27)	ns
D	37 (53)	17 (30)	*
E	50 (24)	52 (27)	ns
F	20 (10)	52 (27)	ns
All categories	32 (200)	40 (119)	ns
* Statistically Significant Chi Square P<0.05 **ns** non significant **n/a** not applicable			

Across the sample, 35% of stations could be accessed via at least one ‘secluded’ approach. This figure was slightly lower for Secure Stations (32%) than non-accredited stations (40%), although this

difference was not significant. This was the case across all categories of station with the exception of Category D stations; in this category, a greater proportion (37%) of Secure Stations could be accessed via this type of approach compared with non-accredited stations (17%).

Retail and catering activity

Data was collated on whether stations hosted sufficient retail and catering activity (in addition to any in addition to station ticket offices) to provide informal surveillance of the station. This information was available for Secure Stations from the accreditation forms. Maps and photographs that form part of the online station information were scrutinised to make a similar assessment for non-accredited stations. This information was therefore available for all 322 stations; of these, 41% were assessed as hosting sufficient activities to promote enhanced informal surveillance. A higher proportion of Secure Stations provided this form of informal surveillance than non-accredited stations (46% compared to 33% respectively). This difference was statistically significant. It is not surprising, given that the classification of station category takes into account facilities and service provision on stations, that the larger and busier stations were more likely to provide this form of informal surveillance. However, it is interesting that two Category A stations did not. In one case, this was because retail activity was located in a distinctly separate area from the platform areas. Category B Secure Stations were more likely to host sufficient retail/catering activity; 85% compared to 50% of non-accredited stations. In Categories C, E and F, a smaller proportion of Secure Stations provided sufficient retail/catering provision compared to non-accredited stations, although these differences were non-significant. The distribution of responses between Secure Stations and non-accredited stations on this question was broadly similar for Category D.

Table 4.13: Stations with informal surveillance to waiting rooms, by Secure Station status and station category

Proportion of Stations with Informal Surveillance			
	Secure Station Accreditation		
Station Category	**Yes**	**No**	**Significance**
	% (N)	% (N)	
A	100 (11)		n/a
B	90 (20)	100 (7)	ns
C	86 (62)	65 (20)	*
D	79 (33)	82 (28)	ns
E	95 (19)	90 (20)	ns
F	70 (19)	73 (26)	ns
All categories	86 (155)	80 (101)	ns
* Statistically Significant Chi Square P<0.05 **ns** non significant **n/a** not applicable			

Informal surveillance to waiting rooms

Data was collated on whether the construction of waiting rooms maximised natural surveillance, allowing passengers to be seen and to see others. This information was available for Secure Stations from accreditation forms. Maps and photographs that form part of the online station information were scrutinised to make this assessment for non-accredited stations. The desk research established that 55 stations in the sample that did not provide waiting rooms; in addition it was not possible to make an assessment for 11 stations; therefore 66 stations were excluded from Table 4.13 above.

Across most of the sample, station waiting rooms enabled information surveillance and there was no significant difference between Secure Stations and non-accredited stations on this issue. The only exception was for Category C stations where, as shown in Table 4.13, Secure Stations were significantly more likely to provide waiting rooms with sufficient informal surveillance compared to non-accredited stations (86% compared to 65% respectively).

CCTV on stations

Data on the use of CCTV on stations was available for 273 stations. This question was included on the online survey with Secure Station accreditation forms and online information used to supplement missing information. However online information on CCTV was very inconsistent and accreditation forms were only available for Secure Stations; therefore there are more missing data for non-accredited stations (see Appendix 6).

CCTV was in use at the vast majority of sampled stations. Of the 273 stations for which this information was available, 91% had CCTV. This figure was somewhat higher for Secure Stations (95%) than non-accredited stations (82%). CCTV was in use at all of the stations within categories A and B, and at over 90% of stations in categories C, D and E. Category F stations were least likely to have CCTV, with approximately 40% of stations having installations. When the data were broken down by category, there were no significant differences between Secure and non-accredited stations.

Table 4.14: CCTV at stations by Secure Station status and station category

	Proportion of Stations with CCTV		
	Secure Station Accreditation		**Significance**
	Yes	**No**	
Station Category	% (N)	% (N)	
A	100 (13)		n/a
B	100 (26)	100 (6)	ns
C	100 (70)	95 (19)	ns
D	94 (50)	100 (22)	ns
E	91 (23)	81 (16)	ns
F	44 (9)	42 (19)	ns
All categories	95 (219)	82 (103)	**
** Statistically Significant Chi Square P<0.01 **ns** non significant **n/a** not applicable			

Monitoring of CCTV

Information on the monitoring of CCTV was available for 206 of the stations which employed CCTV; this is summarised in Table 4.15. At the majority (78%) of stations with CCTV, a monitor or monitor(s) were available providing live camera feeds. In the remaining stations, recordings of CCTV would only be accessed to investigate an incident after the event. Secure Station status did not influence the extent of CCTV monitoring. There was some variation within the station categories; in categories C, E and F for instance, CCTV monitoring was more prevalent for Secure Stations than for non-accredited stations. Within category B, 100% of non-accredited stations monitored CCTV in real time, compared with 68% of Secure Stations, although the number of accredited stations for which this information was available (5) was considerably less than for Secure Stations. As noted in section 4.6, the fieldwork at stations highlighted a wide variation in monitoring practices. With 'monitoring' practices ranging from purpose-built control rooms with dedicated staff to a small monitor in the corner of a busy ticket office.

Table 4.15: Real time monitoring of CCTV at stations by Secure Station status and station category

Stations with Real Time Monitoring of CCTV			
	Secure Station Accreditation		
	Yes	No	Significant Difference
Station Category	% (N)	% (N)	
A	75 (12)		n/a
B	68 (19)	100 (5)	ns
C	76 (67)	46 (11)	*
D	85 (41)	94 (16)	ns
E	90 (20)	57 (7)	ns
F	75 (4)	75 (4)	ns
All categories	799 (219)	74 (103)	ns

* Statistically Significant Chi Square P<0.05
ns non significant
n/a not applicable

Upgrades to CCTV

Information on upgrades to CCTV were available for 159 stations; of these, 82 reported the implementation of upgrades to CCTV over last five years. A third of these upgrades had taken place in the last 12 months; a similar proportion of upgrades had taken place more than one year but less than two years ago. Upgrades had taken place over two years ago in 13% of stations, and 18% reported that no improvements had been implemented. This was an online survey question for which a large proportion of responses were left blank or answered 'don't know.' This information was missing for 58% of the 248 stations at which that the presence of CCTV was known. As with other questions relating to the recent history of the sampled stations, this reflected the fact that many of the station staff answering the survey had only been in post for a relatively short period of time. There was only a small difference in the proportion of Secure Stations that had upgraded CCTV compared to non-accredited stations (84% compared to 75%). Overall, improvements had occurred more

recently at Secure Stations, with 40% implementing upgrades within the last 12 months compared to 23% of non-accredited stations.

Table 4.16: Lighting at stations by Secure Station status and station category

		Secure Station Accreditation		
		Yes	**No**	**Significance**
Station Category	**Lighting at the station**	%	%	
A	Good and consistent	64		n/a
	In need of improvement	36		
	Poor			
	N	**11**		
B	Good and consistent	60	40	ns
	In need of improvement	35	60	
	Poor	5	0	
	N	**20**	**5**	
C	Good and consistent	73	70	ns
	In need of improvement	23	30	
	Poor	4		
	N	**56**	**13**	
D	Good and consistent	76	57	ns
	In need of improvement	21	43	
	Poor	3		
	N	**34**	**14**	
E	Good and consistent	68	30	ns
	In need of improvement	32	60	
	Poor		10	
	N	**19**	**10**	
F	Good and consistent	88	70	ns
	In need of improvement	12	20	
	Poor		10	
	N	**8**	**10**	
All categories	Good and consistent	72	56	ns
	In need of improvement	26	40	
	Poor	3	4	
	N	**148**	**52**	

ns non significant
n/a not applicable

Lighting

The online survey asked a number of questions about lighting quality on the station. The responses to these questions were amalgamated to produce a scale ranging from 'poor' to 'good and consistent' (Table 4.16). Information on the quality of lighting was available from the online survey for 200 of the stations in the sample; at these stations, 67% of respondents reported that the station lighting was 'good with consistent levels of lighting across all areas'. 30% of respondents felt that lighting at the station would 'benefit from improvements', while only 3% reported that lighting quality at the station was 'poor'. Respondents representing Secure Stations were more likely to state that lighting was 'good and consistent'; 72% stated this compared to 56% of respondents from non-accredited stations. Conversely, respondents from non-accredited stations were more likely to state that station lighting was 'in need of improvement'; 40% of non-accredited stations compared to 26% of Secure Stations. However this difference was not statistically significant. This pattern was repeated when the data was split by station category. Differences in lighting quality were greatest for category E stations, where 68% of responses relating to Secure Stations reported 'good and consistent lighting' compared to 30% of those relating to non-accredited stations.

Thirty per cent of stations reported implementing improvements (other than ongoing maintenance) to lighting over the last five years. Of these 12% (5% of the total sample) had implemented improvements to lighting in the last 12 months, 12% had implemented changes between one and two years previously and 5% had implemented changes between two and five years ago (stations were able to report up to three improvements).

There was no difference between Secure and non-accredited stations with regards to improvements made to lighting, although improvements made at Secure Stations tended to have been made more recently (ie within the last 12 months) when compared to those at non-accredited stations.

Informal surveillance, improvements to lines of sight

The online survey asked whether improvements or modifications have been made to the station in order to improve lines of sight and enhance informal surveillance. This might include correcting corners, changing wide pillars and recesses, improving passageways subways and stairways, or vegetation removal. Responses to this question were received for 203 stations. Around a quarter of changes were implemented more than five years ago, and 10% within the last 12 months. In the majority of cases respondents did not know when the improvements had been made. Secure Stations were significantly more likely to implement this form of improvement compared to non-accredited stations (63% compared to 29%). This pattern applied across all categories of station.

Ticket gates

Automated ticket gates are installed at 58% of the 322 stations in the sample. Table 4.17 illustrates that ticket gates have been installed at a significantly higher proportion of Secure Stations compared to non-accredited stations (62% compared to 50% respectively). The difference between Secure Stations and non-accredited stations was greatest within Category E (28% and 7% respectively). Ticket gates are least common within Category F stations; this is due to the requirement to staff automatic ticket gates and the high proportion of unmanned stations in this category. Category B is an anomaly in that ticket gates more prevalent for non-accredited stations.

Table 4.17: Stations with automated ticket barriers by Secure Station status and station category

Proportion of stations with automated ticket barriers			
	Secure Station Accreditation		
	Yes	No	Significance
Station Category	% (N)	% (N)	
A	69 (13)		n/a
B	58 (26)	62 (8)	ns
C	39 (75)	39 (28)	ns
D	21 (53)	10 (30)	ns
E	28 (25)	7 (27)	*
F	0 (10)	4 (27)	ns
All categories	35 (202)	18 (120)	**
* Statistically Significant Chi Square P<0.05 ** Statistically Significant Chi Square P<0.01 **ns** non significant **n/a** not applicable			

Cycle storage

Around three quarters of stations in the sample provided stands or lockers for the storage or bicycles. Cycle storage was available at a significantly higher proportion of Secure Stations compared to non-accredited stations (82% compared to 69%). The difference between Secure Stations and non-accredited stations was most apparent within Category F, where 90% of Secure Stations provided cycle parking compared to only 41% of non-accredited stations.

British Transport Police operations

Of the 118 stations answering the question in the online survey, 50% were aware of BTP operations that had taken place at the station over the last five years. There was no difference in the number of operations that respondents were aware of between Secure Stations and non-accredited stations. The personal security issues that were addressed most frequently through these operations were ticketless travel (14 stations), drugs (14 stations), anti-social behaviour (12 stations) and knife crime (11 stations).

Car parks

Of the 322 stations in the sample, 231 had car parks that meet the definition of station car park (see definition in section 2.1). 135 car parks in the sample had received SCP accreditation. Across the sample as a whole, car parks had an average of 227 spaces. The majority (68%) of car parks were pay and display, 20% were free and 10% ‘pay on exit’. Questions about the nature of station car parks were asked in the online survey. Secondary sources of data relating to car parks were sparse in comparison to stations, although data from car park management companies and Parkopedia.com has been used to supplement online survey returns. The following section describes the differences between SCP and non-SCP car parks, and explores these differences by station category. Unfortunately data on the questions were missing for around 40% of stations

Across the sample, 71% of station car parks were covered by CCTV, 19% of car parks were manned, and 63% were surrounded by a boundary fence or wall. There were no significant differences for these variables between SCP car parks and non-accredited car parks or between different station categories. Of the 136 car parks for which data was available, 54% were regularly patrolled; as shown in Table 4.18, this figure was higher for SCP car parks (68%) compared to non-accredited car parks (40%), a difference that was statistically significant.

Table 4.18: Proportion of car parks that are patrolled by Safer Parking accreditation and station category

Proportion of car parks that are patrolled			
	Secure Car Park Accreditation		
	Yes	**No**	**Significance**
	% (N)	% (N)	
A	83 (6)	1 (100)	ns
B	67 (12)	71 (7)	ns
C	83 (30)	53 (8)	*
D	64 (11)	41 (17)	ns
E	25 (12)	0 (12)	ns
F	0 (0)	33 (9)	ns
All categories	68 (71)	40 (62)	*
* Statistically Significant Chi Square P<0.05 **ns** non-significant			

4.5.3 Summary

The above section has demonstrated that there are key differences between Secure Stations and non-secure stations. Secure Stations are more likely:

- **To be staffed and/or have longer staffing hours**; this difference is particularly notable for Categories E and F.
- **To have emergency help points**, particularly Category C and F stations, and at unstaffed stations.
- **To operate CCTV**.
- **To monitor CCTV feed**, particularly in the case of Category C.
- **To host retail activity** that provides informal surveillance, particularly Category B.
- **To have waiting rooms** which lend themselves to informal surveillance, particularly Category C.
- **To have automated ticket barriers** at Category E stations.
- **To provide cycle storage** at Category F stations.
- **Not to have a station approach** that is secluded, particularly Category D stations.

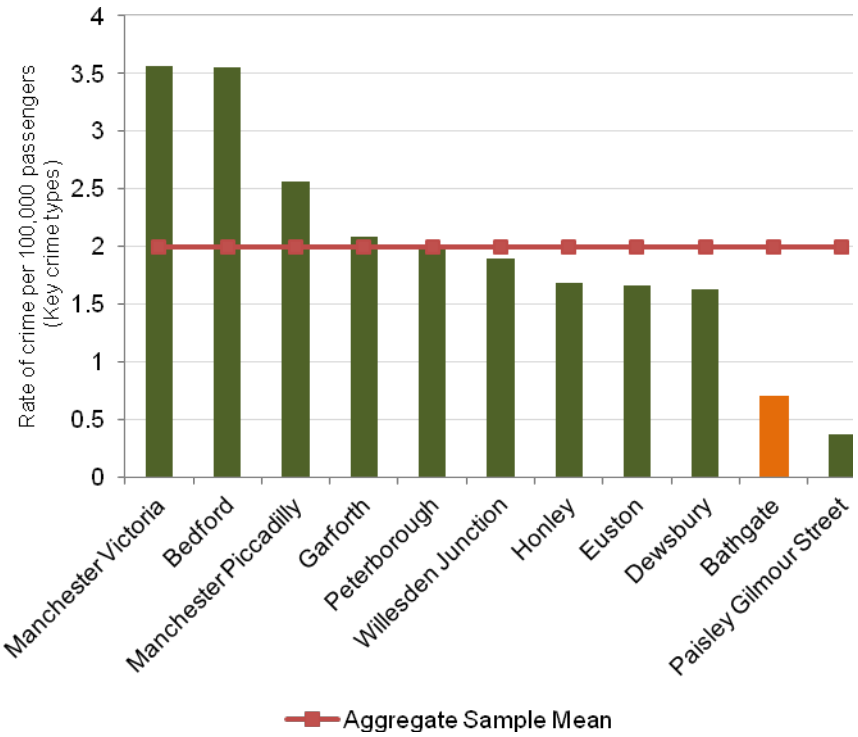
The analysis did not identify as many significant differences between SCP and non-accredited station car parks, although the data was less complete than for stations. The main distinction identified was a greater likelihood of car park patrols; this feature was significant for Category C stations.

4.6 Results Strand 2: Understanding the Implementation of Crime Prevention at Stations

4.6.1 Key themes emerging from the visual audits of stations and car parks

To provide context to the findings of the site visits, Figure 4.4 below shows the crime rates for each of the 11 sites that make up the detailed sample. These are compared to the mean for the aggregate sample of 322 stations. Bathgate is highlighted in the figure as this station only opened in October 2010. The graph shows that crime rates at Manchester Victoria, Bedford and Manchester Piccadilly were above average, crime rates at Garforth, Peterborough and Willesden Junction were close to the average for the wider sample, and the remaining station had a below average crime rate. This demonstrates that the 11 stations vary in terms as of their crime rates, as well as accreditation status and station characteristics more generally.

Figure 4.4: Rate of crime per 100,000 passengers (key crime types) detailed sample sites 2006/7 to 2010/11, (n=11)



Access and approach

The 11 stations varied in their locations, from busy city/town centres, to quiet suburban locations. While all of the stations were surrounded by land uses that provided informal surveillance, this was rarely consistent around the entire station boundary. One station in the sample felt particularly isolated from its surroundings, and was separated from the nearby High Street by an extremely long and narrow footpath (see Figure 4.5). Although the path is covered by lighting and CCTV, it remains quite dark at night. A staff member at the station reported that they themselves avoided using the footpath even during the daytime as this was an area frequented by drug users and drug dealers - a

comment reiterated by a respondent to the passenger survey. There is also a pedestrian access path to the front of the station via a long stairway; again this stairway felt very isolated although it was covered by CCTV. Two other stations in the sample have similar but much shorter pedestrian paths providing access to the rear of each station; in the case of one of them this is covered by CCTV.

Figure 4.5: Footpath approach to one of the stations in the sample

Consideration of the areas surrounding each station serves to highlight the ways in which informal surveillance can be enhanced or restricted. Homes that have recently been built on a brownfield site adjacent to one station provided informal surveillance of the station approach and perimeter. Although the perimeter feels overlooked, access to the platform is through a doorway and up a stairway; this entrance feels dark and isolated (Figure 4.6). The approaches to six of the stations were open and provided visibility and minimised isolation. The perimeter at another station is dotted with retail and catering units; some of these units provide access into/out of the station. A recently built retail unit outside the station has provided surveillance over an area that previously presented problems with cycle theft. One of the stations in the sample has a sports and entertainment Arena situated within its boundary. Crimes occurring at the Arena are the responsibility of BTP rather than the local area Police)[4]. There are seven entrances/exits to the Arena and, with one exception, these all lead into the station; this radically increases the number of people passing through the station, although many of these are not travelling from the station. Overall, this station was extremely permeable with a total of 8 exits/entrances including one with poor informal surveillance.

[4] Conversely there are tram platforms located under the station roof, crimes occurring here are the responsibly of the local area police.

Figure 4.6: Stairwell at a station in the sample

Station layout and environment

The stations visited all had clear directional signage, directing passengers to platforms, facilities and transport links. However the layouts at two of the stations in particular were complicated. At one of the stations, the researchers observed passengers having difficulties finding their way around. Another station in the sample was formerly three stations that have been linked by bridges and passageways; the research team found this difficult to navigate and felt disorientated while finding their way around the station.

At another station, the area at basement level that provides access to the taxi rank and the car park felt dark and unwelcoming, particularly after dark. This area was covered by CCTV, although this may not be obvious to passengers. Other measures had been taken to improve this area, including bright white paint to lighten up dark areas and the use of mirrors to allow passengers to view around corners.

The stations varied in the extent to which they felt like light and welcoming environments. The choice of construction materials exerted a strong influence on the station environment. For example, Figure 4.7 of the footbridges at two stations highlight the difference that the choice of construction materials can make to the station environment. At one station the footbridges retained a light and open feeling, while at another the footbridge felt dark and enclosed. The researchers felt that the large number of people using these two footbridges also ensured feelings of safety. Nevertheless, the design of one of the stations footbridges and particularly the materials used to build them could have been improved to further increase the opportunities for natural surveillance. At one of the stations access to the platforms was via a subway. A combination of brightly coloured walls, wider corridors and high ceilings and good lighting contributed to making this subway feel like a safe place. The researchers did identify a number of blind corners, although CCTV was evidently in use.

Figure 4.7: Pedestrian footbridges at two of the stations in the sample

Two stations in the sample both provided well lit concourse environments and platforms that felt busy, but not overcrowded, throughout the day. In contrast, another station in the sample felt dark and isolated even during the daytime. The platforms of all the stations were well lit after dark. The platforms at one of the stations are very long and towards the extreme ends they felt isolated; passengers would be unlikely to wait in these areas, but they could provide areas for anti-social behaviour to take place. Researchers identified similar areas at two other stations in the sample that could provide places for offenders or anti-social individuals to loiter. At one station in particular, staff reported that they previously found evidence that people have been hiding under the stairs which lead to the pedestrian bridge. At another station, the area outside the toilets felt somewhat secluded compared to the rest of the station, and the interview confirmed that this area poses a slight problem with anti-social behaviour at night. In recent years, the entrance and ticket hall to another station in the sample has been extensively refurbished creating a larger area that is lighter and feels more open (see Figure 4.8). This refurbishment highlights what can be achieved within the exiting framework of older station buildings.

Figure 4.8: Ticket hall at a station in the sample

Ticket gates

Automated ticket gates were in use at three of the stations in the sample. At two of these stations, the gates permitted smooth passenger movement through the concourse at busy times. On the date of the visual audits, the automatic ticket gates at one of the stations were not working. At the remaining stations, tickets were manually checked at the gate line. Researchers observed that this caused a slight overcrowding issue during peak hours at one of the stations in particular. At the remaining stations, tickets are only checked periodically. Although the layout at one of the stations was complicated, it was not possible to leave the station without passing a gate line. This was not the case at another of the stations, where it is possible to leave the station via an alternative exit or the car park and in doing so to avoid the gate line. Table 4.19 summarises information on the proportion of passenger tickets checked at each of the 11 sample stations.

Table 4.19: Proportion of passenger tickets checked, detailed sample

Station	% of passenger tickets checked
Station one	Less than 25%
Station two	More than 75%
Station three	Less than 25%
Station four	Between 50 and 75%
Station five	Less than 25%
Station six	Between 25 and 50%
Station seven	Between 25 and 50%
Station eight	More than 75%
Station nine	Between 50 and 75%
Station ten	Between 50 and 75%
Station eleven	More than 75%

Facilities

Across the stations visited, waiting rooms and shelters tended to have large windows, thus allowing easy surveillance from and onto the platforms. At one station, whilst clear shelters are located on the platforms; they are situated in dark areas which restricted the benefits of visibility provided by this design. At a second station, the recessed entrance to the building has been enclosed with a glass frontage creating a waiting room that is sympathetic to the station building (see Figure 4.9). At a third station, the traditional waiting rooms have been retained but the doors have been replaced with clear glass automatic doors. This change was made to facilitate wheelchair access, but has the added benefit of enhancing informal surveillance. However, the waiting rooms themselves were very sparse and unwelcoming. The Station Manager at a fourth station informed us that although the main waiting room is visible from the ticket office, there is a blind corner concealing a large area of the room. This means that staff must view CCTV if they wish to see if anyone is in that area. It should be noted that waiting rooms at stations staffed part-time are locked when the station is not staffed (which includes three stations in the sample), a point that is returned to below. Train departure and arrival information

was clear at most stations, with departure screens well sited and in working order, and accompanied by announcements. At one station, there were no departure screens, but there were timetables and automated announcements which were operational on the day of the visit. Facilities at the stations including ticket machines, cash machines, public telephones and toilets, all of which were in good working order at the time of the visual audit.

Figure 4.9: Waiting room at a station in the sample

Figure 4.10: Example of surveillance opportunities from one of the waiting rooms at two stations in the sample

With the exception of three stations, the remaining stations provided some form of retail or catering activity. As expected for the size of the stations, two stations in particular provided an extensive range of shopping and catering outlets; this included a large busy food court at one station, and a smaller food court at the other. Both stations have units that remain open for the periods at which trains

operate. In contrast, two other stations in the sample provided only very minimal retail and catering provision (two small newsagents and a cafe at one and a small newsagent at the other). At these two stations, these outlets were located near to the entrance and did not therefore facilitate the guardianship of the main concourse/platform areas.

At another station, two retail/catering outlets were located on the concourse and one immediately outside the main entrance. These provided informal surveillance for passengers entering/leaving the station but not for those waiting on platforms. There is a catering unit on the platform at another station in the sample, although given the nature of the station layout this provides surveillance for only a limited area. A public house is located on the platform at one of the stations, along with a shop located in the ticket hall. During the interviews, station staff commented that the pub provided a presence on the station during the hours it is not manned, and therefore was a benefit to the station rather than a source of problems. There were no retail/catering activities at the three remaining stations. However at one of the three, a taxi office provides day long surveillance and the original station master's house has been rented out, such that the tenant effectively lives 'on the station'.

With the exception of one, all stations provided cycle storage. In most cases this was in the form of hooped stands, although one station in the sample provided cycle lockers and another provided double-decker cycle stands see Figure 4.11. Three other stations have all recently expanded their provision for secure cycle storage. In all the cases where cycle storage was provided, this was covered by CCTV, although at one station staff reported that this coverage was limited. At one station, bike stands are equipped with a movement-sensor-operated announcement that alerts those using the stands to the presence of CCTV. At another station, CCTV had not prevented a number of thefts from the stands; consequently new stands have been relocated to a busy area, within the boundary of the station, and near to staff offices. The station that did not provide cycle storage was because the previous stands had been subject to vandalism. The Station Manager also commented that the majority of cyclists took their bikes onto the train. During the visual audit the research team did not observe any evidence of vandalism to the bikes left on stands. The exception to this was at one station where the researchers noted a broken bike wheel that was left locked to the stand. There was only one location where researchers observed cycles chained to unofficial locations. This might be because the other cycle racks are inconveniently located and situated in dark areas.

Figure 4.11: Cycle stands at a station in the sample

CCTV

With the exception of one station, all of the stations in the sample were covered by CCTV. All of the stations had posters advertising the use of CCTV although it is unclear how apparent these would be to passengers. Due to the large number of cameras, the presence of CCTV was most notable at one of the stations in particular. Staff at most of the stations reported that CCTV coverage was good, although those at two stations were aware of blind spots.

A live feed of the CCTV was available to view on a small screen in the station offices at five of the stations. At two stations, this feed was also linked to an off-site CCTV control room. At three other stations, CCTV was monitored from purpose built control rooms located on the station. However staff in these control rooms are also responsible for other duties including train dispatch; therefore maintaining the monitoring CCTV can prove challenging. At one station in the sample the CCTV was not monitored in real time.

Staff presence

At the manned stations, the researchers noted that the station staff were clearly visible on the station platforms and in the concourse/ticket hall areas. At one station, the presence of staff was limited to revenue protection officers on the gate lines, and did not extend to the platform areas. At a second station, the research team were approached by several staff members with regard to their permission to be on the station; at a third, the researchers noted that staff made an effort to check their ID badges. The researchers viewed these actions as a strong indication that staff were conscious and proactive regarding potential security and safety issues. The researchers were not issued with ID at one of the stations; despite this the researchers were not questioned as they entered platforms without tickets. The location of a London Underground staff mess room at one of the stations meant that there were lots of uniformed staff at the station; the researchers felt this would provide reassurance to passengers even though these staff were not actually working at that station.

The researchers observed BTP officers on patrol at three stations in the sample. Police Community Support Officers (PCSOs) were observed at two other stations. At the sixth station, the researchers did not see any officers from BTP although during the interview, although station staff reported that they make a number of patrols each day. Help points were available at several points at each of the stations visited, although these were not immediately obvious and may benefit from clearer signposting.

Crime prevention

Of the Secure Stations audited (five in total), none publically advertised their station's accreditation. Stations did display BTP posters aiming to reassure the public by advising them of crime prevention and security measures in place (noted at three of the stations). Public address systems were in operation at all of the stations visited, but during the visual audits the researchers did not hear any crime prevention or security announcements.

The researchers did not find evidence of litter, graffiti or vandalism at the stations, with the exception of the one unmanned station. Staff engaged in cleaning and maintaining the appearance of the station were observed at all of the staffed sites. At this unmanned station, the audit was undertaken on a Monday and there were signs that drinking had been taking place in the shelters over the weekend (ie

empty and broken beer bottles)[5]. Litter levels at this station may have been aggravated by the fact that during times of poor weather, as was the case during the audit, cleaning teams are diverted to gritting platforms. This was the only station with visible graffiti; this was etched into the windows of the waiting shelter. The Station Manager also reported that vandalism to the Help Point was a frequent problem, resulting in a need to replace the help point on a number of occasions.

Car parks

Car parks were audited at seven stations. One of the stations has one long stay multi-story car park. The second has a short stay single level car park and a long stay multi-story car park. There are three Network Rail car parks at a third station, two single level long stay car parks and a short stay car park. A fourth station also has three car parks, one short stay and two long stay car parks. The fifth and sixth stations both have large single level car parks and the seventh station has a single level car park; this is normally pay and display but at the time of the audit the car park was free due to ongoing refurbishment works at the station. The car parks at two other stations are owned and controlled by the local authority and there is no car park at a third, with only limited on street parking available therefore these were not included in the audit.

The car parks audited at three of the stations are all pay on foot and barrier controlled. There is no charge for parking at two other stations that were audited. All other car parks were pay and display. The car parks were all well used. At two stations the car parks were completely full and passengers have complained about lack of parking capacity at the stations. At one of the car parks which is free, it is frequently used by non-rail users.

Two of the long stay car parks, both managed by ACPOA, were manned full-time, with the attendants undertaking hourly patrols. Although not manned full-time, NCP make one daily patrol of each car park at a third station. At a fourth station, BTP officers include the car parks in their regular patrols of the station, making a number of patrols per day. At a fifth station, the car park is patrolled by BTP officers and Police officers; the car park is also regularly patrolled, and the researchers observed a van making a patrol of the car park on the day of the audit. Station staff at two other stations reported that they conduct daily litter picks of the car parks which act as a further deterrent to offenders.

All of the car parks audited were bordered by a secure perimeter. This clearly defined each of the car parks and allowed for good natural surveillance. There was one exception to this at a short stay car park; the perimeter here was predominantly brick and restricted any opportunities for natural surveillance. The multi-story car parks at two other stations were both well lit and did not have any dark corners where offenders could hide. White paint had been used at one of these car parks which maximised the feeling of light. The research team felt that both of the long stay car parks at one of the stations provided a number of isolated and secluded areas which had poor informal surveillance. Pedestrian entrances to most of the audited car parks offered good visibility. An exception was one of the pedestrian entrances to the standard long stay car park at another station car park; this entrance was concealed and did not allow pedestrians to view around a blind corner.

The majority of car parks audited were well lit; however the researchers identified that lighting at the one of the long stay car parks was more limited. All car parks were covered by CCTV, although the presence of CCTV may not always be obvious to customers. There were no posters or signs concerning crime or crime prevention. Help points were available at the car parks at three stations; in all cases these were conveniently located next to the self service payment machines. There were no

[5] Visual audits were also conducted on Mondays at two of the other stations. At these manned station evidence of weekend anti-social behaviour was not evident.

help points at two stations in the sample. The researchers noted that bollards were positioned in front of the pay and display machines at one of the station car parks to prevent ram-raiding.

During the daytime the researchers did not have any concerns about their personal safety when assessing any of the car parks. However, after dark the researchers felt less safe in the long stay car parks at one station in particular; this was due to its distance from the station, the absence of informal surveillance from surrounding land uses, and limited sources of lighting.

Safer Parking

The Safer Parking status of car parks at two of the station car parks audited was clearly displayed. This information was also displayed at a third station car park, but would not have been so apparent to passengers. The Safer Parking status of a fourth car park was not displayed; indeed staff were unaware of the Safer Parking status at this location.

4.6.2 Key themes emerging from interviews with station staff

Crime and anti-social behaviour at the stations

Staff at the stations reported that crime problems were minor, particularly taking into account that a number of the sampled stations are open 24 hours a day, and that a large volume of passengers travel through each of the stations. Interviewees pointed out that crime problems at stations often result from problems in the areas in which stations are located, for example one of the stations is situated in a challenging area that is subject to extensive crime and anti-social behaviour problems.

The most consistently reported crime problem across the 11 stations was anti-social behaviour, particularly alcohol-related anti-social behaviour. Associated problems include fights between passengers, verbal abuse against staff and irresponsible behaviour on the platforms which can endanger safety. This was particularly associated with weekends and the night-time economy. At one station, this behaviour sometimes follows events at a local Arena, although this is dependent on the nature of the event and those attending. A number of stations reported that football matches have a remarkably small impact on anti-social behaviour. Toilets were a site of anti-social behaviour at three of the stations. At a fourth station, there have also been instances of staff abuse at the turnstiles to the toilets.

At a fourth station, one staff member commented that few incidents of drunkenness were severe enough to involve the BTP. However, another staff member felt that drunkenness was a serious problem, with verbal abuse posing a threat to personal safety and raising stress levels by needing to be extra vigilant in viewing the CCTV. This staff member stated that she had not anticipated that handling drunk/disorderly people would be part of her role. At a fifth station, much of the anti-social behaviour is related to young people from the neighbouring high school; problems include vandalism, ticketless travel and trespassing. Young people have also caused problems at the fourth station by riding on bikes inside the station, although this problem has since dissipated (indeed this was behaviour was observed on the day of the audit; staff responded with a tannoy announcement which appeared to work).

Bicycle theft was reported as significant issue at many of the stations visited (with the exception of four). Station staff reported that theft of cycle components was as much a problem as theft of entire cycles. At one station, they believed that components were often stolen to order while at another station staff speculated that cycle parts are being stolen for their scrap value. A third station has improved CCTV coverage to cycle stands, and a fourth is currently working to improve the lighting

and CCTV coverage to stands. As noted above, two of the stations in the sample have both relocated stands to busier areas that they feel will be more secure.

Stations have operated a number of initiatives to reduce cycle theft. At four of the stations in the sample, BTP have implemented operations to target serial and professional bike thieves. These investigations have included visits to second hand stores and car boot sales to recover stolen cycles and gather information on potential perpetrators. One of these stations is currently exploring funding opportunities to provide bicycle locks to passengers and another station is running a cycle marking initiative in conjunction with the local council.

Bicycle theft was not reported to be a problem at two stations in the sample. One of these stations provides both cycle lockers and hooped cycle stands, both of which were conveniently located near to the station entrance. On the day of the visit the lockers appear to have been favoured by cyclists. However, cycle lockers are not appropriate at all stations due to the difficulty of checking what is inside. At the second station, cycle racks were appropriately positioned in a well-lit area to the front of the station, but the station supervisor reported that the majority of cyclists took their cycles with them on the train.

Theft of personal property from passengers was reported as a considerable problem at two stations in the sample. The busy food court at one station was identified as an area where passengers are likely to be more distracted from their belongings. At London stations there is a concern that offenders may target passengers visiting for the upcoming Olympics. To counter this multi-lingual announcements and crime prevention literature has been prepared.

As noted above, crimes committed at an Arena local to one of the stations are reported as occurring at the local station. While the number of crimes occurring at the Arena is extremely low given the thousands of people attending events, it can impact on crime rates for the station. Some events have been targeted by offenders stealing personal property (especially mobile phones during shows). These are known groups of thieves who follow specific tours and intelligence is shared between venues on a national basis. Some of the Arena events also lead to the presence of ticket touts and sellers of unlicensed merchandise at the station. The layout of the station makes these crimes difficult to prevent, with sellers simply leaving the station by one exit and returning again by another.

Fare evasion was reported as a major problem at two stations in the sample. In the case of one, the problem was reported to be greater than at neighbouring stations on the line. Gate lines, whether automatic or manual, were reported as a site of potential conflict, occasionally resulting in verbal and physical assaults on staff. Automatic ticket gates do not necessarily resolve these problems on their own, as offenders often attempt to jump over them or turn their frustration towards station staff. Station staff and managers across the stations generally agreed that it is preferable to allow confrontational passengers to pass through rather than endanger personal safety. Station staff at another station reported few problems with crime on the station, but stated that where problems do occur they are principally related to tickets. This station deals with a number of ticket disputes particularly where passengers have been requested to alight at the station because the ticket dispute was not resolved on the train. There are no automated ticket gates at another station, although they were included on the original station plans. The station supervisor stated that automatic ticket barriers would have been beneficial, as there is an issue with ticketless travel at the station and no regular ticket inspections at the station.

Three other stations also reported the problem of homeless people seeking shelter on the stations overnight. At one of these locations, this is thought to have increased following the closure of several local shelters; some of these homeless people are candidates for Criminally Related Anti-Social Behaviour Orders (CRASBO) and this is being pursued in conjunction with the local authority's Community Safety Partnership.

Two stations in the sample both reported problems with shoplifting from retail units located on the station. At one of the two stations, it was reported that such offences are often associated with public disorder and assault offences when security guards attempt to tackle the offender. This station is considering changing the tenancy agreements for retail units to ensure that greater responsibility is taken to prevent thefts and to ensure that stores implement crime reduction measures suggested by BTP. At the other station, BTP are currently working with a city centre management company, to establish exclusion orders to ban repeat shoplifters from two stations in the local area.

As noted above, there were few signs of graffiti at the stations visited. Most stations reported that this problem was minor and that any incidents of graffiti are immediately removed by cleaning contractors. One station reported that graffiti tends to occur out of sight of passengers, such as at the external front of the station. However, this station also reported graffiti in the toilets which is often explicit and engraved into surfaces making it difficult to remove. Anti-graffiti paint was not used at stations visited. At another station, it was explained that there is a preference to paint stations in corporate colours; anti-graffiti paint only being supplied in a limited range.

Cash machines at one of the stations were targeted by a ‘cash trap scam’; offenders made simple modifications to the cash machines, this resulted in notes being caught in a concealed trap rather than released to the customer making the withdrawal. It is thought that the machines were targeted, firstly because they were a model easy to modify and secondly because they are located in proximity to a main road from which offenders can watch the machines.

The station staff interviewed did not feel that there were any particular problems with vehicle crime in their station car parks. One station car park reported that they have only had one crime reported since the station opened and this was an incident where a car had been vandalised. Another station car park had experienced problems with thefts from vehicles but this has decreased over recent years. The station has run a number of initiatives to tackle this problem including leafleting car park users about items left on display in cars, and ‘crime prevention roadshows’ to raise awareness. Although the car park at a third station is the responsibility of the local authority, station staff reported a number of issues, including aggressive begging and drug use, which have the potential to impact on passengers’ feelings of safety.

Staffing

Station management reported that questions around customer care skills were included in staff recruitment and staff members recalled being asked to give examples of when they have dealt with conflict in previous jobs when they were interviewed for their role. All of the stations visited provided training in managing conflict and dealing with difficult passengers. At two stations in the sample, BTP have also provided conflict management training specifically for gate line staff. Representatives from three stations felt that training in conflict awareness had come too late as they had already had to learn to deal with such situations on the job prior to receiving their training. They stressed that this training should be received at the very start of employment.

A number of staff raised concerns about staffing levels. At off-peak times, smaller stations may have only one or two staff members on duty and staff reported feeling isolated in these situations. Staff at three stations reported experience of serious incidents of verbal abuse and as a consequence did not feel safe working alone. At one of the stations radios were introduced approximately 12 months ago; this has improved communication around the station and is very reassuring to staff members, especially when working alone at night. Although not having experienced a serious incident of verbal abuse, staff at another station also reported concerns around lone working. At stations staffed part-time, staff raised concerns about the need to ensure waiting rooms are empty before locking the

facilities. On most occasions passengers understand the need to lock up but at times passengers have been abusive.

Although staff are encouraged to report all incidents, some interviewees believed there was a tendency for staff members not to report verbal assault as they view it as part of the job and they are trained to not take insults personally, there may also be a reluctance to complete the associated paperwork. One staff member stated that there was a greater tendency for female staff to log incidents, as men tended not to feel that incidents were severe enough to warrant logging. A customer service adviser at one station felt that there was little in the way of aftercare for staff following an incident and expressed a need to be able to talk to someone other than a line manager about difficult incidents.

CCTV

As noted above, CCTV was in use at all stations, with one exception. At another station, it was explained that the system is regularly improved, but that this happens in a progressive way, with each camera that needs replacing being exchanged for the latest model (rather than upgrading the whole system). In contrast, a third station's CCTV system is scheduled for a full upgrade in 2012, which will replace current cameras with the latest technology. At a fourth station, the number of CCTV cameras was expanded in the summer 2011; there are plans to add yet more cameras, including cameras to improve the coverage of the pedestrian access routes to the station. The Station Manager at that location stated that CCTV was essential at because the layout of the station makes it 'impossible to see anything other than a small part of the station at any one time - regardless of where you stand!'. At the station without CCTV, it was explained that unstaffed stations tended not to have CCTV as it was not possible to monitor the cameras from the station. The Station Manager stated that, ideally, station cameras should link into local authority control rooms to counter this problem.

British Transport Police

It was clear from the all of the interviews that the station staff and BTP have a very close working relationship and work in partnership on number initiatives. At two stations, BTP operate ‘BTP surgeries’ enabling station staff to meet BTP officers, raise concerns and receive advice while BTP officers can gather intelligence on crime problems.

There are BTP stations at four of the stations in the sample. At stations with no BTP station there were concerns about the time it can take to receive help in an emergency. Three stations reported the success of short term initiatives to increase the visibility of BTP on stations. In all cases staff reported reductions in verbal abuse to staff and expressed a desire for an increased police presence to be extended. Staff at one station reported that without these initiatives they can ‘go for days’ without seeing a BTP officer. At another, station staff expressed concern that patrols by BTP appeared to have been cut back, particularly at night. Staff at two stations stated that they would like to see ticket gates staffed by BTP at peak times.

In addition to BTP officers, two stations reported that security teams employed by the TOC conduct patrols as part of a wider patrol of the line. One station reported that the emergency response from the security team was often quicker than that from the police. At a fourth station, security teams had previously visited the station at the end of shifts to support staff locking up the station. This patrol has now been cut back, adding to the concerns staff have about this part of their duties.

Stations also reported close working relationships with Community Safety Partnerships and local authorities; two stations are both represented on local authority Community Safety meetings, whilst a third sits on the boundary of three local authorities which presents challenges to partnership working.

Modifications

At two of the stations, modifications had been made to prevent passenger access to unauthorised areas at the end of the platforms through the installation of controlled gates. A third station was redesigned in 2007-8; this helped reduce many of the crime problems experienced there, including prostitution on the station which had been a problem previously. A redevelopment of a fourth station, funded by Network Rail and the City council, is planned to begin in October 2012. This will include improved lighting, a simplification of the current layout and a reduction in the number of entrances/exits, enabling the station to be locked down if necessary. Interviewees from three stations commented on the restrictions to investment that are created by the current franchise timeframes. At a fifth station, crowd control gates have been installed to allow station staff to easily close off parts of the station; these gates are also useful in the event of the need to evacuate the station. There are also plans at this location to improve railway-owned land surrounding the station, which is outside the station lease. This includes the Station Approach Road and the long pathways that link the station to local roads.

Passenger satisfaction

None of the stations audited had their own dedicated passenger user group or forum although there were passenger groups representing the lines on which stations were situated. The Station Manager at one station monitors a twitter feed for the station which he identified as a source of useful passenger feedback. The stations reported that passengers tended to raise concerns around the operation of trains rather than the stations themselves, although passengers had raised concerns regarding overcrowding of the concourse at this location[6]. Another station is planning to launch a 'Station Watch' scheme to replicate schemes that have been successful on the South East network.

Views on the Secure Station and Safer Parking schemes

The majority of interviewees were aware of the Secure Stations scheme, although they did not have a detailed knowledge of the scheme or the requirements of accreditation. While station managers tended to be aware of a station's Secure Station or Safer Parking status, this often did not permeate down to all members of staff on the station. Station staff interviewed at one station were unaware of the station's accreditation status. None of the Secure Stations audited actively promoted their status to passengers; this was not a conscious decision, and several staff members thought that accreditation should be marketed more widely.

One Station Manager reported that the criteria for Secure Stations was 'too easy', particularly for stations with a high footfall. He stated that membership of the scheme was just a 'tick box exercise' but that it would be embarrassing to lose the accreditation. However another Station Manager reported that the process of accreditation had been gruelling but that the requirements were 'realistic'.

Overall, the station staff interviewed felt the scheme was beneficial in ensuring that stations remain mindful of crime and security matters and that the scheme helped to instil a sense of pride in stations. Staff at Secure Stations did feel that their station's accreditation was appropriate for that station. Staff at one location were unsure whether consideration had been given to applying for accreditation but believed that the station would meet the requirements. Interviewees at two other stations did not anticipate that their stations would be successful if they were entered for the award.

[6] The station manager reported that while the concourse is often busy, passenger levels are monitored via CCTV to ensure safety.

Safer Parking

As with Secure Stations, not all staff were aware of their car park's accreditation; the staff at one station were unaware of their car park's Safer Parking status. Interviewees were of the consensus that car park accreditation provided reassurance to customers. A car park manager expressed the view that the Safer Parking scheme was less established than the Secure Stations scheme, and that the British Parking Association (BPA) needed to raise awareness. The same interviewee stated that the scheme lacked consistency and was too subjective, citing evidence of substantial differences in car parks that all achieved Safer Parking accreditation.

4.6.3 Summary

The site visits were undertaken at 11 stations that varied in terms of their accreditation status, crime rates, and station characteristics.

A striking difference between the stations visited was the **station layouts**. These varied from the straightforward to those that were complicated and difficult to navigate. Complicated layouts present challenges for managing crime problems. Greater number of exits/entrances increases the opportunities to enter and escape from station to commit crime, whilst additional entrances/exits can also increase opportunities for fare evasion. The more complicated layouts were more likely to produce isolated areas on the station, where legitimate activity is minimal and illegitimate or anti-social activity can go unsupervised. The station environments varied in the extent to which they felt bright, light and welcoming, and this was largely influenced by the choice of materials used in construction. Stations benefited from the use of transparent materials which maximise light and allow for visibility and informal surveillance. This is particularly important for waiting areas and passenger footbridges/subways. Although station layouts and environments are largely dictated and resistant to change, there is scope for improvement. One station has successfully implemented significant changes to the layout of the entrance and ticket hall; attention to lighting, decor and maintenance at two others have ensured that subways feel safer; the plans for re-development at a fourth station look promising in being able to improve the feel of the environment while enhancing the ability to manage the flow of passengers.

CCTV was present at all bar one of the stations, although the nature of CCTV was variable, in particular the extent to which live feed is monitored which ranged from not at all, to live feed being available but monitoring balance with other tasks, to dedicated control rooms.

A further notable difference between stations was the extent of **activity**, in the form of retail and catering provision. Clearly, the larger and busier stations generally support more retail outlets. However their location can determine whether or not they overlook key areas of the station, and thus the extent to which they provide informal guardianship for passengers. However, busy areas do not necessarily provide guardianship. At one station, cycle stands overlooked by a busy bus stop were still subject to thefts. It is hoped that the newly located cycle stands, close to staff offices, will benefit from the guardianship of staff activity. It is likely that staff will be more willing to intervene or report thefts in progress than busy bus passengers.

At those stations with either Secure Station or SCP accreditation, the **award status** was not treated with great importance. Station staff were often unaware of the award status, and schemes were not advertised to passengers. Station staff generally believed accredited stations could do more to capitalise on their award.

A final point to note, which represents a challenge for crime prevention evaluations, is the nature of **staff turnover** at stations. Few of the interviewed staff had been working at the station for a

significant period, and were thus unable to comment on crime problems or intervention measures taken in recent years. Improved recording of measures implemented would help to assess the impact of these interventions in future.

4.7 Results Strand 3: Estimating the Impact of Personal Security on Crime Risk

This section presents the results of the analysis of crime data. The discussion begins with a comparison of crime rates between accredited and non-accredited stations over time. Following this, the results of a series of models to estimate the impact of accreditation and individual interventions on crime are presented. Models are presented for six key crime types (violence against a person, sexual assault, criminal damage, theft from a person, vehicle crime and commercial theft). Finally, relationships are explored between station accreditation and perceptions of crime, based on an analysis of the field survey.

4.7.1 Comparing accredited and non-accredited stations

As noted earlier, accreditation with Secure Station or SCP status requires low crime ratios at the station. However, it remains possible that crime rates at stations that have not applied to the two schemes could be equally low. This is explored in Figures 4.12 and 4.13 which compare the crime ratios of accredited and non-accredited stations. The bars represent the inter-quartile range (ie the middle 50% of cases), with the horizontal line representing the median. Essentially, the bars represent the spread of crime ratios in each year with more extreme cases removed. Figure 4.12 compares the crime rate for the key crime types in Secure Stations to those in non-accredited stations for each of the years in the analysis period. With the exception of 2010/11, median crime rates are lower in Secure Stations compared to non accredited stations. It is evident that, for each year, the inter-quartile range is both smaller and lower for Secure Stations. However, for each year there are clearly a group of non accredited stations that experience crime rates that are equivalent to those in Secure Stations. These differences within each year were not statistically significant[7] however, as will be demonstrated in section 4.7.3 when trends are considered across the whole five year period and when factors such as station category are controlled for, differences in crime ratios between Secure Stations and non-accredited stations are statistically significant.

Figure 4.13 compares rates of vehicle crime per car parking space between Safer Car Parks and non-accredited car parks (stations without car parks are excluded). For each year from 2006/7 and 2009/10, median vehicle crime rates are significantly[8] lower for stations with SCPs compared to stations without car park accreditation. However, this observation is reversed in 2009/10 and 2010/11. As with Figure 4.12, it is clear that despite these differences there remains a group of non-accredited car parks in which vehicle crime rates are equivalent to those in SCPs.

[7] Mann Whitney U test $p>0.05$.
[8] Mann Whitney U test $p<0.05$.

Figure 4.12: Rate of crime per 100,000 throughput by Secure Station status 2006/7 to 2010/11 (Key crime types) n=321

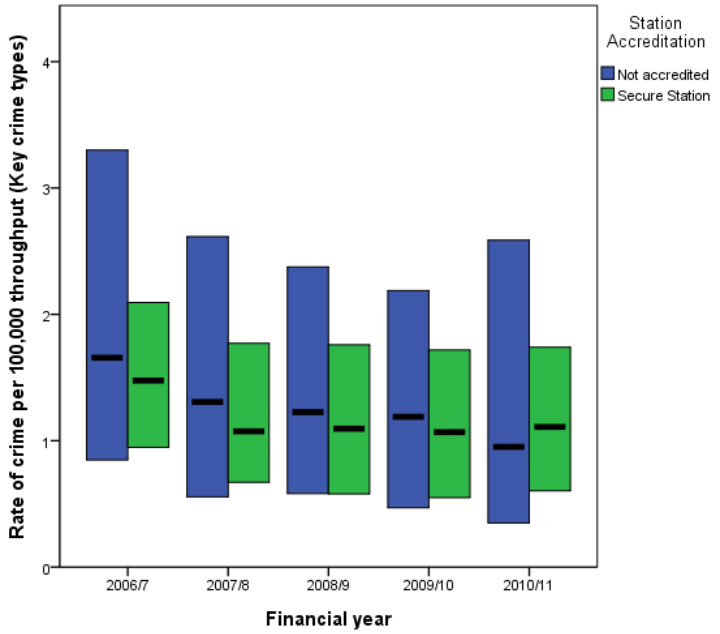
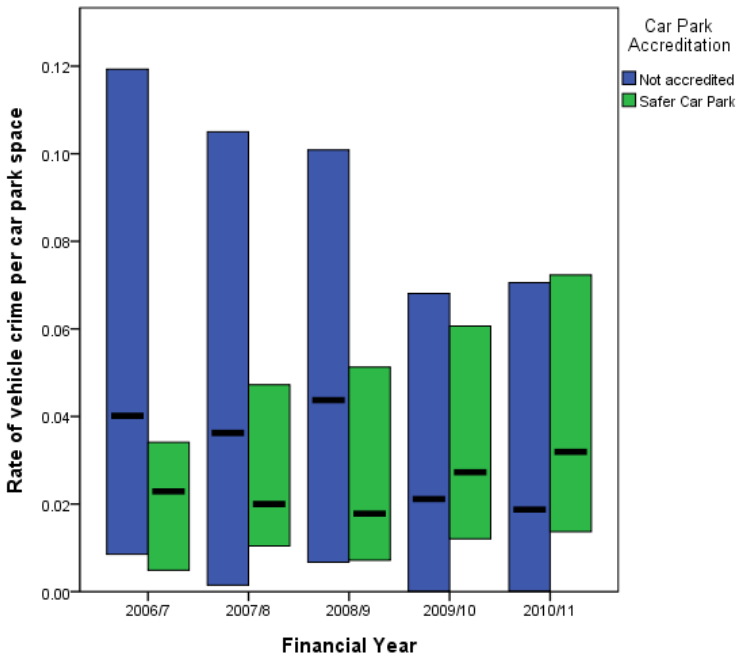


Figure 4.13: Rate of vehicle crime per car park space by Safer Parking status 2006/7 to 2010/11 (Key crime types) n=231



4.7.2 Change over time

The following analysis organised the 322 stations in the aggregated sample into groups according to their accreditation status. First, station crime is analysed by comparing stations that have been part of the Secure Stations scheme throughout the analysis period ('Always Secure' n=78), stations that received accreditation during the analysis period ('Secure Changed' n=125) and non-accredited stations ('Never Secure' n=119). Second, vehicle crime is analysed by comparing car parks that have been part of the SCP scheme throughout the analysis period ('Always SCP' n=19), car parks that received accreditation during the analysis period ('SCP Changed' n=131) and non-accredited car parks ('Never SCP' n=92). Stations without car parks are excluded from the latter analysis.

Figures 4.14 to 4.16 display the average crime ratios per 100,000 passengers across the five financial years, 2006/07 to 2010/11 for the three groups of station. As noted above, low crime ratios are a requirement of Secure Station accreditation it might therefore be expected that Secure Stations would have the lowest crime ratios of the three groups. It could also be hypothesised that the average crime ratios of stations which are accredited during the analysis period would improve over time and that the gap between 'Always Secure' stations and 'Secure Change' stations would narrow over time. However given the schemes element of self selection, it is also possible that stations that have not applied to the scheme could have crime ratios comparable to those at Secure Stations.

Figure 4.14: Average crime ratios for all station crimes by Secure Station status, 2006-2011

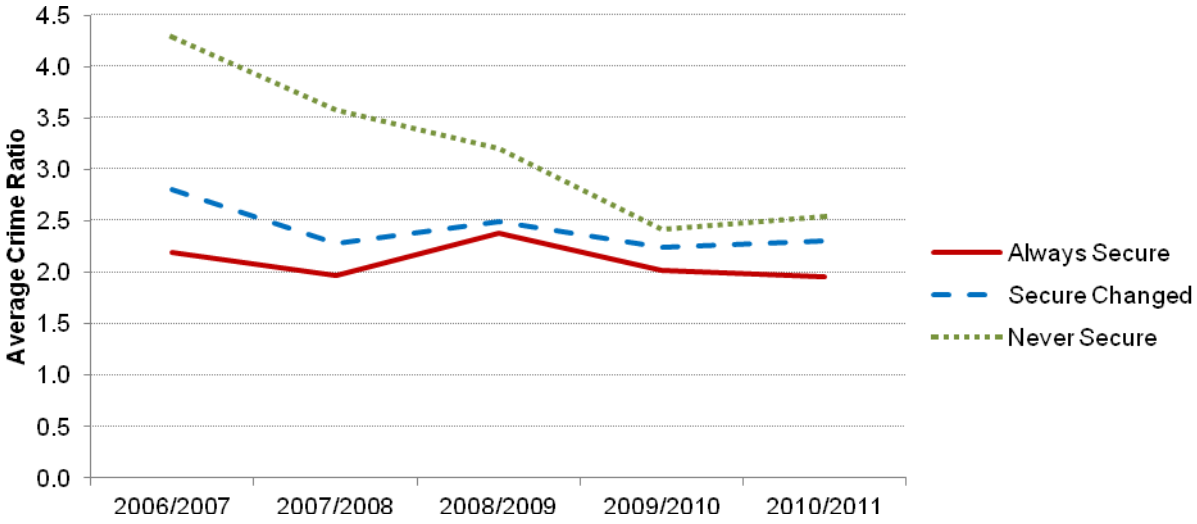
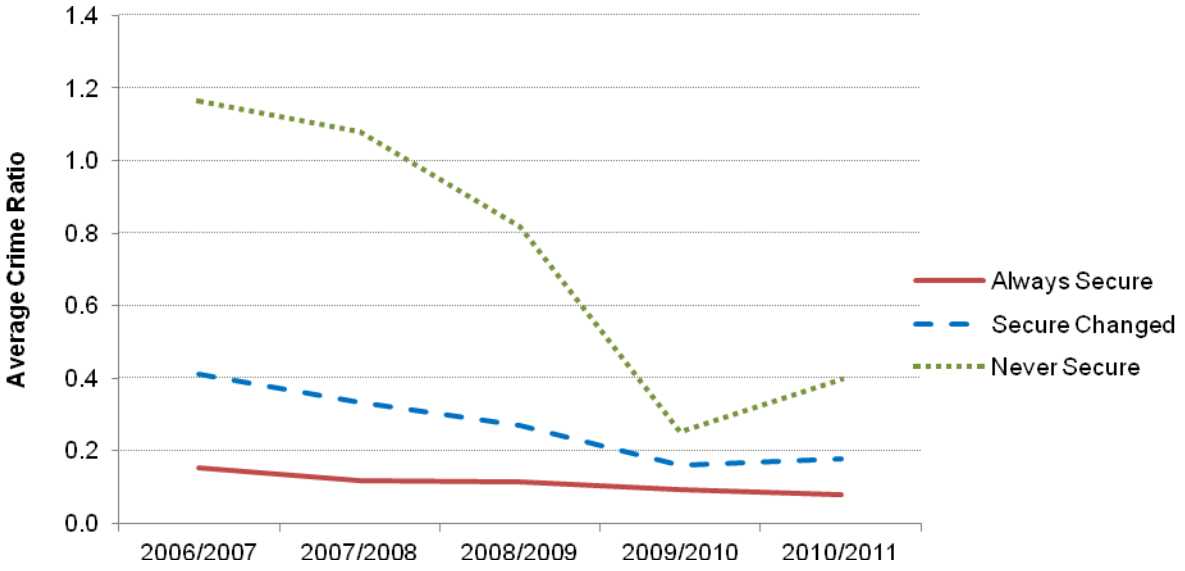


Figure 4.14 shows that for all crimes reported on stations, crime ratios have been consistently lower at 'Always Secure' stations. Crime ratios for 'Secure Changed' stations are higher than those at 'Always Secure' stations. While the gap between these two groups of station narrowed between 2006/7 and 2008/9, it began to widen again by 2010/11. Those stations that have never had Secure Station accreditation had consistently higher crime ratios throughout the period; however the gap between 'Never Secure' stations and the rest of the sample has narrowed considerably over time. There are clearly factors in the external environment that influence crime at stations. However as Secure Stations offer greater protection against crime, these factors have exerted greater influence over the non-secure stations.

Figure 4.15 presents the same information for criminal damage, and reveals a similar pattern to all station crime. For this crime type, there does appear to be a narrowing of the gap between 'Secure Changed' stations and 'Always Secure.' However, there is a dramatic reduction in these crimes within the 'Never Secure' group of stations.

Figure 4.15: Average crime ratios for criminal damage by Secure Station status, 2006-2011



'Always Secure' stations did not have consistently lower crime ratios for all crime types, as shown in Figure 4.16 for Theft from a Person and Figure 4.17 for Violence against a Person.

Figure 4.16: Average crime ratios for theft from a person by Secure Station status, 2006-2011

Figure 4.17: Average crime ratios for violence against a person by Secure Station status, 2006-2011

Figure 4.18: Average crime ratios for car park crimes by Safer Parking status, 2006-2011

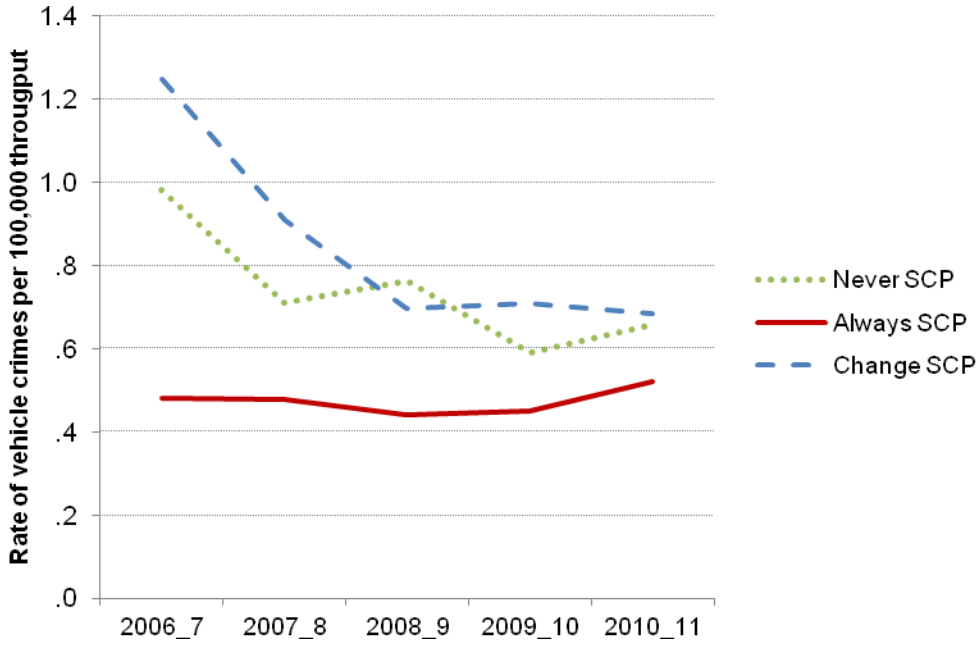


Figure 4.18 compares the average crime ratios for vehicle crime for the three groups of car park accreditation. The crime ratios at Safer Parking car parks were consistently lower than those at non-accredited car parks[8]. Vehicle crime at car parks that have had SCP accreditation throughout the

[8] It should be noted that the only available denominators we have for car parks is station throughput or number of car parking spaces, the ideal denominator of car park usages was not available.

analysis were consistent lower than the other two groups of car parks. Vehicle crime rates have been falling for car parks that have never received accreditation, and for those that gained accreditation during the analysis period. The steepest decrease in crime ratios occurred between 2006/07 and 2008/09 for those stations that gained accreditation but thereafter levelled out.

4.7.3 Estimating the impact of personal security on crime risk

Tables 4.20 to 4.25 present the results of each of the crime models (one per crime type) and show the estimated effects of explanatory variables on each of the 6 key crime types. The values in the tables represent the influence on crime of each variable, when all other variables in the model are controlled for. The final column in each table presents the coefficient as the percent change in crime counts per passenger expected for every 1 unit in that variable assuming all other variables are constant. With categorical variables, the increase should be compared to the base category for that variable; for example, looking at Table 4.20 for violence against a person, a station located in Scotland is predicted to have 36 per cent fewer crimes than a station located in the base category of England, all other things being equal. It should be remembered that the percentage changes relate to the number of crimes per passenger; the latter is normally an extremely low value, which explains some of the extremely high percentages.

Violence against a person

Table 4.20: Model to predict counts of violence against a person

Explanatory Variable		B	SE	% change
Criminal Damage Levels in Local Authority Area		0.142**	0.001	15.26
Country (Base England)	Scotland	-0.442*	0.262	-35.73
	Wales	0.5†	0.292	64.87
Work to improve lines of sight (Base No)	Yes	-0.173†	0.092	-15.89
Staffing (Base Unmanned)	Part-time	-1.026**	0.421	-64.16
	Full-time	-0.695^{ns}	0.412	-50.09
Monitoring of CCTV (Base Not Monitored)	Monitored	-0.401**	0.126	-33.03

Table notes:
** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

Table 4.20 summarises the results of the model to predict violence against a person. As discussed in section 4.4, the model does not distinguish crimes against staff from those against passengers. The table shows that Scottish stations experienced significantly fewer violence against a person offences compared to those in England (around 34% less), whilst Welsh stations experienced around 65% more of these crimes. While there are differences in crime recording conventions between Scotland and England, there are no differences between England and Wales. Criminal damage in the local authority area was positively correlated with violence against a person. One standard deviation increase in local authority criminal damage is associated with a 15% increase in violence against a

person at stations. Additional indicators of crime in the local authority area were tested, including all crime, all acquisitive crimes and all violent crimes; however criminal damage was the only background crime variable found to significantly predict violence against a person. As will be seen subsequently, this was also the case for the other crime types analysed. The possible reasons for this finding are discussed below.

Stations staffed part-time experienced a predicted 64% lower count of violence against the person, compared to unstaffed stations. Stations staffed full-time also experienced less crime than unstaffed stations, but this difference was not statistically significant. This finding is consistent with evidence from the literature that suggests that violence against a person is more prevalent at unstaffed stations. It is not clear why the difference would be stronger between unstaffed and part-time staffed stations than between unstaffed and full-time staffed stations. It is probable that other systematic relationships exist between full-time staffed stations and crime risks. This may include a correlation between their typical locations and the presence of a greater number of generators of violence against a person; for example there may be more licensed premises in the areas in which larger, full-time staffed stations tend to be based.

The presence of CCTV was not itself significant, but the presence of live monitored CCTV was associated with reductions of around 33%, compared to stations without monitoring. Improvements to lines of sight at a station eg reducing blind corners, introducing mirrors resulted in an estimated reduction of violence against a person.

In contrast to the other crime types analysed, station category was not a significant predictor of violence against a person. Secure Station accreditation was associated with reductions in violence against a person but was not statistically significant. Improvements to lighting at stations were also association with less violence against a person but again this intervention was non-significant.

Sexual assault

Table 4.21: Model to predict counts of sexual assault

Explanatory Variable		B	SE	% change
Criminal Damage Levels in Local Authority Area		0.224**	0.055	25.11
Country (Base England)	Scotland	-0.751**	0.308	-52.81
	Wales	-0.053^{ns}	0.493	-5.16
Station Category (Base A)	B	-0.214^{ns}	0.258	-19.27
	C	-0.541*	0.242	-41.78
	D	-0.007^{ns}	0.268	-0.70
	E	-0.15^{ns}	0.337	-13.93
	F	0.631^{ns}	0.544	87.95
Lighting (Base Poor)	Needs improvement	-0.716*	0.299	-51.13
	Good and consistent	-0.465*	0.2	-37.19

Table notes:
** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

Table 4.21 summarises the results of the model to predict the number of sexual assaults. As with violence against a person, background levels of crime in the local authority area (specifically criminal

damage) were associated with significant increases in the number of sexual assaults. Scottish stations experienced an estimated 53% fewer sexual assaults compared to English stations; Welsh stations also experienced fewer sexual assaults compared to English stations but this difference was small and insignificant. Comparing station categories, the only significant difference from the base of Category A stations was Category C. Category C stations experienced an estimated 42% fewer sexual assaults than Category A stations. The only intervention that predicted a significant difference in sexual assault was lighting. Stations that had 'lighting that needed some improvement' experienced 52% fewer incidents than stations with 'poor lighting', while stations that had 'good and consistent lighting' experienced 37% fewer incidents than those with 'poor lighting'. It should be noted that there was no discernible difference between the benefits of having 'lighting that was slightly better than poor', and 'lighting that was considerably better than poor'. The relationship between the quality of lighting and the frequency of sexual assault is not linear and may be moderated by effects other than lighting. Secure Station accreditation was not significantly correlated to the number of sexual assaults at stations. No other interventions tested influenced sexual assault. This is likely to be a consequence of the rare nature of this crime, and the fact that it may be driven more by the individual characteristics of specific events.

Theft from a person

Table 4.22 summarises the results of the model to predict the number of incidents of thefts from the person. As with the other crime types, background levels of crime in the local authority area (specifically criminal damage) were associated with an estimated 33% increase in incidents of theft from a person. Also in common with other crime types, Scottish stations experienced significantly fewer thefts from the person than English stations (56% fewer). Welsh stations experienced more crime than English stations, but this difference was not statistically significant. Unstaffed stations experienced considerably less crime than staffed stations. For stations staffed both part-time and full-time this was a difference of over 1000%.[9] There was no notable difference between the numbers of thefts from the person for part-time and full-time staffed stations. Staffed stations are likely to be larger and busier than unstaffed stations; the greater volume of people travelling through busy stations generates more opportunities for offenders seeking to commit crimes such as theft from a person. Stations in output areas classified as 'multi-cultural' experienced an estimated 52% more crimes than those in areas classified as 'constrained by circumstances'. Research has demonstrated that there are significantly higher concentrations of offenders living in multicultural areas compared to any other OAC groups (Hirschfield et al., forthcoming). Stations in other types of output area experienced less crime that 'constrained by circumstances' but these differences were not significant.

Automatic ticket barriers gates were associated with a predicted 27% reduction of theft from a person. This links to the finding above, that busier staffed stations create more opportunities for this type of crime. The installation of tickets gates restricts access to offenders aiming to capitalise on the opportunities for theft created by large volumes of passengers. Stations that had conducted work to improve lines of sight, such as reducing blind corners and installing mirrors experienced an estimated 17% fewer crimes than those stations which had not undertaken this type of work. Secure Station accreditation was associated with an estimated 24% reduction in thefts from the person. This is the effect of Secure Stations when all other variables have been controlled for; therefore this effect is additional to the impact of the presence of automatic ticket barriers and improvements to lines of sight.

[9] While increases of 1044% and 1078% sound dramatic, the average theft from the person ratio for an unstaffed station in 2006/7 was 0.102, producing estimated crime ratios of approximately 1.17 for stations staffed part-time and 1.20 for stations staffed full-time.

Table 4.22: Model to predict counts of theft from a person

Explanatory Variable		B	SE	% change
Criminal Damage Levels in Local Authority Area		0.287**	0.034	33.24
Country (Base England)	Scotland	-0.822**	0.271	-56.04
	Wales	0.353^{ns}	0.289	42.33
Station Category (Base A)	B	-0.788**	0.257	-54.52
	C	-1.086**	0.244	-66.24
	D	-1.24**	0.266	-71.06
	E	-1.082**	0.289	-66.11
	F	-0.263^{ns}	0.443	-23.13
Staffing (Base Unmanned)	Part-time	2.437**	0.984	1043.87
	Full-time	2.466**	0.988	1077.53
Output Area Classification	Blue Collar Communities	0.434^{ns}	0.32	54.34
(Base Constrained by Circumstances)	City Living	-0.094^{ns}	0.207	-8.97
	Countryside	-0.401^{ns}	0.404	-33.03
	Multicultural	0.417*	0.222	51.74
	Prospering Suburbs	-0.254^{ns}	0.376	-22.43
	Typical Traits	-0.031^{ns}	0.225	-3.05
Secure Station (Base No)	Yes	-0.275**	0.086	-24.04
Automatic ticket barriers (Base No)	Yes	-0.314**	0.125	-26.95
Work to improve lines of sight (Base No)	Yes	-0.192*	0.103	-17.47

Table notes:
** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

Criminal damage

Table 4.23: Model to predict counts of criminal damage

Explanatory Variable		B	S.E.	% change
Criminal Damage Levels in Local Authority Area		0.277**	0.037	31.92
Country (Base England)	Scotland	-0.286^{ns}	0.291	-24.87
	Wales	0.621**	0.256	86.08
Station Category (Base A)	B	0.287^{ns}	0.289	33.24
	C	0.437^{ns}	0.292	54.81
	D	1.025**	0.313	178.71
	E	1.434**	0.338	319.54
	F	0.856^{ns}	0.562	135.37
Staffing levels (Base unmanned)	Part-time	-0.654^{ns}	0.561	-48.00
	Full-time	-1.061†	0.563	-65.39
Secure Station (Base No)	Yes	-0.429**	0.158	-34.88
CCTV installed at station (Base No)	Yes	-0.665**	0.181	-48.57
Proportion of tickets checked	25-50%	-1.022**	0.409	-64.013
(Base less than 25% of passengers)	50-75%	-0.374^{ns}	0.259	-31.202
	75+%	-0.702**	0.187	-50.441
Lighting (Base Poor)	Needs some improvement	-0.302†	0.182	-26.07
	Good and consistent	-0.123^{ns}	0.239	-11.57

Table notes:
** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

Table 4.23 summarises the results of the model to predict the number of incidents of criminal damage. As with other crime types, incidents of criminal damage were significantly and positively associated with background levels of crime (specifically levels of criminal damage) in the local authority area. Scottish stations experienced less criminal damage than English stations, but for this crime type the difference was not statistically significant. Welsh stations experienced and estimated 86% more criminal damage offences compared to English stations; this difference was statistically significant. Category A stations experienced fewer incidents of criminal damage compared to the other five stations categories; however this difference was only significant for Category D and E stations which experienced 179% and 320% more crimes respectively. Both part-time and full-time staffed stations experienced fewer criminal damage incidents than unstaffed stations; this difference was only significant for full-time staffed stations which experienced 65% fewer criminal damage incidents than unstaffed stations. This is consistent with the research evidence that suggests that criminal damage is more likely to occur in unsupervised areas.

Stations with CCTV experienced an estimated 48% fewer incidents than stations without. Although the presence of automatic ticket gates was not a significant predictor of criminal damage, the proportion of passenger tickets that are checked (either manually or automatically) was significantly and negatively associated with criminal damage. This is likely to be an indicator of number of staff on station rather than the actual act of checking tickets. However, the greatest influence of ticket checks was at those stations where 25-50% of passengers are checked for tickets, where there were 65% fewer criminal damage offences than those stations where less than 25% of passengers tickets were checked. The act of checking tickets provides a form of guardianship that gives a clear message to offenders that stations are cared for and under the control of the staff. The level of checking may not be as important as the fact that at least some tickets are checked. Secure Stations experienced an estimated 35% fewer criminal damage incidents than stations without accreditation. Again this impact of Secure Stations is additional to the impact of CCTV and passenger ticket checks.

Vehicle crime

Table 4.24: Model to predict counts of vehicle crime

Explanatory Variable		**B**	**SE**	**% change**
Criminal Damage Levels in Local Authority Area		0.156**	0.034	16.88
Car park spaces (centred on mean)		0.001**	0	0.10
Country (Base England)	Scotland	-2.477**	0.303	-91.60
	Wales	-0.809**	0.27	-55.47
Station Category (Base A)	B	0.713*	0.36	104.01
	C	1.252**	0.332	249.73
	D	1.327**	0.347	276.97
	E	1.832**	0.402	524.64
	F	2.856**	0.534	1639.18
Car park payment type (Base Pay and Display)	Free	-0.781**	0.22	-54.21
	Pay on Exit	-0.557**	0.206	-42.71
Accreditation Status	Not Secure Station/ Safer Car Park	-0.262^{ns}	0.209	-23.05
(Base No Accreditations)	Secure Station /Not Safer Car Park	-0.45**	0.154	-36.24
	Secure Station/ Safer Car Park	-0.66**	0.161	-48.31

Table notes:

** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

Table 4.24 summarises the results of the model to predict the number of incidents of vehicle crime. The majority of these incidents would have occurred within station car parks, however they may also include incidents occurring elsewhere within the boundary of stations, such as at drop off zones. Once again, the level of criminal damage in the wider local authority area was significantly and positively associated with the count of vehicle crimes. The number of car park spaces had a significant positive effect but this was only very small (0.1%), this is because overall those stations with greater throughput of passengers (accounted for with the offset variable) also tend to have larger car parks. Both Scottish and Welsh stations experienced fewer vehicle crimes than English stations, with 91% and 55% fewer offences respectively, in both cases this was statistically significant. All station categories had significantly higher vehicle crime than Category A stations. The estimated number of vehicle crimes increased steadily across the range of station categories; ie vehicle crime was lowest at Category A stations and highest at Category F stations. However, the increase for Category F stations was considerably greater than the increases between other categories, with Category F stations experiencing an estimated 1639% more vehicle crimes (per passenger) than Category A stations. Pay on exit car parks experienced 42% fewer vehicle crimes than pay and display car parks. This is likely to be a result of the controlled entrance and exit barriers that accompany this system, and the absence of displayed tickets which advertise the period which the owner plans to leave their vehicles. Free car parks also experienced less crime than pay and display car parks, with an estimated 54% fewer crimes. The absence of dated tickets at free car parks may, at least in part, also explain the lower crime levels in free car parks. In addition, cars left in free car parks may not present as attractive targets as those left in paid car parks.

The Secure Station and Safer Car Park status of stations was modelled as one categorical variable in order to explore the effect of different combinations of accreditation. Stations that only had SCP accreditation did not have significantly lower vehicle crime levels than those with no accreditations. Stations that only had Secure Stations accreditation status did have significantly lower crime with 36% fewer vehicle crimes. However the largest difference was observed for stations with both Secure Stations and SCP accreditation; these stations experienced 48% fewer vehicle crimes than those stations lacking any accreditation. Manning and patrol of the car park were not significant predictors of vehicle crime; nor was staffing of the station.

Commercial theft

Table 4.25 summarises the results of the model to predict the number of incidents of commercial thefts. The category of commercial theft included burglaries and thefts of railway property, burglaries and thefts against on station catering/retail units and passenger fraud (fare evasion and related offences). Once again, the level of criminal damage in the wider local authority area was significantly and positively associated with the number of commercial thefts on stations, although the influence of background criminal damage levels was smaller than for the other crime types analysed. Scottish stations experienced significantly fewer commercial crimes than English stations (an estimated 61% difference); Welsh stations experienced significant more crimes compared to English station (an estimated 122% difference). With the exception of Category F stations, all categories of station experienced fewer crimes than Category A stations. However, this difference was only significant for Category C and D stations, both of which experienced over 50% fewer commercial thefts than Category A stations. Both part-time and full-time staffed stations experienced significantly more commercial thefts than unstaffed stations, and the difference was considerable, with increases of 924% and 1275% respectively. This difference is likely to be a consequence of the greater opportunity to detect and report such crimes at staffed stations. Perhaps for a similar reason, automatic ticket gates were associated with an increase in commercial thefts of 32%, the probable result of an increase in the number of passengers detected for fare evasion. Conversely the presence of automatic ticket machines was associated with a reduction in commercial theft of 61%. This may

suggest that at least some passengers are less inclined to travel without a ticket if they have ample opportunity to buy a ticket. The presence of CCTV on station was not a significant predictor of commercial theft, however, those stations that reported an upgrade to CCTV during the analysis period had significantly higher levels of commercial crime (a 32% increase). There are at least two possible explanations for this increase; improved CCTV may be more effective at detecting incidents of crime, or the direction of causality may be reversed with upgrades being prioritised for stations that were experiencing problems.

Table 4.25: Model to predict counts of commercial theft

Explanatory Variable		**B**	**SE**	**% change**
Criminal Damage Levels in Local Authority Area		0.104**	0.049	10.96
Country (Base England)	Scotland	-0.977**	0.289	-62.36
	Wales	0.796**	0.338	121.67
Station Category (Base A)	B	-0.372^{ns}	0.296	-31.06
	C	-0.826**	0.277	-56.22
	D	-0.866*	0.302	-57.94
	E	-0.517 ^{ns}	0.331	-40.37
	F	0.763 ^{ns}	0.508	114.47
Output Area Classification	Blue Collar Communities	-1.059**	0.468	-65.32
(Base Constrained by Circumstances)	City Living	-0.684**	0.226	-49.54
	Countryside	-0.297 ^{ns}	0.489	-25.70
	Multicultural	-0.694**	0.254	-50.04
	Prospering Suburbs	-0.871 ^{ns}	0.435	-58.15
	Typical Traits	-0.542**	0.245	-41.84
Staffing (Base Unmanned)	Part-time	2.326**	0.786	923.69
	Full-time	2.622**	0.78	1276.32
Automatic ticket barriers (Base No)	Yes	0.28†	0.155	32.31
Self-service ticket machines (Base No)	Yes	-0.937**	0.249	-60.82
Work to improve lines of sight (Base No)	Yes	-0.283**	0.14	-24.65
CCTV Upgraded (Base No)	Yes	0.274**	0.106	31.52

Table notes:
** Highly significant (p<0.01)
* Significant (p<0.05)
† Marginal significance (p<0.1)
ns Not significant

4.7.4 Summary

Factors in the external environment clearly exert a substantial influence over crime levels in stations and their car parks. Several variables were included in the crime models in an attempt to control for factors external to stations. These variables included indicators of crime levels in the wider local

authority area, a country variable (England, Scotland and Wales) and the socio-demographic profile of the area in which the station is located. These variables are not modifiable, but are important in understanding and estimating the operation of the other, modifiable variables in the crime models.

Levels of criminal damage in the local authority area were significantly and positively associated with each of the crime types analysed. The other indicators of background crime levels, all crime, acquisitive crime and violent crime were not significant predictors of crime on stations. There are two possible reasons why background levels of criminal damage proved to be a better predictor of crime. There are criminological theories that suggest that background levels of minor crime and disorder, particularly those that leave visible signs of decay, can lead to an escalation of other and more serious crimes (eg Broken Windows, Theory (Kelling and Coles (1996) and Signal Crimes (Innes, 2003). High levels of criminal damage in an area may indicate lower levels which in turn could influence station crimes. Differences between countries were significant for all crime types. Scotland stations experienced significantly fewer crimes than England for all crime types, with the exception of criminal damage. Welsh stations experienced more violence against a person, criminal damage and commercial theft, and fewer vehicle crimes than English stations. The differences between Scotland and England may in part be the result of differences in recording conventions.

Station category had a significant impact on all crimes with the exception of violence against a person. The classification of the surrounding output area influenced theft from a person and commercial theft. Staffing influenced all station crimes with the exception of sexual assault and vehicle crime. Staffing on the station was associated with reductions in violence against a person and criminal damage and increases in theft from a person and commercial theft. There was no discernible difference between stations staffed part-time and those staffed full-time.

The presence of CCTV on stations only impacted upon criminal damage offences, resulting in fewer crimes. The monitoring of CCTV influenced violent crimes again resulting in fewer offences. The upgrading of CCTV influenced levels of commercial theft; however in this case improved CCTV was associated with increases in the number of commercial crimes. This increase may be associated with the improved ability to identify and respond to crimes occurring (this was identified as a key benefit of CCTV in the evidence review); alternatively the direction of association may be reversed, with problem stations more likely to receive an upgrade in CCTV.

Lighting levels on the station influences levels of sexual assault and criminal damage; in both cases stations with poor lighting were associated with higher levels of crime. However there was no discernible difference between stations where the lighting was better than poor but needed improvement and those stations where lighting was good and consistent. Work to improve lines of sight was associated with reductions in both violence against a person and theft from a person. The presence of automatic ticket barriers was associated with lower levels of theft from a person and higher levels of commercial theft. In the case of theft from a person, it is likely that barriers prevent access to the station to those who are attracted by criminal opportunities rather than travel. In the case of commercial theft it is likely that ticket barriers aid the detection of crimes such as ticket evasion.

Importantly, for the purposes of this evaluation, the crime models identified that both the Secure Station accreditation taken as a package and individual measures taken at stations exert an influence on crime when these external factors have been controlled for. Secure Station accreditation was associated with lower levels of theft from a person, criminal damage and vehicle crime. Although Secure Station accreditation requires low crime ratios across the station and car park, the detected effects are influences of Secure Station when all other variables in each model are controlled for, including the initial levels of crime. This suggests that Secure Station accreditation retains an

influence on these crimes even when the existing low crime is controlled for. Similarly, the identified impact of Secure Stations should be regarded as impacts that are additional to the presence of any individual crime prevention measures.

In the absence of SS accreditation, SCP accreditation did not influence vehicle crime. However the impact of combining the two schemes is greater than the impact of the Secure Stations scheme in isolation. It is clear that the crime reduction effects of Secure Stations and SCP cannot be treated as simply additive.

4.8 Results Strand 4: Passenger Survey Results

The final section of analysis will consider data collected from questionnaire surveys of station and car park users at eight stations in the detailed sample (see Table 3.2). Both the station and car park questionnaires followed a common format as follows (versions of each are reproduced in Appendices 1 and 2 respectively):

- INTRODUCTION: The questionnaire opens with some introductory comments concerning the purpose of the study, and background information concerning the social costs of crime.
- ABOUT YOUR JOURNEY: The respondent is asked some questions concerning their journey purpose, and how often they use the station/car park.
- ABOUT YOUR RAIL TICKET/CAR PARK CHARGES: The respondent is asked about their rail fare/car park charge, and their expenditure on rail travel/ parking at the station generally.
- ABOUT YOU: The questionnaire records socio-economic-demographic data.
- ABOUT YOUR EXPERIENCES OF PERSONAL SECURITY AT THIS CAR PARK: The respondent is asked about their perceptions of criminality at the station/station car park.
- ABOUT SECURITY MEASURES AT THE STATION CAR PARK: Four repetitions of the station improvement game are administered.
- ABOUT YOUR VIEWS ON RAILWAY INVESTMENT PRIORITIES – SAFETY AND SECURITY: Six repetitions of the objective risk of crime game are administered.

The focus of the questionnaire was the elicitation of Willingness-To-Pay (WTP) estimates in relation to security measures and railway investment priorities; these estimates formed an input to the economic analysis, and will be discussed in more detail subsequently. However, alongside the WTP questions in the survey, additional questions were included concerning broader experiences of personal security. These latter questions will be the subject of the present discussion. For a more complete discussion regarding the operational details of the survey, and in particular the analysis of WTP, the reader is referred to section 5.5.

4.8.1 Perceptions of personal safety; findings from the passenger survey

The analysis described in this section is based on the passenger survey questions distributed at:

- Two accredited and two non-accredited stations (Appendix 1)
- Two accredited and two non-accredited car parks (Appendix 2)

Both the station and car park surveys included four questions relating to concerns about crime and perceptions of crime at the station or in the car park. These questions are summarised in the first column of Table 4.26 and 4.27 below. The analysis explores the extent to which passenger and car park user perceptions varied between Secure Stations and non-accredited stations, and Safer Car Parks and non-accredited car parks. The analysis then proceeds continues to explore whether differences between accredited and non-accredited locations are moderated by key passenger attributes including age, gender and frequency of travel.

Awareness of accreditation status

The majority of respondents (69.5%) did not know whether the station they were travelling from had Secure Station accreditation (Table 4.26). Approximately 14% of respondents correctly identified Secure Stations and only 3.4% correctly identified non-accredited stations. 11% of respondents thought non-accredited stations were Secure Stations, and 2.5% of respondents thought Secure Stations were non-accredited.

Table 4.26: Passenger awareness of Secure Stations accreditation

	Accreditation status % (N)	
Passenger Perception	Secure	Non-Accredited
Yes	13.6 (112)	11.0 (91)
No	2.5 (21)	3.4 (28)
Don't Know	35.7 (295)	33.8 (279)

As with stations, the majority of car park users in the survey (93.8%) did not know whether the car park they were using had received Safer Car Park accreditation (Table 4.27). Approximately 2% of respondents correctly identified Safer Car Parks and only 2.5% correctly identified non-accredited station car parks. Less than 1% of respondents thought Safer Car Parks were not accredited and less that 1% of respondents thought non-accredited car parks had accreditation.

Table 4.27: Passenger awareness of Safer Parking accreditation

	Accreditation Status % (N)	
Passenger Perception	Safer	Non-Accredited
Yes	1.8 (6)	0.6(2)
No	0.9 (3)	2.5(8)
Don't Know	36.0 (117)	57.8(118)

Station survey

The station user survey achieved responses from 850 passengers of which 429 (50.4%) were from Secure Stations and 398 (46.8%) were from non-accredited stations. There were no significant

differences between Secure Stations and non-accredited stations in the distribution of passengers by gender, age group or travelling frequency. This provided a good basis for comparison. For example, at Secure Stations there were 224 returns by males (52.2%) and 200 returns from females (46.6%); this compared with non-accredited stations where there were 165 returns from males (41.5%) and 226 from females (56.8). Fewer under-20s and over-60s returned this survey, although the distribution of age was similar across Secure Stations and non-accredited stations. The majority of passengers who responded reported their trip frequency as being at least once per week; this proportion was similar for both Secure Stations and non-accredited stations. At Secure Stations, 360 passengers (83.9%) travelled at least once a week compared with 284 (71.4%) of passengers travelling from non-accredited stations.

Table 4.28: Relationship between station accreditation status and passenger perceptions of security

	Secure vs. non-accredited stations			
Question	**All respondents**	Age	Gender	Travel frequency
Q15. During the past 6 months, have you had cause to worry about your personal security whilst at this station (Yes/No)	*	all age groups: ns	male: ns **female**: **	**at least once per week**: ** less than once per week: ns
Q16. Thinking about the last time you felt concerned, how worried did you feel (not very worried; a little bit worried; quite worried; very worried)	**	**60 plus**: * other ages: all ns	male: ns **female**: *	**at least once per week**: * less than once per week: ns
Q17. During the past 12 months, have concerns about personal security stopped you from travelling from this station or to adapt your journey (Yes/No)	ns			
Q18. How much of a problem are the following at this station (a very big problem; a fairly big problem; not a very big problem; not a problem at all; don't know)				
a) Rubbish or litter lying around	ns			
b) Vandalism and graffiti	ns			
c) People using or dealing drugs	*	**under 20**: ** other ages: ns	ns	ns
d) People being drunk or rowdy	*		male: ns **female**: *	**at least once per week**: ** less than once per week: ns
e) People being harassed or intimidated	ns			
f) car crime (theft or damage)	ns			

* Statistically Significant Chi Square P<0.05
** Statistically Significant Chi Square P<0.01
ns: non-significant

Table 4.28 shows a summary of the analysis of the relationship between station accreditation and passenger perceptions of safety. The majority (87.3%) of passengers did not report feeling concerned for their personal security whilst at the station in the last 6 months. No significant differences were identified between males and females, between age groups or by travel frequency. The analysis did identify a statistically significant difference in passenger concerns about crime depending upon accreditation status; 9.4% of passengers from Secure Stations reported having cause for concern, compared with 16.2% of passengers from non-accredited stations.

When examining the relationship between accreditation and feelings of safety further by age, gender and frequency of travel, the only significant differences were for females and for those who travelled at least once per week. Therefore females and frequent travellers at non-accredited stations were significantly more likely to report concerns. Of those who had expressed concerns, the survey asked how worried they had felt (Q16). Again, the analysis identified statistically significant differences between Secure Stations and non-accredited stations, with passengers at non-accredited stations prone to worry more than those at Secure Stations. When comparing these differences further by age, gender and frequency of travel, significant differences were found for females, those aged 60 plus, and those who travelled at least once per week. No significant differences were found for males, less frequent travellers, and other age groups. Of those passengers who had expressed concerns, 24% stated that these concerns had caused them to stop using stations or adapt to their journeys (Q17); there were no significant differences between Secure Stations and non-accredited stations on this question. Therefore, although a higher proportion of passengers at non-accredited stations expressed concerns about crimes, these passengers were no more likely than passengers at Secure Stations to alter their travel plans as a result of these concerns.

No significant differences between Secure Stations and non-accredited stations were identified for passenger perceptions concerning the level of rubbish or litter lying around, vandalism and graffiti, people being harassed or intimidated, or car crime (theft or damage). The majority of passengers either stated that people using or dealing drugs was not a problem at the station (39.7%) or that they did not know whether there was a drug problem at the station (38.6%); passengers at Secure Stations were more likely to state that drugs were not a problem at the station than those travelling from non-accredited stations (43.7% compared to 35.3%). When inspecting this relationship by age, gender and frequency of travel, the only significant difference was for travellers aged under 20. Therefore, under-20s travelling from non-accredited stations were more likely to state that there was a drug problem at this station. This may reflect this age group having a different level of awareness of drug use to other age groups on the rail network.

Passengers most frequently reported that people being drunk or rowdy on the station was not a big problem (45.6%). Passengers at non-accredited stations were more likely to state that this was a very big or fairly big problem (20.6%) than passengers at Secure Stations (13.5%). When elaborating upon this relationship by age, gender and frequency of travel, significant effects were detected for females and those who travelled at least once per week. Therefore females and frequent travellers at non-accredited stations were more likely to report that people being drunk or rowdy at the station was a big problem.

Car parks

The car park survey achieved 338 responses, of which 128 (37.9%) were from Safer Car Parks and 198 (58.6%) were from non-accredited station car parks. As with the station survey, the proportion of respondents by age, gender and frequency of travel were broadly similar for the two car park types. Of the respondents from Safer Car Parks, 52% were male and 40.6% were female, compared to

51.5% male respondents and 47.5% female respondents from non-accredited car parks. As with the station survey, fewer under-20s and over-60s returned the car park survey, but the overall distribution of age was a fairly similar between the two car park types. Just under half (46.9%) of respondents from Safer Car Parks used the car park more than once a week, compared to just over half (53%) of respondents from non-accredited car parks.

Table 4.29 below shows a summary of findings relating to the perceptions of safety for passengers, comparing Safer Car Parks with non-accredited car parks. When comparing concern for personal security over the past six months, there was no statistically significant difference between Safer Car Parks and non-accredited car parks. Similarly, amongst those respondents who had expressed concern, there were no significant differences between the level of worry experienced or the need to stop using car park stations or adapt their journeys in response to safety concerns.

Table 4.29: Relationship between station accreditation status and passenger perceptions of security

	Safer vs. non-accredited station car parks			
Question	All respondents	Age	Gender	Travel Frequency
Q 15: During the past 6 months, have you had cause to worry about your personal security whilst at this car park (Yes/No)	ns			
Q 16: Thinking about the last time you felt concerned, how worried did you feel (not very worried; a little bit worried; quite worried; very worried)	ns			
Q17:During the past 12 months, have concerns about personal security stopped you from using from station car park or to adapt your journey (Yes/No)	ns			
Q18: How much of a problem are the following at this car park (a very big problem; a fairly big problem; not a very big problem; not a problem at all; don't know)				
a) Rubbish or litter lying around	ns			
b) Vandalism and graffiti	*	all age groups: ns	male: ns **female: ***	at least once per week: ns **less than once per week: ***
c) People using or dealing drugs	ns			
d) People being drunk or rowdy	ns			
e) People being harassed or intimidated	ns			
f) car crime (theft or damage)	ns			
* Statistically Significant Chi Square P<0.05 ** Statistically Significant Chi Square P<0.01 ns**:** non-significant				

Respondents at Safer Car Parks were significantly less likely than those at non-accredited car parks to report that vandalism and graffiti were a very big or fairly big problem at the station car park. When comparing across age, gender and frequency of travel, the relationship only held for females, and those who use the car park less than once per week. Therefore female and less frequent parkers at non-accredited stations were more likely to report that vandalism and graffiti were a problem at the station car park.

4.8.2 Summary

Passenger awareness of station and car park accreditation was extremely low. This is not surprising given the findings stemming from the interviews with station staff (section 4.6) that the schemes are not widely publicised. Despite the lack of awareness regarding station accreditation, statistically significant differences were identified in passenger's feelings of safety between Secure Stations and non-accredited stations, suggesting that, to a small degree, these locations are perceived as safer environments. Although only a small minority of passengers expressed concerns about their personal security, the analysis did identify a significant difference between Secure Stations and non-accredited stations. Passengers at Secure Stations were less likely to report having concerns about personal safety, and less likely to have been very worried about those concerns. When these findings were investigated further, they only remained significant for females and those who travelled at least once a week. Only a small minority of passengers reported changing their travel behaviour in response to personal safety concerns, with no significant difference between Secure Stations and non-accredited stations. Passengers at non-accredited stations were more likely to report that people using and dealing drugs and people being drunk or rowdy were a problem at the station.

No differences were identified between perceptions of personal safety at Safer Car Parks and non-accredited car parks. When asked about the extent to which crime and anti-social behaviour issues were a problem in the car park, users of non-accredited car parks were significantly more likely to report that graffiti and vandalism were a big or fairly big problem in the car park. When this difference was investigated further, it only remained significant for females and those who used the car park less than once per week.

4.9 Summary of Findings from the Crime Evaluation

In summarising the key findings from the crime analysis, two key interests are pursued, namely the profiling of stations and car parks (which is supported by the on-line survey and visual audits) and explaining crime at stations and station car parks (which is supported by the crime model).

4.9.1 Profiling of stations and car parks

Analysis of the intervention dataset revealed that, although accreditation allows for flexibility in approaches to crime prevention, several attributes were common to Secure Stations and Safer Parking but significantly different from their non-accredited counterparts. These differences include the following:

- Secure Stations were more likely to be staffed, or to be staffed full-time rather than part-time; this difference was particularly notable for smaller stations.

- CCTV was prevalent across the sample and present at 91% of stations; despite this CCTV was still more prevalent at Secure Stations (95% compared to 82%). Also, the ability to monitor CCTV was more likely to be available at Secure Stations.
- Secure Stations were more likely to have automated ticket barriers installed (35% compared to 18%).
- Secure Stations were less likely to be approached by an entrance which was secluded such as an alleyway of isolated footpath.
- Secure Stations were more likely to provide emergency help points for passengers. Waiting rooms at Secure Stations were more likely to provide good informal surveillance.
- Secure Stations were more likely to host retail or catering outlets which provided benefits of informal surveillance and guardianship.

Overall these differences suggest that Secure Stations offer a higher standard of crime prevention with a greater provision of facilities that research evidence suggests are likely facilitate crime prevention.

In the case of the SCP award, the analysis did not identify as many significant differences between SCP car parks and non-accredited car parks (although the data was less complete for station car parks with a larger proportion of missing data). The main distinction identified was a greater likelihood that SCP car parks would be patrolled.

4.9.2 Explaining crime on stations and in station car parks

Factors in the external environment clearly exert a substantial influence over crime levels in stations and their car parks. Analysis of crime trends over time revealed that in both stations and their car parks, crime levels have decreased over the five years that formed this project's frame of reference. These trends reflect wider national trends that have seen reductions in several key crime types. The observed reductions in station and car park crime were steeper for non-accredited stations/car parks compared to accredited locations. This may reflect that fact that accreditation protected stations from high crime levels in previous years.

Several variables were included in the crime models in an attempt to control for factors external to stations. These variables included indicators of crime levels in the wider local authority area and the socio-demographic profile of the area in which the station is located. In line with expectations, levels of crime in the wider area were significantly and positively associated with each of the crime types analysed; stations situated in areas of higher crime (specifically criminal damage) experienced higher levels of crime. This finding was supported by the site visits to the detailed sample stations, during which station staff pointed to crime problems in the wider locality as explanation for many of the crimes experienced at the station.

The Network Rail station classification of stations (A-F) provided an indicator of station size and facilities. This variable was significantly associated with all crime types, with the exception of violence against a person. The influence of this variable was not uniform across all crime types. In particular, it was found that as stations get smaller:

- Incidences of vehicle crime and criminal damage increase (pro rata to passenger throughput); this may be because lower passenger throughput results in lower guardianship.
- Incidences of theft from a person and commercial theft decrease; this may be because opportunities for these types of crimes are dependent on levels of throughput.

The principles of CPTED assert that approaches to crime prevention should enhance guardianship and surveillance, control access to the location and support legitimate activities. A number of CPTED interventions proved to significantly reduce levels of station crime. Importantly, for the purposes of this evaluation, the crime models found that Secure Station accreditation in combination with individual measures taken at stations exert an influence on crime reduction over and above the sum of the individual parts.

Guardianship

Staffing levels were significantly associated with violence against a person, theft from a person, criminal damage and commercial theft. Unstaffed stations experienced significantly higher levels of violence against a person and criminal damage. However, for violence against a person, no additional crime reduction benefits were gained from staffing full-time rather than part-time. For criminal damage, only full-time staffed stations experienced significantly lower levels of crime than unstaffed stations. Levels of theft from a person and commercial theft were significantly higher at staffed stations compared to unstaffed stations. Staffing and patrols of station car parks did not significantly affect levels of vehicle crime.

Surveillance

Formal surveillance in the form of CCTV was prevalent across the sample. Stations with CCTV experience significantly lower levels of criminal damage; however this was the only crime type that was significantly associated with the presence of CCTV. The presence of CCTV in car parks was not significantly associated with car park crime. An upgrade to the CCTV system over the last five years was significantly associated with commercial theft; in this case, stations where upgrades had taken place experienced higher levels of commercial theft. This may reflect an enhanced ability to detect crimes, or that stations with more entrenched theft problems are being prioritised for an upgrade. Stations that had the ability to monitor live CCTV feed experienced significantly lower levels of violence against a person. This may reflect the ability to identify and respond to violent incidents that may not otherwise be reported, such as fights breaking out between passengers. The quality and extent of CCTV coverage were not significant predictors of any of the crime types analysed. However, key differences were identified in the extent and nature of CCTV monitoring, which varied from no monitoring at all to centralised control rooms with dedicated staff.

In addition to formal surveillance through CCTV, informal surveillance can be enhanced by improving lines of sight and ensuring that passengers and staff can see around corners and into waiting areas. Stations that had undertaken work to improve lines of sight experienced significantly less violence against a person, theft from a person and commercial theft. Waiting rooms with enhanced informal surveillance were not significantly associated with any of the crime types analysed.

Lighting quality, which can help passengers be seen and see others, was significantly associated with sexual assault and criminal damage; stations with poor lighting experienced more of these crimes than stations where lighting was ‘in need of improvement’. More generally, the relationship between the quality of artificial lighting and the frequency of these crimes was not linear, and may be moderated by other factors such as careful design to maximise natural light.

Defensible space and access control

The control of access to the station through automatic ticket barriers was associated with lower levels of theft from a person and higher levels of commercial theft. In the case of theft from a person, it is likely that barriers prevent access to the station to those who are attracted by criminal opportunities. In the case of commercial theft, it is likely that ticket barriers aid the detection of crimes such as fare evasion. Although not significant in the statistical models, a number of the stations visited discussed problems created by having multiple entrances/exits to the station.

In the analysis of car parks, ‘pay on exit’ car parks experienced significantly less vehicle crime than ‘pay and display’ car parks. The former car park payment system involves the installation of automatic barriers which control exits from the car park. However, interviews suggested that this finding may also be an effect of the absence of ‘pay and display’ tickets which advertise the time period for which a car will be left. Free car parks also experienced less vehicle crime than ‘pay and display’ car parks; again this could also be explained by the absence of timed tickets.

Activity support

Activity support ensures that there are sufficient numbers of people in, or passing through, a particular place, conducting routine, honest activities like shopping or dining; in so doing, their presence prevents or discourages offenders from committing crime. The literature review identified that the presence of kiosks and shops at stations can enhance passengers’ feelings of safety. However, no empirical support for this relationship was found in the crime model.

The visual audits of stations noted that the location of these activities can influence the extent to which they enhance informal surveillance and guardianship for passengers; in a number of cases these outlets were separated from the concourse and platform areas. Interestingly, the presence of self-service ticket machines was associated with a significant reduction in commercial theft. This may suggest that where passengers are provided with sufficient opportunities to purchase tickets, they are less inclined to evade their fare.

Accreditation

Secure Station accreditation was associated with lower levels of theft from a person, criminal damage and vehicle crime. That is to say, even when pre-existing levels of crime and the presence of other crime prevention measures are controlled for, Secure Stations has a distinct effect upon crime rates for these crime types. In the absence of Secure Station accreditation, SCP accreditation has no discernible influence upon vehicle crime. However, if the two schemes are combined, then the collective impact on crime is greater than that of Secure Stations in isolation. On the basis of this finding, the crime reducing effects of Secure Stations and SCP cannot be treated as additive.

Passenger perceptions

Passenger awareness of station and car park accreditation was extremely low. This is not surprising given the findings from the evidence review and interviews with station staff that the schemes are not widely publicised. However, this finding is unfortunate, given that publicity can support crime prevention by influencing the perceptions of offenders. Despite the lack of awareness regarding station accreditation, the passenger survey identified statistically significant differences in passengers’ feelings of safety between Secure Stations and non-accredited stations, suggesting that - to some degree - Secure Stations are perceived as safer environments. Differences between Secure and non-accredited car parks were less apparent, and no significant differences were estimated.

5 Economic Evaluation of Secure Stations and Safer Parking

The purpose of this section is to describe the Economic Evaluation of Secure Stations and Safer Parking. The costs of crime and the valuation of station security measures are complex topics because the costs of crime are not limited to a single group (ie passengers who are victims of crime), but are felt in different ways by railway users generally, railway staff, the railway industry and society at large. Moreover, there are witnesses as well as victims. Not only are there multiple impact groups, but the costs of crime include 'intangible' costs such as psychological harm to victims as well as 'tangible' costs such as injuries requiring medical treatment or damage to property. Additionally, crime is an occasional rather than a regular occurrence, but occasional occurrences of crime may provoke a lasting 'fear' response among individuals. This potentially creates a 'risk premium' over and above the expected costs of being a victim/witnessing a crime; namely the additional costs associated with 'fear' or 'threat' each time the individuals travels – or considers travelling – by rail.

Finally, it needs to be recognised that crime risk may provoke changes in behaviour, on the part of individuals (and also businesses and public bodies). Reductions in crime therefore open up the possibility of changes in behaviour, which may change the final 'equilibrium' outcome once the individual has re-optimised their pattern of activities and expenditure. For example, an individual may choose to spend part of their disposable income on rail travel from a station which was formerly perceived as somewhat 'unsafe' in terms of personal security. To take another example, individuals are known to make 'defensive expenditures' on items such as personal attack alarms, and these costs are sensitive to perceived crime risk.

There will be several key components to the Economic Evaluation, as follows.

- First, relevant literature and evidence on the costs of crime and methods for estimating the economic effects of crime are summarised, especially in the transportation sector.
- A method for calculating the costs and benefits of Secure Stations and Safer Parking specifically is outlined.
- This method draws upon both primary and secondary data. With regards to the secondary data analysis, various research activities are outlined, including the collation and adaptation of existing economic evidence, as well as bespoke econometric modelling. With regards to the primary data analysis, the design, implementation and analysis of a Willingness-To-Pay (WTP) experiment is described.
- The discussion will consider the manner in which the method supports the Planning Tool - the Excel-based evaluation spreadsheet - applied in section 6. More specifically, the discussion will outline the conceptual relationships between the existing evidence on social costs of crime, estimates of WTP, and the NPV outputs from the Planning Tool.
- The detailed design of the Planning Tool will be described in section 6.

5.1 Review of Literature and Evidence on the Costs of Crime

The 'costs of crime' entail a range of complex and diverse factors, and previous writers have employed various typologies in an attempt to organise these different factors in a coherent way. As a basis for the present review, it is useful to introduce the following typology (Table 5.1), which is adapted slightly from that proposed by Dolan and Peasgood (1997). Note that this typology is focused upon crimes to individuals; the scope will be extended to crime involving theft and crimes against property and revenue in due course. This typology is attractive in encompassing a wide range of factors giving rise to crime costs, couched in terms of the UK evidence base.

Table 5.1: Typology of the costs of crime, and sources of evidence on costs

	Realised costs of crime to the victim	**Anticipated costs of crime to ex-victims and the wider public**
Tangible cost		
Direct cost for treatment of health issues	HO30/05	
Indirect cost due to productivity losses	HO30/05	
Direct cost to the criminal justice system	HO30/05	
Direct cost of security measures		HO30/05
Direct cost of insurance administration		HO30/05
Direct cost from changes in behaviour		+?
Intangible cost		
Non-health loss: changes in behaviour		+?
Non-health loss: changed view of society		+?
Health-related loss: physical	HO30/05	
Health-related loss: psychological		Dolan and Peasgood (2007)

Note: **+?** denotes possible source of additional cost

This typology makes an important distinction between tangible and intangible costs.

- **Tangible costs** are those which are relatively easy to observe and quantify in monetary terms, especially the additional resources needed to deal with crime. The definitive UK reference in this regard is Home Office Report Online Report 30/05 (referred to as HO30/05 in what follows), published in 2005, which updated Home Office Research Study 217 (HORS217), published in 2000 (the latter is sometimes referred to as Brand and Price (2000)).
- **Intangible costs** are less easy to observe and measure, encompassing issues such as the emotional and physical effects of crime. Key references here are HO30/05, Dolan et al. (2005) and Dolan and Peasgood (2007).

There is a further distinction between realised costs and anticipated costs.

- **Realised costs** are those which relate directly to an actual crime, such as treatment of physical injuries in hospital.
- **Anticipated costs** are related to the fear of crime rather than actual crime; the literature acknowledges that this can be a nebulous concept. Dolan and Peasgood (1997) define these costs as all the *'tangible and intangible costs in anticipation of possible victimization'* (p123).

The specific categories of tangible cost include:

- **Direct cost for treatment of health issues;** eg treatment in hospital following a crime.
- **Indirect cost due to productivity losses;** eg leaving work early to avoid walking to a station car park in darkness.
- **Direct costs to the criminal justice system;** eg prosecuting offenders.
- **Direct cost of security measures;** eg expenditure on CCTV and additional staff at railway stations.
- **Direct cost of insurance administration;** eg associated with the administration of claims (but not the premiums themselves, which would be a transfer payment).
- **Direct cost from changes in behaviour;** eg changing travel mode in response to the fear of crime, and incurring additional monetary cost as a result.

The specific categories of intangible cost include:

- **Non-health loss: changes in behaviour;** eg changing travel mode in response to the fear of crime, and incurring additional journey time as a result.
- **Non-health loss: changed view of society;** eg perceptions regarding the extent of criminality in society.
- **Health-related loss: physical;** eg impacts of fear of crime on physical health.
- **Health-related loss: psychological;** eg impacts of fear of crime on psychological health.

A further distinction - not employed by Dolan and Peasgood (1997) - is between **internal** and **external costs.** The relevance of this distinction is that a rational and reasonably well-informed individual could be expected to perceive and respond to (be incentivised by) the costs they themselves bear (internal costs) but probably not to costs borne by employers and taxpayers (external costs). For example:

- **Direct cost for treatment of health issues:** some of this is borne by the victim (an internal cost - eg prescription charges, healthcare-related travel expenses) and some is borne by taxpayers in general (an external cost - eg costs to the NHS of treatment).
- **Indirect cost due to productivity losses:** this is shared by the individual, the employer and taxpayers (the individual loses their future consumption, the employer loses profit from future output, and the taxpayer loses tax revenue from future output).
- **Direct cost to the criminal justice system:** this is largely borne by taxpayers, although sometimes victims bear some legal costs.
- **Direct cost of security measures:** this might include costs which are in the first instance borne by the station operator, but potentially shared with users once rail fare setting taken into account, as well as costs incurred by individuals making their own provisions.
- **Direct cost of insurance administration:** this is borne by all insured individuals.
- **Direct cost from changes in behaviour:** this is borne entirely by the individual, assuming that operators adjust price and quantity to maintain profitability even if consumers change their travel behaviour to work around security issues.

In developing a framework for the present project, it will be useful to consider the extent to which evidence exists to populate the cells of Table 5.1. This exercise will help to distinguish between those

elements of cost which are informed by existing evidence, and those which are not. As regards the latter, subsequent sections of the report will consider the feasibility of deriving the valuations, and the methods that would be involved in doing this.

Focussing the discussion, it is appropriate to make the following opening remarks:

- On many components of Table 5.1, there exists an established source of evidence that is widely used in the UK, namely Home Office Online Report 30/05. This evidence has been adopted by DfT as the basis for the report 'Estimated costs to society of crime on public transport in England in 2006/07'. The latter represents the most complete and definitive statement of the costs of crime on railways in the UK, however it is notably incomplete in relation to the following three categories of cost.
- On anticipated costs associated with **health-related loss: psychological**, the literature is limited. The most notable contribution is Dolan and Peasgood (1997), but this should be regarded as exploratory research which has not, as yet, been corroborated by other sources of evidence. Indeed, the magnitudes of cost indicated by Doland and Peasgood are large, and there is thus a need to review (and possibly refine) these estimates.
- On **changes in behaviour**, this is a potential gap in the evidence base. In the context of Secure Stations/Safer Parking, this could be a significant source of additionality because rail travel is an option not a necessity for many users hence there may be significant latent demand if we find security is a key issue at certain stations. Methods for eliciting valuations of change in behaviour will be outlined in section 5.8.
- On **changed view of society**, this is again a potential gap which we believe could be significant in the context of Secure Stations/Safer Parking. Methods for eliciting valuations of changed view of society will be outlined in sections 5.3 and 5.4.

5.1.1 Home Office Online Report 30/05

This report updates estimates of the costs of crime published in HORS 217. In particular, HO30/05 reports cost estimates for crimes against individuals and households in 2003/04; it does not include the costs of crimes against commercial and public sector victims (where the latter could of course be relevant to the railway context). The cost estimates are adjusted to account for the potential under-reporting of crimes.

Table 5.2 reproduces estimates of the unit costs of crime against individuals and households from HO30/05. All unit costs of crime are presented in 2003 prices. Note that, whilst encompassing many of the same elements as Table 5.1, Table 5.2 employs a slightly different typology, in particular distinguishing between:

1. **As a consequence of crime** (including the costs of physical and emotional impact of offences, health costs, lost output and victim services).
2. **In response to crime** (mainly the costs of the criminal justice system, including policing, use of the courts and prison service).
3. **In prevention or anticipation of crime** (ie preventive costs, including the cost of defensive measures such as alarms and insurance administration costs).

The report reveals some problems of transferability between the BCS categorisation of crimes, and the categorisation employed by BTP. In particular, HO30/05 valuations are based upon actual crimes as opposed to those recorded by BTP. This creates some issues of correspondence in relation to both:

The categorisation of crime: HO30/05 highlights the definition of wounding as being one of the most significant sources of disparity. This definition does not include common assault with minor injury, whereas the BTP definition (since 2002) regards common assault with minor injury as less serious wounding.

The incidence of crime: given their reliance on BCS, the HO30/05 valuations are (in effect) weighted by the probability that they will be incurred, which in turn depends on the probability that an offence is reported, recorded, investigated and so on.

As well as updating the valuations published in HORS217, HO30/05 updated some of the methods used to develop the valuations. The most significant methodological update was the approach used for valuing the emotional and physical costs of violent crime. HORS 217 had adopted estimates of the Value of Preventing a Fatality (VPF) commissioned by DfT, on the basis of a postulated analogy between the value of reducing the risk of a fatality (or serious injury) due to a road traffic accident and the value of reducing the risk of a fatality/injury due to crime. See RSSB (2006, 2008) for applications to the rail sector.

HO30/05 notes that the adoption of this analogy *'...was due to a lack of alternative and dedicated evidence, and was recognised as an unsatisfactory long-term measure. The particular nature of physical injuries and the degrees of consequent psychological trauma entailed by criminal wounding, for example, could well be very different from those involved in road traffic accidents, which produces a potential for biased and misleading indicators of the cost of violent crime'* (p18).

Based on this judgment, the Home Office commissioned research to develop and apply methodologies for specifically valuing the intangible victim costs of violent crime. The approach which was eventually adopted by HO30/05 involved:

- Collating evidence from a range of sources, including the BCS, on the prevalence and severity of various health state outcomes associated with a range of violent crime incidents.
- Translating descriptions of health states into estimated losses of quality-adjusted life years (QALYs).
- Converting estimates of QALY loss into money terms, by applying a monetary estimate of a QALY derived from research again undertaken for the DfT.
- Uprating to account for both inflation and growth in income per capita, in accordance with advice in the HM Treasury's Green Book and the DfT's Highways Economics Series.

The QALY concept is widely used in the health sector. The principle behind the concept is that any health profile can be represented in terms of years of life weighted by some index of health-related quality of life. The index ranges from a score of 1, representing full health, to 0, representing death. States which are considered better than death but not as good as full health are assigned scores of between 0 and 1.34. The attraction of the concept is that it is based on established health state assessments, and can in principle be applied to any health state or outcome which can be characterised in terms of the same health and lifestyle dimensions as the QALY. This means that it can produce valuation estimates which are closely tailored to the actual health impacts of the particular crime incidents of interest. For consistency, HO30/05 also updated the costs of health services and lost output resulting from violent crime, based on the same health outcome profiles used to generate the QALY estimates.

Table 5.2: Estimated average costs of crimes against individuals and households in 2003/04 by crime type and by cost category (in £, 2003 prices)

BTP Categorisation	BCS Categorisation		In anticipation			As a consequence								In response	TOTAL
			Defensive expenditure	Insurance administration	Total	Physical and Emotional Impact on Direct Victims	Value of Property Stolen	Property Damaged/ Destroyed	Property Recovered	Victim Services	Lost Output	Health Services	Total	Criminal Justice System	
CRIME AGAINST A PERSON	CRIME AGAINST A PERSON														
Violence against a person (pax)	Violence against a person		1	1	2	5472	-	-	-	9	1648	1347	8476	1928	10407
	Homicide		145	229	374	860380	-	-	-	2102	451110	770	1314362	144239	1458975
	Wounding		1	1	2	4554	-	-	-	7	1166	1348	7075	1775	8852
		Serious wounding	1	1	2	4554	-	-	-	7	1166	1348	7075	14345	21422
		Other wounding	1	1	2	4554	-	-	-	7	1166	1348	7075	978	8056
	Common Assault		0	0	0	788	-	-	-	6	269	123	1186	255	1440
Violence against a person (staff)			?	?	?	?	-	-	-	?	?	?	?	?	?
	Homicide		?	?	?	?	-	-	-	?	?	?	?	?	?
	Wounding		?	?	?	?	-	-	-	?	?	?	?	?	?
		Serious wounding	?	?	?	?	-	-	-	?	?	?	?	?	?
		Other wounding	?	?	?	?	-	-	-	?	?	?	?	?	?
	Common Assault		?	?	?	?	-	-	-	?	?	?	?	?	?
Sexual Offences	Sexual Offences		3	5	8	22754	-	-	-	32	4430	916	28132	3298	31438
CRIME INVOLVING THEFT	CRIME INVOLVING THEFT														
Theft from a person and robbery															
	Theft		59	52	111	192	281	69	-36	1	10	-	236	217	844
	Robbery		0	21	21	3048	109	12	-19	16	1011	483	4832	2601	7282
	Theft - Not Vehicle		-	33	33	118	175	17	-13	1	3	-	235	301	634
Theft of and from motor													175		

vehicles															
	Theft of Vehicle		546	370	916	800	2367	349	-542	1	47	-	655	199	4138
	Theft From Vehicle		116	50	166	266	240	126	-11	1	20	-	2769	50	858
	Attempted Vehicle Theft		65	21	86	194	-	154	-	1	11	-	600	65	510
Burglary/theft of commercial premises	Burglary in a Dwelling		221	177	398	646	846	187	-22	11	64	-	886	1137	3268
CRIMES AGAINST PROPERTY/REVENUE	CRIMES AGAINST PROPERTY/REVENUE														
Criminal Damage	Criminal Damage		13	36	49	472	-	212	-	2	6	-	692	126	866
Line of route offences	-		-	-	-	-	-	-	-	-	-	-	-	-	-
Graffiti	-		-	-	-	-	-	-	-	-	-	-	-	-	-
Ticket /fare evasion	-		-	-	-	-	-	-	-	-	-	-	-	-	-

Note: ? entry denotes category not explicitly identified within HO30/05.

5.1.2 DfT report on the costs to society of crime on public transport in England

The costs reported in HO30/05 were adopted by DfT in developing the report 'Estimated costs to society of crime on public transport in England in 2006/07' (Table 5.3). The latter report covers all of the main public transport modes. In the case of rail, the analysis combines BTP data on the incidence of crime by type with the aforementioned Home Office evidence on the costs of crime. Data was drawn from a sample of PTEs and TOCs, as well as BTP and other agencies, and estimates derived by extrapolation across all public transport journeys.

Again following Home Office conventions, distinction is made between:

- **As a consequence of crime**
- **In response to crime**
- **In prevention or anticipation of crime**

As regards costs **as a consequence** of crime, the DfT estimates were calculated on the basis of estimates of total incidents (reported and unreported), whereas costs **in response** to crime were calculated on the basis of reported incidents only. Costs **in anticipation** of crime were omitted altogether; the report offers two justifications for this position. First, some defensive measures have functions other than preventing crime, eg the use of CCTV for crowd control. Second, the nature and scale of provision of such measures varies considerably across operators, making it difficult to extrapolate costs from a 'typical' operator.

One feature of the DfT costs of crime, relative to HO30/05, is the distinction between crimes against passengers and staff. Whereas the costs of crimes against passengers were taken directly from HO30/05, the costs of crimes against staff were derived via a slightly different method. In particular, the numbers of incidents against staff were drawn from the rail industry's Safety Management Information System (SMIS), rather than from BTP data. Unlike BTP, SMIS encompasses both verbal and physical assaults. The number of incidents reported was adjusted for under-reporting using the multiplier from the Health and Safety Executive FIT3 survey, which assumes that a third of incidents are not reported. Having generated a figure for the incidence of crimes against staff, these were combined with average unit costs from HO30/05[10]. The DfT report reasons that the total costs of violence against staff are much lower than the total costs of violence against passengers because of the lower number of incidents against staff, and also because many incidents against staff do not result in physical injury.

Finally, there are some further omissions/qualifications in the scope of the DfT report, specifically:

- Anti-social behaviour: reliable estimates of total numbers of incidents and total costs could not be calculated.
- Ticket/fare evasion: a total figure was generated for 'as a consequence', but no figures were reported for number of incidents or 'in response'.
- Criminal damage/graffiti: the category of 'criminal damage' includes the cost of graffiti (calculated on the basis of industry information), but does not account for the number of graffiti incidents.

[10] It is debatable whether this method is internally consistent, since HO30/05 assumes a particular level of incidence.

Table 5.3: Estimated average costs of crimes rail, light rail and London Underground in 2006/07 by crime type and by cost category (in £, 2006/07 prices)

BTP Categorisation	BCS Categorisation	DfT Categorisation	As a consequence	In response
				Criminal Justice System
CRIME AGAINST A PERSON	CRIME AGAINST A PERSON	CRIME AGAINST A PERSON		
Violence against a person (pax)		Violence against a person (pax)		
	Homicide	Homicide	1,417,338	155,540
		Attempted murder	7,629	155,540
	Wounding			
	Common assault			
		Common assault and racially aggravated assault/harassment	1,279	275
		Serious assault	7,629	15,469
		Other violence	1,279	275
		Total violence	2,634	7,672
Violence against a person (staff)		Violence against a person (staff)		
	Homicide		?	?
	Wounding		?	?
	Common Assault			
		Assaults on rail staff-verbal	120	275
		Assaults on rail staff-threats	120	275
		Assaults on rail staff-physical with no recorded injury	1,314	275
		Assaults on rail staff-physical with injury and time lost	7,754	1055
		Assault on police	6,876	1055
		Total violence	2,766	355
Sexual Offences	Sexual Offences	Sexual Offences		
		Sexual offences against females and males	26,846	3556
		Indecent exposure	1,279	275
		Other sexual offences	1,279	275
		Total sexual offences	13,813	1884
CRIME INVOLVING THEFT	CRIME INVOLVING THEFT	CRIME INVOLVING THEFT		
Theft from a person and robbery				
	Theft	Total theft	307	325
		Theft from a person	325	325
		Theft of personal property and luggage	282	325
	Robbery	Robbery	5,025	2804
	Theft - Not Vehicle			
Theft of and from motor vehicles				
	Theft of Vehicle	Theft of motor vehicle and taking without consent	3,259	214
	Theft From Vehicle	Theft from motor vehicle	692	54
		Damage to/interfere with motor vehicle	388	70
		Theft or damage to pedal cycle	406	70
		Total theft/damage to motor vehicle or cycle	591	71
	Attempted Vehicle Theft			
Burglary/theft of commercial premises	Burglary in a Dwelling			
		Burglary of booking office	4,368	1226
		Other burglary – commercial	4,368	1226
		Burglary/theft from a shop	109	325
		Theft from vending machines	109	54
		Theft undertaking stores	4,368	2804
		Cable theft	24,106	2804
		Other theft/burglary offences (including	4,368	2804

		handling)		
		Total theft or burglary of commercial property (notifiable)	4,226	1586
CRIMES AGAINST PROPERTY/REVENUE	CRIMES AGAINST PROPERTY/REVENUE	OTHER CRIMES AGAINST PROPERTY/REVENUE		
Criminal Damage	Criminal Damage	Criminal damage	3,537	136
		Arson	19,842	136
Line of route offences		Line of route offences	4,000	136
Graffiti		Graffiti	N/A	136
Ticket /fare evasion		Ticket /fare evasion	N/A	N/A

Note: ? entry denotes category not explicitly identified within DfT figures.

5.1.3 Other literature on the valuation of crime and personal security intervention

Another research strand that is relevant to the project, and to some extent informs and supports the standard Home Office and DfT valuations of crime detailed above, is the literature on the 'Willingness-To-Pay' (WTP) for reductions in crime per se and/or the introduction of personal security measures which could facilitate reductions in levels of criminality. In basic terms, this strand of literature employs non-market economic valuation techniques to elicit measurements such as:

- 'How much people would be willing-to-pay to reduce levels of crime?'
- 'How much compensation people would be willing-to-accept for increases in levels of crime?'
- 'How much people would be willing to pay for the introduction or upgrade of personal security interventions such as CCTV?'
- 'How much compensation people would be willing to accept for the removal or downgrade of personal security measures such as CCTV?'

The research literature in this area is limited in size and scope; the following discussion will be focussed on this literature.

The paper by Atkinson et al., (2005) claims novelty in two respects. First, it claims to report the first Stated Preference (SP) study of crime risks in the UK, and second, it claims to be the first study to present respondents with realistic descriptions of the physical and mental health impacts of violent crime of varying severity. In so doing, the authors *'seek to bridge some of the existing gaps in knowledge on the costs associated with the intangible impacts of crime'*.

Pursuing a Contingent Valuation (CV) approach, respondents were asked to consider the benefits to themselves of reducing the risk of suffering the health outcomes associated with a violent assault. Respondents were advised that:

- Common assault is associated, on average, with no physical injury and short-term mental distress;
- Other wounding is associated, on average, with moderate physical injury and medium-term
- Mental distress;
- And, serious wounding is associated with serious physical injury and long-term mental distress.

Respondents were further advised as to the pre-policy risk of the incident (and its outcomes) occurring, specifically 4% in the case of common assault and 1% for both other wounding and serious wounding. These figures were an approximation of the (average) actual risks of being a victim of a violent assault in the UK; in reality, the risk of incidence might vary considerably across different demographic and socio-economic groups as well as geographical location. A further feature of the survey was the use of visual aids to depict the concept of risk changes, and thereby minimize the occurrence of risk insensitivity. Finally, the experiment

adopted a split sample design in which each respondent was asked to consider only one of the three offence categories, randomly chosen, from the perspective of his or her current (average) chance of being the victim of the specified offence and its (average) consequences in terms of physical injury and mental distress.

The respondent was invited to express his/her WTP to reduce his or her chance of being a victim of this offence by 50% over the next 12 months, via the payment vehicle of a one-off increase in local charges for law enforcement. WTP was elicited by means of a payment card, with amounts varying from £0 to £5,000, where respondents were asked to place a tick against that amount which corresponded to the maximum they would be prepared to pay for reducing the risk by half. The paper found the costs of crime to be £5,300 for common assault (no injury), £31,000 for other (moderate) wounding, and £36,000 for serious wounding. The authors do however conclude that valuing the intangible costs of crime is a challenging task, and acknowledge a number of problem areas in eliciting such valuations.

Cohen et al., have been responsible for a number of papers on the WTP for reducing crime in the United States. The discussion here focuses on their 2001 paper, which claims to report a new methodology for estimating the cost of crime, adapting the CV method used in the environmental economics literature to estimate the public's WTP for reductions in crime.

An interesting issue noted by the authors is that in focus group analysis preceding the CV exercise, one of the key concerns expressed by participants was that survey respondents would not be able to separate out their desire for reduced crime from the mechanism by which crime reductions take place. More specifically, in evaluating preliminary survey questions, some participants noted that they had trouble separating their cynicism for the ability of the government to effectively reduce crime from their WTP. For this reason, the final survey did not specify a particular crime control policy, and instead respondents were told that a crime prevention strategy had worked last year and that the program had community support.

Turning to the CV vehicle, respondents were asked if they would be willing to vote for a proposal that would require each household in their community to pay a certain amount that would be used to prevent one in ten crimes in their community. They were randomly assigned three out of five crimes, namely: (1) burglary, (2) serious assault, (3) armed robbery, (4) rape or sexual assault, and (5) murder. These crimes were not explicitly defined for the respondents, and no information was provided on the prevalence, risk of victimization, average tangible losses or severity of injuries normally associated with the violent offences. Rather, respondents were asked simply to respond based on their understanding of these crimes. The experiment was administered by telephone interview, drawing upon a representative sample of the United States population of adults age 18 or over. A random digit dial sample of 4,966 phone numbers yielded a total of 1,300 completed interviews.

The authors found that the typical household would be willing to pay between $100 and $150 per year for crime control programs that reduced specific crimes by 10% in their communities. In the aggregate, these amounts imply a marginal WTP to reduce crime of about $31,000 per burglary, $75,000 per serious assault, $253,000 per armed robbery, $275,000 per rape and sexual assault, and $9.9 million per murder. It is remarked that these new estimates are between two and ten times higher than previous estimates of the cost of crime to victims. The authors claim that these costings more fully represent the true cost of crime to society, by including social costs above and beyond simply costs to the victims of crime and the criminal justice system.

Returning to a UK context, Potoglou et al. (2010) addressed the research question of 'to what extent would people sacrifice their right to privacy and liberty in exchange for potentially safer and more secure travel?'. A stated choice experiment was employed to quantify individuals' tradeoffs between privacy and security on the UK rail network. The experiment was based on a choice between 3 options, where each option was described in terms of 7 variables, namely: type of camera, time required to pass through security, type of security check (frequency of pat down and bag search, use of metal detector/x-ray), presence of different kinds of security personnel, increase on price of ticket to cover security, number of known terrorist plots

disrupted, and visibility of response to a security incident. The experiment was applied to a nationwide Internet-based market research panel (although the paper makes no mention whether participants were required to have recent experience of rail travel).

The data were analysed using discrete choice modelling techniques, eliciting estimates of WTP for the aforementioned safety/security features, in terms of an increment to the average ticket price. The highest valuations were given to increased effectiveness on the part of security authorities to disrupt terrorist plots; for example, if the number of plots disrupted over 10 years increased from 1 to 20, then this attracted a valuation of £4.44. By comparison, a reduction in waiting time to pass through security from 13 minutes to 1 minute attracted a valuation of £3.13. The installation of CCTV technology enabling facial recognition attracted a WTP of £3.10 relative to no CCTV, whilst respondents were willing-to-pay £2.41 for security checks involving metal detectors and X-rays relative to no checks. Finally, respondents reported a positive WTP for BTP staff presence in addition to rail staff (of £0.72), but a negative WTP for the further addition of armed police and uniformed military.

5.1.4 Literature on the value of preventing a fatality

Previous discussion has already alluded to the relevance of literature on the value of preventing a fatality (VPF); the purpose of the present section is to review this literature in more detail. As noted in RSSB Report T430 (2006), VPF refers to the value of preventing one statistical fatality, in the sense that the mean of the number of deaths preventable is precisely one. If individuals are, on average, each willing to pay £v for a 1 in 100,000 reduction in the probability of death afforded by a safety improvement, then the aggregate WTP will be given by £v x 100,000. This is what is meant by the WTP-based value of preventing one statistical fatality (VPF). Convention in the rail sector is to couch the VPF for rail accidents in terms of a 'baseline case' of a single-fatality rail accident involving an adult passenger behaving responsibly; the actual figure for the VPF is set at a level equivalent to that used in DfT road project appraisal, specifically £1.4 million in 2004 prices.

Report T430, which offers a review and analysis of the conceptual basis for the VPF, argues that the same approach can be used to derive values for preventing non-fatal injuries (VPIs). It cites the example of a safety improvement that is expected not only to prevent one fatality but also to prevent 10 serious injuries. If members of the population valued the reduction in their risks of being seriously injured (in this case, an average reduction of 1 in 10,000) at £8 per head, then the VPI for a serious injury would be £80,000. The report remarks that both the VPF and VPI reflect the valuations of a ‘representative consumer’, which effectively amplifies the (typically lower) WTP of poorer individuals and deflates the (typically higher) WTP of WTP of richer individuals.

The report makes an important distinction between textbook and DfT definitions of VPF. DfT defines VPF as not only the aggregate WTP for improved safety per se (as above), but also avoided net output losses and avoided medical and ambulance costs associated with a premature fatal casualty. More specifically, it its Highways Economics Note No 1 (HEN 1), the Department for Transport defines the roads VPF as comprising three components, namely avoided lost input, avoided medical and ambulance costs, and avoided human costs.

The authors of the report seek to draw a correspondence between this definition of VPF, and the earlier textbook definition. More specifically, they derive the identity:

VPF = (WTP-C) + GQ + MA

where:

WTP ≡ the pure Willingness-To-Pay component of the roads VPF

GQ ≡ Average (discounted) loss of gross output resulting from one road fatality

C ≡ Average (discounted) reduction in consumption resulting from one road fatality

NQ (≡ GQ-C) ≡ Average (discounted) loss of net output resulting from one road fatality

MA ≡ Medical and ambulance costs associated with one road fatality

Finally, a further feature of DfT conventions is that, in defining overall accident (as opposed to casualty) costs, the DfT also includes (in 2003 prices) avoided police costs (£1,530), avoided insurance administration costs, and avoided physical damage to vehicles and property (£9,030).

The report considers the case for a universal VPF, or for different versions of the VPF in different contexts. In particular, there is detailed discussion of various potential sources of additionality, specifically:

Category 1: Variables whose influence on WTP may be modified by socio-political value judgments; variables here include income/wealth, age, and number of dependants.

Category 2: Variables whose influence on WTP may be accepted by socio-political value judgments; these include personal (dis)tastes, 'baseline' levels of risk, fear/anxiety/dread, health effects preceding death, health state unrelated to the hazard.

Category 3: Variables not picked up in WTP and/or that a citizen perspective might want to incorporate into VPF; these include people who are disenfranchised or disadvantaged as consumers and the distribution of responsibility.

Category 4: Factors of concern that may need to be incorporated as separate items; these include fear/anxiety only weakly correlated with risk, distribution of risks and benefits, deterrence of socially undesirable actions, blame/culpability, identifiability, and ambiguity.

The report concludes by summarising the following points.

- A WTP-based VPF is essentially the aggregate, across affected members of society, of individual Willingness-To-Pay for (typically very small) risk reductions which will on average prevent one fatality. The VPF is not is the 'price of a life'.
- Neither the possibility of multiple fatality accidents nor the rail context per se appears to provide grounds for setting the rail VPF at a premium in relation to the roads figure.
- While it therefore appears that rail and road safety project appraisal should share a common 'baseline' VPF for the typical adult rail passenger or road user, there are other considerations that may point towards the application of rail VPF 'multipliers' (that may not necessarily be greater than unity) for other groups of individuals. These include non-adult rail passengers, railway workers, adult or child trespassers, or suicides.
- In the case of both the rail and road VPF, aggregate individual WTP is typically augmented by sums that reflect the direct economic costs avoided by preventing a premature fatality, such as the avoided loss of net output and avoided medical and ambulance costs. The authors remark that this 'add-on' for avoided direct economic costs is legitimate.
- It is noted that avoided material damage costs are included as separate items in the CBA of proposed road safety project appraisal, and there is thus an incontrovertible case for their inclusion in rail safety project appraisal.
- With respect to so-called 'societal concerns', the report argues that these should be regarded as factors not included within a narrow notion of the self-interested consumer. However, given the absence of hard evidence on some of the relevant factors (eg the distribution of risks and safety benefits, the potential identifiability of victims, and ambiguity), the authors suggest that it may be

more appropriate to account for them within the context of safety investment decision-making, rather than attempting to modify the VPF.

- To the extent that societal concerns might include issues of equity/fairness/distribution, the authors argue that these considerations should not be the sole responsibility of the rail industry.
- The report acknowledges that there will be uncertainty associated with any estimate of prospective costs and benefits. Since most organisations, including the rail industry are risk-averse, it is argued that forecasted benefits should exceed costs by an appropriate 'safety margin' or risk premium.

Building upon Report T430, RSSB Report T616 conducts fresh empirical analysis aimed at estimating multipliers of the baseline VPF (£1.4 million in 2004 prices) for a range of other cases involving, for example, the death of a responsible adult in a multiple-fatality rail accident; a track worker; an adult trespasser or suicide, etc.

The researchers' approach was to recruit 1033 respondents to a nationally representative sample survey. The survey involved a series of 'matching questions' designed to elicit their relative preferences, in terms of the number of rail fatalities of a given type that would need to be prevented by a safety improvement in order for the respondent to regard that safety improvement as being 'equally as socially desirable' as the prevention of a given number of baseline case fatalities.

The report details the following main findings:

- No more than half the sample regarded the prevention of a fatality in a multiple-fatality rail accident as taking priority over the prevention of a baseline case fatality in a single-fatality rail accident.
- Based on the means of the matching responses, the VPF valuation ratio relative to the baseline case was estimated to be 1.28:1 for the prevention of a fatality in a multiple-fatality accident caused by signal failure, and 1.12:1 for a multiple-fatality accident involving a fire in a tunnel. In medians were used instead, the ratios were always 1:1.
- The authors found that where the victim of the fatality was, to all intents and purposes, behaving responsibly, or where the victim was a child trespasser taking a shortcut, the VPF ratios relative to the baseline case did not significantly differ from 1:1.
- In cases where adult victims were behaving irresponsibly, child trespassers were engaged in acts of vandalism, or the fatality involved suicide, the VPF ratios relative to the baseline case were in the range 0.4:1.

Otherwise, the report recommends no further differentiation in the VPF.

5.1.5 Literature on the value of personal security interventions and station quality more generally

Finally, evidence can be drawn from a small number of SP studies aimed at valuing personal security interventions and quality more generally at railway stations. The objectives of the 2000 study commissioned by the SRA and undertaken by ITS Leeds were:

- To estimate passengers' valuations of avoiding the need to interchange and the associated transfer and waiting time.
- To examine how passengers' valuations differ with the physical characteristics of the interchange location and the type of interchange.
- To estimate the impact of reliability and frequency of connections on interchange values.
- To estimate the benefits of improved interchange facilities and better integration between rail and other modes.

Of relevance to the current RSSB work is that the ITS Leeds study valued packages of improvements to facilities at interchange stations; among these improvements were CCTV and better lighting. Among the various analyses conducted was a ranking exercise used to evaluate passengers' preferences towards different improvements in facilities at the interchange station. The range of attributes covered and their associated abbreviations are given in Table 5.4.

Table 5.4: Interchange station attributes covered

Attribute	**Term**	**Attribute**	**Term**
Intercom to control centre	IN	Heated and Refurbished Waiting Room	HE
Mini Supermarket	MS	Clear Departure Information	DE
Real Time Information Monitors	RT	Plenty of Seats on Platform	SE
Escalators replace Stairways	ES	Better Lighting	LI
Additional Staff Present	ST	More Printed Timetable Information	PR
CCTV	TV	Journey Time Savings	TS

Comparing data from South East and Transpennine passengers, Table 5.5 below reports an ordered logit model estimated to the ranking data. The reported values are expressed in equivalent minutes of train time.

Table 5.5: Interchange facilities ranking exercise – overall model

Attribute	South East			TransPennine		
	Coeff (t)	Value (t)	Scaled	Coeff (t)	Value (t)	Scaled
IN	0.238 (3.3)	0.59 (3.5)	0.60	n.s		
MS	-0.543 (6.4)	-1.33 (5.8)	-1.36	n.s		
RT	1.312 (18.5)	3.23 (23.1)	3.29	1.628 (7.8)	6.76 (8.6)	2.16
ES	-0.218 (2.8)	-0.54 (2.7)	-0.55	0.900 (5.7)	3.73 (6.6)	1.43
ST	0.657 (9.2)	1.62 (10.5)	1.65	1.660 (8.0)	6.91 (8.8)	2.21
TV	0.479 (6.6)	1.18 (7.2)	1.20	0.715 (4.4)	2.98 (4.9)	1.14
HE	n.a			0.539 (2.0)	2.24 (2.1)	0.90
DE	n.a			2.010 (7.7)	8.38 (7.8)	3.36
SE	n.a			1.253 (7.1)	5.20 (8.2)	1.95
LI	n.a			0.378 (2.0)	1.57 (2.1)	0.59
PR	n.a			1.018 (3.9)	4.22 (4.1)	1.81
TS	0.406 (37.3)			0.241 (13.4)		

Note: The scaled column adjusts for the package effect. Where an attribute is common to more than one package, the average of the relevant scale is used.

Of particular note, given present interests, is that the time valuations of staff presence (ST) and closed circuit television (TV) were much greater for TransPennine travellers than for South East. Secondly, and related to the first point, the 'package' effect was much greater for TransPennine travellers. Further work on socio-demographic segmentation found that a number of security effects were more apparent for females, including higher values of intercom connections (IN), staff presence and closed circuit television (TV).

The report by Faber Maunsell, ITS Leeds and John Bates Services (2003) was part of a programme of work aiming to improve the treatment of public transport quality in transport modelling and appraisal. The objective of this report, commissioned by the Department for Transport, as the first stage in a programme of work, was to produce a literature review of how quality aspects of public transport have been built into transport models, highlighting the range of values suggested. For present purposes, it will suffice to highlight specific pieces of evidence from the Faber Maunsell report.

First, in Accent's (2002) study - UK Bus Priorities Modal Shift, Final Report for LEK - they found that car users valued CCTV on buses at 70.9p and CCTV on all buses and stops at 75.5p. Bus users on the other hand valued these at 4.6p and 5.8p (2001 prices). Second, LUL (2000) - LU Customer Priorities Survey 1999/2000 Results (November 2000) - found the following values of service attributes relating to security on train (pence per trip – 1999 prices).

Table 5.6: LUL Value of Security - pence per trip (1999 prices)

Staff on the train	0.74
Customer alarms on the train	2.65
Access between carriages	1.03
Ability to see between carriages	0.32
Brightness of lighting on the train	0.29
Ability of staff to stop the train form the platform	3.28

5.1.6 Synthesis

A significant challenge in exploiting the literature described above will be to synthesise the evidence into an appropriate form for application to the evaluation of Secure Stations and Safer Parking. This task is far from trivial given that:

- The evidence covers a broad and disparate set of interests: the social costs of crime, the WTP to reduce crime, the VPF, the value of personal security interventions, etc.
- The evidence is couched at different levels of aggregation (eg individual, social), and in different dimensions (eg for a given individual, for an incident, for a journey, for a station).
- There is a potential for duplication/double-counting.

Section 5.2 will outline an economic evaluation framework for Secure Stations / Safer Parking from first principles, which will subsequently be populated with some of the secondary evidence described above. Following from the review, there is a case for primary data analysis to cover substantive gaps in the evidence base, as follows.

Valuing changes in perceptions

The cost estimates detailed in Table 5.2 have been adopted by DfT, and could be readily applied to the present study. However, a significant omission in the scope of these estimates is costs **in anticipation** of crime, which potentially includes both defensive expenditure and insurance administration. One might recall that the DfT report justifies their omission on the basis that some measures have functions other than preventing crime, and that the nature and scale of provision of such measures varies considerably across operators.

In the case of insurance administration, the study team judged that it would not be feasible within the constraints of the present study to develop more accurate estimates of cost. In other words, it was judged that the estimates given in HO30/05 represented the best available evidence and should be straightforwardly adopted.

In the case of defensive expenditure, two remarks are appropriate. First, even if the apportionment to crime prevention could be isolated, the costs of defensive expenditure might not fully reflect the anticipated costs of crime. This is because users of stations/station car parks (and indeed some non-users) might be willing-to-pay a premium over and above the costs of defensive expenditure for the reassurance that crime prevention measures are in situ. In other words, there might be a consumer surplus associated with measures that serve to reduce the fear of crime. Second, once the broader notion is introduced that defensive intervention might have a social welfare impact through a reduction in the fear of crime, DfT's concerns regarding the isolation of costs specific to crime prevention seem, perhaps, less clear cut. That is to say, users of stations/station car parks (and again non-users) might be willing-to-pay for the presence of CCTV and other interventions, without necessarily concerning themselves with the precise function of those interventions.

Drawing together the previous two remarks, the present study will adopt the costs of defensive expenditure from HO30/05. In addition to these costs, estimates of Willingness-To-Pay (WTP) for defensive intervention will be adopted. In principle, the net benefits of defensive expenditure will be given by the perceived benefit plus the wider social benefit less costs. The review of literature and evidence has established the existence of a small literature on the perceived value of specific components of personal security intervention, for example CCTV (eg University of Southampton, Accent and ITS Leeds, 2008). For purposes of the present study, new estimates of WTP for defensive intervention will be developed, considering a range of components broader than simply CCTV (but focussing especially on those components most relevant to Secure Stations and Safer Parking). The existing literature will be useful in providing a basis for comparison against new estimates.

Whilst adopting the WTP approach, note that some previous studies (eg Cohen et al., 2001) have found WTP estimates to be markedly in excess of cost-based estimates. The discrepancy may be explained by the propensity for WTP to pick up effects additional to direct costs, such as general concerns about community safety and anxiety over anticipated crime. (In passing, we note that, Dolan and Peasgood (1997) employed a QALY-based approach to estimating the costs of the fear of crime. This approach has not however been accommodated within the Home Office figures, and cannot therefore be regarded as standard). Moreover, one should remain mindful that, by definition, WTP potentially includes not only the direct costs of crime, but also the surplus of welfare over cost (ie consumer surplus). At the same time, high quality WTP studies must be designed to control for hypothetical bias, strategic bias and embedding effects which - if not addressed - can be the source of overestimates of WTP in some studies.

Valuing changes in behaviour

It is important to recognise that this source of cost represents a second-order effect. That is to say, the first-order effect of a personal security intervention would be to reduce levels of crime and, as of consequence, the costs associated with crime. Any improvement in crime prevention provision/reduction in crime levels could in turn provoke the second-order effect of increasing the demand for rail. In generalised cost terms, this would entail a movement along the demand function for rail, bringing a potential benefit in terms of revenue and consumer surplus gain.

Past studies have used various methods to value such costs, as discussed in Dolan and Peasgood (1997). In the present project, the cost of behaviour change will be inferred from aggregate ticket sales data. This method was used previously in the ITS study for Transport Scotland to examine the impacts of changes in car parking provision for the demand for rail travel. This has enhanced standard rail demand models estimated to LENNON ticket sales data by including measures of car parking provision for carefully selected rail flows. As far as the study team is aware, this was the first study to successfully estimate a car parking provision 'elasticity'. In the present study, this approach will be extended to cover personal security issues. Changes in patronage arise from increased travel by existing rail travellers, or from the attraction of new travellers. In both cases, it will be important to understand - from a commercial perspective - the demand response, and associated revenue change, as levels of personal security (perceived or actual) change.

5.2 Theory and Method

This section seeks to specify in detail the relationships between all key variables. This necessarily includes definitions of concepts and terms.

5.2.1 Economic evaluation of Secure Stations and Safer Parking

Consistent with cost-benefit analysis practice (DfT, 2011, 'WebTAG'; HM Treasury, 2003, 'Green Book'), let the social Net Present Value (NPV) of the scheme be the sum of the discounted net social benefits over time.

Let: $$NPV_{scheme} = \sum_{n=1}^{N} \frac{Total\ NSB_{scheme,n}}{(1+r)^n} \quad (5.1)$$

where: the *scheme* involves Secure Station and/or Safer Parking accreditation at the particular station, or individual security measures such as CCTV (scheme composition is defined below in section 5.2.2);

the *NPV* compares the scheme with a *do-minimum* (denoted *DM* in what follows), which is a realistic alternative scenario defined across the appraisal period;

N is the appraisal period in years, and the years are indexed $n = 1,...,N$, with 1 representing the first year in which costs are incurred;

N is also the sum of the investment period (including any planning and installation costs) plus the economic life for the longest-lived asset created – which may be the CCTV or station lighting installation, for example;

r is the social discount rate (further discussion of this will follow in section 6).

Let: $$NSB_{scheme,n} = \Delta CS_n + \Delta PS_n + \Delta GS_n \quad (5.2)$$

where: ΔCS_n is the change in consumer surplus in year *n* between the scheme and do-minimum scenarios (ie $\Delta CS_n = CS_{n,scheme} - CS_{n,DM}$) – a positive number indicates a benefit to the household sector;

ΔPS_n is the change in producer surplus in year *n* between the scheme and do-minimum scenarios – a positive number indicates a benefit to the production sector, including the rail industry;

ΔGS_n is the change in government surplus in year *n* between the scheme and do-minimum scenarios – a positive number indicates a benefit to the government sector, eg in the form of a net saving in expenditure or an increase in tax revenue.

Let: $$\Delta PS_n = \Delta TR_n - \Delta TC_n \quad (5.3)$$

where ΔTR_n is the change in operator revenue in year *n* between the scheme and do-minimum scenarios;

ΔTC_n is the change in operator costs in year *n* between the scheme and do-minimum scenarios.

Both ΔTR_n and ΔTC_n are expressed here as totals, but could be broken down further by organisation within the rail industry (Network Rail; TOCs; etc).

5.2.2 Composition of a scheme

A scheme could involve a change in the station's *accreditation status* or a change in the station's *security-relevant characteristics* or both.

Table 5.7 Accreditation status, *as* and *ap*

Secure Stations	First time accreditation (*as*=1) Re-accredited (*as*=2) Working towards (*as*=3) Not accredited (*as*=4)
Safer Parking	First time accreditation (*ap*=1) Re-accredited (*ap*=2) Working towards (*ap*=3) Not accredited (*ap*=4)

Table 5.8: Security measures, *b*

CCTV (*b*1=1 yes; 0 no) Staffing (*b2*=2 police and station staff; 1 station staff only; 0 unstaffed) Lighting (*b3*=1 good lighting throughout station; 0 good lighting in waiting areas only) Ticket barriers (*b4*=1 yes; 0 no)

On this basis, the scheme and the DM can be described in terms of its accreditation status and the presence or otherwise of each of the security measures.

Thus: $scheme = scheme(as, ap, b1..b5)$ (5.4a)

$DM = DM(as, ap, b1..b5)$ (5.4b)

The possible combinations of *as, ap* and *b1..b5* could be narrowed if the requirements for accreditation were made explicit.

5.2.3 Crime types

To make things practicable, the present study will - from the perspective of individuals (whether passengers or staff) using Secure Stations / Safer Parking - focus upon 5 principle *crime types*, which are indexed $m = 1,...,5$

$m = 1$: Violence against a person
$m = 2$: Sexual attack
$m = 3$: Theft from passengers
$m = 4$: Criminal damage
$m = 5$: Car crime

Underlying these are more detailed *crime types*. Let these be indexed *q*. Table 5.9 below also slightly regroups the top-level crime types and reflects the full gamut of crimes including crimes impacting mainly on

the industry, ie commercial burglary, theft and ticket/fare evasion. Cost estimates for these crime types are available (in most cases) from the research by DfT (2006/7) and Home Office (2005).

Table 5.9: Crime types

Crime types ***m*=1,...,5**	**Detailed crime types** ***Q***	**Regrouped crime types**
Violence against a person	Homicide Attempted homicide Wounding – serious; other Serious assault Common assault Racially aggravated assault Harassment Other Assaults on rail staff – verbal/threats; physical with no recorded injury; physical with injury and time lost Assaults on police	Violence against a person
Sexual attack	Sexual attack Indecent exposure/other	Sexual offences
Theft from passengers	Theft from a person Theft of personal property and luggage Robbery	Theft from passengers
Criminal damage	Criminal damage Arson Line of route offences Graffiti	Criminal damage
Car crime	Theft of a motor vehicle/taking without consent Theft from a motor vehicle Damage to/interference with a motor vehicle Theft or damage to pedal cycle Attempted vehicle theft	Vehicle crime
	Burglary of booking office Other burglary – commercial Burglary/theft from a shop Theft from vending machines Theft undertaking stores Cable theft Other Ticket/fare evasion	Burglary/theft – commercial

The annual social costs of crime C_m in top-level category m is a weighted sum of the costs of the detailed crime types C_m for all $q \in m$. The weights are the frequencies f_q of each detailed type, in crimes per annum. Formally:

$$C_m = \sum_{m \in q} \left(C_q \frac{f_q}{f_m} \right) \tag{5.5}$$

A key source for these frequencies is DfT (2006/7) Table 5.3, which uses a very similar classification.

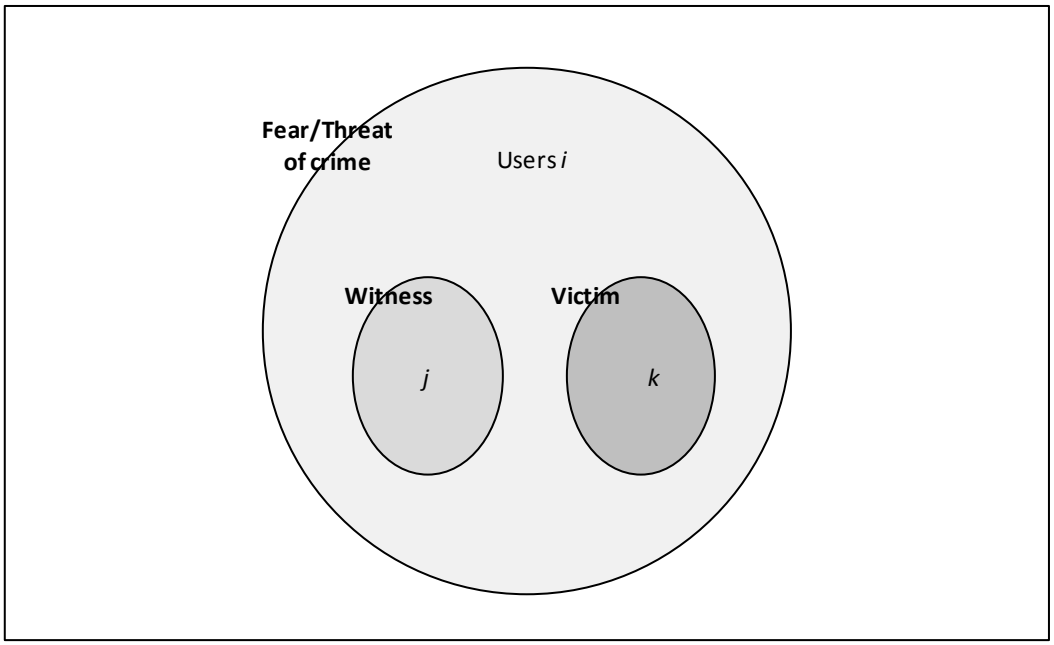
5.2.4 The costs of crime

As noted in section 5.1.1, the literature focuses on the itemisation of crime costs and their grouping into costs **in anticipation of**, **as a consequence of**, and **in response to** crime – this grouping is due to Brand and Price (2000). As Cohen and Bowles (2010) observe, these categories are not mutually exclusive – eg the criminal justice system provides a deterrent function **in anticipation of** crime as well as punishment and rehabilitation afterwards **in response to** crime. What is more fundamental in an economic assessment of a crime reduction policy is the *incidence* of the costs of crime, and hence the incidence of the benefits of crime reduction. That is, who is impacted and by how much? Crime costs which are borne by individual rail users themselves can be expected to deter individuals from using rail. Other costs which are borne by the industry or government may have little incentive effect on individual rail users yet be highly relevant for a social assessment of the intervention.

Moreover, in a WTP survey, individuals' responses relate to their own perceptions of the questions asked. Thus in questions about security vs. rail fare on their journey, their responses are expected to reflect their private costs. In questions about alternative rail industry investment programmes, their responses are expected to blend private and public preferences. In equilibrium, it can be expected that people spend a certain amount of money to achieve a certain level of security, individually (defensive expenditures) and collectively (police and CJS costs); they also incur the remaining uncontrolled losses (eg lost output, NHS costs). Thus could break costs down into planned (compensated) costs and unplanned (uncompensated, 'external') costs.

It is appropriate to distinguish between the impacts borne by individuals and the impacts borne by other groups, in particular the rail industry, government and society as a whole. It is also relevant to distinguish between passengers and staff. The analysis should also recognise the impacts to witnesses as well as to victims of crime, and the impacts to users as a whole from the fear or threat of crime. First, consider the impacts on individual rail users, indexed $i = 1,...,I$. Victims, *k,* and witnesses, *j*, can be seen to be a subset of all rail users (Figure 5.1).

Figure 5.1: Impacts on rail users



The literature points to impacts of the following types:

- Physical health
- Psychological health
- Lost consumption
- Defensive expenditures
- Property stolen
- Property damaged/destroyed

The first four of these may be felt to some extent by all users *i*, the last two are unique to victims of property crimes of types $m = 3,4,5$.

Impacts borne by users

For a given user $i = 1,...,I$, the annual costs of crime can be written:

$$C_i = \left(c_{m,i} \cdot t_i\right) + \left(c_{m,j}\big|_{i \in j} \cdot z_{m,j}\right) + \left(c_{m,k}\big|_{i \in k} \cdot z_{m,k}\right) \qquad (5.6)$$

where C_i is the annual cost of crime to user *i;*

$c_{m,i}$ is the cost per trip due to the fear/threat of crime type *m* to user *i*;

t_i is the number of trips per annum made by user *i*;

$c_{m,j}\big|_{j \in I}$ is the cost per incident of crime type *m* to witnesses *j*, applicable to witnesses *j* who are also users in that year;

$z_{m,j}$ is the number of crimes of type *m* experienced by *j* as a witness in that year; and

$c_{m,k}\big|_{k \in I}$ is the cost per incident of crime type *m* to victims *k*, applicable to individuals *k* who are also users in that year;

$z_{m,k}$ is the number of crimes of type *m* experienced by *k* as a victim in that year.

Note: subscripts for the year have been suppressed, but would apply to all terms in (5.6).

The costs in (5.6) include some that are financial costs to the individual and some that are non-financial impacts on individual welfare, eg on health. Conversion between the two metrics is by the individual's marginal utility of money, λ_i

$$\Delta U_i = \lambda_i \Delta C_i \qquad (5.7)$$

where Δ again indicates the change between the scheme and the 'do-minimum' scenarios.

While (5.6) would be appropriate for a past year, in which the individual's experience of crime was known with certainty, in a future year under a proposed Secure Station / Safer Parking scheme, an estimate must be made of crime risk exposure with and without the scheme. Let the *objective risk* of an individual experiencing crime type *m* as a witness or a victim be $p_{m,j}$ and $p_{m,k}$ respectively. If the total number of trips

made by rail is *T* and the numbers of victims of and witnesses to crime type *m* are K_m and J_m respectively, then by definition the objective risks (in terms of relative frequency) are:

$$p_{m,k} = \frac{K_m}{T} \quad \text{and} \quad p_{m,j} = \frac{J_m}{T} \tag{5.8}$$

The individual *defensive expenditures* are a choice variable, rather than a fixed externality from crime. Individual *i* can be expected to increase his or her annual defensive expenditures a_i up to the point where:

$$\Delta a_i = \Delta C_i \big|_{\Delta p_{m,k}} \tag{5.9}$$

where: Δa_i is the increment in defensive expenditures between the scheme and do minimum scenarios; and

ΔC_i is the resulting reduction in annual cost of crime to the individual given the reduction in individual risk of becoming a victim of crime type *m*, $\Delta p_{m,k}$

This is also a *subjective risk* situation, in which theory indicates individuals may respond not only to the expected value of key variables but to the risk itself. Thus individuals may perceive the utility difference between the do-minimum and the 'with scheme' scenario as

$$U_{i,scheme} - U_{i,DM} = \Delta r_i + s_i \tag{5.10}$$

where: Δr_i is the utility difference derived from the expected difference in crime outcome, incorporating the impacts listed above; and

s_i is a risk premium –this is a consequence of fear/threat *additional* to the expected crime outcome.

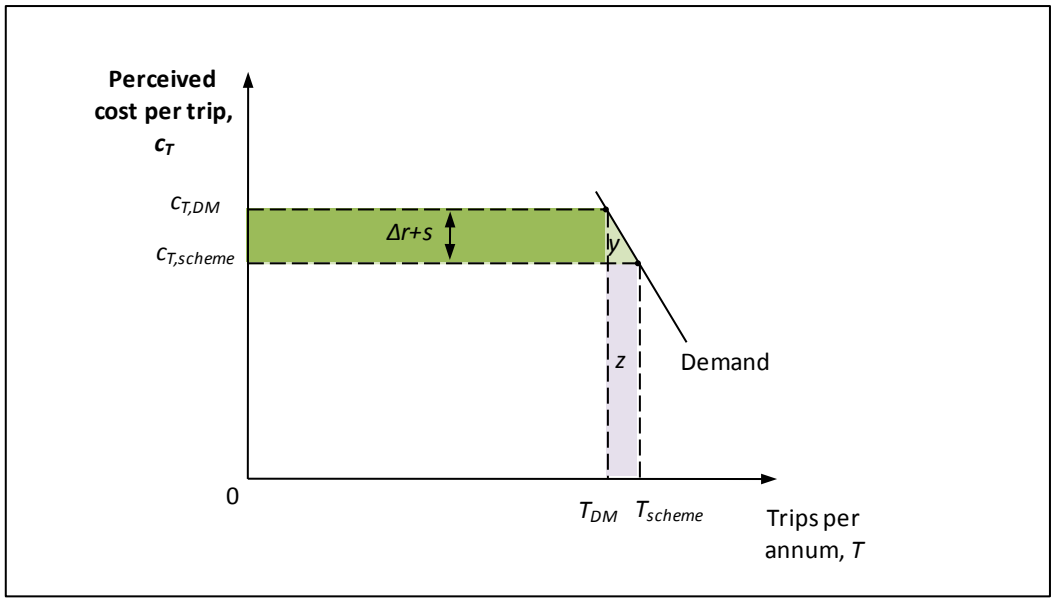
Finally, the analysis should consider behavioural change, since a reduced perceived cost of rail travel due to improved security could stimulate demand – the extent to which it does so is being investigated using ticket sales data (sections 5.8 and 5.9). The benefits of any increased rail use due to reduced security costs can be captured using the consumer surplus change measure in equation (5.2). The additional benefit due to any increase in demand is shown as the triangle *y* in Figure 5.2, and calculated as

$$y = 0.5\left(\Delta r + s\right)\left(T_{scheme} - T_{DM}\right) \tag{5.11}$$

The total benefit to *individual users* from the scheme is therefore

$$\Delta CS = y + \left(\Delta r + s\right)\left(T_{scheme} + T_{DM}\right) = 0.5\left(\Delta r + s\right)\left(T_{scheme} + T_{DM}\right) \tag{5.12}$$

Figure 5.2: Potential behavioural response and consumer surplus / revenue impacts



The WTP experiments in this study (described in sections 5.3 and 5.4) are designed to elicit individuals' total utility difference $\Delta r + s$ between the Secure Station / Safer Parking scenario and the do-minimum scenario. By including a numeraire in each experiment, WTP estimates of this amount can be elicited, ie with money as the metric rather than utility. This is the form required to calculate equation (5.2).

Not included in this framework so far are the impacts on staff, operators, government and the population at large. These are discussed below.

Impacts borne by staff

Like users, station / car park staff are susceptible to physical and psychological health impacts from crime, and an associated risk premium. They are also potentially impacted by loss of earnings, hence consumption, although this may be partly offset by compensation for injury at work. Conversely, defensive expenditures to protect rail staff at work are typically borne by the employer rather than the individual staff, and the employer bears the cost of equipment theft and damage at work.

Impacts borne by the rail industry

Within the framework of *ΔPS* set out in equation (5.3), the rail industry is likely to bear the following costs:

- Defensive expenditures on behalf of staff and railway property and revenues
- Theft of railway property
- Damage to railway property
- Lost output
- Delays

The rail industry is also the funding source for Secure Station and Safer Parking schemes – hence this is a cost to be accounted for in the 'with scheme' scenario. Changes in ticket revenue need to be set against this – Figure 5.2 shows a case where the security improvement produces a revenue increase.

The industry costs and revenues in each scenario will be written

Do-Minimum: TC_{DM}, TR_{DM} Scheme: TC_{scheme}, TR_{scheme}

Hence the impact of the scheme will be

$$(TR_{scheme} - TR_{DM}) - (TC_{scheme} - TC_{DM}) = \Delta TR - \Delta TC = \Delta PS \quad (5.13)$$

Impacts borne by government

These are ultimately borne by citizens as a whole through changes in taxation and expenditure.

Government does not directly contribute to Secure Stations / Safer Parking or benefit from it, however the costs of crime at stations include the following which are borne by government:

- Health services (eg provided by the NHS)
- Victim services
- Criminal justice system

Conceivably, government revenue could also be affected if mode shift effects led to a reduction in fuel duty and VAT on fuel duty from private car use.

These effects are recorded as

$$\Delta GR - \Delta GC = \Delta GS \quad (5.14)$$

Impacts on non-users

Finally, residents within a station catchment may value the provision of a more secure station as a consequence of *option and non-use values*. Note that non-users may begin to use the station if its security improves, in which case their benefits will be measured within the term *y* above. For current non-users who would remain non-users, these option and non-use benefits are relevant in principle. In practice, however, it is difficult to conceive of a payment vehicle that would allow measurements of those benefits. Fare would be inappropriate since the potential beneficiaries are non-users, whilst council tax would not be a credible vehicle since station improvements are not funded from the public purse.

5.2.5 Summary of the costs of crime

Tables A5.1, A5.2 and A5.3 (to be found in Appendix 5) summarise - from a conceptual perspective - the costs of crime at railway stations and railway station car parks by way of. More specifically:

- Table A5.1 shows the potential costs of crime at railway stations and railway station car parks, breaking these down by the specific source of cost (rows of the table) and the section of society which bears the cost (columns of the table).
- Table A5.2 shows the potential benefits of the Secure Stations / Safer Parking interventions, focussing on existing rail usage (again the table specifies the source and beneficiary).
- Table A5.3 shows the potential benefits of the Secure Stations / Safer Parking interventions, focussing on new rail usage that might be stimulated (specifying the source and beneficiary).

5.3 Valuing Changes in Perceptions Regarding the Risk of Crime

5.3.1 Introductory comments

This section will deal with methods used to value the area $\Delta r + s$ in Figure 5.2; the change in perceptions - on the part of existing rail users - associated with a personal security intervention. As noted above, a fundamental problem, in the context of the present project, is that there exists no formal statement of the criteria that must be met in order to achieve Secure Stations/Safer Parking accreditation. Having interviewed relevant staff at BTP, it is understood that accreditation is more about demonstrating an ongoing commitment towards personal security, and less about the provision of specific elements of a personal security package, such as CCTV and additional station staff.

Whilst not trivialising this problem, users, staff and non-users are more likely to derive value from specific elements of a personal security package, rather than from changes to management practice per se. With this justification, the study, in the first instance, focussed the valuation work around these elements; these valuations will be related to Secure Stations/Safer Parking when applying the Planning Tool (section 6).

An appropriate method for valuing improved perception is Willingness-To-Pay (WTP); this is used widely across UK public policy. In the present context, and drawing reference to Figure 5.1, the study is concerned with the willingness of users to pay money in exchange for specific elements of a personal security package (and the consequential effects on crime rates). This interest is developed through two distinct Stated Preference (SP) experimental games, referred to as the 'station improvement game' (Figure 5.3) and the 'car park improvement game' (Figure 5.4) respectively.

5.3.2 Format of the station/car park improvement game

The goal of the station/car park improvement game is to infer the value of crime risk reduction, by comparing different crime reduction programmes, in terms of the trade-off between crime risk, cost, and specific elements of the programme. The representation of crime risk within the game is intended to offer insight into valuations associated with the fear of crime rather than simply objective risk, ie the effect of crime rates on the broader public, rather than only the victims of crime.

As background, respondents were advised of the unit costs of crime to society, ie

- **Violence against a person**; on average, each incidence of this crime costs society **£7,121** (in current prices), including costs associated with the NHS, the criminal justice system, and financial loss to the victim.
- **Sexual attack**; on average, each incidence of this crime costs society **£17,196**
- **Theft from passengers**; on average, each incidence of this crime costs society **£1,197**
- **Criminal damage (eg damage to property)**; on average, each incidence of this crime costs society **£4,431**
- **Car crime (ie theft of and from cars)**; on average, each incidence of this crime costs society **£783**

Figure 5.3: Station improvement game

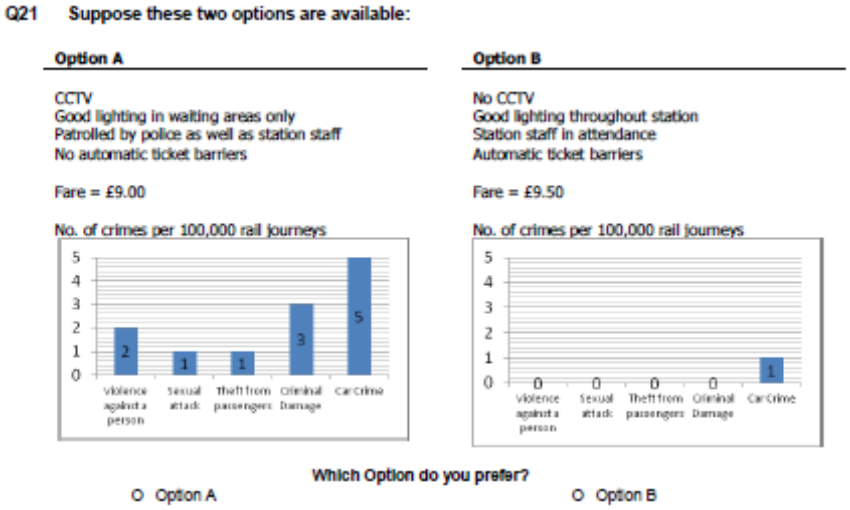
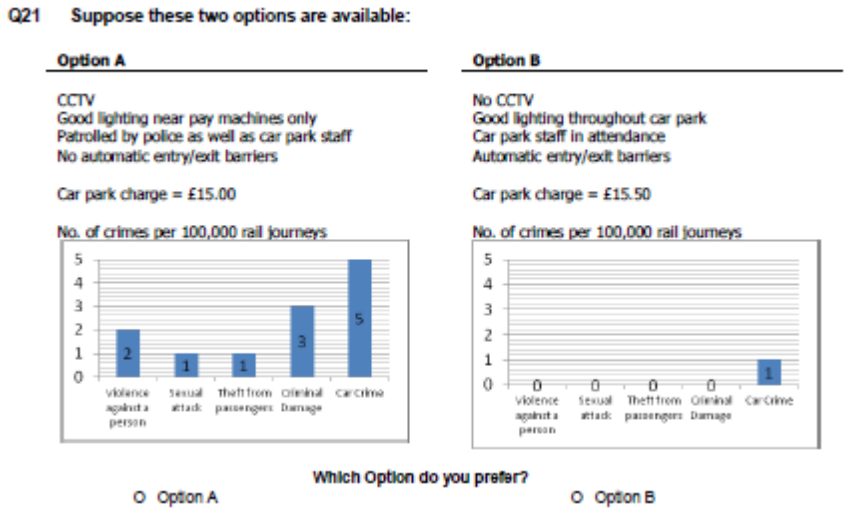


Figure 5.4: Car park improvement game



Against this background, the respondent was advised that the questionnaire was interested in his/her preferences about personal security and rail fares (or car park charges). The respondent was invited to choose between two different journey options (A and B), where the options were described in terms of the level of personal security provision at the station(s), rail fare (car park charge), and the level of crime risk. It was not specified whether the description of personal security provision referred to the origin station, destination station, or to both. The binary choice format is a popular presentation in SP analysis, particulary as it minimises the cognitive burden placed on the respondent.

Options A and B were described in terms of:

- **Station (car park) facilities which affect personal security**

Arising from the review of literature and evidence (together with the expert insight of the Steering Group), the experiment focussed upon 4 key attributes of station/car park facilities, as follows:

- Whether or not the station (car park) has CCTV
- Whether there is good lighting throughout the station (car park), or good lighting only in waiting areas (near pay machines)
- Whether or not the station (car park) is staffed
- Whether police routinely patrol the station (car park); and
- Whether the station (car park) has automatic ticket (road) barriers

- **Cost**

This was specified as the fare equivalent to the single portion of a return journey, or the car park charge equivalent to a full day of parking.

- **Number of crimes that might arise**

Stylised 'low', 'medium' and 'high' profiles of crime at the station/station car park were devised. These were based upon the 5 crimes types detailed in section 5.2.2, and informed by actual crime data from different station types. Indeed, the profiles were designed to mimic those available for every GB station on BTP's public web-site. One member of the Steering Group questioned the use of zeros in the crime profiles, on the basis that there could never be zero risk. In fact, crime data suggests that the risks are very small; many of the profiles on BTP's web-site actually show zero entries. In responding to this question, evidence from experiments in behavioural economics was drawn upon, which shows that individuals tend to over-state small risks relative to zero risks (Kahnemen and Tversky, 1979). All things considered, it was decided that zero (rather than very small) probabilities would, in approriate cases, represent a fair representation of the reality, and would avoid any additional complications associated with the over-statement of small risks.

5.3.3 Analysis of the station/car park improvement game

The station/car improvement games lend themselves to econometric analysis using discrete choice modelling methods (eg Train, 2001), in the following manner. First, for each alternative (ie options A and B) and each survey respondent $(i = 1,...,N)$, a conditional indirect utility function can be specified:

$$\left.\begin{aligned} \tilde{v}_{\mathrm{A}}^{i} &= W_{\mathrm{A}}\left(c_{\mathrm{A}}, y, \mathbf{x}_{\mathrm{A}}\right) + \varepsilon_{\mathrm{A}}^{i} \\ \tilde{v}_{\mathrm{B}}^{i} &= W_{\mathrm{B}}\left(c_{\mathrm{B}}, y, \mathbf{x}_{\mathrm{B}}\right) + \varepsilon_{\mathrm{B}}^{i} \end{aligned}\right\} \quad \text{for } i = 1,...,N \qquad (5.15)$$

where:

$\tilde{v}^{i}$ is conditional indirect utility for individual i

W is deterministic utility, which is in principle functional upon price (or cost) c, income y (of a representative individual), and other qualitative descriptors $\mathbf{x}$ of the options

ε^{i} is a random term, which is specific to individual i

Second, choice can be related to utility via the framework of the Random Utility Model (RUM) (Marschak, 1960; Block and Marschak, 1960) thus:

$$\begin{aligned}\pi_A &= \Pr\left\{\tilde{v}_A \geq \tilde{v}_B\right\} = \Pr\left\{W_A + \varepsilon_A \geq W_B + \varepsilon_B\right\} \\ &= \Pr\left\{W_A - W_B \geq \varepsilon_B - \varepsilon_A\right\} \\ &= \varphi\left(W_A - W_B\right)\end{aligned} \quad (5.16)$$

where:

π_A is the probability of picking option A over option B

Depending upon the distributional form of the random error term ε^i, different specific forms of RUM will arise; for example, logit will arise where the random error term is IID Gumbel.

Applying (5.15) and (5.16) to the station improvement game (Figure 5.3), deterministic utility can be specified as functional upon the attributes of options A and B, as follows:

$$\begin{aligned}W_A &= F\left(fare_A, income, CCTV_A, light_A, staff_A, barrier_A, risk_A\right) \\ W_B &= F\left(fare_B, income, CCTV_B, light_B, staff_B, barrier_B, risk_B\right)\end{aligned} \quad (5.17)$$

where:

fare and *income* are specified as continuous variables

CCTV is a dummy variable at 2 levels representing the presence of CCTV (=1 for present, =0 otherwise)

light is a dummy variable at 2 levels representing the presence of lighting (=1 for good lighting throughout station, =0 for good lighting only in waiting areas)

staff is a dummy variable at 3 levels representing the presence of staff (=2 for police patrols in addition to station staff, =1 for station staff, =0 for unstaffed)

barrier is a dummy variable at 2 levels representing the presence of ticket barriers (=1 for present, =0 otherwise)

risk is a dummy variable at 3 levels representing the profile of crime risk by crime type (=2 for ‘high’, =1 for ‘medium’, =0 for ‘low)

Deterministic utility can be specified in a similar fashion for the car park improvement game, but with car park charge replacing fare, road barriers replacing ticket barriers, and a slight change in the description of the lighting attribute.

In practical terms, the experimental design was assembled using the *Ngene* software, employing D-optimality as the design criteria. Given 3 attributes at 2 levels each and 2 attributes at 3 levels, the resulting design consisted of 6 blocks of 4 repetitions.

Following from the discussion at the outset of section 5.3.3, it is relevant to note that the risk attribute is correlated with expected (social) cost; given this feature, the implied expected social cost and standard deviation of social cost can be calculated for each of the ‘low’, ‘medium’ and ‘high’ crime levels (Table 5.10).

Table 5.10: Social costs implied by crime levels

	Expected cost (£)	Standard deviation of cost (£)
Low	783	350
Medium	14315	2883
High	49843	6985

In other words, (5.17) could be re-written:

$$W_A = F\left(fare_A, income, CCTV_A, light_A, staff_A, barrier_A, \mathrm{E}\left(cost_A\right), \mathrm{SD}\left(cost_A\right)\right)$$
$$W_B = F\left(fare_B, income, CCTV_B, light_B, staff_B, barrier_B, \mathrm{E}\left(cost_B\right), \mathrm{SD}\left(cost_B\right)\right) \quad (5.18)$$

where:

$\mathrm{E}\left(cost\right)$ and $\mathrm{SD}\left(cost\right)$ are perfectly correlated with each other, and are represented by a dummy variable at 3 levels for different profiles of crime risk (=2 for 'high', =1 for 'medium', =0 for 'low)

Moreover, the station/car park improvement games *in principle* lend themselves to the elicitation of both private valuations (via fare or car park charge, presuming the traveller is personally liable) and social valuations (via the risk attribute). The private valuation is what is meant by WTP. The distinction between private and social highlights the fact that the Secure Stations/Safer Parking interventions, and any consequent reductions in crime, could be regarded as public goods. In other words, they are both non-rivalrous (consumption by one economic agent does not prevent their simultaneous consumption by others) and non-excludable (it is not possible to prevent their consumption by others). Therefore even if property rights were adequately defined and enforced, market failure might still occur as a result of the free-rider problem. For instance, if it were possible for rail passengers to trade with rail operators in order to reduce levels of crime on the railway, each individual traveller would have an incentive not to pay/trade, in the hope of benefitting from the payments/trading of others. *In practice*, risk is specified at only 3 levels in the experimental design, and does not therefore readily lend itself to the empirical estimation of social cost. The focus on 3 levels was designed to allow easy discrimination – on the part of the respondent – between different levels of crime.

Using the station/car park improvement game, private and social valuations can in principle be derived for each of the scheme attributes. For example, in the case of CCTV:

$$\text{Marginal private valuation of CCTV} = \frac{\partial W / \partial CCTV}{\partial W / \partial fare} \quad (5.19)$$

$$\text{Marginal social valuation of CCTV} = \frac{\partial W / \partial CCTV}{\partial W / \partial E\left(cost\right)} \quad (5.20)$$

The private valuation is the primary focus of the SP survey, but evidence on the social valuation (even with the restricted variance of the risk variable) gives us insight into the propensity for free-riding behaviour.

5.4 Valuing the Objective Risk of a Crime Incident

5.4.1 Introductory comments

Following from the 4-point typology discussed in section 5.1, the NSB of crime reduction is associated especially with the value of the direct costs of crime. A second element of the NSB of crime reduction is the value of objective risk of a crime incident. With reference to Figure 5.2 once again, objective risk refers to the s variable – the risk premium – within the change in generalised cost.

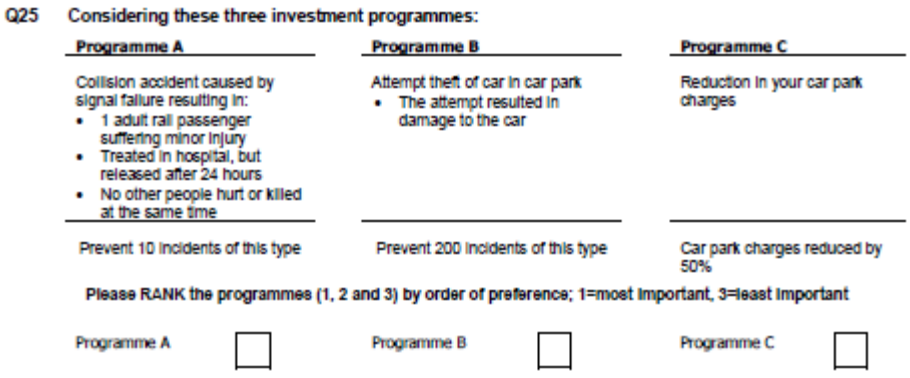
In consultation with RSSB and the Steering Group, the study team sought to develop estimates of this valuation via an analogy to the Value of Preventing a Fatality (VPF). There exists a reasonably robust evidence base on VPF, eg RSSB (2006), RSSB (2008). Evidence on VPF has been used previously to infer estimates of the Value of Preventing Injury (VPI) short of fatality, through a method of calculating multipliers of VPF for different types of injury. A similar method was adopted in the context of the present project, developing the following experimental game, which is referred to in what follows as the 'reduction in objective risk game'. The purpose of the game was to seek validation for the method of inferring the value of objective risk via an analogy to the VPF, and to elicit empirical evidence on the relevant multipliers.

The preamble to the game asked the respondent to consider their views on how investment in the railways could best be allocated, bearing in mind that the money available to invest may be limited. With reference to Figure 5.5, the respondent was presented with several sets of choices between three alternative programmes:

- **Programme A was a safety programme**; it would prevent a given number of railway accidents of a given type.
- **Programme B was a personal security programme**; it would prevent a given number of crimes of a given type.
- **Programme C was a fares (car park charges) programme**; fares (car park charges) would be reduced by a given percentage.

Programme A was based upon a stylised railway accident scenario which had been narrated in previous work (RSSB, 2008). Programme B was based upon the same 5 crime types $m = 1,...,5$ introduced above. For each crime type, a narrative of a stylised crime scenario was developed, thereby mimicking the railway accident scenario. Programme C was couched in terms of a blanket fares reduction programme affecting all journeys.

Figure 5.5: Objective risk of crime game



5.4.2 Analysis of the objective risk of crime game

This game was analysed by translating the rankings into 'best-worst' choice observations. This process generated 2 choice observations for every set of rankings, thus:

- The complete 1-2-3 ranking was translated into an initial choice observation based on a choice set of 3 alternative programmes; the first-ranked programme was taken to be the 'chosen' programme.
- Having identified the overall preferred (ie rank 1) programme, this programme was eliminated from consideration. The two remaining programmes were then translated into a second observation based upon a binary choice set; rank 2 was taken to be the 'chosen' programme over rank 3.

For each alternative (ie options A, B and C) and each survey respondent $(i = 1,...,N)$, a conditional indirect utility function can be specified as follows:

$$\left.\begin{aligned} \tilde{v}_{\mathrm{A}}^{i} &= W_{\mathrm{A}} + \varepsilon_{\mathrm{A}}^{i} \\ \tilde{v}_{\mathrm{B}}^{i} &= W_{\mathrm{B}} + \varepsilon_{\mathrm{B}}^{i} \\ \tilde{v}_{\mathrm{C}}^{i} &= W_{\mathrm{C}} + \varepsilon_{\mathrm{C}}^{i} \end{aligned}\right\} \quad \text{for } i = 1,...,N \tag{5.21}$$

Furthermore, deterministic utility for programmes A, B and C can be specified, thus:

$$\begin{aligned} W_A &= \alpha \cdot f_A \cdot D_A \\ W_B &= \beta_c \cdot f_{B,m} \cdot D_B \quad \text{for } m = 1,...,5 \\ W_C &= \phi \cdot Fare \cdot D_C \end{aligned} \tag{5.22}$$

where:

f_A is the frequency of railway accidents, which is always =10

$f_{B,m}$ is the frequency of crime type $m = 1,...,5$

$Fare$ is the % reduction in railway fares

D is a dummy variable to represent the chosen alternative, =1 if chosen, =0 otherwise

α, β, ϕ are parameters to be estimated

The mathematical properties of RUM (5.16) are such that all utilities can be multiplied by a common factor without materially changing the model; this implies that (5.22) can be re-stated entirely equivalently:

$$\begin{aligned} W_A &= \alpha \cdot D_A \\ W_B &= \beta_m \cdot \left(f_{B,m} / f_A\right) \cdot D_B \quad \text{for } m = 1,...,5 \\ W_C &= \phi \cdot \left(Fare / f_A\right) \cdot D_C \end{aligned} \tag{5.23}$$

The station/car park improvement game lends itself, in principle, to the elicitation of trade-offs between (objective) accident risk, (objective) crime risk and fares. To illustrate, consider a second-round choice between programmes A and B, where programme C (fares reduction) has been chosen as the overall preferred option. At the point of indifference between programmes A and B, it must be the case that:

$$\alpha = \beta_m \cdot \left(f_{B,m} / f_A\right) \tag{5.24}$$

In this case it can be inferred that the marginal rate of substitution between crime and accidents is given by:

$$\frac{f_A}{f_{B,m}} = \frac{\beta_m}{\alpha} = MRS_{B,m;A} \qquad (5.25)$$

Using this multiplier, valuations of crime incidents can be developed which pivot off the VPF. In a similar fashion, at the point of indifference between programmes B and C, it must be the case that:

$$\frac{Fare}{f_{B,m}} = \frac{\beta_m}{\phi} = MRS_{B,m;C} = \text{Marginal social valuation of crime type } m \qquad (5.26)$$

Note that the latter MRS (5.26) gives us an alternative basis for directly valuing the social costs of crime in monetary terms.

It should be acknowledged that the method outlined above implies an assumption of 'fungibility'; ie assumes that it is valid to triangulate between monetary quantities along three different dimensions, the value of accident reduction, the value of crime reduction, and the value of fares reductions. The assumption of fungibility is widely applied in public policy analysis, but has been challenged by some researchers (eg Hess et al., 2011).

A difficult aspect of design, in the case of the objective risk of crime game, was to establish an appropriate range of levels and trade-offs. The rationale behind the game was to allow respondents to indicate policy preferences. To inform matters, Table 5.11 considers a subset of crime types, and assumes that respondents' valuations of fatal railway accidents and crime reduction are exactly the same as those of a DfT economist following CBA rules (TAG Unit 3.4.1 and DfT's social costs of crime, 2007).

Table 5.11: Ratio of accident cost to crime cost

Safety		Security		Ratios of values
Unit	**Value/accident (a)**	**Unit**	**Value/crime (b)**	**(b/a)**
Fatalities	1,759,286	Mobile thefts	694	0.0004
		Laptop thefts from car**	~1,428	0.0008
		Violent fights***	26,405	0.0150

Note: all values uplifted to 2011/12 prices and values; **assume worth (£750-247) more than average property loss in Theft from a vehicle (=£247) in 2006/7; ***valued as Serious assault.

It might be reasoned, however, that a further dimension to the ratio of values is the probability of occurrence of the crime relative to the accident. On this basis, the above ratios were recalculated in terms of *expected* unit cost, taking account of the incidence of railway accidents and railway crimes in any given year. Having adjusted on these grounds, the ratios were taken forward to the experimental design stage.

As before, the experimental design was assembled using the *Ngene* software, employing D-optimality as the design criteria. In this case, the resulting design consisted of 6 blocks of 6 repetitions.

5.5 The Passenger/Car Park User Questionnaires

5.5.1 Questionnaire format

For purposes of implementation, the two games described above – the station improvement game and the objective risk of crime game – were embedded within the station user (Appendix 1) and car park user questionnaires (Appendix 2). The basic format of the questionnaires was explained in section 4.8. In terms of

the current discussion, it will suffice to make the additional comment that each questionnaire involved 4 repetitions of the station improvement game and 6 repetitions of the objective risk of crime game.

5.5.2 Pilot survey

The station improvement game was piloted as Leeds City Station on 16th August 2011 from 5-7pm. The questionniare was distributed in 'pen-and-paper format', together with a freepost return envelope. This format was adopted for various reasons:

- It was reasoned that the evening peak (in hours of darkness) might be an appropriate time to survey travellers about feelings of personal security.
- The pen-and-paper format is tried and tested, and allows us to interact with a large volume of potential respondents.
- It was reasoned that interaction time with the surveyor should be minimised, since passengers would likely be rushing through the station.

Surveyors were positioned on the station platform, targeting passengers travelling from Leeds to Manchester (the fare in the station improvement game was customised accordingly). In total, 270 questionnaires were dsitributed, and 79 were eventually returned, giving a response rate of 29% - very respectable for this kind of survey format. Of these 79 returns:

- 54% of respondents were commuters, 23% were travelling on business, and 23% were travelling for other reasons.
- 56% of respondents were female, and 44% were male.
- The respondents covered a good range of age groups, with the modal class being 40-49 years.
- 14% of respondents said that they had had cause to worry about personal security when using Leeds Station in the past.

Applying the data from the pilot questionniare, preliminary models were estimatedfor both the station improvement and objective risk of crime games. From the properties of these models, confidence was drawn that the games were credible and fit for purpose. The games were therefore developed further towards a full implementation, using the preliminary models to help us finesse the experimental designs underpinning the games. The estimation process will be outlined in greater detail when reporting the field survey (section 5.5.3).

The substantive changes to the questionniare following the pilot survey were as follows:

With regards to the objective risk of crime game:

- The pilot survey offered only a choice between programme A (accident reduction) and programme B (crime reduction). On the basis of the results generated, and feedback collated more generally, programme C (fares/car park charges reduction) was introduced. The motivation for this change was to offer an alternative numeraire, if passengers/car park users were unable/unwilling to trade off between accidents and crime, which was the primary focus of the game.
- The estimates of the ratio of crime value to accident value were found to be rather extreme. The study team's response to this finding was to change the accident scenario from a fatal railway accident to a minor railway accident. In this way, more plausible trade-offs were designed-in, whilst avoiding the need to present scenarios involving very large reductions in the numbers of crime incidents.

With regards to the station/car park improvement game:

- Additional variance in the fare/car park charge attribute was introduced, by increasing the number of design levels for that attribute.
- The experimental design was redesigned using parameter estimates from the pilot survey as prior information.

5.5.3 Field survey

The field survey was based upon eight locations; four stations and four station car parks. In consultation with RSSB and the Steering Group, the study team carefully selected these eight sites so as to allow a comparison between sites which were/were not accredited as Secure Stations/Safer Parking car parks, whilst at the same time providing variety in terms of other contextual features, especially the A-F station classification. In the case of car parks, sites with relative large capacities were deliberately identified, so as to try to maximise the sample sizes.

Table 5.12 outlines the four sites chosen for the station user survey. This survey was undertaken in late November-early December 2011, and involved surveyors working during the evening peak on two consecutive days at each site. The station improvement game was bespoked to a specific journey operating to or from the station involved as follows (with fares specified as appropriate to the journey):

- **London Euston: to Watford Junction**
- **Manchester Victoria: to Leeds**
- **Paisley Gilmour Street: to Glasgow Central**
- **Willesden Junction: to London Euston**

Against this background, the surveyors were positioned on the relevant platform for these journeys, and sought to intercept passengers boarding or alighting. In three of the four cases, the full allocation of 1250 questionnaires was distributed; the exception was Paisley Gilmour Street, where passenger volumes were much lower than at the other stations. With reference to Table 5.12, the response rates show varying degrees of success. The response rates for London Euston and Manchester Victoria were reassuringly healthy. The response at Paisley Gilmour Street was moderate, whilst the response at Willesden Junction was somewhat low. Based on feedback from the surveyors, and the study team's experience with these kinds of surveys more generally, it is probable that the lower response rates reflect socio-demographic features specific to the sites, such as relatively low incomes, and the transient nature of the local population (especially in the case of Willesden).

Table 5.12: Sites chosen for station user survey

	Safer Parking	Secure Stations	A-F Classification	Distributed	Returned	Response
London Euston	Y	Y	A	1250	298	0.24
Manchester Victoria	Y	N	B	1250	241	0.19
Paisley Gilmour Street	N	N	C	900	140	0.16
Willesden Junction	N	Y	D	1250	131	0.10

Table 5.13 outlines the 4 sites chosen for the car park user survey. Again, this survey was undertaken in late November-early December 2011, and involved surveyors working on two consecutive days at each site. In contrast to the station user survey, the car park user survey was undertaken during the morning peak. That is to say, drivers were intercepted as they arrived at the station car park. Unlike the station user survey, it was unnecessary to target specific journeys. However, the station car park improvement game was bespoked to the relevant car park charges at each site.

The target questionnaire distribution for car parks was (at 350) much lower than for stations (1250), since the number of car park places acted as a constraint (this was despite selecting railway car parks with relatively large capacities). With reference to Table 5.13, the response rates were generally healthy, especially so in the case of Bathgate (where there is presently a zero charge for car parking). The moderate response at Manchester Piccadilly was due to long stay parking, meaning that there was limited renewal of cars/survey subjects on the second survey day.

Table 5.13: Sites chosen for car park user survey

	Safer Parking	Secure Stations	A-F Classification	Distributed	Returned	Response
Bathgate	N	N	F	350	97	0.28
Bedford	N	Y	C	350	71	0.20
Manchester Piccadilly	Y	Y	A	350	56	0.16
Peterborough	Y	Y	B	350	65	0.19

Table 5.14: Sites chosen for station user survey

	Euston	Peterborough	Manchester Victoria	Willesden	TOTAL
Business	50	7	9	17	83
Commute	208	64	127	84	483
Other	37	82	102	30	251
TOTAL	295	153	238	131	817

Table 5.15: Sites chosen for car park user survey

	Bathgate	Bedford	Manchester Piccadilly	Peterborough	TOTAL
Business	7	29	45	26	107
Commute	83	69	2	44	198
Other	5	2	8	4	19
TOTAL	95	100	55	74	324

Tables 5.14 and 5.15 present, for the station user and car user surveys respectively, cross-tabulations of survey site against journey purpose. In the case of the station user survey, the predominant journey purpose was ‘commute’, followed by ‘other’, and then ‘business’. In the case of the station car park user survey, ‘commute’ was again predominant, followed by ‘business’; few respondents to the car park survey were travelling for ‘other’ purposes.

5.6 Results Strand 1: Analysis of the Station Improvement Game

5.6.1 Estimation process

All models were estimated using the *BIOGEME* software. Given the repeated nature of the data - ie each individual was presented with four repetitions of the game - a multinomial logit for panel data specification was employed.

5.6.2 Results

Tables 5.16 and 5.17 show models estimated on the complete datasets for stations and station car parks respectively.

Looking first at the station model, the key features are as follows:

- The model demonstrates a modest but acceptable level of overall fit.
- With regards to the personal intervention interventions, the coefficients on the dummy variables are in most cases significantly different from zero and have the expected sign. For example, in the case of CCTV, ‘CCTV absent’ is set as the base, and ‘CCTV present’ attracts a significant and positive coefficient, implying that respondents derive greater utility from the presence of CCTV vis-a-vis the absence of CCTV.
- Similarly, in the case of lighting, ‘good lighting throughout station’ is regarded as significantly better than ‘good lighting in waiting areas only’.
- ‘Medium crime risk’ is regarded as significantly better than ‘high crime risk’, but ‘low crime risk’ is not regarded as significantly better than ‘medium crime risk’.
- ‘Staffed’ stations are found to be significantly better than ‘unstaffed’, but ‘police patrols in addition to station staff’ adds no significant utility.

The most notable finding, bearing in mind that this is a WTP experiment, is that the coefficient on fare is insignificant. On first inspection, this suggests that passengers are unwilling to trade-off fare against personal security interventions. In other words, they are unwilling to pay for personal security improvements through the fare box.

Table 5.16: Results from station improvement game (all stations, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	0.0216	0.31
barr2	0	
cctv1	0.391	6.69
cctv2	0	
fare	0.0179	0.35
light1	0.2	3.15
light2	0	
risk1	1.04	8.9
risk2	0.961	11.15
risk3	0	
staff1	0.374	4.39
staff2	0.353	4.75
staff3	0	
adjusted rho-square	0.121	
observations	3241	

Table 5.17: Results from car park improvement game (all car parks, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.083	-1.04
barr2	0	
cctv1	0.477	6.02
cctv2	0	
car park charge	-0.471	-7.71
light1	0.395	4.66
light2	0	
risk1	1.81	9.73
risk2	1.14	9.35
risk3	0	
staff1	0.467	4.32
staff2	0.417	2.99
staff3	0	
adjusted rho-square	0.129	
observations	1273	

The car park model reveals broadly the same pattern of results, with the following exceptions:

- Car park users discriminate between the ‘low crime risk’ and ‘medium crime risk’ profiles; the former is regarded as significantly better than the latter. This could, perhaps, reflect an increased sensitivity to crimes 4 and 5 (criminal damage and car crime) in the crime profiles.
- In contrast to the weak (indeed insignificant) response to the fare attribute in the station user model, the car park user model returns a highly significant coefficient on the car park charge attribute, with the expected sign. This suggests that car park users are willing-to-pay for personal security improvements.

Having estimated models on the complete datasets, further analysis was conducted to try to understand certain features of the results in greater depth, especially the weak response to the fare attribute in the station user version of the game. With this objective in mind, a further set of models was estimated at the site level, mindful that each site entails different levels of personal security provision, different crime levels, and different contextual factors generally. Tables 5.18 to 5.21 present results from the station improvement game, by site, whereas Tables 5.22 to 5.25 present results from the station car park improvement game. The principal insights arising from the site-specific models are as follows:

- Although the overall dataset is large in volume, segmentation by site means that the dataset for each site-specific model is modest in volume, especially for car parks.
- Most of the site-specific models demonstrate a moderate-to-poor overall fit; the exceptions are the models for Peterborough and Manchester Piccadilly, which show a good level of explanatory power.
- The coefficient on fare is insignificant at all four railway stations.
- The coefficient on car park charge is significant at two car parks (namely Bathgate and Bedford), and insignificant at the other two car parks (Manchester Piccadilly and Peterborough). It should be remembered the Bathgate car park presently has a zero charge; one might therefore expect a degree of policy response bias to the possibility of car park charges being introduced.
- All other effects are strong and intuitive; that is to say, individuals derive value from specific personal security provisions.

Table 5.18: Results from station improvement game (Euston, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.0132	-0.11
barr2	0	
cctv1	0.369	4.21
cctv2	0	
fare	0.0867	1.17
light1	0.177	1.73
light2	0	
risk1	0.62	3.48
risk2	0.766	5.78
risk3	0	
staff1	0.495	3.6
staff2	0.488	3.83
staff3	0	
adjusted rho-square	0.101	
observations	1174	

Table 5.19: Results from station improvement game (Manchester Victoria, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.0165	-0.13
barr2	0	
cctv1	0.401	3.29
cctv2	0	
fare	-0.00549	-0.06
light1	0.332	2.82
light2	0	
risk1	1.16	4.7
risk2	1.06	5.63
risk3	0	
staff1	0.51	3.03
staff2	0.438	3.1
staff3	0	
adjusted rho-square	0.133	
observations	944	

Table 5.20: Results from station improvement game (Paisley, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.00872	-0.05
barr2	0	
cctv1	0.291	1.95
cctv2	0	
fare	0.295	1.22
light1	0.0181	0.11
light2	0	
risk1	1.16	4.28
risk2	0.997	5.07
risk3	0	
staff1	0.205	1.02
staff2	0.2	1.08
staff3	0	
adjusted rho-square	0.136	
observations	605	

Table 5.21: Results from station improvement game (Willesden Junction, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	0.114	0.68
barr2	0	
cctv1	0.387	2.88
cctv2	0	
fare	-0.029	-0.25
light1	0.281	1.73
light2	0	
risk1	1.25	4.54
risk2	1.01	5.3
risk3	0	
staff1	0.155	0.75
staff2	0.19	1.13
staff3	0	
adjusted rho-square	0.099	
observations	518	

Table 5.22: Results from car park improvement game (Bedford, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.138	-0.99
barr2	0	
cctv1	0.527	3.35
cctv2	0	
car park charge	-0.52	-5.14
light1	0.411	2.5
light2	0	
risk1	1.72	5.71
risk2	0.803	3.53
risk3	0	
staff1	0.638	3.72
staff2	0.502	2.12
staff3	0	
adjusted rho-square	0.098	
observations	391	

Table 5.23: Results from car park improvement game (Bathgate, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.0461	-0.28
barr2	0	
cctv1	0.234	1.58
cctv2	0	
car park charge	-0.545	-4.64
light1	0.347	1.92
light2	0	
risk1	0.87	2.58
risk2	1.09	5.35
risk3	0	
staff1	0.326	1.32
staff2	0.464	1.58
staff3	0	
adjusted rho-square	0.146	
observations	376	

Table 5.24: Results from car park improvement game (Manchester Piccadilly, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	0.0486	0.21
barr2	0	
cctv1	0.349	1.16
cctv2	0	
car park charge	0.677	1.47
light1	1.2	4.25
light2	0	
risk1	1.53	1.84
risk2	1.39	3.27
risk3	0	
staff1	0.265	0.55
staff2	0.413	0.95
staff3	0	
adjusted rho-square	0.435	
observations	223	

Table 5.25: Results from car park improvement game (Peterborough, based on multinomial logit for panel data)

Name	Value	Robust t-test
barr1	-0.0728	-0.39
barr2	0	
cctv1	0.486	2.71
cctv2	0	
car park charge	0.394	1.51
light1	0.571	2.38
light2	0	
risk1	1.07	2.01
risk2	0.923	3.45
risk3	0	
staff1	-0.327	-0.97
staff2	0.0856	0.23
staff3	0	
adjusted rho-square	0.234	
observations	283	

Finally, models by journey purpose (Tables 5.26-5.31) were estimated, since it is well understood that different types of traveller may exhibit different sensitivities to cost (eg depending on whether the journey is discretionary and/or whether journey costs are reimbursed by an employer).

Table 5.26: Results from station improvement game (all stations 'business', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	-0.00751	-0.04
No automatic Entry Exit Barriers	0	
CCTV	0.351	1.99
No CCTV	0	
Fare	0.216	1.75
Good lighting throughout Station	0.304	1.35
Good lighting in waiting areas only	0	
Low risk	0.612	1.86
Medium risk	0.646	2.69
High risk	0	
Patroll by police as well as station staff	0.592	2.21
Station staff in attendance	0.587	2.3
Unstaffed	0	

Table 5.27: Results from station improvement game (all stations 'commute', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	0.0857	1.11
No automatic Entry Exit Barriers	0	
CCTV	0.373	5.03
No CCTV	0	
Fare	-0.0022	-0.04
Good lighting throughout Station	0.228	2.65
Good lighting in waiting areas only	0	
Low risk	0.855	6.06
Medium risk	0.83	8.03
High risk	0	
Patroll by police as well as station staff	0.449	4.27
Station staff in attendance	0.427	4.21
Unstaffed	0	

Table 5.28: Results from station improvement game (all stations 'other', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	-0.118	-0.99
No automatic Entry Exit Barriers	0	
CCTV	0.427	3.49
No CCTV	0	
Fare	0.0122	0.12
Good lighting throughout Station	0.139	1.06
Good lighting in waiting areas only	0	
Low risk	1.56	6.45
Medium risk	1.36	7.49
High risk	0	
Patroll by police as well as station staff	0.152	1
Station staff in attendance	0.152	1.06
Unstaffed	0	

Table 5.29: Results from station car park improvement game (all stations 'business', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	0.0767	0.49
No automatic Entry Exit Barriers	0	
CCTV	0.568	3.6
No CCTV	0	
Car Park Charge	-0.241	-1.77
Good lighting throughout Carpark	0.709	4.18
Good lighting only near pay machines	0	
Low risk	2.6	6.78
Medium risk	1.65	6.78
High risk	0	
Patroll by police as well as Car park staff	0.724	2.95
Car park staff in attendance	0.2	0.86
Unstaffed	0	

Table 5.30: Results from station car park improvement game (all stations 'commute', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	-0.132	-1.4
No automatic Entry Exit Barriers	0	
CCTV	0.524	5.19
No CCTV	0	
Car Park Charge	-0.611	-8.28
Good lighting throughout Carpark	0.241	2.28
Good lighting only near pay machines	0	
Low risk	1.3	6.06
Medium risk	0.845	5.85
High risk	0	
Patroll by police as well as Car park staff	0.545	3.68
Car park staff in attendance	0.723	4.45
Unstaffed	0	

Table 5.31: Results from station car park improvement game (all stations 'other', based on multinomial logit for panel data)

Name	Value	Robust t-test
Automatic Entry Exit Barriers	0.555	1.32
No automatic Entry Exit Barriers	0	
CCTV	1.02	1.58
No CCTV	0	
Car Park Charge	-0.271	-0.74
Good lighting throughout Carpark	0.235	0.42
Good lighting only near pay machines	0	
Low risk	2.68	1.93
Medium risk	1.7	2.29
High risk	0	
Patroll by police as well as Car park staff	1.49	2.28
Car park staff in attendance	0.96	1
Unstaffed	0	

Models segmenting by journey purpose broadly replicated the same pattern of results that emerged from the earlier models.

A further strand of analysis examined interactions between the various interventions. The findings from this analysis were mixed. No significant interactions were estimated in the case of car parks. In the case of stations, by contrast, significant interactions were estimated for CCTV in combination with ticket barriers, and for good lighting throughout the station in combination with staffing.

5.6.3 Summary

Drawing together the results from the various dimensions of segmentation (station vs. car park; survey site; and journey purpose), the following headline findings arise:

- Fare is generally not significant at all. This could be a protest response.
- By comparison, car park charge exhibits a stronger response; this is perhaps unsurprising given that use of a car park implies that personal property will be left in the care of the car park. However, the response is inconsistent and not always significant. The clearest response applies to the commuting segment, and implies WTP estimates:
    - For CCTV of 86p per day of parking, vis-a-vis no CCTV

- For ‘good lighting throughout the car park’ as opposed to ‘good lighting at pay machines only’ of 39p
- For staffed as opposed to unstaffed of £1.18
- For reduction in risk from high to medium of £1.38

- Since all effects other than fare/car park charge are strong, it can be concluded that passengers/car park users place value on personal security interventions and reduced risk, but are reluctant to pay for them through the fare box/car park charges.
- In particular, it is noticeable that crime risk exhibits a significant effect. With reference to the earlier discussion in section 5.3.3, recall that, in terms of the experimental design, crime risk was perfectly correlated with the expected social costs of crime. On this basis, it can be concluded that passengers/car park users demonstrate classic public good behaviour in relation to personal security interventions; they believe that personal security is good for society, but are unwilling to pay for such interventions on a private basis.

5.7 Results Strand 2: Analysis of the Objective Risk of Crime Game

5.7.1 Estimation process

All models were again estimated using the *BIOGEME* software. In this case it was necessary to translate the ranking data into a form appropriate for discrete choice modelling. To this end, the ‘best-worst’ format was adopted, which is current best-practice for modelling ranking data. That is to say, the first-ranked alternative was represented as the chosen alternative from a choice set of all three programmes (A, B and C). Eliminating the first-ranked alternative from consideration, the second-ranked alternative was represented as the chosen alternative from a choice set of the two remaining programmes. In short, the ‘best-worst’ format delivered two data points for each complete set of rankings. The model was specified as MNL.

5.7.2 Results

Separate models were developed for the station and car park based games (Tables 5.32 and 5.33, respectively), but the two models show close correspondence. The key features of the models are as follows:

- The models show a respectable level of overall fit, with adjusted rho-square statistics of around 0.2.
- All of the parameter estimates are significantly different from zero (at 1%) and have the expected signs.
- With reference to (5.25), the estimated parameters can be applied to derive a multiplier representing the trade-off between crimes and accidents, for each of the crime types.
- Generally speaking, these multipliers show an increasing monotonic relationship corresponding to the physical severity of the crime accident (ie violent assault has the largest multiplier and theft from a car has the lowest).

Using these multipliers, inferences can be drawn regarding the *perceived* social costs of crime, as distinct from the *actual* social costs of crime employed by the Home Office, as follows:

- **Violence against a person**: based on their perceptions of cost and risk, rail passengers would appear to considerably over-state (by a factor of more than four) the actual costs to society.
- **Sexual attack**: perceived costs are around a half of the actual social costs; this could reflect the difficulty of enumerating physical and emotional costs, which are potentially considerable in this case. Another possibility is that respondents had difficulty interpreting precisely what was meant by the wording 'sexual attack' in the questionnaire, since it could potentially encompasses a variety of crimes, some more serious than others. A further possibility is that respondents focussed upon particular costs associated with this kind of attack, namely the physical and emotional costs to the victim; in this case, these costs amounted to 72% of the Home Office unit costs - more in line with the multiplier estimated here.
- **Theft from passengers**: perceived costs show close correspondence to actual costs.
- **Criminal damage**: perceived costs are substantially less than actual costs; this could reflect the fact that some of these costs will (in the first instance) be borne by the station operator rather than the passenger.
- **Car crime**: again, perceived costs understate the actual costs; note that car park users are more sensitive to car crime than rail passengers generally.

In contrast to the station/car park improvement game, it is notable that the coefficient on the fare/car park charge attribute in the objective risk of crime game is highly significant and of the expected sign. A likely reason for this result is that the objective risk of crime game offered a **fare/car park charge reduction** as opposed to a **fare/car park charge increase** in the station/car park improvement game. That is to say, station/car park users demonstrate an unwillingness to pay for personal security improvements that could lead to a reduction in crime levels, but a willingness to accept compensation for an increase in crime levels (and also an increase in the prevalence of railway accidents).

5.7.3 Summary

Drawing together the results from the two models reported above, the following headline findings arise in relation to the objective risk of crime game:

- Although the method was to some extent speculative, the results appear plausible.
- In terms of plausibility, the respondents seemed comfortable with the trade-off between the three social goods; reductions in accidents, reductions in crime and reductions in rail fares.
- With regards to the estimated trade-offs between accidents and crime - which was the primary focus of the game - respondents demonstrated an ability to discriminate between the five different crime types considered, and to value them appropriately.
- The inferred valuations of each crime type, which were derived through a process of pivoting off the VPF, are (broadly speaking) monotonically increasing in the physical severity of the crime incident.

It was found that, compared with Home Office unit costs of crime, respondents substantially over-valued (by more than four times) the social costs of violence against a person, and undervalued sex attacks (by half). The latter discrepancy could be due to respondents' interpretation of the term 'sex attack'; the questionnaire was not explicit that this term could include a range of attacks including rape.

Table 5.32: Results from objective risk of crime game (stations), based on multinomial logit estimation

Name	Value	Robust t-test	Value crime/Value Accident	VPF/accident	Perceived VPF/crime	Actual social costs of crime
accident	1.61	51.19				
violence against person	5.91	30.97	3.72	8796.43	32696.16	7121.00
sex attack	1.78	26.21	1.12	8796.43	9847.58	17196.00
theft from pax	0.20	23.06	0.13	8796.43	1117.53	1197.00
crim damage	0.05	13.05	0.03	8796.43	289.34	4431.00
theft from car	0.01	3.49	0.01	8796.43	54.88	783.00
% reduction in fares	0.05	33.18				
adjusted rho-square	0.183					
observations	9438					

Table 5.33: Results from objective risk of crime game (car parks), based on multinomial logit estimation

Name	Value	Robust t-test	Value crime/Value Accident	VPF/accident	Perceived VPF/crime	Actual social costs of crime
accident	1.59	32.10				
violence against person	5.80	20.19	3.65	8796.43	32087.61	7121.00
sex attack	1.55	17.85	0.97	8796.43	8575.14	17196.00
theft from pax	0.16	12.52	0.10	8796.43	907.30	1197.00
crim damage	0.10	16.71	0.06	8796.43	564.30	4431.00
theft from car	0.03	6.45	0.02	8796.43	147.16	783.00
% reduction in car park charges	0.04	20.06				
adjusted rho-square	0.173					
observations	3754					

5.8 Valuing Changes in Behaviour

5.8.1 Introductory comments

Referring back to Figure 5.2, the preceding discussion has been concerned with the elicitation of individuals' total utility difference $\Delta r + s$ between the Secure Stations/Safer Parking scenario and the do-minimum scenario. The quantity $\Delta r + s$ does not however include changes in patronage which could arise, from both existing and new rail travellers, as a result of the interventions. In both cases, it will be important to understand - from a commercial perspective - the demand response, and associated revenue change, as levels of personal security (perceived or actual) change; these would account for the quantities y and z in Figure 5.2. The demand response will be the subject of this section.

Given that improvements in security have value to existing and potential rail travellers, existing travellers will experience some welfare gain whilst train operators will experience increased revenue from the induced travel. The purpose of this econometric analysis of rail ticket sales data is to determine whether changes in security, however defined, have a discernible and believable effect on rail demand.

Rail ticket sales has been widely used for many years to support the analysis of a wide range of demand impacts. The key elasticities in the Passenger Demand Forecasting Handbook (PDFH), which contains the forecasting framework and parameters widely used in the rail industry, are almost entirely obtained from analysis of ticket sales. These elasticities cover GDP, fare and generalised journey time (GJT) which is a measure of timetable related service quality covering station-to-station journey time, frequency and interchange. Increasingly, ticket sales has been used to examine other influences on rail demand, most notably in recent years the effects of travel time variability, rolling stock type and car parking provision.

There is no reason in principle why ticket sales analysis cannot be extended to examine the impact of security on rail demand. However, it should be recognised that the effect is likely to be small, and indeed smaller than rolling stock and the provision of additional car parking spaces which would seem to have been the most ambitious applications prior to this. Hence, the selection of the data is critical if there is to be any hope of recovering statistically robust effects. In particular, a large data set is needed, and flows should be selected to cover a range of different security levels and indeed variations in security over time.

5.8.2 The modelling framework

Following convention, the demand model is estimated in constant elasticity form. Taking V_{ijt} to be the number of rail trips between stations i and j in time period t, the the demand model is specified as:

$$V_{ijt} = e^{\mu_{ij}} F_{ijt}^{\alpha} GJT_{ijt}^{\beta} GVA_{it}^{\gamma} P_{it}^{\delta} FPI_{t}^{\tau} e^{\theta NCA_{it}} \qquad (5.27)$$

This is termed a fixed effects model since the μ_{ij} are flow-specific 'fixed-effects' or intercept terms which account for time-invariant differences between flows not specified in the model. This fixed-effect, for example, can be explained as a difference in the magnitudes of demand between flows which are not explained by the explanatory variables included in the model. It is important to stress that the model is static, and does not therefore distinguish between short run and long run demand responses.

F_{ijt} and G_{ijt} denote the fare and *GJT* respectively between stations i and j in period t. For non-season tickets, *GVA* is the measure of economic activity and income used and this is specific to the origin, as is the

proportion of households without a car (*NCA*) and the population (*P*). The fuel price index (*FPI*) is specific to the time period and does not vary across flows or origins.

In the case of season ticket demand, the key driver is employment at the destination in time period t (E_{jt}) and this replaces GVA in this model.

The parameters of equation (5.27) are estimated by applying least squares regression to its logarithmic transformation expressed as:

$$\ln V_{ijt} = \mu_{ij} + \alpha \ln F_{ijt} + \beta \ln GJT_{ijt} + \gamma \ln GVA_{it} + \delta \ln P_{it} + \tau \ln FPI_t + \theta NCA_{it} \qquad (5.28)$$

In addition, given that the data covers four weekly periods, 12 dummy variable terms are specified to discern seasonal effects. The α, β, γ and δ are own elasticities with respect to the relevant variables, τ denotes the cross-elasticity of rail demand with regard to fuel price and θ indicates the proportionate change in rail demand after a change in the proportion of households without a car in the same form as in PDFH.

The above are standard rail demand models. Other variables would ideally be included, such as train reliability, car journey times and measures of bus competition, but historic data at the necessary level of detail is not readily available in this case.

In the context of the present project, the security variables were also added to this equation. These can be of different types and hence enter in different forms. Essentially security was represented in four different ways:

1. The number of incidents in the station or its car park, either in absolute or relative to station throughput.
2. The presence of security related features at stations or in car parks.
3. A composite security index term constructed upon either the number of incidents of different types or the number of different security features present.
4. Whether there is Secure Station or Safer Parking accreditation.

The subsequent discussion will consider each of these in turn.

Incidents

We have information on the number of crime incidents in each time period relevant to a station and its car park. These are composed as theft from a person (*TFP*), sexual assaults (*SA*), vehicle (car and cycle) crime (*VC*), criminal damage (*CD*), violence against a person (*VAP*) and commercial theft/burglary (*COMM*).

Perceptions of safety might relate to the number of crimes or else to the number of crimes relative to station throughput. For example, a given number of crimes at a small station might be regarded as indicating that it is more dangerous than the same number of crimes at a large station where more crime might be expected, but also the larger throughput provides an added element of security. Against this context, the number of crimes was entered into the models as both the absolute number (*SC*) and the number relative to station (passenger) throughput expressed per million passengers per annum (*SC-REL*).

If I is the number of crime incidents in some form, then the model would be specified as:

$$V_{ijt} = e^{\mu_{ij}} F_{ijt}^{\alpha} GJT_{ijt}^{\beta} GVA_{it}^{\gamma} P_{it}^{\delta} FPI_t^{\tau} e^{\theta NCA_{it} + \lambda I_{it}} \qquad (5.29)$$

Even though I is a continuous variable as with fare, GJT and GVA, it cannot be entered in constant elasticity form since it can take a value of zero; logarithms cannot therefore be taken in estimation. The λ coefficient indicates the proportionate change in rail demand after a change in I.

Security features

Information was collected on the security related features at a station. These covered:

- Whether there was station staff on a full-time (*SSFT*) or part-time (*SSPT*) basis
- Whether ticket gates were in operation (*TG*)
- Whether there was an auto-help facility (*AH*)
- Whether closed circuit television monitoring was present at the station (*CCTV-S*)
- Whether lighting was good (*LG*) or satisfactory (*LS*)

For the car park, the information collected was:

- Whether there was CCTV in the car park (*CCTV-CP*)
- Whether the car park was staffed (*CPM*)
- Whether the car park was patrolled (*CPP*)
- Whether the car par was lit (*CPL*)

These variable are all entered as dummy variables. In the case of the station security terms, the model would be specified as:

$$V_{ijt} = e^{\mu_{ij}} F_{ijt}^{\alpha} GJT_{ijt}^{\beta} GVA_{it}^{\gamma} P_{it}^{\delta} FPI_{t}^{\tau} e^{\theta NCA_{it} + \eta_1 SSFT_{it} + \eta_2 SSPT_{it} + \eta_3 TG_{it} + \eta_4 AH_{it} + \eta_5 CCTV-S_{it} + \eta_6 LG_{it} + \eta_7 LS_{it}} \quad (5.30)$$

The exponential of, say, η_4 would indicate the proportionate effect on demand of the presence of auto-help facilities.

Security indices

Security indices can be created from both the crime data and from the station and car park facilities data. In the former case, it is clear that not all crimes are of equal severity and it would be sensible to apply weights to the component crimes. The situation regarding the facilities is different, since as is apparent in equation (5.30) they already each have their own weight. Here it might be argued that it is difficult to discern the separate effects of a number of facilities each of which can be expected to have only a very small influence on demand. Creating a composite term would increase the chances of recovering a statistically significant effect, and indeed increase the precision of any estimated effect, but weights need to be applied to the different facilities to reflect their relative importance.

Two sets of weights are used for creating the security index for the number of station crimes (*SIC*). These are:

- Home Office data on the unit costs of crime (Tables 5.2 and 5.3).
- Weights obtained from the objective risk of crime game (Table 5.32).

The security index based on the Home Office data is created as:

SIC = (623**TFP*) + (14560**SA*) + (574**VC*) + (161**CD*) + (2762**VAP*) + (312**COMM*)

Using the WTP-derived weights, the security index is:

SIC = (1118**TFP*) + (9848**SA*) + (147**VC*) + (289**CD*) + (32696**VAP*) + (559**COMM*)

In both cases, the *VC* term is removed for the specification for the destination station on the grounds that car parking issues are origin specific.

The security index based on the facilities (*SIF*) is composed as:

SIF = (0.086**TG*)+(0.373**CCTV-S*)+(0.228**LG*)+(0.114**LS*)+(0.427**SSFT*)+(0.21**SSPT*)+(a**AH*)

The weights are informed by the station improvement game (specifically the commute segment shown in Table 5.27), with the exception of that for AH (a) which was not covered. In the latter case, figures from PDFH4 were used which indicated that for commuters an intercom connection was worth 40% of CCTV presence whereas for business and leisure it was valued about 1.5 times more. Nor did the SP cover satisfactory lighting or part-time staff, whereupon weights were assigned at half those assigned to good lighting and full-time staffing respectively.

The security index for car parks (SICP), informed by the station improvement game, is:

SICP = (0.477**CCTV-CP*) + (0.417**CPM-F*) + (0.208**CPM-P*) + (0.467**CPP*) + (0.395**CP-L*)

The SP exercise provided a weight for full-time manning (*CPM-F*) and it was assumed that part-time staffing (*CPM-P*) takes half that weight.

Although the indices are continuous variables, they can still be zero and hence enter the models in the same way as for I in equation (5.29). The estimated coefficient (λ) then reflects the proportionate change in demand after a change in the security index.

The security indices based on crimes and facilities can also be specified relative to station throughput (*SIC-REL, SIF-REL, SICP-REL*).

Accreditation

The final measure of security is whether in the time period in question the station has obtained Secure Station status (*SECST*) or Safer Parking accreditation (*SAFCP*). These are simply represented by dummy variables and hence enter the model in just the same way as for the dummy variables representing the presence of facilities as specified in equation (5.30). The estimated parameter therefore indicates the proportionate effect on rail demand of achieving accreditation.

5.9 Results Strand 3: Analysis of the Econometric Ticket Sales Model

5.9.1 Dimensions of the model and other data needs

Given the sample of 322 stations, the basic dimensions of interest were station-to-station (ie 322*322) flows by 4-week railway reporting period for 62 four weekly periods from period 10 2006/7 through to period 6 2011/12.

Within these dimensions, four types of data were collected, as follows:

Demand and revenue

Using LENNON, data was collected on ticket volume, offering a measure of demand, and ticket revenue, from which it is possible to derive revenue per trip as a proxy for fare.

Data processing started with 62*4-week periods of LENNON ticket sales data which were compatible with the dates of the GJT and socio-economic-demographic data, from 2007 period 10 (January 2010) through to 2012 period 6 (August/September 2011). These data were for flows between the 322 stations under consideration, giving a possible 103,362 OD pairs. Smaller flows were removed using the following criteria.

Season ticket data was removed if:

- The flow was London-based (ie London destination or origin) flow and distance was >100 miles
- The flow was non-London and distance was >50 miles

Also, the whole flow (ie including non-seasons) was removed if the average number of standard (full+off-peak+advanced) journeys over the 62 periods was <100 per period. This was to remove small, insignificant flows. Flows were also dropped in cases where there was no supporting GJT data.

These procedures left us with 2,154 flows potentially available for analysis (although of course many of these will be of sufficiently long distances that there are no season ticket sales). A further 14 flows were lost where crime data was unavailable for the destination station.

GJT

Using MOIRA, data was collected on GJT and journey distance by O-D and timetable period.

Socio-economic-demographic

Using GIS methods together with publicly-available data, a dataset was assembled on levels of population, Gross Value Added (GVA), employment, car ownership for each of the 322 stations. The GIS methods employed catchment zones of 2km or 5km around each station, as appropriate for the station type. Population and employment data were recorded nominally, GVA was also nominal but standardised to 2006 prices, and car ownership was recorded as the percentage of households without a car.

Crime and intervention

Using BTP crime, data was assembled on crime levels by crime type $m = 1,...,5$ for each station, by railway reporting period. Using the online survey of station managers (section 4.3.1), annual data was also developed on the timing and form of personal security interventions at each station.

5.9.2 Results from the econometric model

Separate models are estimated to the season ticket data and the non-season ticket data, but there are some common themes in the estimation process.

It should be recognised that the ticket sales data supplied to us could contain some anomalies and errors for a wide range of reasons. Whilst it is the purpose of the error structure of regression models to accommodate such effects, there might be instances where the error in the ticket sales data correlates with other variables and hence causes misleading parameters estimates. For example, it would be unfortunate if the vast majority of stations that had received accreditation did so at the onset of the recession. It is not possible, as is common practice, to inspect the data sets here for outliers due to their very large size. However, a standard procedure is to examine the impact of removing 'outlier' observations with standardised residuals in excess of plus or minus two. Somewhat surprisingly, the removal of this 5% of observations had a negligible impact on the coefficient estimates and hence this exclusion was not retained.

Another procedure that is widely adopted is to weight the observations according to the magnitude of the flow. One might expect the error variance to be larger, at least in proportionate terms, on smaller flows, given that these will be less reliable due to the impact of random events. Various weighting systems were experimented with, including the number of observations, the square root of the number of observations, the inverse of the number of observations and the inverse of the square root of the number of observations. The weighted estimation made little material difference.

The models are therefore based on the largest amount of data available. This can be contrasted with many other studies where, for one reason or another, it has been necessary to remove sometimes substantial numbers of observations in order to achieve more plausible results than would have otherwise prevailed.

5.9.3 Season ticket results

The total number of observations in the season ticket sales model is 31,000, made up of 500 flows and 62 observations per flow. The results are reported in Table 5.34.

The coefficient estimates for the flow specific dummy variables or the period variables are not reported. In addition to the terms in Table 5.34, terms were also included representing employment at the destination, population and the proportion without a car at the origin, and the fuel cross-elasticity. A common problem in time-series models is that these variables tend to move together and hence counter-intuitive results or insignificant coefficients can often be obtained due to the large correlations.

This was also a problem here with wrong sign yet significant coefficient estimates. Indeed, this was the case for employment; although it should be pointed out that the variation in employment levels over the period was minor. Nonetheless, it is important to isolate the effects of these terms. The employment and population elasticities were therefore constrained to PDFH recommendations of 1.0. Similarly, the fuel price cross-elasticity was constrained to 0.3 following PDFH recommendations. Given that most commuters can afford a car and that car ownership in this market segment is high, the non-car ownership effect was constrained to be zero. Whilst the constraints allow the expected effects of these variables to be isolated, it turned out that the impacts on the freely estimated coefficients were minor.

In terms of accreditation, the following dummy variables were specified in the relation to the origin station:

- Secure Station but not Safer Parking and a car park provided (*S1*)
- Not Secure Station but Safer Parking and a car park provided (*S2*)
- Secure Station and Safer Parking and car park provided (*S3*)
- Not Secure Station and not Safer Parking yet car park provided (*S4*)
- Secure Station and no car park provided (*S5*)
- Not Secure Station and no car park provided (*S6*)

Additionally, a dummy variable was specified for whether the destination had Secure Station accreditation, but intuition suggests that car parking at the destination is not a relevant consideration. The base was set at Not Secure Station and not Safer Parking with a car park provided (*S4*).

The Secure Station and Safer Parking term (*S1*) had the correct sign and was highly statistically significant. However, both the other two terms where a car park was provided (*S2* and *S3*) were far from significant. There was a 16% lower demand where there was no car park and no Secure Station accreditation (*S6*). This reduction in demand in the absence of a car park is not surprising but, with a t ratio of 1.7, it was not quite significant. In contrast, Secure Station accreditation even without a station car park increased demand by 23% with a t ratio of 2.0. Secure Station at the destination had a wrong sign coefficient of -0.033 and a t ratio of 2.5.

This is not a clear pattern of results. The Secure Station at destination term was therefore dropped, as was the Safer Parking terms. Whilst it might be considered prudent to allow for the absence of a car park, the relevant term had a t ratio of 0.13 and was therefore far from significant. The lack of any effect from the absence of a station car park may be because there are other car parks nearby, the flow specific dummy variable discerns the effect or because only a small proportion of rail users access by car. No effect from the absence of a car park was detected in any of the subsequent models developed.

The model reported (I) therefore contains only a term (*SECST*) for a Secure Station at the origin. In this model, and the others reported, the fare elasticity is somewhat outside the range of -0.5 to -0.9 recommended in PDFH for season tickets across different flows. Likewise, the GJT elasticity is somewhat lower than the recommended value of between -0.7 and -0.9 in PDFH. The reason for this is the large positive correlation between fare and GJT over the period.

A generalised cost elasticity, which avoids the problems of correlation between GJT and fare, would be the sum of the price and GJT elasticities. Here it would be around -1.9. PDFH would have it at around -1.5 on the sort of flows under consideration here. Given the flows here are less dominated by Central London and other major centres where elasticities will be relatively low, this difference between the results and conventional wisdom is not of great concern.

The *SECST* coefficient in Model I is highly statistically significant and implies that Secure Station accreditation will increase rail demand in the longer term by 7%. This is perhaps on the high side. The security index (*SIF*) was also entered; both in absolute and relative to station throughput, alongside *SECST* but their effects were insignificant and had little material impact of the *SECST* coefficient estimate. Nonetheless, it is encouraging that a positive effect on rail demand arises from apparent improvements in station safety, although it could be argued that it is perceived crime levels and/or safety related facilities that are the more relevant influences on rail demand.

When crime data is adopted as a measure of station safety, there is a choice between specifying the data per four weekly period, as with demand data, or using something more aggregate of which annual data would seem sensible. The advantage of the latter is that it will be more stable than four weekly data and an annual figure might well represent a more accurate representation of passengers' impressions of safety than four weekly figures. In the case of four weekly data, the proposition is that demand will (perhaps unrealistically) follow sharp variations in crimes across periods. On the other hand, a risk with annual data is that (in itself) it embodies insufficient variance; in the present context, however, this is compensated for by substantial cross-sectional variation across flows.

It turned out that the annual data provides a somewhat better fit than the four weekly data, with improvements also in the t ratios of coefficient estimates. Model II specifies the number of crimes at the origin and destination stations (*SC-ORIG* and *SC-DEST*). The former has a counter intuitive sign but in any event both are not significant at the usual 5% level. Models IIIa and IIIb instead specify security indices for the origin and destination (*SIC-ORIG* and *SIC-DEST*). In Model IIIa, based on the Home Office-derived weights, the destination effect (*SIC-DEST*) is highly significant and of the correct sign; neither is true of the origin effect (*SIC-ORIG*). Matters are worse in Model IIIb, where the WTP-derived weights are used, since now the origin effect is actually highly significant whilst retaining its wrong sign.

Matters are improved somewhat, in terms of signs of coefficient estimates, t ratios and goodness of fit, when the crime variables are specified relative to station throughput[11]. Such specifications are reported in Models IV, Va and Vb and confirm the theoretical expectations. In Model IV, the pro-rata number of crimes at the origin station (*SC-REL-ORIG*) is correct sign and statistically significant whilst the pro-rata number of crimes at the destination station (*SC-REL-DEST*) is correct sign but not quite significant at the 10% level. This provides some support for the argument that it is relative crime that is more relevant.

Models Va and Vb are variants upon Models IIIa and IIIb by specifying the crime indices (*SIC*) relative to station throughput and again such a transformation yields an improvement in model fit. Model Va based on the Home Office-derived weights achieves a better fit that Model Vb based on the WTP-derived weights, although both models yield correct sign and highly significant coefficient estimates. The implied demand forecasts are considered further in section 5.6.5.

The discussion now turns to the security interventions themselves. An issue here is that a lot of data is lost because information is not available for all variables for all stations. This is a problem because these are

[11] Note that the correlation between demand and throughput (as defined in the model) is extremely low (0.02-0.11, depending on the precise model specification). This dispels any concern that the introduction of throughput as an explanatory variable (i.e. as the denominator to the crime rate variable) introduces endogenous effects, which would be prevalent if demand is a function of crime rate, which is itself a function of demand. Endogeneity might be a concern if demand and throughput were highly correlated.

obviously more minor effects given that they disaggregate the overall effect into what might be hypothesised to be its constituent parts. Hence a larger not smaller sample would ideally be desired. Model VI simply specifies the security interventions for the origin station and does not specify the car park features. The results are not entirely convincing. Even though the coefficient estimates are highly significant, they are not credible since they imply very large changes in demand. This is possibly due to correlations between the specific interventions and station size. For example, all large stations will have CCTV and will be staffed. The large positive correlations of the input variables will lead to negative correlations of the coefficient estimates which results in the strong negative coefficients obtained. Given this pattern of results, and that specifying the model to cover specific features of the car park and the destination station loses yet more data, the present discussion does not report models which contain such effects. Needless to say the results did not help in understanding this whilst the number of observations falls to fewer than 6,000.

A possible way forward, although not overcoming the problem of missing data, is to create the security index (*SIF*) based on the WTP results as set out above. Such a model is reported as Model VII. It is restricted to the security facilities at the origin station (*SIF-ORIG*) since the same term for the destination station and the equivalent term for the origin car park were not significant. Even then, the estimated coefficient is not quite significant at the usual 5% level although it is of the correct sign. Specifying SIF relative to station size though did not yield a better model. The preferred model is Va since it provides some weighting of the different crime types, the coefficients are correct sign and significant and it provides the best fit to the data. It also produces credible demand forecasts. The model Va was further developed by exploring whether the coefficients vary with station category.

Table 5.34: Season ticket models

	I	II	IIIa	IIIb	IV	Va	Vb	VI	VII
Fare	-1.648 (70.0)	-1.635 (69.8)	-1.638 (69.9)	-1.634 (69.8)	-1.646 (69.8)	-1.647 (70.3)	-1.645 (70.2)	-1.652 (48.8)	-1.653 (48.8)
GJT	-0.260 (3.0)	-0.301 (3.5)	-0.323 (3.7)	-0.319 (3.7)	-0.304 (3.5)	-0.315 (3.7)	-0.316 (3.7)	-0.258 (2.3)	-0.258 (2.3)
SECST	0.069 (5.6)								
SC-ORIG		0.00061 (0.5)							
SC-DEST		-0.0027 (1.7)							
SIC-ORIG			1.559-7 (1.2)	8.338-8 (4.3)					
SIC-DEST			-9.684-7 (5.9)	-7.113-8 (3.3)					
SC-REL-ORIG					-0.00496 (2.9)				
SC-REL-DEST					-0.00378 (1.5)				
SIC-REL-ORIG						-0.0000028 (6.9)	-3.214-7 (6.2)		
SIC-REL-DEST						-0.0000023 (5.3)	-2.672-7 (4.7)		
TG								0.030 (0.9)	
CCTV-S								-1.607 (10.6)	
AH								-0.544 (4.0)	
SSFT								-1.870 (15.0)	
SSPT								-1.786 (12.5)	
LG								1.216 (6.2)	
LS								1.159 (7.34)	
SIF-ORIG									0.0383 (1.9)
R^2	0.816	0.816	0.816	0.816	0.816	0.817	0.816	0.803	0.803
RSS	9309.4	9313.6	9307.9	9310.1	9312.7	9295.0	9300.6	5472.0	5471.1
Obs	31000	31000	31000	31000	31000	31000	31000	16241	16241

Table Note: t-ratios in parentheses

5.9.4 Non-season ticket results

The 2,140 flows available to us yield a maximum of 132,680 observations for modelling purposes. After removing those cases where there is missing information or zero demand, 132,438 observations for non-season tickets remained. The results for the same set of models as reported for season tickets are contained in Table 5.35.

As with the season ticket models, cross-elasticity terms were introduced for fuel price and the proportion of households without a car and an own elasticity for the origin population. These are each constrained to PDFH recommendations given the difficulties in freely estimating them. Alongside the conventional GJT and fare elasticity terms, origin GVA was also entered. However, this was significant but wrong sign, a result of the continued growth in rail demand witnessed over a period of economic contraction. This has been observed within the rail industry but its precise causes are unclear. There will be other factors at work, perhaps relating to changing work patterns in response to increased unemployment or congestion issues which work to rail's advantage. Improvements in revenue protection might also be a causal factor. Rather than return a wrong-sign GDP elasticity, a time trend was specified which reflects the quite marked growth in rail demand over the admittedly short period.

As with the season ticket modelling process, combinations of Secure Station and Safer Parking accreditation at the origin, as set out above (*S1*-*S6*) were examined, along with whether the destination had Secure Station status. In common with seasons, the results did not make a great deal of sense. Secure Station status had a positive but insignificant effect when there was no Safer Parking (*S1*), a strong negative effect when there was also Safer Parking (*S3*) and a very strong effect where there was no car park at all (*S5*). However, the absence of a Secure Station and no car park (*S6*) also had a positive effect relative to the base (*S4*) where there was no Secure Station but a car park was provided. The only intuitive result was that a Secure Station at the destination was statistically significant and increased rail demand by a plausible 1.1%.

Faced with such a diverse set of results, the model was simplified, specifying dummy variables for Secure Station at the origin and the destination, Safer Parking at the origin and the absence of a car park. The no car park coefficient was significant but wrong sign. However, its removal did not impact on the residual sum of squares and hence must be detecting effects attributable to other terms. In the resulting model, both the Secure Station terms were significant and correct sign but Safer Parking was of the wrong sign and is therefore no retained. The resulting model, specifying variables for the origin (*SECST-ORIG*) and destination (*SECST-DEST*), is reported as Model I in Table 5.35.

The GJT elasticity in Model I, and indeed the other models, is very much in line with PDFH recommendations. However, the fare elasticity is somewhat larger than a figure of a little in excess of -1 recommended by PDFH. Whilst it is conceivable that the recent economic hardships could have exerted an upward influence on price elasticities, there is a strong correlation with the constant term which may well have had a bearing. Indeed, when the fare elasticity is constrained to be -1, the constant falls from 1.25 to 0.67. The trend term indicates demand growing at around 0.25% per period or just over 3% per annum on average over the period.

Turning now to models based on the crime data, there is again a choice of using four weekly or annual crime data. It again turned out that the annual data provides a better fit than the four weekly data. Model II contains crimes at the origin station (*SC-ORIG*) and at the destination station (*SC-DEST*) but the former is significant but wrong sign. Models IIIa and IIIb, based on the crime index *(SIC)* achieve a better fit to the data, but perform little better in terms of the sign for the origin term (*SIC-ORIG*). Matters improve in Models IV, Va and Vb when the variables are deflated by station throughput. All the coefficient estimates are correct sign and significant. As with the season ticket models, Model Va based on the crime index using the Home Office-derived weights is the best performing model. The implied demand forecasts are considered in section 5.9.5.

Model VI specifies security facilities as separate terms. These are all wrong sign or else implausibly large, no doubt discerning other effects such as station size. The number of observations is also reduced somewhat. As with the season ticket models, additionally specifying the destination and car park facilities led to further large reductions in the number of observations and did not in any event produce a credible pattern of results. The various facilities were combined into a single term using the WTP weights for the origin station (*SIF-ORIG*), the destination (*SIF-DEST*) and the origin car park (*SICP*) to examine whether any credible composite effect can be discerned. The sample size is only 12% of the maximum available, and the results are not credible.

Table 5.35: Non-season ticket models

	I	II	IIIa	IIIb	IV	Va	Vb	VI	VII
Fare	-1.819 (181.7)	-1.818 (181.7)	-1.819 (181.9)	-1.819 (182.5)	-1.818 (181.7)	-1.819 (181.9)	-1.818 (181.7)	-2.019 (142.8)	-1.717 (58.8)
GJT	-1.048 (42.3)	-1.049 (42.3)	-1.039 (41.9)	-1.036 (41.9)	-1.051 (42.3)	-1.053 (42.5)	-1.054 (42.5)	-0.889 (25.1)	-1.018 (21.4)
Trend	0.0025 (39.1)	0.0026 (47.2)	0.0026 (47.8)	0.0027 (50.0)	0.0025 (45.5)	0.0024 (42.9)	0.0024 (42.8)	0.0014 (16.1)	-0.00016 (0.9)
SECST-ORIG	0.0068 (1.6)								
SECST-DEST	0.012 (2.8)								
SC-ORIG		0.00106 (3.1)							
SC-DEST		-0.0016 (3.5)							
SIC-ORIG			6.137-7 (18.0)	1.617-7 (33.5)					
SIC-DEST			-3.420 (7.7)	-3.119-8 (4.8)					
SC-REL-ORIG					-0.00198 (3.2)				
SC-REL-DEST					-0.00359 (4.3)				
SIC-REL-ORIG						-8.514-7 (7.0)	-9.902-8 (6.2)		
SIC-REL-DEST						-0.00000158 (13.5)	-1.943-7 (12.2)		
TG								0.135 (15.6)	
CCTV-S								-4.713 (47.9)	
AH								-2.038 (26.6)	
SSFT								1.759 (13.7)	
SSPT								-1.509 (15.6)	
LG								1.392 (11.9)	
LS								2.389 (25.9)	
SIF-ORIG									1.481 (8.2)
SICP									-10.687 (6.0)
SIF-DEST									0.107 (0.7)
R^2	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.922	0.937
RSS	15285	15284	15241	15153	15283	15258	15264	9661	1764
Obs	132438	132438	132438	132438	132438	132438	132438	69414	16514

Table Note: t-ratios in parentheses

5.9.5 Illustrative demand impacts

For both season and non-season tickets, the model (Va) based on the crime index (*SIC-REL*) using the Home Office-derived weights and expressed relative to station throughput provided the best fit to the data. However, it is not readily apparent from the reported model what the demand impacts would be.

To illustrate the range of possible changes that might be experienced, it is instructive to look at a range of changes in *SIC-REL* based around the 5th, 25th, 50th, 75th and 95th percentiles across the observations in the estimated models. As can be seen from Tables 5.36 and 5.37 below, this implies a large range in *SIC-REL* which will have doubtless contributed to the ability to estimate coefficients with large t ratios.

The base situation is the 95th percentile of *SIC-REL* for both the origin and the destination. For season tickets, these are 33,395 and 27,010 respectively. The first row and first column containing numbers represent the different levels of *SIC-REL*. Reading upwards within a column shows the effect of increasing the improvement at the origin station. Reading from right to left within a row shows the effects of increasing the improvement at the destination station.

For season tickets, some large increases in demand can be achieved. For example, moving from the 'worst' performing origin and destination station to the 'best', as here specified, implies a 16% increase in demand. Whilst this seems large, it is for a large change in crime levels. Nonetheless, just improving the origin station by this margin and leaving the destination unchanged will increase demand by 9%. However, typical changes are likely to increase demand by somewhat less than this and more than 5% would not generally be expected.

Table 5.36: Season tickets; illustrative demand impacts

Dest→ Orig↓	SIC-REL	5%	25%	50%	75%	95%
SIC-REL		445	4577	8338	14425	27010
5%	2154	+16.02	+14.91	+13.93	+12.35	+9.14
25%	6649	+14.57	+13.48	+12.51	+10.94	+7.78
50%	11876	+12.90	+11.83	+10.87	+9.33	+6.21
75%	19304	+10.58	+9.53	+8.59	+7.08	+4.02
95%	33395	+6.30	+5.30	+4.39	+2.94	Base

Turning to the demand forecasts for Non-Season tickets, reported in Table 5.37, the range of variation in *SIC-REL* is, as would be expected, broadly similar to that for season tickets. However, the demand impacts here are smaller. Improving both the origin and destination stations from the worst to the best levels increases demand by around 7%. Improving only the origin station increases demand by a much more limited 2.75%.

Comparing the demand responses for Season and Non-Seasons, it should be acknowledged that commuting trips are made more frequently and hence there will be greater awareness of changes in crime levels. There will also be more exposure to crime since trips are made more frequently. Another point to countenance, in comparing the demand responses of Season and Non-Season tickets, is that in dense networks where commuting/season ticket purchase high, there is the scope to switch stations. Thus there is the possibility that after crime variations, some of the change in demand is attributable to switching between stations, rather than new demand per se.

Table 5.37: Non-season tickets; illustrative demand impacts

Dest→ Orig↓	SIC-REL	5%	25%	50%	75%	95%
SIC-REL		592	4781	9190	14739	27227
5%	1564	+7.16	+6.46	+5.72	+4.79	+2.75
25%	6680	+6.70	+5.99	+5.26	+4.34	+2.30
50%	12205	+6.20	+5.50	+4.76	+3.85	+1.82
75%	18970	+5.59	+4.89	+4.16	+3.25	+1.24
95%	33395	+4.30	+3.61	+2.89	+1.99	Base

5.9.6 Comparison with other demand impacts

To put these demand impacts of improved station security into perspective, the subsequent discussion reports some impacts of other variables, including such 'secondary' and 'soft' variables, that have been reported.

PDFH provides forecasts for soft factors by converting monetary or more usually time equivalent values of the improvement into a demand impact through the use of a GJT or price elasticity. Since these are not directly estimated, more interesting and relevant comparisons are between the directly estimated demand impacts and other directly estimated ones.

By way of context, the GDP elasticities in PDFH would for most flows imply an annual increase in demand of 2% or more for a corresponding 2% increase in GDP. Similarly, a 10% increase in fuel prices would be forecast to increase rail demand by around 2% on most routes. Thus the implied demand impacts can be equivalent to several years worth of underlying growth in 'normal' circumstances or significant and continued fuel price hikes say along the lines of those induced by the fuel duty escalator.

In a recent study on the impact of car parking provision on rail demand (ARUP and ITS Leeds, 2011), based on the analysis of ticket sales data as here conducted, the headline results were that a 10% increase in parking spaces would be forecast to lead to a 0.4% increase in season ticket trips and a 0.9% increase in non-season ticket trips. However, there would be virtually no increase in non-season ticket demand where it is considered that there are ample local free alternatives to the station car park. In contrast, a 10% increase in parking spaces would be forecast to increase the sale of season tickets for inter-urban trips by around 0.6%.

University of Southampton et al. (2008) examined the impact of improvement station facilities, and in part inspected how different levels of provision impacted on rail demand through analysis of ticket sales data. It was found that for smaller stations, of category C and below, station enhancements could improve rail demand by 7%, although with a subsequent 'wear and tear' decay effect of 0.5% per year. In contrast, category A and B stations could experience 8% demand growth without any subsequent decay effects.

The most robust evidence obtained from analysis of ticket sales changes after new rolling stock was for the introduction of the InterCity 225 trains on the East Coast route which led to a statistically significant 4% uplift in demand for journeys to London with 3% for trips from London (Operational Research, 1993). More recently, a study by Accent et al. (2006) did an 'after' study of behavioural response to new trains introduced on Southern, Scotrail and First Great Western. The reported actual demand responses indicated demand uplifts of 0.72%, 1.79% and 2.42% respectively.

Bearing in mind the significance of the benefits that accrue as a result of the improvements in a range of attributes here discussed, the demand impacts that the present study have obtained for security do not seem to be out of line with a range of other evidence.

5.9.7 Summary

The econometric analysis has followed what is now a conventional approach in the rail industry of attempting to identify an effect on demand, as measured by ticket sales data, of the intervention in question. Many previous studies have examined 'hard' factors, such as GDP, fares and timetable related service quality, and a select few have examined 'soft' factors such as station enhancements, rolling stock improvements and the provision of station parking. This study continues in that tradition and is original in focussing upon the impacts of station security. It has assembled one of the largest data sets ever used in rail demand analysis in Great Britain and this has been critical in being able to obtain statistically robust estimates of what might be expected to be relatively small effects. Different measures can be used to represent station security, based around the number of crimes, the security facilities at the station and whether the station has secure station and/or safer parking accreditation. The best explanation of rail demand was obtained by using a crime index, where different crime types were weighted by their unit costs according to Home Office (2005) figures, deflated by the station throughput. Separate models were estimated for season and non-season tickets and in both cases crime levels at the origin and the destination station were statistically significant. The effects of security improvements are larger for seasons than non-seasons, accounting for demand uplifts of 7% and 1% respectively, as might be expected. Bearing in mind the anticipated benefits that accrue as a result of the improvements in station facilities, rolling stock and car park provision, the demand impacts estimated for security do not seem to be out of line with the range of evidence for these other attributes.

5.10 Summary of Findings From the Economic Analysis

In summarising the key findings from the economic analysis, it is appropriate to consider the principal elements of Figure 5.2, which makes an important distinction between existing rail users, and new users who might be attracted to the network given improvements in personal security (whether actual or perceived).

5.10.1 Existing users

Benefits to existing users arise from two principal sources, namely:

Reductions in the frequency of crime incidents

Valuing reductions in the frequency of crime incidents is relatively straightforward in the sense that there already exists an established source of evidence, in the form of the Home Office's (2005) unit costs of crime. The latter identifies and enumerates (through a variety of methods) costs that arise **as a consequence of crime, in response to crime**, and **in prevention or anticipation of crime**. DfT has already commissioned work to translate this evidence to transportation contexts (DfT, 2007). The main obstacle in adopting these valuations in the present project was to develop a model to forecast the likely change in the number of crime incidents as a result of the Secure Stations/Safer Parking; this was the motivation for the crime model (section 4.7).

Improvements in perceptions of crime risk

Even if Secure Stations/Safer Parking serve to reduce the number of crime incidents, there remains a question as to whether the unit costs of these crimes constitutes the full extent of the benefits to existing users, or whether there is the potential for a premium associated with improved perceptions of crime risk. That is to say, quite aside from the reduction in incidents and associated unit cost savings, there is a question as to whether rail users who have not themselves been the victims of crime but may have witnessed crime or be aware of general levels of criminality, place a value on the perceived reduction in crime risk that arises from Secure Stations/Safer Parking interventions. This question was investigated through two alternative WTP games.

- The 'station/car park improvement game' presented a pair of station/car park options, where each station/car park option was described in terms of various elements of a personal security package and the associated crime rate. Respondents were invited to select their preferred option.
- The 'objective risk of crime game' presented three alternative industry investment options; an accident reduction programme, a crime reduction programme, and a fare reduction programme. Respondents were invited to rank the three options.

The conclusions from the two games are as follows:

- Station/car park users place significant value upon personal security interventions at stations/car parks, but are reluctant to pay for them through the fare box/car park charges. There is some evidence (albeit inconsistent) that car park users may be willing to pay a premium for improved security; this perhaps reflect the fact that car park usage implies that personal property will be left in the custody of the car park. By contrast, station users are clear and definitive in their unwillingness to pay; this could be a protest response.
- Crime risk exhibits a highly significant effect. Since crime risk is perfectly correlated with the expected social costs of crime, it can be concluded that passengers/car park users demonstrate classic public good behaviour in relation to personal security interventions; they believe that personal security is good for society, but are unwilling to pay for such interventions on a private basis.
- Station/car park users are willing to trade-off between the three social goods; reductions in accidents, reductions in crime and reductions in rail fares. With regards to the estimated trade-offs between accidents and crime - which was the primary focus - respondents demonstrate an ability to discriminate between the five different crime types considered, and to value them accordingly.
- The inferred valuations of each crime type, which were derived through a process of pivoting off the VPF, are (broadly speaking) monotonically increasing in the physical severity of the crime incident. Relative to the Home Office unit costs of crime, respondents substantially over-valued (by more than 4 times) the social costs of violence against a person, and undervalued sex attacks (by half).
- The latter discrepancy could be due to respondents' interpretation of the term 'sex attack'. This gives credence to the proposition that the perceived reduction in risk associated with Secure Stations/Safer Parking could give rise to addition benefit above and beyond the Home Office's unit costs of crime. On this basis, the Planning Tool (section 6) includes this premium – for violence against a person only.

5.10.2 New users

Whilst the term ‘new users’ is common parlance in travel demand modelling, it is appropriate to clarify that – strictly speaking – the study's interests are broader, encompassing the generation of any new rail journeys, whether these are additional journeys undertaken by existing rail users, or are journeys undertaken by new customers. An appropriate method for valuing the benefits to new users is to estimate the relevant demand function (as shown in Figure 5.2) and, from the properties of that function, infer the ‘benefit triangle’ to new users (as well as the associated revenue benefit to operators from additional ticket sales).

Guided by PDFH modelling conventions, a demand model was developed which estimates the specific influence of Secure Stations/Safer Parking, in combination with a range of physical interventions (eg CCTV), on ticket sales, whilst controlling for other background drivers of rail patronage (such as levels of fares, GJT, service quality incomes, car ownership and population).

The conclusions from this exercise are as follows:

- Secure Stations and Safer Parking have a significant effect on rail demand.
- For season tickets, the demand response is approximately 7%.
- For non-seasons, the demand response is somewhat weaker, at around 1%.

It is worth noting that the demand impact reported is largely driven by the Secure Stations scheme (although it is possible that this impact is - to some extent - confounded with various aspects of physical personal security interventions). The specific contribution of Safer Parking was difficult to discern statistically.

6 The Planning Tool

6.1 Introduction

Alongside the crime evaluation and economic evaluation research, an Excel-based Planning Tool was developed which could be used by the industry to support cases for investment in personal security at stations. It was not within the scope of the study to develop a full commercial software implementation of the Planning Tool, rather the goal at this stage was to develop the mechanisms which could underpin such software. This set of Excel spreadsheets should be viewed as an interim step - and still work in progress.

The Planning Tool allows the economic benefits of future Secure Stations and Safer Parking schemes, and specific security measures at stations, to be estimated and compared with the scheme costs. The resulting Net Present Value and Benefit:Cost Ratio form part of the business case for rail transport investments (DfT,2011; RSSB, 2010; ORR, 2008). Key components of the Tool are:

- Incorporation of the crime model, to provide a first estimate of the crime reduction impact of an intervention.
- Estimation of the rail demand impact, based on the ticket sales model.
- Valuation of benefits using the current evidence derived from this study.
- Aggregation of benefits and costs to a Net Present Value (NPV) and Benefit:Cost Ratio (BCR) using methods and parameters consistent with industry and DfT practice.
- Also the financial impact in the form of an NPV and Internal Rate of Return (IRR) to the industry.
- Sensitivity analysis for key parameters.

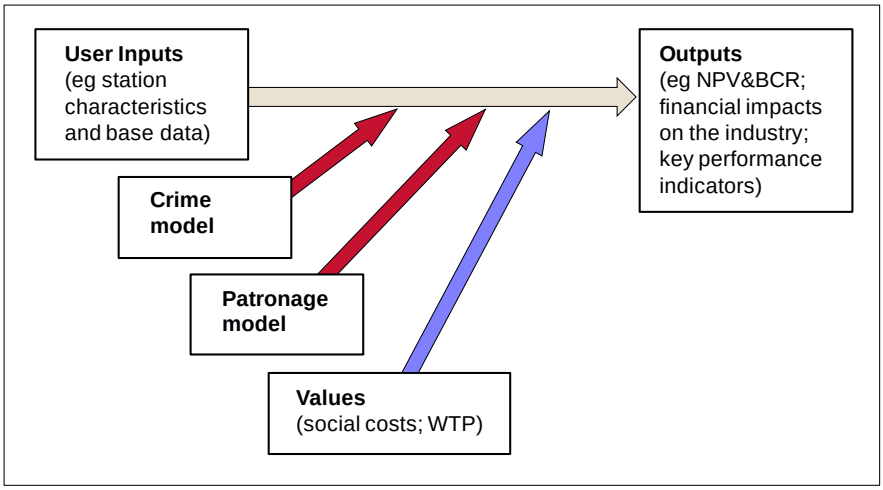
The HM Treasury (2011) convention was adopted that the appraisal period is equal to the lifetime of the longest-lived asset created, or a default value of 20 years for a Secure Station / Safer Parking intervention including the ongoing operating costs of the scheme. The general discount rate is assumed to be equal to 3.5% for the first 30 years, whilst the discount rate is adapted for rail health and safety benefits to be equal to a 1.5% effective discount rate assuming zero growth in the value of preventing casualties (or in this case crimes) (ORR, 2008).

The Planning Tool is intended to contribute to the wider process of *scoping, analysis, decision* and *review* of station security interventions – it allows estimation of the crime and economic impacts from an early stage in the development of a scheme. A limitation of the Tool is that it is not intended to be a polished software product; instead the aim is to carry out the essential calculations – with sufficient guidance to allow an industry professional to use it. The guidance is presented on an initial sheet within the tool, and in the form of Notes on the right hand side of the various other functional sheets. The user inputs are requested on sheet '1.Inputs', while sheet '5.CBA' allows for sensitivity testing and sheet '6.Output Summary' presents the key findings. The sequence of worksheets and calculations within the Tool is described in the following section.

6.2 Outline of the Tool

6.2.1 Sequence of the Planning Tool

Figure 6.1: Basic structure of the Planning Tool



6.2.2 Inputs by the user and default values

An Input Screen invites the user to enter *key information about the scheme* to be appraised, including planned changes in accreditation status and specific security measures, as well as *base data* on the station characteristics, crime rates and annual throughput.

The Tool can consider any permutation of Secure Station/Safer Parking accreditation/non-accreditation. As regards the specific security measures listed on the Input Screen, these are the ones found to be significant in the crime model (section 4.7). In some cases only one simple threshold is shown (eg staffed vs unstaffed) because that was all that was significant in the model, even though further levels were investigated (eg part-time vs. full-time staffing).

The throughput, seasons/non-seasons, full/reduced and interchange data should all come from the ORR source cited on the Guidance page. This link could potentially be automated, should there be a wish to further develop the functionality of the Planning Tool. The user should also input data on local crime rates, which is available from BTP.

The Input Screen shown in Table 6.1 has been reviewed in the light of crime/patronage/WTP model findings, in particular the set of influential variables over crime rate, WTP and ticket sales; the design of the input template is thus a reconciliation of the evidence collected across all strands of the present study. Default values are provided for some cells – eg 2010 as the base year for discounting (it was confirmed by DfT at the Steering Group that it is acceptable to move on from the 2002 base year in WebTAG). Some cells are locked – eg the HM Treasury (2003) discount rate 3.5% for non-safety benefits, and the RSSB (2008) discount rate 1.5% for safety benefits. Since scheme costs may vary considerably depending on the nature and context of the intervention, the user should input data on the investment, operational and maintenance costs for the intervention of interest.

Notes in a panel to the right provide guidance on data entries. At the Steering Group's suggestion, longer background notes are included, but located in a 'Guidance' tab.

Table 6.1 (part i): Input sheet

Inputs

Scheme Title: Secure Station scheme with monitored CCTV at a Category C station

Description:

Station name: Station Name and 3-letter code ---

Station category: -

Accreditation status:

	Current= No Scheme	Scheme
-Secure Station	N	Y
-Safer Parking	Y	Y

Security-relevant measures:

Station	No Scheme	Scheme
- CCTV installed	N	Y
- CCTV monitored	N	Y
- Staffing: Staffed	Y	Y
- Lighting: above Poor	Y	Y
- Automatic ticket barriers	Y	Y
- Tickets checked (>25%)	Y	Y
- Self service ticket machines	Y	Y
- Work to improve lines of sight	Y	Y
Car Park		
- CCTV installed	Y	Y
- Staffing: Staffed	Y	Y
- Staffing: Police Patrol and Staffed	Y	Y
- Lighting: Good Throughout	Y	Y
- Car park payment type - free	N	N
- Car park payment type - pay on exit	Y	Y

Notes

A=National Hub; B=Regional interchange; C=Important Feeder; D=Medium staffed; E=Small staffed; F=Small unstaffed

The station's accreditation status during the operating life of the proposed scheme.
No Scheme = scenario without the scheme - usually the station's current status;
Scheme = scenario with the accreditation scheme implemented.

'Poor lighting' is lighting which creates pools of intense brightness and areas of shadow, is inconsistent across the station does not allow all signage on the station to be easily read after dark and/or does not support the effectiveness of CCTV.

'Work to improve lines of sight' means that where necessary the operator has extended sight lines at corners, wide pillars and recesses, along passageways, subways and stairways, or other areas where passengers need to access.

versus Good Lighting only near pay machines, or worse

Guidance | 1.Inputs | 2.Forecast Crime Outcomes | 3.Forecast Patronage | 4.Social Costs | 5.CBA | 6.Output Summary | Annex A - Visual audit

Table 6.1 (part ii): Input sheet

Annual passenger throughput at the station:	6,666,510	in year	2010			Units: passenger journeys passing through this station per annum, incl. interchange Obtain throughput data from ORR (2012): http://www.rail-reg.gov.uk/server/show/nav.1529
of which	Seasons	35.1 %				
	Non-Seasons	64.9 %				
	of which	Full Fare	24.1 %			
		Reduced	75.9 %			
Interchanging		4.6 %				
Enter/exit station		95.4 %				
Projected patronage growth per annum (No Scheme)				(2010 to 2033)		
	Seasons	1 %p.a.				or insert forecasts manually on Sheet '3.Forecast Patronage'
	Non-Seasons	2 %p.a.				
Revenue: estimated average fare per single trip equivalent at this station:	Seasons	£3.3	in year	2010		Suggested assumptions if no data: • 480 single trip equivalents per annum for Season tickets; to/from a representative station for commuting trips.
	Non-Seasons	£5.6				• Full Fare = Anytime Single fare to/from a representative station for business trips.
	Full Fare	£8.0				• Reduced = typical Off-Peak Return fare ÷ 2 , or typical Advance Single fare, whichever is more representative for leisure/ other travel, to/from a representative station.
	Reduced	£5.0				

Crime rate:		
BTP data for years	2006/7 to 2010/11	
average rate will be applied to year	2010	

Crime type:	Rate	
1. Violence against a person	0.67	Units: incidents per 100,000 journeys through this station
2. Sexual attack	0.05	
3. Theft from a person	1.10	
4. Criminal damage	0.11	
5. Vehicle crime	0.64	Includes both car and cycle crime
6. Commercial theft	0.99	

Table 6.1 (part iii): Input sheet

Appraisal Parameters		
- Appraisal start year	2012	
- Scheme opening year	2014	
- Operating life (# years including opening year)	20	Use the economic life of the longest-lived asset
- Appraisal base years:		
for prices and values	2010	
for discounting	2010	
- Social discount rates:		
for costs and non-safety benefits	3.5%	Assuming appraisal period < 30years. HM Treasury (2003); NERA (2007)
for safety benefits	1.5%	Assuming appraisal period < 30years. NERA (2007); RSSB (2008)
finance rate	6.0%	
- Commercial discount rates:		
rail industry	10%	
- Indirect tax correction factor	1.209	This factor is expected to be updated shortly by DfT to 1.190 as part of a WebTAG update (May 2012): http://www.dft.gov.uk/webtag/documents/expert/pdf/unit3_5_6-VOT-opcost-05-12.pdf see Para 1.1.10 (contact for queries: tasm@dft.gsi.gov.uk).
- Optimism bias adjustment:		
for investment costs (rail)	40%	At Project Development Level 3 (equivalent to Network Rail GRIP stage 3). See TAG Unit 3.1.13: https://www.dft.gov.uk/webtag/documents/expert/pdf/unit3_13_1-guidance-on-rai-appraisal-0512.pdf
for the change in operating & other costs (rail)	1%	

Table 6.1 (part iv): Input sheet

Scheme Costs		Cost, £			
		Invest	Operate	Maintain	Renew
Appraisal Start Year =	2012	140,000			
	2013		30,000	15,000	
	2014		30,000	15,000	
	2015		30,000	15,000	
	2016		30,000	15,000	
	2017		30,000	15,000	
	2018		30,000	15,000	
	2019		30,000	15,000	
	2020		30,000	15,000	
	2021		30,000	15,000	
	2022		30,000	15,000	
	2023		30,000	15,000	
	2024		30,000	15,000	
	2025		30,000	15,000	
	2026		30,000	15,000	
	2027		30,000	15,000	
	2028		30,000	15,000	
	2029		30,000	15,000	
	2030		30,000	15,000	
	2031		30,000	15,000	
	2032		30,000	15,000	

Costs at constant prices, consistent with the Base year for prices and values

Table 6.1 (part v): Input sheet

Cost and Revenue Sharing				
Who pays for the scheme costs?		Invest	Other	
before franchise end				
	Private, TOC (%)	30%	30%	TOC = Train Operating Company
	Public, Broad Transport Budget (%)	70%	70%	Broad Transport Budget includes central and local government expenditure on transport,
		100%	100%	defined in TAG Unit 3.5.1: http://www.dft.gov.uk/webtag/documents/expert/unit3.5.1.php
after franchise end		assumed to be met from Broad Transport Budget		
Who receives any additional revenue from fares?				
before franchise end				
	Private, TOC (%)	50%		
	Public, Broad Transport Budget (%)	50%		
		100%		
after franchise end		assumed to accrue to the Broad Transport Budget		
Who receives any cost savings to industry from crime reduction?				
before franchise end				
	Private, TOC (%)	50%		
	Public, Broad Transport Budget (%)	50%		
		100%		
after franchise end		assumed to accrue to the Broad Transport Budget		
Date of franchise end	Month	4	Year	2029

Partly due to the combination of private and public sector involvement in rail markets, and partly due to the use of the DfT Benefit:Cost Ratio (DfT BCR) as a value for money measure, it is very important to be identify who receives revenues and who bears the costs associated with the scheme. Table 6.1 (part v) shows how this data is collected. In fact the default allocation is:

- 50:50 between the Private and Public participants up to the end of the franchise.
- All revenues retained by (and liability for costs assumed by) the Public budget after the end of the franchise.

In the example shown above, it has been decided to allocate 30% of the scheme costs to the TOC and 70% to the public Broad Transport Budget. This was a preferable allocation since it makes the scheme attractive to both parties.

6.2.3 Crime and patronage impacts of the scheme

The evidence and models from the crime-based and economic-based evaluations of Secure Stations and Safer Parking (sections 4 and 5) were reviewed, with the goal of producing a synthesis on:

- The appropriate form of models of crime impact and patronage impact for forecasting purposes.
- The extent to which such models can be automated for inclusion in the Planning Tool.

Insofar as case-specific inputs from the user on crime and patronage are required, the Planning Tool will make clear what offline evidence base and methods are expected.

The 'Forecast Crime Outcomes' sheet is underpinned by the model of the impacts of personal security on crime risk (section 4.7). This sheet forecasts the number of crimes - by crime type - prevented as a result of the scheme, where the scheme could involve Secure Stations and/or Safer Stations accreditation, together with one or more of the specific personal interventions listed on the Input Sheet. Crime outcomes are forecasted across an appraisal period of 20 years.

An important practical issue is the extent to which there could be a 'package effect' from making one or more interventions in combination. The crime model was unable to discern clear relationships on this issue, but intuition and qualitative evidence from the likes of the visual audits suggests that such relationships exist. In particular, intuition suggests that the crime-preventing effects of two or more interventions in combination will not be as large as the sum of the independent effects of each individual intervention, but will be larger than each of the effects individually. Given the absence of quantitative evidence on package effects, an algorithm was used which:

- Ranks each element of a package of interventions in terms of its relative effectiveness.
- Assumes that the first-ranked intervention will have full effect.
- Assumes that second, third (and so on) interventions will have a gradually decaying effect on additional reductions in the crime rate.

Further discussion of the algorithm and an example, is provided in the notes to the 'Forecast Crime Outcomes' sheet.

Another important set of issues is how to deal with variables in the crime model which are not statistically significant, or wrong-sign, or have multiple levels but no significant/plausible difference between some levels. In these cases, the general rules were: insignificant variables were omitted from the Planning Tool; wrong sign variables were considered case-by-case and all omitted – typically because there are reporting effects whereby a security improvement (eg automatic ticket barriers) leads to an increase in catching and recording offenders hence an apparent step upwards in the crime rate; and finally the model was simplified where there were multiple levels but only one step was significant (eg lighting improved from Poor to Satisfactory, but no significant effect from further improvements). When there were two coefficients that could be relevant, a simple mean was taken.

The 'Forecast Patronage' sheet is underpinned by the model of the impacts of personal security on rail demand (section 5.9). This sheet forecasts the number of railway journeys generated as a result of the scheme. In common with the 'Forecast Crime Outcomes' sheet, patronage outcomes are forecasted across an appraisal period of 20 years.

It is important to acknowledge that the demand change predictions are driven by the crime change predictions from the previous sheet. This relationship is based on Model Va, for reasons of good fit to the data. The model is also widely applicable - to any intervention for which crime change can be estimated -

whereas other models, eg Model I, are tied to specific interventions, and not all of them perform well at that level.

More generally, Model Va is faithful to the basic model structure advocated by PDFH and standard in the railway industry.

Table 6.2: Forecast Crime Outcomes sheet

Forecast Crime Outcomes								**Notes**	
			Base crime numbers in 2010						
		Type *m* =1	Type *m* =2	Type *m* =3	Type *m* =4	Type *m* =5	Type *m* =6		
		Violence against a person	Sexual attack	Theft from passengers	Criminal damage	Car crime	Commercial theft		
	2010	9.6	0.6	4.5	1.8	30.0	6.3	Units:	numbers of crimes per annum
		Crimes prevented							
		Type *m* =1	Type *m* =2	Type *m* =3	Type *m* =4	Type *m* =5	Type *m* =6		
		Violence against a person	Sexual attack	Theft from passengers	Criminal damage	Car crime	Commercial theft		
	2013	3.30	0.00	1.12	1.54	11.30	0.00	Units:	numbers of crimes prevented per annum
	2014	3.34	0.00	1.14	1.56	11.45	0.00		
	2015	3.38	0.00	1.15	1.58	11.60	0.00		
	2016	3.43	0.00	1.17	1.60	11.75	0.00		
	2017	3.47	0.00	1.18	1.62	11.91	0.00		
	2018	3.52	0.00	1.20	1.64	12.06	0.00		
	2019	3.56	0.00	1.22	1.66	12.22	0.00		
	2020	3.61	0.00	1.23	1.68	12.38	0.00		
	2021	3.66	0.00	1.25	1.71	12.55	0.00		
	2022	3.71	0.00	1.26	1.73	12.71	0.00		
	2023	3.76	0.00	1.28	1.75	12.88	0.00		
	2024	3.81	0.00	1.30	1.77	13.05	0.00		
	2025	3.86	0.00	1.32	1.80	13.23	0.00		
	2026	3.91	0.00	1.33	1.82	13.40	0.00		
	2027	3.96	0.00	1.35	1.85	13.58	0.00		
	2028	4.01	0.00	1.37	1.87	13.76	0.00		
	2029	4.07	0.00	1.39	1.90	13.95	0.00		
	2030	4.12	0.00	1.41	1.92	14.13	0.00		
	2031	4.18	0.00	1.43	1.95	14.32	0.00		
	2032	4.23	0.00	1.44	1.97	14.52	0.00		

Table 6.3: Forecast Patronage sheet

Forecast Patronage													
		Forecast patronage											
		increase, %,	Journeys originating or terminating at the station:					Total passenger throughput including interchange:					
		due to crime risk	No Scheme		Scheme			No Scheme		Scheme			
		reduction	Seasons	Non-Seasons	Seasons	Non-Seasons		Seasons	Non-Seasons	Seasons	Non-Seasons		
2014		3.9	2,325,185	4,465,459	2,466,767	4,591,164	2014	2,437,301	4,680,774	2,585,710	4,812,541		
2015		3.9	2,348,437	4,554,768	2,491,435	4,682,987	2015	2,461,674	4,774,390	2,611,567	4,908,791		
2016		3.9	2,371,921	4,645,863	2,516,349	4,776,647	2016	2,486,290	4,869,878	2,637,682	5,006,967		
2017		3.9	2,395,640	4,738,781	2,541,512	4,872,180	2017	2,511,153	4,967,275	2,664,059	5,107,107		
2018		3.9	2,419,597	4,833,556	2,566,928	4,969,623	2018	2,536,265	5,066,621	2,690,700	5,209,249		
2019		3.9	2,443,793	4,930,227	2,592,597	5,069,016	2019	2,561,628	5,167,953	2,717,607	5,313,434		
2020		3.9	2,468,231	5,028,832	2,618,523	5,170,396	2020	2,587,244	5,271,312	2,744,783	5,419,702		
2021		3.9	2,492,913	5,129,408	2,644,708	5,273,804	2021	2,613,116	5,376,738	2,772,231	5,528,096		
2022		3.9	2,517,842	5,231,997	2,671,155	5,379,280	2022	2,639,247	5,484,273	2,799,953	5,638,658		
2023		3.9	2,543,020	5,336,637	2,697,867	5,486,866	2023	2,665,640	5,593,959	2,827,953	5,751,432		
2024		3.9	2,568,451	5,443,369	2,724,845	5,596,603	2024	2,692,296	5,705,838	2,856,232	5,866,460		
2025		3.9	2,594,135	5,552,237	2,752,094	5,708,535	2025	2,719,219	5,819,955	2,884,794	5,983,789		
2026		3.9	2,620,076	5,663,281	2,779,615	5,822,706	2026	2,746,411	5,936,354	2,913,642	6,103,465		
2027		3.8	2,646,277	5,776,547	2,807,411	5,939,160	2027	2,773,876	6,055,081	2,942,779	6,225,534		
2028		3.8	2,672,740	5,892,078	2,835,485	6,057,943	2028	2,801,614	6,176,182	2,972,207	6,350,045		
2029		3.8	2,699,467	6,009,919	2,863,840	6,179,102	2029	2,829,630	6,299,706	3,001,929	6,477,046		
2030		3.8	2,726,462	6,130,118	2,892,478	6,302,684	2030	2,857,927	6,425,700	3,031,948	6,606,587		
2031		3.8	2,753,727	6,252,720	2,921,403	6,428,738	2031	2,886,506	6,554,214	3,062,267	6,738,719		
2032		3.8	2,781,264	6,377,775	2,950,617	6,557,312	2032	2,915,371	6,685,298	3,092,890	6,873,493		
2033		3.8	2,809,077	6,505,330	2,980,123	6,688,459	2033	2,944,525	6,819,004	3,123,819	7,010,963		

Notes

Units: passenger journeys passing through this station per annum

Growth in patronage in this table is driven by a base level of Forecast Patronage Growth without the Scheme, plus the predicted effect of the Scheme based on the demand modelling work in this study (RSSB T954).

The base Forecast Patronage Growth (No Scheme) is assumed to be:

1% per annum, Seasons

2% per annum, Non-Seasons

6.2.4 Social costs

Having defined the form of the intervention, calculated the impact of the intervention on crime reduction, and then calculated the knock-on effects of the crime reduction on rail demand, the next task is to enumerate the associated social benefits. Within the Planning Tool, valuation of social benefits is based primarily on the Home Office unit costs of crime data, adjusted for the rail context (Table 6.4 below).

An important question considered by the current project was the extent to which there was evidence of benefit over and above the unit costs of crime, associated with reductions in crime risk (as might arise from the intervention) that benefit **all passengers** using railway stations and railway station car parks, as opposed to simply those passengers who had been victims of crime.

Reconciling the evidence from the WTP experiments (sections 5.6 and 5.7), the judgement was made that that evidence of such additionality was sufficiently convincing in only one specific case, namely the case of social valuations of 'violence against a person' from the objective risk of crime game (Table 5.32). This judgment was reasoned on the basis that violence against a person was the only crime type for which the value of crime/value of accident multiplier was estimated to be substantially (and significantly) greater than one for both stations and station car parks. It is however worth recognising that the objective risk of crime game represented one of the innovative aspects of method; it is therefore difficult to find existing evidence base (from previous applications of similar method) to provide corroboration. For this reason, the benefits of reduced crime risk are represented as a sensitivity test in the Planning Tool, rather than as a component of 'core' benefits; in this way, the incremental contribution of the objective risk of violence against a person over and above the Home Office's unit costs of crime is clearly shown.

Table 6.4: Social Costs of Crime sheet

Summary of estimated average costs of crimes on National Rail in 2006/07 by crime type and by cost category or cost bearer (in £, 2006/07 prices)							
	Crime types						
	1	2	3	4	5	6	7
	Violence against a person (passenger)	Violence against a person (staff)	Sexual offences	Theft from passengers	Criminal damage	Vehicle crime	Burglary/ theft - commercial
Physical and Emotional Impact	1,842	723	10,605	313	14	290	
Net Value of Property Stolen				159		212	
Property Damaged/Destroyed				8		100	
Lost Output	574	95	2,131	65		12	
Health Services	402	154	479	31			
Victim Services	7	3	18	1		1	
Delay Cost (operator)		26			2,045		
Other Rail Operator Cost		50			1,681		4,183
Retailer Cost							540
Criminal Justice System	3,404	334	1,809	470	136	70	1,489
Average cost per crime	6,229	1,384	15,043	1,047	3,876	685	6,212
costs borne by Users	2,416		12,736	545		502	
costs borne by Staff		723			14		
costs borne by Industry		170			3,726	112	4,183
costs borne by Government/Society	3,813	491	2,306	502	136	71	2,029
Average cost per crime							
uplifted to 2010 current prices and values	6,676	1,484	16,122	1,122	4,154	734	6,658
costs borne by Users	2,589		13,650	584		538	
costs borne by Staff		775			15		
costs borne by Industry		183			3,994	120	4,484
costs borne by Government/Society	4,087	526	2,472	538	146	76	2,174

6.2.5 CBA

Once the preceding sheets have been generated, the Planning Tool is equipped to conduct the CBA for the scheme (Table 6.5).

Following the detailed method outlined in section 5.2, the Tool estimates the benefits of the scheme in each modelled year. Forecasting, interpolation and extrapolation are used, with assumptions on the growth of values of crime reduction, to estimate the profile of benefits over the appraisal period. The benefits to users, staff, other individuals, operators and government are separated out.

The calculations include the 'benefit triangle' for new users (Figure 5.2). This was done by adopting the rail fare elasticities from TRL593 for business, commute and leisure, and converting the predicted % change in demand to a % change in fare; this gave the two quantities needed to calculate $0.5 * \Delta GC * \Delta T$.

It remains to subtract the costs of the scheme (see the Input sheet) from the benefits, and to discount over the appraisal period. The Planning Tool discounts at 3.5% for costs and non-safety benefits, and at 1.5% for safety benefits.

Note that a series of sensitivity tests were conducted relating to:

- % trend in the underlying crime rate
- Underreporting of crime
- Optimism bias
- Crime reduction
- Patronage forecasts

6.2.6 Results

Finally, the Planning Tool summarises the outcomes of the scheme (Table 6.6) in terms of:

- Changes in crime
- Changes in patronage
- NPV
- BCR (both the DfT BCR found in WebTAG, and an alternative 'social' BCR with all scheme costs as the denominator)
- Financial IRR
- Financial NPV

Table 6.5 (part i): Social CBA sheet

Social Costs and Benefits, Discounted and adjusted to Market Prices														Benefits and Costs, Undiscounted										
Totals:	Benefits	Costs												Benefits, £										
	PVB, £	PVC, £			Discounted						Indirect	Discount			Household				Industry			Government / Society		
	13,197,811	10,201,453			Benefits, £					Costs, £	tax	Factors			User		Staff	Non-user	ΔRevenue	Allocated Industry		Fare	Other	Total
					Household			Industry	Government	Scheme	correction	Safety	Other	Crime		Crime	Increased		Crime Savings		revenue		
Year			Year		User	Staff	Non-User		/Society	Costs	factor	@ 1.5%	@ 3.5%	reduction	Risk premium	reduction	Patronage		to Industry	to Gov't			
2012	0	237,579	2012							237,579	1.209	0.971	0.934										
2013	0	839,646	2013							839,646	1.209	0.956	0.902		SEE								
2014	824,349	805,620	2014		67,381	1,547	33,600	308,630	413,190	805,620	1.209	0.942	0.871	71,516	COLUMNS	1,642	35,662	245,617	47,320	47,320	245,617	99,243	392,179
2015	759,306	756,486	2015		67,486	1,549	33,556	252,525	404,190	756,486	1.209	0.928	0.842	72,701	TO THE	1,669	36,149	248,073	48,104	48,104	248,073	100,888	397,065
2016	744,475	710,747	2016		67,592	1,552	33,512	246,425	395,394	710,747	1.209	0.915	0.814	73,908	RIGHT	1,697	36,643	250,554	48,903	48,903	250,554	102,562	402,018
2017	729,992	666,277	2017		67,700	1,554	33,468	240,473	386,796	666,277	1.209	0.901	0.786	75,136	HEADED	1,725	37,145	253,059	49,715	49,715	253,059	104,267	407,041
2018	715,849	624,929	2018		67,810	1,557	33,426	234,664	378,393	624,929	1.209	0.888	0.759	76,387	"SENSITIVITY	1,754	37,654	255,590	50,543	50,543	255,590	106,002	412,135
2019	702,039	584,719	2019		67,921	1,559	33,384	228,996	370,178	584,719	1.209	0.875	0.734	77,660	TEST"	1,783	38,171	258,146	51,385	51,385	258,146	107,768	417,299
2020	688,552	547,380	2020		68,034	1,562	33,344	223,465	362,149	547,380	1.209	0.862	0.709	78,956		1,813	38,697	260,727	52,242	52,242	260,727	109,567	422,536
2021	675,383	511,062	2021		68,148	1,565	33,304	218,067	354,300	511,062	1.209	0.849	0.685	80,275		1,843	39,230	263,334	53,115	53,115	263,334	111,397	427,847
2022	662,523	477,381	2022		68,264	1,567	33,265	212,800	346,628	477,381	1.209	0.836	0.662	81,618		1,874	39,772	265,968	54,004	54,004	265,968	113,261	433,232
2023	649,966	444,614	2023		68,382	1,570	33,226	207,660	339,128	444,614	1.209	0.824	0.639	82,985		1,905	40,322	268,627	54,908	54,908	268,627	115,158	438,694
2024	637,703	414,271	2024		68,501	1,573	33,189	202,644	331,797	414,271	1.209	0.812	0.618	84,377		1,937	40,880	271,314	55,829	55,829	271,314	117,090	444,233
2025	625,729	384,743	2025		68,622	1,575	33,152	197,749	324,630	384,743	1.209	0.800	0.597	85,794		1,970	41,448	274,027	56,767	56,767	274,027	119,056	449,850
2026	614,036	357,442	2026		68,745	1,578	33,116	192,972	317,624	357,442	1.209	0.788	0.577	87,237		2,003	42,024	276,767	57,722	57,722	276,767	121,058	455,547
2027	602,619	330,868	2027		68,870	1,581	33,081	188,311	310,776	330,868	1.209	0.776	0.557	88,705		2,037	42,609	279,535	58,693	58,693	279,535	123,096	461,325
2028	591,469	306,339	2028		68,996	1,584	33,047	183,763	304,080	306,339	1.209	0.765	0.538	90,201		2,071	43,203	282,330	59,683	59,683	282,330	125,171	467,185
2029	609,207	282,456	2029		69,123	1,587	33,013	44,831	460,653	282,456	1.209	0.754	0.520	91,723		2,106	43,807	71,288	15,173	106,208	499,019	127,284	732,511
2030	607,451	260,452	2030		69,253	1,590	32,980	0	503,628	260,452	1.209	0.742	0.503	93,273		2,141	44,420	0	0	123,432	576,010	129,435	828,878
2031	596,416	239,020	2031		69,384	1,593	32,949	0	492,490	239,020	1.209	0.731	0.486	94,852		2,178	45,043	0	0	125,521	581,770	131,626	838,917
2032	585,637	219,312	2032		69,517	1,596	32,917	0	481,607	219,312	1.209	0.721	0.469	96,459		2,215	45,675	0	0	127,647	587,588	133,856	849,091
2033	575,109	200,110	2033		69,651	1,599	32,887	0	470,972	200,110	1.209	0.710	0.453	98,095		2,252	46,318	0	0	129,813	593,464	136,126	859,403

Table 6.5 (part ii): Social CBA sheet

														Sensitivity Test	
												Value growth		Undiscounted	Discounted
Costs, £												(safety benefits,		Benefits, £	Benefits, £
	Invest +		Other+					SubTotal	SubTotal			ORR/RSSB approach)			
	Optimism		Optimism				Financing	Scheme	Scheme	TOTAL		Base 2010=1.000		User	User
Invest	Bias	Other	Bias		Depreciation	Net book	cost	Cost to	Cost to	Scheme				Risk premium	Risk premium
	Adjustment		Adjustment		(straight line)	value	@ 6.0%	Rail Industry	Public	Costs				(violence)	(violence)
2,500,000	3,500,000	500	505			3,500,000	210,000	63,152	147,354	210,505		1.000			
2,500,000	3,500,000	0	0		350,000	7,000,000	420,000	231,000	539,000	770,000		1.000			
0	0	15,500	15,655		350,000	6,650,000	399,000	229,397	535,259	764,655		1.000		141,482	133,303
0	0	15,000	15,150		350,000	6,300,000	378,000	222,945	520,205	743,150		1.000		143,828	133,509
0	0	15,500	15,655		350,000	5,950,000	357,000	216,797	505,859	722,655		1.000		146,215	133,720
0	0	15,000	15,150		350,000	5,600,000	336,000	210,345	490,805	701,150		1.000		148,645	133,933
0	0	15,500	15,655		350,000	5,250,000	315,000	204,197	476,459	680,655		1.000		151,119	134,150
0	0	15,000	15,150		350,000	4,900,000	294,000	197,745	461,405	659,150		1.000		153,637	134,370
0	0	15,500	15,655		350,000	4,550,000	273,000	191,597	447,059	638,655		1.000		156,201	134,593
0	0	15,000	15,150		350,000	4,200,000	252,000	185,145	432,005	617,150		1.000		158,810	134,819
0	0	15,500	15,655		350,000	3,850,000	231,000	178,997	417,659	596,655		1.000		161,467	135,049
0	0	15,000	15,150		350,000	3,500,000	210,000	172,545	402,605	575,150		1.000		164,172	135,282
0	0	15,500	15,655		350,000	3,150,000	189,000	166,397	388,259	554,655		1.000		166,926	135,518
0	0	15,000	15,150		350,000	2,800,000	168,000	159,945	373,205	533,150		1.000		169,729	135,758
0	0	15,500	15,655		350,000	2,450,000	147,000	153,797	358,859	512,655		1.000		172,583	136,001
0	0	15,000	15,150		350,000	2,100,000	126,000	147,345	343,805	491,150		1.000		175,489	136,247
0	0	15,500	15,655		350,000	1,750,000	105,000	141,197	329,459	470,655		1.000		178,447	136,496
0	0	15,000	15,150		350,000	1,400,000	84,000	33,686	415,464	449,150		1.000		181,459	136,749
0	0	15,500	15,655		350,000	1,050,000	63,000	0	428,655	428,655		1.000		184,526	137,005
0	0	15,000	15,150		350,000	700,000	42,000	0	407,150	407,150		1.000		187,648	137,264
0	0	15,500	15,655		350,000	350,000	21,000	0	386,655	386,655		1.000		190,828	137,527
0	0	15,000	15,150		350,000	0	0	0	365,150	365,150		1.000		194,065	137,793

Table 6.5 (part iii): Social CBA sheet

Financial analysis						Public accounts	Crime costs borne initially by Industry		
Undiscounted		Discounted	@ 10.0%		Internal	Present Value	Undiscounted		
ΔCosts to industry, £	ΔRevenue to industry, £	ΔCosts to industry, £	ΔRevenue to industry, £	Net Present Value, £	Rate of Return (IRR) to industry	of Cost to Broad Transport Budget, £	Savings due to Scheme	Savings allocated to industry	Savings allocated to Broad Transport Budget, £ (public)
63,152	0	52,191	0	-52,191	-1,113,152	166,305			
231,000	0	173,554	0	-173,554	-1,176,000	587,752			
229,397	292,937	156,681	200,080	43,399	168,540	255,304	94,640	47,320	47,320
222,945	296,177	138,431	183,903	45,471	178,232	228,048	96,208	48,104	48,104
216,797	299,456	122,376	169,035	46,659	187,660	203,001	97,805	48,903	48,903
210,345	302,775	107,940	155,371	47,431	197,430	178,678	99,431	49,715	49,715
204,197	306,133	95,259	142,813	47,554	206,936	156,381	101,086	50,543	50,543
197,745	309,531	83,863	131,271	47,408	216,786	134,725	102,770	51,385	51,385
191,597	312,970	73,869	120,663	46,795	226,373	114,925	104,485	52,242	52,242
185,145	316,450	64,892	110,914	46,022	236,305	95,691	106,231	53,115	53,115
178,997	319,972	57,034	101,953	44,919	245,975	78,159	108,008	54,004	54,004
172,545	323,536	49,980	93,717	43,737	255,991	61,123	109,817	54,908	54,908
166,397	327,143	43,817	86,147	42,330	265,747	45,647	111,659	55,829	55,829
159,945	330,794	38,290	79,189	40,900	275,849	30,606	113,534	56,767	56,767
153,797	334,489	33,471	72,795	39,324	285,692	16,991	115,443	57,722	57,722
147,345	338,228	29,151	66,917	37,765	295,883	3,757	117,387	58,693	58,693
141,197	342,013	25,395	61,514	36,119	305,817	-8,172	119,366	59,683	59,683
33,686	86,461	5,508	14,137	8,629	79,025	-119,336	121,381	15,173	106,208
0	0	0	0	0	0	-164,531	123,432	0	123,432
0	0	0	0	0	0	-176,199	125,521	0	125,521
0	0	0	0	0	0	-186,372	127,647	0	127,647
0	0	0	0	0	0	-196,261	129,813	0	129,813
					5%				

Table 6.5 (part iv): Social CBA sheet

Cost Benefit Analysis

Social Cost-Benefit Analysis

Base Year: 2010
@ 3.5% for costs and non-safety benefits
@ 1.5% for safety benefits
@ 6.0% finance rate

Summary: using Standard Values for Benefits:

Net Present Value (NPV), £	=	2,996,358
DfT Benefit:Cost Ratio (DfT BCR)	=	2.99
with respect to the Public Accounts		
PV of Cost to Broad Transport Budget, £	=	1,506,223
Social Benefit:Cost Ratio (BCR)	=	1.3
with respect to all costs		

using Increased Values for Benefits
including risk premium
(from Objective Risk of Crime game):

Net Present Value (NPV), £	=	5,705,445
DfT Benefit:Cost Ratio (DfT BCR)	=	4.79
with respect to the Public Accounts		
PV of Cost to Broad Transport Budget, £	=	1,506,223
Social Benefit:Cost Ratio (BCR)	=	1.6
with respect to all costs		

Financial Analysis for the Rail Industry

Internal Rate of Return (IRR)	=	5%

Base Year: 2010
@ 10.0% discount

Net Present Value (NPV), £	=	438,716

Sensitivity Tests:

(i)	**Base Assumption:**	**0% trend in crime rate**	Base (0% trend in crime rate)
	Sensitivity Test:	0% trend in crime numbers	
(ii)	**Base Assumption:**	**reported crimes**	Base
	Sensitivity Test:	estimate of total crimes accounting for underreporting	
(iii)	**Base Assumption:**	**optimism bias adjustment +40% (on investment costs)**	Base (+40%)
	Sensitivity Test 1:	optimism bias adjustment +66% (on investment costs)	
	Sensitivity Test 2:	optimism bias adjustment +6% (on investment costs)	
(iv)	**Base Assumption:**	**forecast patronage increase as shown on Sheet 3.**	Base
	Sensitivity Test 1:	lesser patronage increase (-50%)	
	Sensitivity Test 2:	greater patronage increase (+100%)	
(v)	**Base Assumption:**	**crime reduction impact as shown on Sheet 2.**	Base
	Sensitivity Test 1:	lesser crime reduction impact (-50%)	
	Sensitivity Test 2:	greater crime reduction impact (+100%)	

Table 6.6: Output Summary sheet

Output Summary				Notes
Crime reduction in 2015 by crime type		Number	% vs 2010 base	Units: numbers of crimes prevented per annum
1. Violence against a person		7.70	17%	
2. Sexual attack		1.59	48%	
3. Theft from a person		46.89	64%	
4. Criminal damage		3.76	51%	
5. Vehicle crime		16.78	39%	
6. Commercial theft		17.66	27%	
Patronage increase, %, in 2015				Units: % change in passenger journeys passing through this station per annum (including interchange)
Seasons		6.1%		
Non-Seasons		2.8%		
NPV	£2,996,358			
DfT BCR	2.99			DfT Benefit:Cost Ratio (DfT BCR) = (NPV / Present Value of Cost to the Broad Transport Budget) + 1 see sheet 5.
Social BCR	1.29			Social Benefit:Cost Ratio (BCR) = PVB/PVC see sheet 5.
Financial IRR (industry)	5%			
Financial NPV (industry)	£438,716			

6.3 Application of the Planning Tool to Two Case Studies

Both case studies illustrate, using hypothetical schemes, how the Planning Tool could be applied.

6.3.1 Case Study I: Station One

Case Study I is loosely based on the personal security issues at a Category B 'Regional Interchange' station used by 6.7million passengers per annum. This station is not a Secure Station, and has some design issues which contribute to a poor customer perception of the station.

Station One is now the subject of a large scale redevelopment and improvement scheme, which goes far beyond its security issues. These improvements include additional platforms and both retail and commercial development. The overall costs of this work are in excess of £20million.

In the case study below, a reduced scheme (referred to henceforth as the 'Scheme') focussing on personal security is considered. The Scheme costs are hypothetical, and sensitivity tests are conducted to understand how the strength of the business case would vary with different levels of cost.

Assessment of personal security issues

It is good practice to begin with an assessment of the personal security issues which exist and the scope for improvements. A *visual audit* was conducted at Station One and the findings are summarised in Box 6.1.

The following may be identified as the key issues to be addressed in the fabric of the station, comparing the results of the audit with the key variables driving station crime in the crime model (section 4):

- *Lines of sight* – Improvements are needed to address the hidden areas of platforms, of which there are many given the current arrangement of tracks, platforms and pillars in the station (Figure 6.2a), and the design of waiting areas which feature obstructing pillars and are partly recessed into the walls (Figure 6.2b). Poor lines of sight are also an issue for the secluded station entrance (Figure 6.2c) and the overbridges where the design of the stairwells and the fire doors create obstructions to a clear view (Figures 6.2d and e).
- *Lighting* – The inconsistency in light levels between the open and enclosed areas of the station platforms makes it difficult to observe all areas of the platform clearly (Figure 6.2a), and there is a general issue with the enclosed areas appearing dark due to lack of natural and sufficient artificial light, combined with the choice of materials (all Figures 6.2).
- *Ticket gateline security* – The station lacks automatic ticket barriers, which the crime evaluation demonstrated to have a significant impact on theft from a person. Generally, automatic ticket barriers would also be expected to reduce fare evasion.

The station also lacks Secure Station status, and addressing these physical issues would provide an opportunity to implement the requirements of Secure Stations in full. In this case there are potential changes to procedures enabled by the physical improvements, eg more effective use of staff previously allocated to ticket check duties. There is also a generic requirement as part of Secure Stations to measure – through surveys – and confirm levels of perceived passenger security at the station.

Box 6.1: Visual audit findings, Station One

Approach – Overall the approach to the station is open, with informal surveillance of the entrances from surrounding land uses. However one entrance is through an alleyway which is very secluded. This is unlikely to be used by many passengers but could facilitate access to the station by offenders. Station One has a total of eight entrances/exits, including those via the car park and a local entertainment and sports Arena. This creates problems for controlling access through the station, locking down the station when necessary and apprehending any offenders on the station.

Layout – There are several possible routes through the station, with several sets of bridges providing access to platforms. This is necessary to enable the safe evacuation of large numbers of guests at the Arena, but makes the station complicated to navigate and the control of fare evasion extremely difficult. The layout also results in large areas of the station that feel remote and unused. These areas are unlikely to be used by passengers but they do provide areas for offenders to hide and/or anti-social behaviour to take place.

Station environment – The construction station feels dark even during the daytime; Platforms 3 to 6 felt particularly dark. The station was clean and there were no signs of litter or graffiti.

Staffing – Staff presence is concentrated on the gate lines and there are fewer staff on the platforms.

CCTV – CCTV is on use on the station, although there are several blind spots. A monitor is available to view live CCTV feed but the task of monitoring is shared with other responsibilities.

Ticket checks – Tickets are checked by gateline staff. Over 75% of passengers are checked for tickets.

Retail and catering activity – There are only limited retail outlets given the size of the station. These are separated from the main concourse and platform areas and therefore do not enhance informal surveillance of the station.

Cycle storage – The station provides hooped stands in the concourse area to facilitate the secure storage of cycles. There is some CCTV coverage of these stands, but the quality is limited.

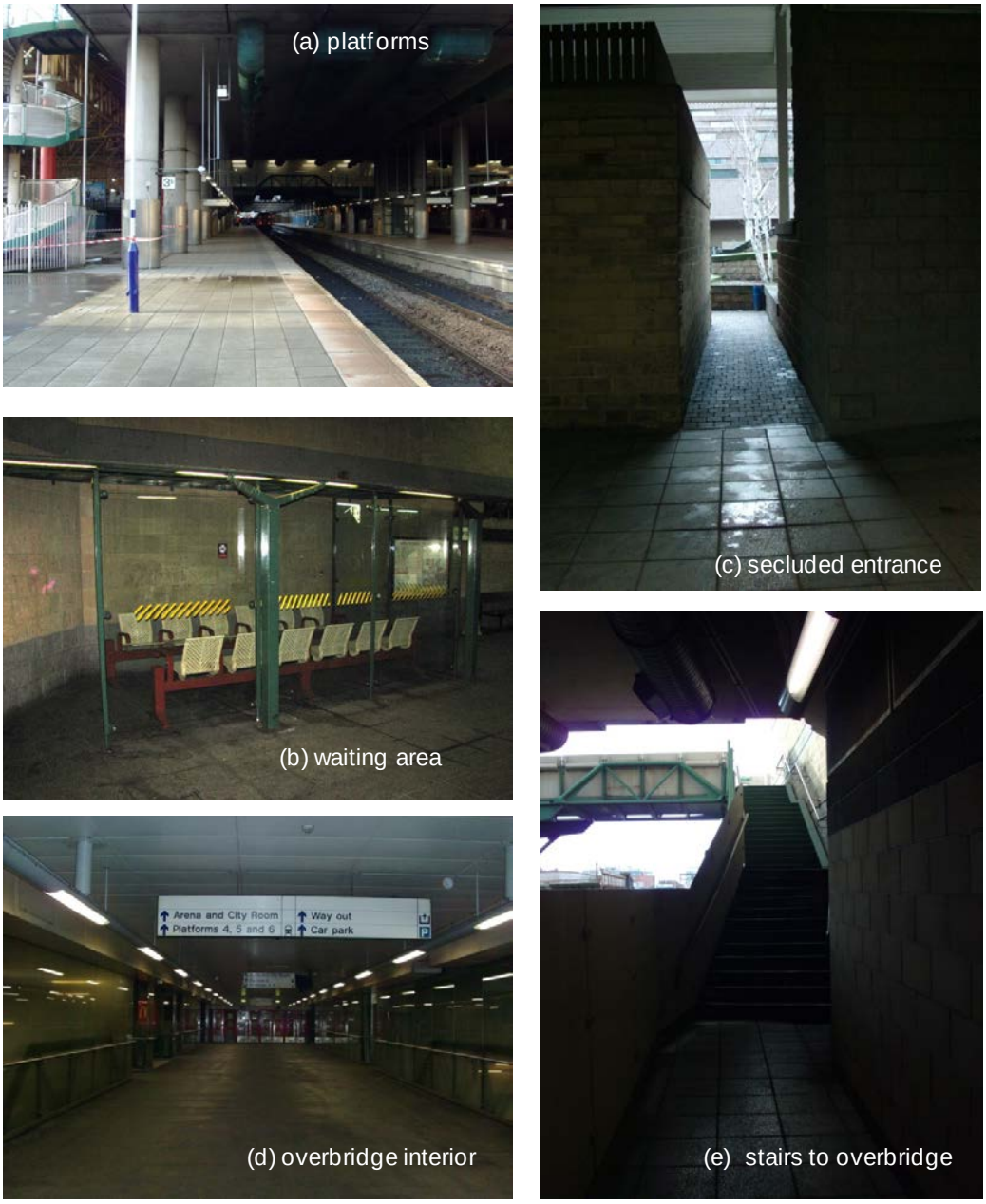
Waiting areas – There are clear 'bus stop style' waiting shelters on the platform. However their location in dark areas minimises the benefits of visibility offered by this design.

Car park – There is a pay and display multi-storey car park owned by the local authority and managed by NCP.

Crime problems – Crime problems reported by staff included:

- Anti-social behaviour commonly linked to the night-time economy.
- Crimes related to events at the Arena including theft from a person, illegal ticket sales and the sale of unlicensed merchandise.
- Fare evasion
- Indecent acts in the public toilets
- Thefts of cycles

Figure 6.2: Station images – Case Study I



Hypothetical Scheme definition

Based on the assessment of personal security issues at the station, the following Scheme elements are proposed:

(i) Roofing and lighting – enhancement to both artificial lighting in covered areas and natural lighting in open areas, combined with increased use of light materials throughout.

(ii) Redesign of platforms to eliminate hidden spaces.

(iii) Fully transparent waiting areas.

(iv) Remodelling of overbridges and the secluded entrance.

(v) Automatic ticket barriers.

(vi) Secure Station status sought and achieved.

The expected asset life for the physical elements of the Scheme is assumed to be 20 years, and this is used to set the appraisal period from 2012 to 2033 – comprising a two year construction period + a 20 year operating period).

Benefits of the Scheme

A judgement is made that the improvements above will raise the levels of key variables from:

- Lighting – from 'Poor' to 'above Poor' (Satisfactory)
- Work to improve Lines of Sight – from 'No' to 'Yes'
- Automatic ticket barriers – from 'No' to 'Yes'
- Secure Station status– from 'No' to 'Yes'

These changes are input into the Planning Tool through the sheet '1.Inputs' (see Table 6.7).

Table 6.7: Inputs for station characteristics with and without the Scheme – Case Study I

Station name:	Station One	
Station category:	B	
Accreditation status:	Current=	
	No Scheme	Scheme
-Secure Station	N	Y
-Safer Parking	Y	Y
Security-relevant measures:		
Station	No Scheme	Scheme
- CCTV installed	Y	Y
- CCTV monitored	Y	Y
- Staffing: Staffed	Y	Y
- Lighting: above Poor	N	Y
- Automatic ticket barriers	N	Y
- Tickets checked (>25%)	Y	Y
- Self service ticket machines	Y	Y
- Work to improve lines of sight	N	Y

Information on station throughput, average fare revenue and crime rate without the Scheme is also entered (Table 6.8):

- Station throughput is derived from the ORR website 'Station Usage': http://www.rail-reg.gov.uk/server/show/nav.1529, while average fare estimates may be sought from the operator or estimated with reference to fares information and ORR usage data, and should represent typical Season and Non-Season (full and reduced) fares paid by users of the station – the Planning Tool contains guidance on estimating these (the average fares included in Table 6.8 are study team estimates and should be treated as illustrative).
- Recent BTP crime data for the station should also be input – at Station One the BTP data gives the following rates per 100,000 passenger journeys including interchanging passengers, ie station throughput. These crime rates are averaged over 5 years to minimise the effect of annual variability in the data.

Table 6.8: Inputs for station throughput, average revenue and crime rates – Case Study I

Annual passenger throughput at the station:	6,666,510	in year	2010		
of which	Seasons	35.1 %			
	Non-Seasons	64.9 %			
	of which	Full Fare	24.1 %		
		Reduced	75.9 %		
	Interchanging	4.6 %			
	Enter/exit station	95.4 %			
Projected patronage growth per annum (No Scheme)			(2010 to 2033)		
	Seasons	1 %p.a.			
	Non-Seasons	2 %p.a.			
Revenue: estimated average fare per single trip equivalent at this station:	Seasons	£3.3	in year	2010	
	Non-Seasons	£5.6			
		Full Fare	£8.0		
		Reduced	£5.0		

Crime rate:	BTP data for years	2006/7 to 2010/11
	average rate will be applied to year	2010

Crime type:	Rate
1. Violence against a person	0.67
2. Sexual attack	0.05
3. Theft from a person	1.10
4. Criminal damage	0.11
5. Vehicle crime	0.64
6. Commercial theft	0.99

Appraisal parameters are checked – in this case the defaults for base years, discount rates and the indirect tax correction factor are accepted (Table 6.9). The optimism bias adjustment of +40% on investment costs assumes that the Scheme is at Stage 2 of its development, which corresponds to GRIP Stage 4 Option Selection for rail projects (see DfT, 2011, TAG Unit 3.5.9). The tool contains a sensitivity test for optimism bias at Stages 1 or 3 of project development in the 'CBA' sheet (+66% or 6% respectively).

Table 6.9: Inputs for appraisal parameters – Case Study I

Appraisal Parameters	
- Appraisal start year	2012
- Scheme opening year	2014
- Operating life (# years including opening year)	20
- Appraisal base years:	
for prices and values	2010
for discounting	2010
- Social discount rates:	
for costs and non-safety benefits	3.5%
for safety benefits	1.5%
finance rate	6.0%
- Commercial discount rates:	
rail industry	10%
- Indirect tax correction factor	1.209
- Optimism bias adjustment:	
for investment costs (rail)	40%
for the change in operating & other costs (rail)	1%

In Case Study I, it was decided to allocate 30% of the scheme costs to the TOC and 70% to the public Broad Transport Budget, up to the end of the current franchise period. This was a preferable allocation since it makes the scheme attractive to both parties. Meanwhile revenues were allocated 50:50 up to the end of the franchise. After the end of the franchise, both revenue and cost changes were assumed to rest with the Public sector.

The crime model and patronage model components of the Planning Tool take this data and use it to predict crime and patronage outcomes (Table 6.10). The patronage model uses the predicted crime rate, by six crime types, to drive the change in Season and Non-Season tickets sold.

Table 6.10: Outputs for crime and patronage – Case Study I

Output Summary

Crime reduction in 2015 by crime type	Number	% vs 2010 base
1. Violence against a person	7.70	17%
2. Sexual attack	1.59	48%
3. Theft from a person	46.89	64%
4. Criminal damage	3.76	51%
5. Vehicle crime	16.78	39%
6. Commercial theft	17.66	27%
Patronage increase, %, in 2015		
Seasons	6.1%	
Non-Seasons	2.8%	

The Tool also applies the monetary values of the social costs of crime to estimate the benefits. The benefits in Table 6.11 are discounted using the chosen discount rates selected above.

Table 6.11: Outputs for Scheme benefits – Case Study I

	Discounted Benefits, £				
	Household			Industry	Government
Year	User	Staff	Non-User		/Society
2012					
2013					
2014	67,381	1,547	33,600	308,630	413,190
2015	67,486	1,549	33,556	252,525	404,190
2016	67,592	1,552	33,512	246,425	395,394
2017	67,700	1,554	33,468	240,473	386,796
2018	67,810	1,557	33,426	234,664	378,393
2019	67,921	1,559	33,384	228,996	370,178
2020	68,034	1,562	33,344	223,465	362,149
2021	68,148	1,565	33,304	218,067	354,300
2022	68,264	1,567	33,265	212,800	346,628
2023	68,382	1,570	33,226	207,660	339,128
2024	68,501	1,573	33,189	202,644	331,797
2025	68,622	1,575	33,152	197,749	324,630
2026	68,745	1,578	33,116	192,972	317,624
2027	68,870	1,581	33,081	188,311	310,776
2028	68,996	1,584	33,047	183,763	304,080
2029	69,123	1,587	33,013	44,831	460,653
2030	69,253	1,590	32,980	0	503,628
2031	69,384	1,593	32,949	0	492,490
2032	69,517	1,596	32,917	0	481,607
2033	69,651	1,599	32,887	0	470,972

Costs of the Scheme

The Scheme has a construction phase (2012-13) and an operational phase (2014-33). The wide range of construction cost estimates shown in Table 6.12 reflects the scope for different approaches to solving the problems: an incremental approach versus comprehensive redesign of the station.

Table 6.12: Cost estimates for improvement works – Case Study I

Cost element	**Cost estimate,** 2010 prices at factor cost		
	Low	**Central estimate**	**High**
Construction costs: including (i) Roofing and lighting work, Remodelling of (ii) platforms and (iv) the overbridges and secluded entrance, and (iii) transparent waiting shelters	£1.0 million	£5.0 million	£15.0 million
Operating and maintenance costs: since the new station will be similar in size but simpler in layout, with slightly increased throughout, we allow a nominal additional operating and maintenance cost	£7,500 per annum	£15,000 per annum	£30,000 per annum
(v) Automatic ticket barriers minus revenue protection benefit to operators (net cost = zero)	-	-	-
Secure Station accreditation costs: (vi) Secure Station Status sought and achieved	£500 biennial	£500 biennial	£1,000 annual

For the Secure Station accreditation costs, a figure provided by RSSB is taken as a minimum.

Since operators' costs (and revenues) are measured at factor cost, the *indirect tax correction factor* of 1.209 is applied to these in the social CBA, in order to make them comparable with the benefits which are measured at market prices. (The indirect tax correction factor is expected to increase shortly to 1.190).

Results and sensitivity analysis

All the results of this hypothetical case study are illustrative.

The Scheme is estimated to produce the following crime and patronage impacts, and cost-benefit analysis results, assuming 'central estimate' costs (Table 6.13).

Table 6.13: Output summary for Case Study I, central scenario

Output Summary

Crime reduction in 2015 by crime type	Number	% vs 2010 base
1. Violence against a person	7.70	17%
2. Sexual attack	1.59	48%
3. Theft from a person	46.89	64%
4. Criminal damage	3.76	51%
5. Vehicle crime	16.78	39%
6. Commercial theft	17.66	27%

Patronage increase, %, in 2015	
Seasons	6.1%
Non-Seasons	2.8%

NPV	£2,996,358
DfT BCR	2.99
Social BCR	1.29
Financial IRR (industry)	5%
Financial NPV (industry)	£438,716

Sensitivity testing allows us to explore how the Scheme would perform under different assumptions. Table 6.14 shows the results of a set of sensitivity tests conducted using the Planning Tool. The Social BCR is used in preference to the DfT BCR in this table because the DfT BCR produces a negative number for most of the cells – this is an artefact of the way the DfT BCR is defined.

Table 6.14: Sensitivity tests to key assumptions – Case Study I

Performance measure	Low scheme costs (£1m)	Central scheme costs (£5m)			High scheme costs (£15m)		
			with Sensitivity Test for under-reported crimes			with Sensitivity Test for under-reported crimes	
				and reduced optimism bias adjustment (6%)			and reduced optimism bias adjustment (6%)
Social BCR	6.2	1.3	4.9	6.4	0.4	1.6	2.1
Social BCR with increased values for reduction in violence against a person (SP Game 1)	7.5	1.6	5.6	7.4	0.5	1.9	2.5
Financial IRR	49%	5%	33%	43%	-	7%	12%

Table 6.13 indicates that in the central scenario, the Scheme could potentially achieve 'High' Value for Money on the DfT rating scale[12] since the DfT BCR is 2.99. If the increased values for a reduction in violence against a person are adopted (from the 'Objective Risk of Crime Game', section 5.4 in this study), , the DfT BCR rises from 2.99 to 4.69 – hence 'Very High' value for money.

For the other sensitivity tests, an alternative measure of value for money must be relied upon, such as the Social BCR which differs from the DfT BCR mainly in that it takes all scheme costs as the denominator, instead of the net cost to the Broad Transport Budget. Using this measure, the Tool examines the impact of the multipliers for under-reporting of crime, taken from DfT (2007) 'Estimated costs to society of crime on public transport in England in 2006/7', and of adopting the lowest optimism bias adjustment, which corresponds with Stage 5 in the Network Rail GRIP process – 'Design development' (DfT, 2011, TAG Unit 3.5.9).

It is clear that most of these tests act to increase the BCR, with the exception of the High Scheme Cost (£15m) test, which pushes the BCR below 1.0. However, with the inclusion of the multiplier for under-reporting, the BCR even for the High Cost version returns to a potentially acceptable 1.6-1.9.

These results certainly provide grounds to develop the Scheme concept further.

6.3.2 Case Study II: Station Two Car Park

Case Study II is based on the personal security issues at Station Two Car Park. This station already offers a generally good level of personal security; however there are a number of issues associated specifically with the car parks. The visual audit below gives an overview. Station Two Car Park is a Category C station ('important feeder') serving 3.2million passenger journeys per annum, with strong commuter flows to London.

[12] BCR<1 'Poor'; 1-1.5 'Low'; 1.5-2 'Medium'; 2-4 'High'; >4 ' Very High'

Box 6.2: Visual audit findings, Station Two Car Park

Approach – The approach to the station is open with good visibility to station entrances. There is only one entrance to the station. The entrance is overlooked by surrounding land uses, providing informal surveillance.

Layout – The layout of the station is straightforward and easy to navigate. Areas towards the end of platforms feel isolated from the rest of the station, although these are unlikely to be frequented by passengers and could facilitate anti-social behaviour.

Station environment – The use of glazing throughout, particularly on the passenger footbridge, results in a light and open feel. Lighting levels after dark are good and consistent across all areas of the station. The station was clean and there were no signs of litter of graffiti.

Staffing – There is a visible staff presence throughout the station.

CCTV – There is good CCTV coverage across the station; this is linked to a central control room for monitoring.

Ticket checks – Ticket gates are in operation at the station; over 75% of passengers are checked for tickets.

Retail and catering activity – Retail and catering outlets provide additional guardianship of the concourse, but not of the platforms.

Cycle Storage – Ample secure cycle storage is provided in a large covered cycle stands outside the station.

Waiting areas – The design of the waiting rooms on the platforms maximises the use of glazing and offers good informal surveillance.

Car parks – Station Two has three car parks, one short stay and two long stay (standard and executive). All car parks are single level and pay and display.

All car parks are covered by CCTV although this may not be obvious to passengers. All car parks are surrounded by a clearly defined perimeter. The long stay car parks are situated a short distance from the station; this makes them feel isolated. Lighting of the long stay car parks was insufficient after dark. One of the pedestrian entrances to the standard long stay car parks was somewhat concealed, thus reducing pedestrians' opportunity to see who was approaching, as demonstrated in the images below (Figure 6.3). Help points were available in all three car parks and were conveniently located next to the self service payment machines.

Crime problems – Crime problems reported by staff included:

- Thefts of cycles
- Thefts from vehicles in the car parks (although this was reported to have reduced)
- Indecent acts in the public toilets

(Note that cycle thefts are included in Vehicle Crime in the crime model, patronage model and Planning Tool).

Figure 6.3: Station Two Car Park showing partly concealed pedestrian entrance – Case Study II

Hypothetical Scheme definition

Comparing the effectiveness of different interventions (crime modelling results in section 4) with the visual audit for Station Two car park, the following security interventions appear promising in this case:

- Secure Parking accreditation – in addition to the Secure Station accredition already held – to help focus on and reduce vehicle/cycle thefts.
- Improved lighting in the long stay car parks – to address a recognised deficiency.
- Minor revisions to pedestrian lines of sight to and from car parks – again to address a recognised deficiency.
- Signs or announcements that CCTV is being monitored – likewise, addressing a deficiency.

Benefits of the Scheme

The aim of the Scheme design in this case would be to raise the levels of key variables as indicated in Table 6.15:

- Safer Parking status – from 'No' to 'Yes'.
- Lighting – from 'Poor' to 'above Poor' (Satisfactory), although only specifically in the long stay car parks, affecting long stay car park users – it is estimated that these make up 10% of total station throughput.
- Work to improve lines of sight, again affecting long stay car park users primarily.

Whilst signs or announcements that CCTV is being monitored may play a role in deterring offending behaviour, the link is not clear enough to attempt quantification. Specific data on this issue would need to be gathered and analysed as part of a causal model of station/car park crime.

Table 6.15: Inputs for station characteristics with and without the Scheme – Case Study II

Station name:	Station Two	
Station category:	C	
Accreditation status:	Current= No Scheme	Scheme
-Secure Station	Y	Y
-Safer Parking	N	Y
Security-relevant measures:		
Station	No Scheme	Scheme
- CCTV installed	Y	Y
- CCTV monitored	Y	Y
- Staffing: Staffed	Y	Y
- Lighting: above Poor	N	Y
- Automatic ticket barriers	Y	Y
- Tickets checked (>25%)	Y	Y
- Self service ticket machines	Y	Y
- Work to improve lines of sight	N	Y

As in Case Study I, additional inputs including station throughput, average revenue and crime rates need to be input by the user. Online data from ORR, and the guidance contained in the Planning Tool, should ease this process.

Table 6.16: Inputs for station throughput, average revenue and crime rates – Case Study II

Annual passenger throughput at the station:	3,210,902	in year	2010		
of which	Seasons	44.3 %			
	Non-Seasons	55.7 %			
	of which	Full Fare	23.3 %		
		Reduced	76.7 %		
Interchanging		1.1 %			
Enter/exit station		98.9 %			
Projected patronage growth per annum (No Scheme)			(2010 to 2033)		
	Seasons	1 %p.a.			
	Non-Seasons	2 %p.a.			
Revenue: estimated average fare per single trip equivalent at this station:	Seasons	£7.6	in year	2010	
	Non-Seasons	£11.9			
		Full Fare	£21.0		
		Reduced	£9.0		

Crime rate:	BTP data for years	2006/7 to 2010/11
	average rate will be applied to year	2010

Crime type:	Rate
1. Violence against a person	0.32
2. Sexual attack	0.02
3. Theft from a person	0.15
4. Criminal damage	0.06
5. Vehicle crime	2.79
6. Commercial theft	0.21

The appraisal parameters were retained from Case Study I (Table 6.9).

The crime model and patronage model components of the Planning Tool take this data and use it to predict crime and patronage outcomes (Table 6.17). The patronage model uses the predicted crime rate, by six crime types, to drive the change in Season and Non-Season tickets sold.

Table 6.17: Outputs for crime and patronage – Case Study II

Output Summary

Crime reduction in 2015 by crime type	Number	% vs 2010 base
1. Violence against a person	0.18	2%
2. Sexual attack	0.03	5%
3. Theft from a person	0.09	2%
4. Criminal damage	0.04	2%
5. Vehicle crime	18.32	20%
6. Commercial theft	0.18	3%
Patronage increase, %, in 2015		
Seasons	1.0%	
Non-Seasons	0.3%	

The Tool then applies the monetary values of the social costs of crime to estimate the benefits. The benefits in Table 6.18 are discounted using the discount rates selected above.

Table 6.18: Outputs for Scheme benefits – Case Study II

	Discounted Benefits, £				
	Household			Industry	Government
Year	User	Staff	Non-User		/Society
2012					
2013					
2014	9,892	35	965	61,122	63,858
2015	9,898	35	962	58,045	62,340
2016	9,905	35	959	56,643	60,857
2017	9,912	35	955	55,275	59,411
2018	9,919	35	952	53,940	57,999
2019	9,927	35	949	52,637	56,620
2020	9,935	35	946	51,366	55,275
2021	9,942	35	943	50,125	53,962
2022	9,951	35	940	48,914	52,680
2023	9,959	35	937	47,733	51,429
2024	9,968	35	934	46,580	50,208
2025	9,977	35	931	45,455	49,016
2026	9,986	35	928	44,357	47,852
2027	9,995	35	925	43,285	46,716
2028	10,005	35	922	42,240	45,608
2029	10,015	35	919	10,305	76,370
2030	10,025	35	916	0	84,910
2031	10,035	35	913	0	82,885
2032	10,046	35	910	0	80,908
2033	10,057	35	907	0	78,979

Costs of the Scheme

As in Case Study I, an investment phase (2012-13) is assumed followed by an operational phase of 20 years' duration (2014-33) (Table 6.19). For the Safer Parking accreditation costs, the same estimates as for Secure Stations are employed, based on a rule-of-thumb amount provided by RSSB.

Table 6.19: Cost estimates for improvement works – Case Study II

Cost element	**Cost estimate,** 2010 prices at factor cost		
	Low	**Central estimate**	**High**
Safer Parking accreditation costs	£500 bi-annual	£500 bi-annual	£1,000 annual
Investment costs: including lighting furniture, installation, and minor works to clear sight lines in and out of car parks, and to relocate billboard	£150,000	£300,000	£450,000
Operating and maintenance costs: including the costs of replacement bulbs and maintenance of the lighting system	£30,000	£60,000	£90,000

Since operators' costs (and revenues) are measured at factor cost, the *indirect tax correction factor* of 1.209 is applied to these in the social CBA, in order to make them comparable with the benefits which are measured at market prices.

Results and sensitivity analysis

All the results of this hypothetical case study are illustrative. The Scheme is estimated to produce the following crime and patronage impacts, and cost-benefit analysis results, assuming 'central estimate' costs (Table 6.20).

Table 6.20: Output summary for Case Study II, central scenario

Output Summary

Crime reduction in 2015 by crime type	Number	% vs 2010 base
1. Violence against a person	0.18	2%
2. Sexual attack	0.03	5%
3. Theft from a person	0.09	2%
4. Criminal damage	0.04	2%
5. Vehicle crime	18.32	20%
6. Commercial theft	0.18	3%

Patronage increase, %, in 2015	
Seasons	1.0%
Non-Seasons	0.3%

NPV	£663,212
DfT BCR	see Note (A)
Social BCR	1.43
Financial IRR (industry)	6%
Financial NPV (industry)	£44,887

Sensitivity testing allows us to explore how the Scheme would perform under different assumptions. Table 6.21 shows the results of a set of sensitivity tests conducted using the Planning Tool.

Table 6.21: Sensitivity tests to key assumptions – Case Study II

Performance measure	Low scheme costs (£150,000)	Central scheme costs (£300,000)			High scheme costs (£450,000)		
			with Sensitivity Test for under-reported crimes			with Sensitivity Test for under-reported crimes	
				and reduced optimism bias adjustment (6%)			and reduced optimism bias adjustment (6%)
BCR	2.85	1.4	3.1	3.5	0.95	2.1	2.3
BCR with increased values for reduction in violence against a person (SP Game 1)	2.93	1.54	3.3	3.6	0.98	2.2	2.4
Financial IRR	30%	6%	33%	43%	-	18%	24%

Table 6.20 indicates that the Scheme in its 'central' form has a positive NPV and a Social BCR of 1.43. This is an example of a scheme which generates a flow of funds into - rather than out of - the Broad Transport Budget, which leads to a counterintuitive negative result on the DfT BCR. This is, however, simply an artefact of the definition of the DfT BCR (see TAG Unit 3.13.1). When combined with the NPV shown and the PVC to the Broad Transport Budget of £-283,869, this indicates that the scheme has 'High' value for money on DfT's criteria (TAG Unit 3.13.1, Table 5). By using the Social BCR and varying the scheme definition, as shown in Table 6.21, it can be seen that the scheme offers good value for money in most scenarios – hence is robust. However, there are particularly large benefits to be found, subject to using the multipliers for under-reporting of crime in DfT (2007), 'Estimated costs to society of crime on public transport in England in 2006/7' and adopting the lowest optimism bias adjustment, which corresponds with Stage 5 in the GRIP process – 'Design development' (DfT, 2011, TAG Unit 3.5.9).

In the scenario defined as the 'central' one, the BCR is increased slightly from 1.4 to 1.5 by the adoption of the higher values for reduction in violence against a person, derived from the WTP experiment ('Objective Risk of Crime Game', section 5.4) in this study.

These results give some encouragement to develop the Scheme proposal further with the goal of:

- Increasing confidence in the cost estimates, allowing the optimism bias adjustment to be reduced to 6%.
- Ensuring that lower cost options have been fully considered, and that procurement arrangements have been explored so as to minimise the cost of the preferred option.
- Considering and evaluating any promising alternative design options, to ensure that the best value for money is achieved.

6.4 Summary of Findings from the Planning Tool

Synthesising and reconciling the outcomes from the crime and economic analyses (sections 4 and 5 respectively), an Excel-based Planning Tool was developed, which could potentially be used by the industry to support cases for investment in personal security at stations. It should be reiterated that it was not the intention of the present study to develop a full commercial software implementation of the Planning Tool; the goal at this stage was to develop the mechanisms which could underpin such software.

The Planning Tool allows the economic benefits of future Secure Stations and Safer Parking schemes, and specific security measures at stations, to be estimated and compared with the scheme costs. The key components of the Tool are:

- Incorporation of the crime model, to provide a first estimate of the crime reduction impact of an intervention.
- Estimation of the rail demand impact, based on the ticket sales model.
- Valuation of benefits using the current evidence derived from this study.
- Aggregation of benefits and costs to a Net Present Value (NPV) and Benefit:Cost Ratio (BCR) using methods and parameters consistent with industry and DfT practice.
- Also the financial impact in the form of an NPV and Internal Rate of Return (IRR) to the industry.
- Sensitivity analysis for key parameters.

Application of the Planning Tool was illustrated through two case studies, based upon sites drawn from the detailed sample (Table 3.2), as follows:

- **Case Study I**; this was a station security intervention. In this case, a central BCR estimate of 1.3 is reported, but an overall range of 0.4-7.5 for the BCR depending upon assumptions concerning scheme costs, underreporting of crimes, optimism bias, and the risk premium associated with the fear of crime.
- **Case Study II**: this was a station car park intervention. In this case, a central BCR estimate of 1.4 is reported, but an overall range of 0.95-3.6 depending upon the assumptions employed.

7 Findings

7.1 Crime Evaluation: Does Secure Stations/Safer Parking Reduce Crime?

7.1.1 What are the practical features of Secure Stations/Safer Parking?

As was noted in the introduction to this report, a significant complication for the evaluation was that neither Secure Stations nor Safer Parking can be articulated in terms of a clear and definitive set of criteria. Accreditation is as much about the station/station car park management's culture towards personal security, as about the extent of physical crime prevention measures, such as CCTV. Having now completed the evaluation, a clearer description can be given of what practical features embody a Secure Station and/or Safer Car Park.

Analysis of the intervention dataset revealed that, although accreditation allows for flexibility in approaches to crime prevention, several attributes were common to Secure Stations and Safer Parking but significantly different from their non-accredited counterparts, notably:

- Features of CCTV provision
- Presence of automated ticket barriers
- Seclusion of entrance routes
- Installation of emergency help points
- Extent of informal surveillance and guardianship

Overall, these differences suggest that Secure Stations offer a higher standard of crime prevention, with a greater provision of facilities that are likely facilitate crime prevention. In the case of SCP, the analysis did not identify as many significant differences between SCP car parks and non-accredited car parks (although the data was less complete for station car parks with a larger proportion of missing data). The main distinction identified was a greater likelihood that SCP car parks would be patrolled.

7.1.2 What are the key drivers of crime at railway stations/railway station car parks?

Having accounted for external drivers of crime (such as crime in the locality of the station/station car park), the following key drivers of crime at railway stations/station car parks - that could potentially be controlled through Secure Station/Safer Parking and/or physical interventions - are identified.

Guardianship

- Unstaffed stations experienced significantly higher levels of **violence against a person** and **criminal damage** (although the crime-reducing effect of full-time vs. part-time staffing was not consistent across these crimes).
- Staffed stations experienced significantly higher levels of **theft from a person** and **commercial theft** compared to unstaffed stations.
- Staffing and patrols of station car parks did not significantly affect levels of **vehicle crime**.

Surveillance

Formal surveillance in the form of CCTV was prevalent across the sample. However, it was still possible to discern the following findings:

- Stations with CCTV experience significantly lower levels of **criminal damage** - this was the only crime type that was significantly associated with the presence of CCTV.

- The presence of CCTV in car parks was not significantly associated with **vehicle crime**.
- An upgrade to the CCTV system over the last five years was significantly associated with **commercial theft**; this may reflect an enhanced ability to detect crimes, or that stations with more entrenched theft problems are being prioritised for an upgrade.
- Stations that had the ability to monitor live CCTV feed experienced significantly lower levels of **violence against a person**; this may reflect the ability to identify and respond to violent incidents that may not otherwise be reported, such as fights breaking out between passengers.
- The quality and extent of CCTV coverage were not significant predictors of any of the crime types analysed.
- However, key differences were identified in the extent and nature of CCTV monitoring, which varied from no monitoring at all to centralised control rooms with dedicated staff.

In addition to formal surveillance through CCTV, informal surveillance can be enhanced by improving lines of sight and ensuring that passengers and staff can see around corners and into waiting areas.

- Stations that had undertaken work to improve lines of sight experienced significantly **less violence against a person**, **theft from a person** and **commercial theft**.
- Waiting rooms with enhanced informal surveillance were not significantly associated with any of the crime types analysed.

Lighting quality, which can help passengers be seen and see others, was significantly associated with some crimes. The study found that:

- Stations with poor lighting experienced more incidences of **sexual assault** and **criminal damage** than stations where lighting was 'in need of improvement'.
- However, the relationship between the quality of artificial lighting and the frequency of these crimes was not linear, and may be moderated by other factors such as careful design to maximise natural light.

Defensible space and access control

The visual audits identified a number of stations with issues relating to the control of space, especially the presence of multiple entrances/exits to the station. As regards the crime model, the following specific relationships were detected:

- The control of access to the station through automatic ticket barriers was associated with lower levels of **theft from a person** and higher levels of **commercial theft**. In the case of theft from a person, it is likely that barriers prevent access to the station to those who are attracted by criminal opportunities. In the case of commercial theft, it is likely that ticket barriers aid the detection of crimes such as fare evasion.
- 'Pay on exit' car parks experienced significantly less **vehicle crime** than 'pay and display' car parks. Interviews suggested that this finding may also be an effect of the absence of 'pay and display' tickets which advertise the time period for which a car will be left. Free car parks also experienced less **vehicle crime** than 'pay and display' car parks; again this could also be explained by the absence of timed tickets.

Activity support

The principle of activity support ensures that there are sufficient numbers of people in, or passing through, a particular place, conducting routine, honest activities like shopping or dining; in so doing, their presence prevents or discourages offenders from committing crime.

- However, no empirical support for this relationship was found in the crime model.
- As an aside, it was found that the presence of self-service ticket machines was associated with a significant reduction in commercial theft. This may suggest that where passengers are provided with sufficient opportunities to purchase tickets, they are less inclined to evade their fare.

7.1.3 What is the effect of Secure Stations and Safer Parking on crime?

Having identified a comprehensive range of drivers of crime, the focus of the crime evaluation was to consider the effect of Secure Stations and Safer Parking on crime. It was found that:

- Secure Station accreditation was associated with lower levels of **theft from a person**, **criminal damage** and **vehicle crime**. That is to say, even when pre-existing levels of crime are controlled for, Secure Stations has a distinct effect upon crime rates for these crime types.
- In the absence of Secure Station accreditation, SCP accreditation has no discernible influence upon **vehicle crime**.
- However, if the two schemes are combined, then the collective impact on crime is greater than that of Secure Stations in isolation. On the basis of this finding, the crime reducing effects of Secure Stations and SCP cannot be treated as additive.

It was found that passenger awareness of station and car park accreditation was extremely low. This is not surprising given the findings from the evidence review and interviews with station staff that the schemes are not widely publicised. However, this finding is unfortunate, given that publicity can support crime prevention by influencing the perceptions of offenders.

7.2 Economic Evaluation: Does Secure Stations/Safer Parking Generate Net Social Benefit?

7.2.1 What are the benefits of Secure Stations/Safer Parking to existing users?

As a result of Secure Stations and Safer Parking interventions, there is evidence of benefits to existing rail users from two sources, namely reductions in the frequency of crime incidents and improvements in perceptions of crime risk.

Reductions in the frequency of crime incidents

The crime model gives us a basis for predicting specific reductions in crime rate by crime type associated with accreditations in combination with other drivers of crime (notably physical crime prevention interventions). For example, **Secure Station accreditation is associated with 24.04% fewer incidences of theft from a person, relative to non-accreditation, all else equal**. Equipped with these predictions, it is a reasonably straightforward procedure to apply the Home Office's (2005) unit costs of crime, and to thereby calculate the social benefit from reduced incidence of crime at stations/station car parks.

Improvements in perceptions of crime risk

Quite aside from the reduction in incidents and associated unit cost savings, there is a question as to whether rail users who have not themselves been the victims of crime but may have witnessed crime or be aware of general levels of criminality, place a value on the perceived reduction in crime risk that arises from Secure Stations/Safer Parking interventions. This question was investigated through two alternative Willingness-To-Pay (WTP) games - one based upon valuation of station/car improvements and a second based upon valuation of different crime types - finding that:

- **Station/car park users place significant value upon personal security interventions at stations/car parks, but are reluctant to pay for them through the fare box/car park charges**. There is some evidence (albeit inconsistent) that car park users may be willing to pay a premium for improved security; this perhaps reflects the fact that car park usage implies that personal property will be left in the custody of the car park. By contrast, station users are clear and definitive in their unwillingness to pay; this could be a protest response.
- Crime risk exhibits a highly significant effect. Since crime risk is perfectly correlated with the expected social costs of crime, **it is concluded that passengers/car park users demonstrate classic public good behaviour in relation to personal security interventions; they believe that personal security is good for society, but are unwilling to pay for such interventions on a private basis**.
- Relative to the Home Office unit costs of crime, **station/car park users substantially over-valued (by more than four times) the social costs of violence against a person**, and undervalued sex attacks (by half). The latter discrepancy could be due to respondents' interpretation of the term 'sex attack'. As regards the former discrepancy, this gives credence to the proposition that the perceived reduction in risk associated with Secure Stations/Safer Parking could give rise to additional benefit above and beyond the Home Office's unit costs of crime.

7.2.2 What are the benefits of Secure Stations/Safer Parking to new users?

Whilst the term 'new users' is common parlance in travel demand modelling, it is appropriate to clarify that – strictly speaking – the study's interests are broader, encompassing the generation of any new rail journeys, whether these are additional journeys undertaken by existing rail users, or are journeys undertaken by new customers.

Guided by PDFH modelling conventions, a demand model was developed which estimates the specific influence of Secure Stations/Safer Parking, in combination with a range of physical interventions (eg CCTV), on ticket sales, whilst controlling for other background drivers of rail patronage (such as levels of fares, GJT, service quality incomes, car ownership and population). The conclusions from this exercise are that:

- **Secure Stations and Safer Parking have a significant effect on rail demand.**
- For season tickets, the demand response is approximately 7%.
- For non-seasons, the demand response is somewhat weaker, at around 1%.

It is worth noting that the demand impact reported is largely driven by the Secure Stations scheme (although it is possible that this impact is - to some extent - confounded with various aspects of physical personal security interventions). The specific contribution of Safer Parking was difficult to discern statistically. This increase in demand implies the existence of benefits to new users, and increased revenue to TOCs from increased patronage.

7.3 Planning Tool: How Should Secure Stations/Safer Parking Interventions be Evaluated?

Synthesising and reconciling the outcomes from the Crime and Economic Evaluations, an Excel-based Planning Tool was developed, which could potentially be used by the industry to support cases for investment in personal security interventions at stations. Such interventions could include Secure Station accreditation, Safer Parking accreditation, and/or specific physical measures such as CCTV.

It was not within the scope of the study to develop a full commercial software implementation of the Planning Tool; the goal at this stage was to develop the mechanisms which could underpin it. Should the industry wish to progress the Tool to full implementation, then some enhancements to its functionality would be advisable (see section 8, recommendation R5).

Through two case studies, the basic workings of the Tool were demonstrated, and it was shown that the Tool embodies intuitive evidence-based relationships in terms of:

- The effects of personal security interventions on crime rates
- The effects of crime rates on rail patronage
- The net social benefits that follow

More specifically:

- **Case Study I** was a station security intervention. In this case, a central BCR estimate of 1.5 was reported but an overall range of 0.5-8.3 for the BCR depending upon assumptions concerning scheme costs, underreporting of crimes, optimism bias, and the risk premium associated with the fear of crime.
- **Case Study II** was a station car park intervention. In this case, a central BCR estimate of 1.5 was reported, but an overall range of 0.98-4.4 depending upon the assumptions employed.

7.4 Follow-On Research

This study has delivered **evidence on Willingness-To-Pay** (WTP) for personal security improvements, **methods to support the appraisal** of Secure Stations/Safer Parking/security measures, **an Excel-based Planning Tool,** and two **case studies** showing how the Tool could be applied in practice.

Following on from the study, a number of additional research activities are identified which could support adoption of the Planning Tool, and further evaluation of Secure Stations/Safer Parking:

1. Real case studies – involving significant input from TOC/Network Rail partners on the scheme design and costing side.
2. Software – a fully developed software implementation.
3. An evaluation of the Secure Stations/Safer Parking programmes as a whole – this would require the partners (BTP, TOCs, Network Rail and perhaps RSSB themselves) to gather a significant amount of information on resources allocated to these programmes over the years.

8 Recommendations

R1. This study has found clear and convincing evidence that:

a. Secure Stations and Safer Parking interventions reduce crime

b. Reduced crime yields benefits to existing rail users

c. Reduced crime encourages greater patronage of rail

Against this background, there is a good case for formalising the evaluation of Secure Stations/Safer Parking interventions in line with the evaluation of other comparative interventions such as station/service quality and railway safety improvements.

R2. RSSB is encouraged to promote the findings of this study, and the existence of the Planning Tool, to relevant industry stakeholders. There is a good case for inclusion of the findings in PDFH. DfT may also wish to consider the case for commissioning associated WebTAG guidance.

R3. The Tool is designed to represent general relationships between personal security interventions, crime and rail patronage. It is recommended that, in assembling a business case for investment, the Planning Tool should be combined with a visual audit of the local site by a practitioner skilled in such analysis. Such an audit could provide a justification for any deviation from the Tool's default assumptions on the basis of local conditions.

R4. It appears that rail users place significantly greater value on the reduction of violent crimes against the person than the official values in the Home Office 'social costs of crime' or the DfT values for crime reduction on public transport. The difference could be interpreted as a risk premium, or value associated with reductions in the fear of crime. It is recommended that this additionality be included within economic evaluations of Secure Station, Safer Parking and station/car security improvements more generally.

R5. In order to encourage take-up of the Planning Tool, the design and implementation of a 'front end' interface should be commissioned.

R6. The study has identified significant problems with awareness of Secure Stations/Safer Parking, on the part of both staff and customers. The rail industry may wish to consider mechanisms for better communicating not only accreditation, but security enhancements more generally. This would help to motivate staff, deter criminals, and improve customer perceptions.

R7. As the accreditation schemes evolve over time, the burden of monitoring will increase, and this could potentially have detrimental effects in relation to ongoing maintenance and upgrade of personal security provision at stations/station car parks. The industry would be advised to devote consideration to this matter.

R8. The research identified that workplace assaults were inconsistently recorded, with high levels of under-reporting. As a consequence, it was not possible to ascertain the effects of Secure Stations and Safer Parking on staff incidents specifically. It is recommended that RSSB continues to reinforce guidance provided to the industry on the nature of incidents that should be recorded.

R9. The Secure Stations and Safer Parking accreditations both require an assessment of the station/car park environments. For Secure Stations, the records of this process, which provide information on the interventions implemented, are currently only available as paper hard copies that do not facilitate information retrieval. More recent Secure Stations accreditation forms have been scanned to create

electronic copies but only as image files. The present study has created an intervention database, but this will not support ongoing monitoring of the initiatives. It is recommended that the future administration of the scheme explores efficient and economic solutions for capturing and storing this information in the form of a database.

R10. Reaccreditation for the Secure Stations scheme takes place every two years, and involves the station self-reporting changes and developments occurring since the last accreditation. Stations overwhelmingly report 'no change'; the study found that this description was often inaccurate, and that significant changes went unreported. It is recommended that the future administration of the scheme identifies a mechanism whereby station intervention and management data can be systematically updated on a regular basis, perhaps through the use of online reporting forms, and to explore options to ensure that such data are audited at regular intervals (eg each financial year).

R11. Stations applying for Secure Stations accreditation are judged against three criteria areas, the ratio of crimes to passengers, an audit score derived from an assessment of the station environment, and management processes and passenger perceptions of the station.

a. The crime ratio threshold does not test the largest stations and although flexibility is currently given for stations with very low throughput they report that the crime ratio is still too stringent. Consideration should be given to the development of a tiered scheme, with adjusted crime ratio criteria for stations with different levels of throughput.

b. The current accreditation audit and related score assigns an equal weighting to all questions. It is recommended that the accreditation form be redesigned to provide greater weighting to those items that have greater influence on crime and/or are harder to achieve.

Acknowledgements

We gratefully acknowledge the support and assistance of the following individuals and organisations:

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All station/car park managers, TOC managers, Network Rail managers and station/car park staff who participated in the on-line survey and site interviews.

The station managers/TOCs which facilitated/participated in the station/station car park user surveys and visual audits.

Appendices

Appendix 1: Example of Station User Survey

V6.1/VIC

STATION USER SURVEY

Institute for Transport Studies

Dear Station User

Thank you for agreeing to answer this short questionnaire about your journey today. The questionnaire forms part of a research project being undertaken by the Institute for Transport Studies at the University of Leeds on behalf of the Rail Safety and Standards Board. The project seeks to understand the value that rail passengers and the public place on personal security improvements at railway stations. The information you provide will be treated as confidential and will be used only to assist the planning of railways.

Please return your completed questionnaire in the FREEPOST envelope provided.

If you have any queries concerning this questionnaire, please contact Jeremy Shires on (0113) 343 5347.

INTRODUCTION

This questionnaire will canvass your views concerning crime at the railway station that you are using today.

You may be aware that each incidence of crime imposes costs on society, for example:

- **Violence against a person**; on average, each incidence of this crime costs society **£7,121**, including costs associated with the NHS, the criminal justice system, and financial loss to the victim.
- **Sexual attack**; on average, each incidence of this crime costs society **£17,196**
- **Theft from passengers**; on average, each incidence of this crime costs society **£1,197**
- **Criminal damage (e.g. damage to property)**; on average, each incidence of this crime costs society **£4,431**
- **Car crime (i.e. theft of and from cars)**; on average, each incidence of this crime costs society **£783**

ABOUT YOUR VISIT TO THE STATION

Q1 **What stage of your journey were you making when you were handed this questionnaire?**

The outward stage of a return journey..... O
The return stage of a return journey ..... O
A single journey ..... O

Q2 **For this stage of your journey, please list your starting station, your final station and any stations where you change trains.**

Starting station: _____

Interchange stations: _____

Final station: _____

Q3 **What is/was the purpose of your journey?**

Travelling on business ..... O
Commuting to/from work..... O
Other ..... O

Q4 **How often do you use Manchester Victoria Station?**

4 to 7 days a week..... O
1 to 3 days a week..... O
A few times each month..... O
Less than once a month..... O

Q5 **How often do you travel by rail, in total?**

4 to 7 days a week..... O
1 to 3 days a week..... O
A few times each month..... O
Less than once a month..... O

Q6 **What is/was your main mode of travel to Manchester Victoria station?**

Another train ..... O
Walk or cycle..... O
Bus..... O
Motorcycle..... O
Dropped off by car/taxi..... O
Drove and parked in station car park..... O
Drove and parked elsewhere..... O

ABOUT YOUR TICKET

Q7 **Is/was your ticket for First or Standard class?**

First..... O
Standard..... O

Q8 **Is/was your ticket a Single, a Return, a Travelcard, or a Season?**

Single..... O
Return..... O
1 Day Travelcard..... O
Weekly Season /Travelcard..... O
Monthly Season /Travelcard..... O
Annual Season /Travelcard..... O

Q9 **How much did your ticket/travelcard/season ticket cost?**

Q10 **Roughly how much do you think you spend on rail travel each year?**

The table below may help you estimate how much.

Examples:

Fare:	How often:	Total:
£5 fare	Every weekday all year round (except 4 weeks holiday)	£1,200
£10 fare	Every weekday all year round (except 4 weeks holiday)	£2,400
£20 fare	Every weekday all year round (except 4 weeks holiday)	£4,800
£5 fare	once a week all year (except 4 weeks holiday)	£240
£10 fare	once a week all year (except 4 weeks holiday)	£480
£20 fare	once a week all year (except 4 weeks holiday)	£960
£50 fare	once a week all year (except 4 weeks holiday)	£2,400
£100 fare	once a week all year (except 4 weeks holiday)	£4,800

ABOUT YOU

Q11 **Are you male?** ○ **female?** ○

Q12 **What is your age?**

Under 16 ○	30-39 ○	60-64 ○
16-19 ○	40-49 ○	65-69 ○
20-29 ○	50-59 ○	70 or older ○

Q13 **What is the annual income of your HOUSEHOLD before the deduction of tax?**

Less than £10,000 ○	£30,000 - £39,999 ○	£60,000 - £69,999 ○
£10,000 - £19,999 ○	£40,000 - £49,999 ○	£70,000 and over ○
£20,000 - £29,999 ○	£50,000 - £59,999 ○	

Q14 **How many people are there in your household including you?**

1 ○	3 ○	5 ○
2 ○	4 ○	6+ ○

ABOUT YOUR EXPERIENCES OF PERSONAL SECURITY AT THIS STATION

We would now like to ask you some questions concerning your experiences of personal security at Manchester Victoria Station. By personal security, we mean freedom from anti-social behaviour and crimes such as assault and theft, and your feelings of security.

Q15 **During the last six months, have you had cause to worry about your personal security whilst at Manchester Victoria Station?**

○ Yes [Go to Q16] ○ No [Go to Q18]

Q16 **Thinking about the last time you felt concerned, how worried did you feel?**

○ Not very worried ○ A little bit worried ○ Quite worried ○ Very worried

Q17 **During the past six months, have concerns about your personal security stopped you from travelling from Manchester Victoria Station or forced you to adapt your journey?** [tick any that apply]

- No ○
- Yes, I have travelled by another mode of transport ○
- Yes, I have travelled via a different station ○
- Yes, I have not made the journey I wanted to ○
- Yes, I made the journey at a different time of day ○

Q18 **How much of a problem are the following at Manchester Victoria Station?** [tick any that apply]

	A very big problem	A fairly big problem	Not a very big problem	Not a problem at all	Don't know
Rubbish or litter lying around	○	○	○	○	○
Vandalism and graffiti	○	○	○	○	○
People using or dealing drugs	○	○	○	○	○
People being drunk or rowdy	○	○	○	○	○
People being harassed or intimidated	○	○	○	○	○
Car crime (theft or damage)	○	○	○	○	○

V6.1/VIC

Q19 **The Secure Stations Scheme operated by the Department for Transport recognises stations that have improved security and taken steps to reduce crime.**

To your knowledge, is Manchester Victoria Station a 'Secure Station'?

O	O	O
Yes	No	Don't know

Q20 **The Park Mark Safer Parking Award is given by the Police to car parks that have introduced measures to reduce crime.**

To your knowledge has Manchester Victoria Station Car Park received the Safer Parking award?

O	O	O
Yes	No	Don't know

ABOUT SECURITY MEASURES AT THE STATION

The next few questions are interested in your preferences about personal security and rail fares.

Each question will offer you two options and ask you to choose which you prefer.

The options are described in terms of;

- **station facilities which affect personal security**, in particular:
  - whether or not the station has CCTV
  - whether there is good lighting throughout the station, or good lighting only in waiting areas
  - whether or not the station is staffed, and whether police routinely patrol the station
  - whether the station has automatic ticket barriers
- **the train fare**
  - the fare shown is equivalent to the single portion of a typical return journey from Manchester Victoria to Leeds
- **the number of crimes that might arise**; we have focussed on 5 crime types, based on evidence from the rail network.

The questions now follow...

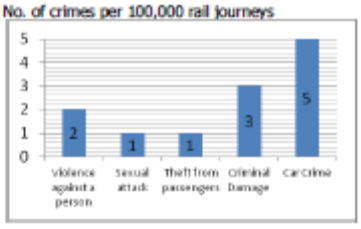
Q21 **Suppose these two options are available:**

Option A

CCTV
Good lighting in waiting areas only
Patrolled by police as well as station staff
No automatic ticket barriers

Fare = £9.00

No. of crimes per 100,000 rail journeys

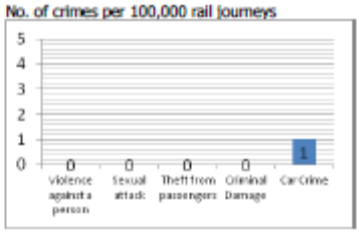


Option B

No CCTV
Good lighting throughout station
Station staff in attendance
Automatic ticket barriers

Fare = £9.50

No. of crimes per 100,000 rail journeys



Which Option do you prefer?

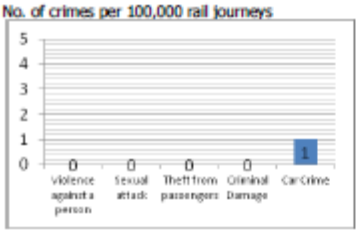
O Option A O Option B

V6.1/VIC

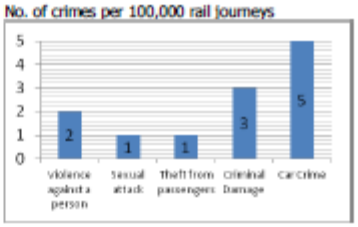
Q22 **Suppose these two options are available:**

Option A	**Option B**
No CCTV Good lighting throughout station Unstaffed Automatic ticket barriers Fare = £9.00	CCTV Good lighting in waiting areas only Station staff in attendance No automatic ticket barriers Fare = £8.50

No. of crimes per 100,000 rail journeys



No. of crimes per 100,000 rail journeys



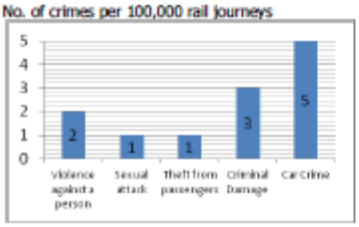
Which Option do you prefer?

O Option A O Option B

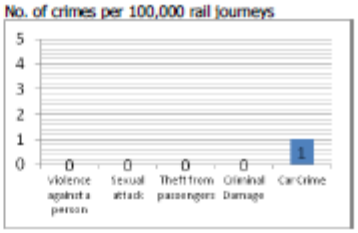
Q23 **Suppose these two options are available:**

Option A	**Option B**
CCTV Good lighting in waiting areas only Station staff in attendance No automatic ticket barriers Fare = £9.50	CCTV Good lighting throughout station Station staff in attendance No automatic ticket barriers Fare = £10.50

No. of crimes per 100,000 rail journeys



No. of crimes per 100,000 rail journeys



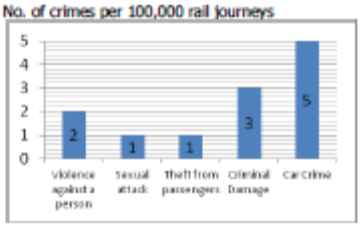
Which Option do you prefer?

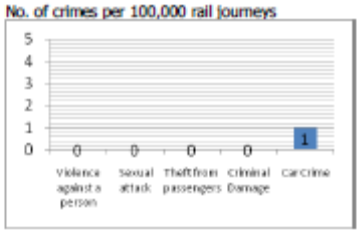
O Option A O Option B

V6.1/VIC

Q24 **Suppose these two options are available:**

Option A	**Option B**
No CCTV Good lighting throughout station Patrolled by police as well as station staff No automatic ticket barriers Fare = £9.00	CCTV Good lighting in waiting areas only Unstaffed Automatic ticket barriers Fare = £10.00
No. of crimes per 100,000 rail journeys	No. of crimes per 100,000 rail journeys





Which Option do you prefer?

O Option A O Option B

ABOUT YOUR VIEWS ON RAILWAY INVESTMENT PRIORITIES –SAFETY AND SECURITY

The next questions are interested in your views on how investment in the railways could best be allocated, bearing in mind that the money available to invest may be limited.

You will be presented with several sets of choices between three alternative programmes:

- **Programme A is a safety programme**; it will prevent a given number of railway accidents.
- **Programme B is a personal security programme**; it will prevent a given number of crimes.
- **Programme C is a fares programme**; your rail fares will be reduced by a given amount.

In each question, you will be asked to RANK the programmes according to their order of importance.

The questions now follow...

Q25 **Considering these three investment programmes:**

Programme A	**Programme B**	**Programme C**
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Attempt theft of car in car park • The attempt resulted in damage to the car	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 200 incidents of this type	Fares reduced by 50%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

V6.1/VIC

Q26 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Attempt theft of car in car park • The attempt resulted in damage to the car	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 150 incidents of this type	Fares reduced by 10%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q27 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Violent assault on a passenger • Violence results in serious injuries • Other passengers witnessed the incident	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 1 incident of this type	Fares reduced by 10%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q28 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Female passenger sexually attacked whilst leaving the train station at night • Attacked by a stranger • No other station users witnessed attack	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 10 incidents of this type	Fares reduced by 20%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

V6.1/VIC

Q29 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Violent assault on a passenger • Violence results in serious injuries • Other passengers witnessed the incident	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 5 incidents of this type	Fares reduced by 30%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q30 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Laptop computer stolen from car parked in car park • Item was left in view while the owner was away from the car throughout the day	Reduction in your rail fares
Prevent 10 incidents of this type	Prevent 250 incidents of this type	Fares reduced by 30%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Finally...

Q31 How easy did you find it to complete this questionnaire?

○ ○ ○ ○ ○

Very easy — Neither easy nor difficult — Very difficult

Q32 We would welcome any comments you might have on the questionnaire.

Thank you very much for your assistance with this survey

Appendix 2: Example of Station Car Park Survey

V6.1/PIC

STATION CAR PARK SURVEY

Institute for Transport Studies

Dear Car Park User

Thank you for agreeing to answer this short questionnaire about your journey today. The questionnaire forms part of a research project being undertaken by the Institute for Transport Studies at the University of Leeds on behalf of the Rail Safety and Standards Board. The project seeks to understand the value that rail passengers and the public place on personal security improvements at railway stations. The information you provide will be treated as confidential and will be used only to assist the planning of railways.

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You may be aware that each incidence of crime imposes costs on society, for example:

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- **Theft from passengers**; on average, each incidence of this crime costs society **£1,197**
- **Criminal damage (e.g. damage to property)**; on average, each incidence of this crime costs society **£4,431**
- **Car crime (i.e. theft of and from cars)**; on average, each incidence of this crime costs society **£783**

ABOUT YOUR JOURNEY

Q0 **What is/was your reason for parking at Manchester Piccadilly Station?**

So that I could leave my car/motorcycle and catch the train..... O
I did not travel by train myself, but delivered/collected others to/from the station..... O [Go to Q7]
Shopping/using station facilities..... O [Go to Q7]
Another reason..... O [Go to Q7]

Q1 **What stage of your journey were you making when you were handed this questionnaire?**

The outward stage of a return journey.... O
The return stage of a return journey ..... O
A single journey ..... O

Q2 **For this stage of your journey, please list your starting station, your final station and any stations where you change trains.**

Starting station: _____

Interchange stations: _____

Final station: _____

Q3 **What is/was the purpose of your journey?**

Travelling on business..... O
Commuting to/from work..... O
Other..... O

Q4 **How often do you use this station?**

4 to 7 days a week..... O
1 to 3 days a week..... O
A few times each month..... O
Less than once a month..... O

Q5 **How often do you travel by rail, in total?**

4 to 7 days a week..... O
1 to 3 days a week..... O
A few times each month..... O
Less than once a month..... O

ABOUT YOUR CAR PARK CHARGES

Q7 **How much did you pay to park at Manchester Piccadilly Station on this occasion?**

Less than £2..... O
Between £2 and £5..... O
Between £5 and £10..... O
Between £10 and £15..... O
Between £15 and £20..... O
More than £20..... O

Q8 **How often do you use the car park at Manchester Piccadilly Station, in total?**

4 to 7 days a week..... O
1 to 3 days a week..... O
A few times each month..... O
Less than once a month..... O

Q10 **Roughly how much do you think you spend on car parking at Manchester Piccadilly Station each year?**

The table below may help you estimate how much.

Examples:

Car park charge:	How often:	Total:
£2 charge	Every weekday all year round (except 4 weeks holiday)	£480
£5 charge	Every weekday all year round (except 4 weeks holiday)	£1,200
£10 charge	Every weekday all year round (except 4 weeks holiday)	£2,400
£15 charge	Every weekday all year round (except 4 weeks holiday)	£3,600
£20 charge	Every weekday all year round (except 4 weeks holiday)	£4,800
£2 charge	Once a week all year (except 4 weeks holiday)	£96
£5 charge	Once a week all year (except 4 weeks holiday)	£240
£10 charge	Once a week all year (except 4 weeks holiday)	£480
£15 charge	Once a week all year (except 4 weeks holiday)	£720
£20 charge	Once a week all year (except 4 weeks holiday)	£960

V6.1/PIC

ABOUT YOU

Q11 **Are you male?** O **female?** O

Q12 **What is your age?**

Under 16 O	30-39 O	60-64 O
16-19 O	40-49 O	65-69 O
20-29 O	50-59 O	70 or older O

Q13 **What is the annual income of your HOUSEHOLD before the deduction of tax?**

Less than £10,000 O	£30,000 - £39,999 O	£60,000 - £69,999 O
£10,000 - £19,999 O	£40,000 - £49,999 O	£70,000 and over O
£20,000 - £29,999 O	£50,000 - £59,999 O	

Q14 **How many people are there in your household including you?**

1 O	3 O	5 O
2 O	4 O	6+ O

ABOUT YOUR EXPERIENCES OF PERSONAL SECURITY AT THIS CAR PARK

We would now like to ask you some questions concerning your experiences of personal security at Manchester Piccadilly Station Car Park. By personal security, we mean freedom from anti-social behaviour and crimes such as assault and theft, and your feelings of security.

Q15 **During the last six months, have you had cause to worry about your personal security whilst at Manchester Piccadilly Station Car Park?**

O Yes [Go to Q16] O No [Go to Q18]

Q16 **Thinking about the last time you felt concerned, how worried did you feel?**

O Not very worried O A little bit worried O Quite worried O Very worried

Q17 **During the past six months, have concerns about your personal security stopped you from using Manchester Piccadilly Station Car Park or forced you to adapt your journey?** [tick any that apply]

- No O
- Yes, I have travelled by another mode of transport O
- Yes, I have travelled via a different station O
- Yes, I have not made the journey I wanted to O
- Yes, I made the journey at a different time of day O
- Yes, I parked elsewhere O

Q18 **How much of a problem are the following at Manchester Piccadilly Station Car Park?** [tick any that apply]

	A very big problem	A fairly big problem	Not a very big problem	Not a problem at all	Don't know
Rubbish or litter lying around	O	O	O	O	O
Vandalism and graffiti	O	O	O	O	O
People using or dealing drugs	O	O	O	O	O
People being drunk or rowdy	O	O	O	O	O
People being harassed or intimidated	O	O	O	O	O
Car crime (theft or damage)	O	O	O	O	O

Q19 **The Secure Stations Scheme operated by the Department for Transport recognises stations that have improved security and taken steps to reduce crime.**

To your knowledge, is Manchester Piccadilly Station a 'Secure Station'?

O	O	O
Yes	No	Don't know

Q20 **The Park Mark Safer Parking Award is given by the Police to car parks that have introduced measures to reduce crime.**

To your knowledge has Manchester Piccadilly Station Car Park received the Safer Parking award?

O	O	O
Yes	No	Don't know

ABOUT SECURITY MEASURES AT THE STATION CAR PARK

The next few questions are interested in your preferences about personal security and car park charges.

Each question will offer you two options and ask you to choose which you prefer.

The options are described in terms of;

- **car park facilities which affect personal security**, in particular:
  - whether or not the car park has CCTV
  - whether there is good lighting throughout the car park, or good lighting only near pay machines
  - whether or not the car park is staffed, and whether police routinely patrol the car park
  - whether the car park has automatic entry/exit barriers
- **car park charge**
  - the charge shown is equivalent to a full day of parking at Manchester Piccadilly Station Car Park.
- **the number of crimes that might arise**; we have focussed on 5 crime types, based on evidence from the rail network.

The questions now follow...

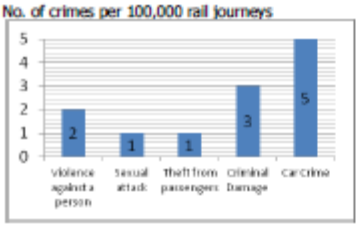
Q21 **Suppose these two options are available:**

Option A

CCTV
Good lighting near pay machines only
Patrolled by police as well as car park staff
No automatic entry/exit barriers

Car park charge = £15.00

No. of crimes per 100,000 rail journeys

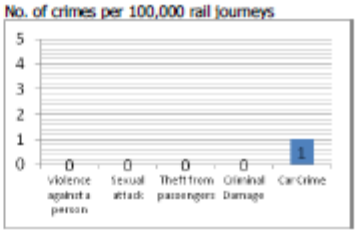


Option B

No CCTV
Good lighting throughout car park
Car park staff in attendance
Automatic entry/exit barriers

Car park charge = £15.50

No. of crimes per 100,000 rail journeys



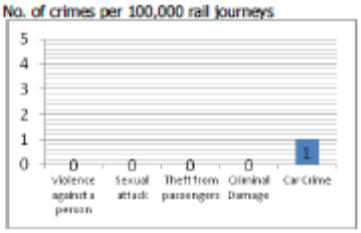
Which Option do you prefer?

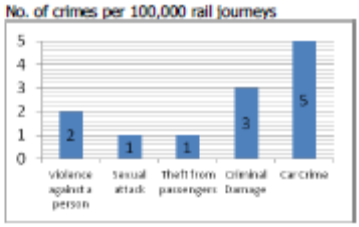
O Option A O Option B

V6.1/PIC

Q22 Suppose these two options are available:

Option A	Option B
No CCTV Good lighting throughout car park Unstaffed Automatic entry/exit barriers	CCTV Good lighting near pay machines only Car park staff in attendance No automatic entry/exit barriers
Car park charge = £15.00	Car park charge = £14.50
No. of crimes per 100,000 rail journeys	No. of crimes per 100,000 rail journeys



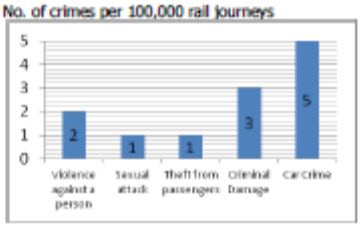


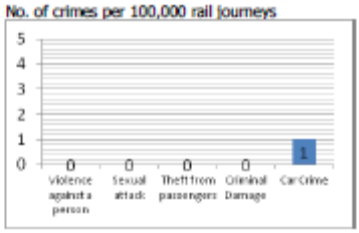
Which Option do you prefer?

○ Option A ○ Option B

Q23 Suppose these two options are available:

Option A	Option B
CCTV Good lighting near pay machines only Car park staff in attendance No automatic entry/exit barriers	CCTV Good lighting throughout car park Car park staff in attendance No automatic entry/exit barriers
Car park charge = £15.50	Car park charge = £16.50
No. of crimes per 100,000 rail journeys	No. of crimes per 100,000 rail journeys





Which Option do you prefer?

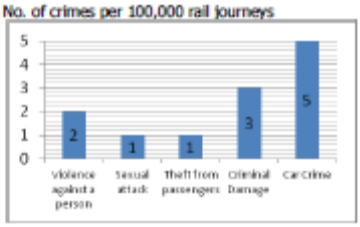
○ Option A ○ Option B

V6.1/PIC

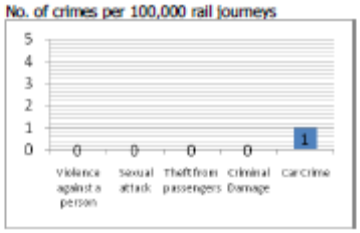
Q24 Suppose these two options are available:

Option A	Option B
No CCTV Good lighting throughout car park Patrolled by police as well as car park staff No automatic entry/exit barriers Car park charge = £15.00	CCTV Good lighting near pay machines only Unstaffed Automatic entry/exit barriers Car park charge = £16.00

No. of crimes per 100,000 rail journeys



No. of crimes per 100,000 rail journeys



Which Option do you prefer?

O Option A O Option B

ABOUT YOUR VIEWS ON RAILWAY INVESTMENT PRIORITIES –SAFETY AND SECURITY

The next questions are interested in your views on how investment in the railways could best be allocated, bearing in mind that the money available to invest may be limited.

You will be presented with several sets of choices between three alternative programmes:

- **Programme A is a safety programme**; it will prevent a given number of railway accidents.
- **Programme B is a personal security programme**; it will prevent a given number of crimes.
- **Programme C is a car park charges programme**; your car park charges will be reduced by a given amount.

In each question, you will be asked to RANK the programmes according to their order of importance.

The questions now follow...

Q25 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Attempt theft of car in car park • The attempt resulted in damage to the car	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 200 incidents of this type	Car park charges reduced by 50%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

V6.1/PIC

Q26 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Attempt theft of car in car park • The attempt resulted in damage to the car	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 150 incidents of this type	Car park charges reduced by 10%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q27 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Violent assault on a passenger • Violence results in serious injuries • Other passengers witnessed the incident	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 1 incident of this type	Car park charges reduced by 10%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q28 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Female passenger sexually attacked whilst leaving the train station at night • Attacked by a stranger • No other station users witnessed attack	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 10 incidents of this type	Car park charges reduced by 20%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

V6.1/PIC

Q29 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Violent assault on a passenger • Violence results in serious injuries • Other passengers witnessed the incident	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 5 incidents of this type	Car park charges reduced by 30%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Q30 Considering these three investment programmes:

Programme A	Programme B	Programme C
Collision accident caused by signal failure resulting in: • 1 adult rail passenger suffering minor injury • Treated in hospital, but released after 24 hours • No other people hurt or killed at the same time	Laptop computer stolen from car parked in car park • Item was left in view while the owner was away from the car throughout the day	Reduction in your car park charges
Prevent 10 incidents of this type	Prevent 250 incidents of this type	Car park charges reduced by 30%

Please RANK the programmes (1, 2 and 3) by order of preference; 1=most important, 3=least important

Programme A ☐ Programme B ☐ Programme C ☐

Finally...

Q31 How easy did you find it to complete this questionnaire?

○ ○ ○ ○ ○

Very easy — Neither easy nor difficult — Very difficult

Q32 We would welcome any comments you might have on the questionnaire.

Thank you very much for your assistance with this survey

Appendix 3: Online Survey: Station Module

RSSB Station Security Survey PDF version

Introduction:

This survey has been sent to you as part of research being undertaken for the Rail Personal Security Group (RPSG), in order to evaluate measures to improve personal security (crime and incidents of anti-social behaviour) and the value of their benefits.

The aim of the survey is to gather additional information about security, facilities and procedures at stations, which will help us to conduct an analysis of the influence of specific measures on crime levels and passenger outcomes. We are asking 300 stations to take part. The survey asks you to outline the measures that your organisation has put in place at the station you work at.

The survey should only take 15-20 minutes to complete.

If you have any questions about the survey or encounter any problems with it, please contact:

Michelle Rogerson
m.rogerson@hud.ac.uk
01484 47 3223

Section 1: Station Details

1. Please enter the station name

2. Please enter the station three letter alpha code (e.g. for Huddersfield=HUD)

3. Please enter the station NLC code (if known)

4. Please enter the operator (Train Operating Company)

5. Please describe your role at the station

- ◯ Station Manager
- ◯ Security Manager

Other (please specify)

Section 2: Monitoring and Responding to Personal Security

6. Are patterns of personal security (crime and anti-social behaviour incidents) at this station regularly monitored?

- ◯ Yes (If Yes, please go to question 7)
- ◯ No (If No, please go to question 8)

Section 2: Monitoring and Responding to Personal Security

RSSB Station Security Survey PDF version

7. How frequently are personal security data reviewed?
(Please tick all that apply)

- ☐ Monthly
- ☐ Quarterly
- ☐ Annually
- ☐ Following specific incidents

Other (please specify)

Section 2: Monitoring and Responding to Personal Security

8. Is the station staffed

- ◯ Full Time? (please go to question 9)
- ◯ Part Time? (please go to question 9)
- ◯ Not Staffed? (please go to question 10)

Section 2: Monitoring and Responding to Personal Security

9. Can you describe how staffing levels vary by time of day across different areas of the station? (For example, peak/off-peak, ticket offices, platforms etc.)

Section 2: Monitoring and Responding to Personal Security

RSSB Station Security Survey PDF version

10. Which members of staff who cover/work at the station (if any) have responsibilities for managing personal security issues?

Please enter job title and describe the nature of their role(s) for each staff type below.

11. Are any staff at the station employed via a security company?

- ◯ Yes
- ◯ No

If Yes please please describe their role(s), level of involvement and responsibilities.

12. Do you have formal procedures for responding to incidents of personal security against staff?

- ◯ Yes
- ◯ No

If Yes, please provide a brief description

RSSB Station Security Survey PDF version

13. Do you have formal procedures for responding to incidents of personal security against passengers?

- ◯ Yes
- ◯ No

If Yes, please provide a brief description

14. Do you have any further comments on procedures for monitoring and responding to personal security?

Section Three: Training

15. Is training in dealing with conflict avoidance and managing aggression available to all staff who have contact with passengers at the station?

- ◯ Yes, provided to all staff who have contact with passengers (please go to question 16)
- ◯ Yes, provided to staff identified as most at risk (please go to question 16)
- ◯ No training provided (please go to question 19)

Section Three: Training

RSSB Station Security Survey PDF version

16. please state when the training was introduced:

- ◯ introduced less than 12 months ago (please go to question 19)
- ◯ introduced more than 12 months but less than 2 years ago (please go to question 19)
- ◯ introduced between 2-5 years ago (please go to question 17)
- ◯ introduced more than 5 years ago (please go to question 17)
- ◯ don't know when introduced (please go to question 19)

Section Three: Training

17. Has the training material been reviewed or updated?

- ◯ Yes
- ◯ No

If Yes, approximately when was this renewed or updated

18. Do staff receive refresher training?

- ◯ Yes
- ◯ No

Section Three: Training

19. Do you have any additional comments on staff training?

Section Four: Formal Surveillance

20. Does CCTV operate at this station?

- ◯ Yes (please go to question 21)
- ◯ No (please go to question 32)

Section Four: Formal Surveillance

RSSB Station Security Survey PDF version

21. How long ago was the CCTV installed?

- ◯ Less than 12 months ago (please go to question 23)
- ◯ More than 12 months but less than two years (please go to question 23)
- ◯ Between 2-5 years ago (please go to question 22)
- ◯ More than 5 years ago. (please go to question 22)
- ◯ Don't know when implemented.(please go to question 23)

Section Four: Formal Surveillance

22. Have there been any significant improvements or upgrades to CCTV at the station in the last two years?

- ◯ Yes
- ◯ No
- ◯ Don't know

Section Four: Formal Surveillance

23. Is there real time monitoring of CCTV?

- ◯ Yes
- ◯ No

24. Approximately, what percentage of the station is covered by CCTV?

- ◯ More than 75%
- ◯ 51 to 75%
- ◯ 26 to 50%
- ◯ Less than 25%

RSSB Station Security Survey PDF version

25. Does CCTV cover

	All	Some	Not Covered	Not applicable
The Station Concourse	◯	◯	◯	◯
Station Platforms	◯	◯	◯	◯
The ticket office	◯	◯	◯	◯
Waiting rooms	◯	◯	◯	◯
Entrances and exits	◯	◯	◯	◯
Ticket machines	◯	◯	◯	◯
Retail/catering areas	◯	◯	◯	◯

Other (please specify area and extent of coverage)

26. Are cameras moveable (e.g. pan, tilt or zoom)?

◯ Yes
◯ No
◯ Don't Know

27. Are cameras adequately protected from damage by vandalism?

◯ Yes
◯ No
◯ Don't know

28. Is the quality of CCTV images sufficient to enable facial recognition (during the day time)?

◯ Yes
◯ No
◯ Don't know

29. Is the quality of CCTV images sufficient to enable facial recognition (during the night time)?

◯ Yes
◯ No
◯ Don't know

RSSB Station Security Survey PDF version

30. Is lighting at the station sufficient to support the effectiveness of CCTV?

- ◯ Yes, across all areas of the station
- ◯ Across most areas of the station
- ◯ Across a limited area of the station
- ◯ Not sufficient
- ◯ Don't know

31. Do you have any additional comments regarding CCTV on the station?

Section Five: Informal Surveillance and Design

32. Have any modifications, alterations or improvements been made to the station to improve or expand lines of sight? This might include correcting corners, changing wide pillars and recesses, improving passageways subways and stairways, vegetation removal or mirrors on blind corners.

- ◯ Yes (please go to question 33)
- ◯ No (please go to question 39)

Section Five: Informal Surveillance and Design

33. Please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 1:

RSSB Station Security Survey PDF version

34. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

35. Please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 2:

36. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

37. Please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 3:

RSSB Station Security Survey PDF version

38. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Five: Informal Surveillance and Design

39. Are lighting levels consistent across the station?

- ◯ Yes
- ◯ No
- ◯ Don't Know

40. Are there any areas of the station that require improvements to lighting?

- ◯ Yes
- ◯ No
- ◯ Don't Know

If Yes please specify

41. Have there been any significant improvements or upgrades, beyond ongoing maintenance, to lighting at the station in recent years?

- ◯ Yes (please go to question 42)
- ◯ No (please go to question 48)

Section Five: Informal Surveillance and Design

42. If yes, please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 1:

RSSB Station Security Survey PDF version

43. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

44. If yes, please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 2:

45. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

46. If yes, please describe what you think have been the most important modifications/improvements made (up to three) over the last five years

Improvement 3:

RSSB Station Security Survey PDF version

47. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Five: Informal Surveillance and Design

48. Do you currently display and/or distribute any of the following personal security advice to passengers?

	Yes	No	Don't know
Posters	◯	◯	◯
Leaflets	◯	◯	◯
Passenger Announcements	◯	◯	◯

Other (please specify)

49. Do you use anti-graffiti paint at the station?

- ◯ Yes, introduced less than 12 months ago (please go to question 50)
- ◯ Yes, introduced more than 12 months but less than 2 years ago (please go to question 50)
- ◯ Yes, introduced between 2-5 years ago (please go to question 50)
- ◯ Yes, introduced more than 5 years ago (please go to question 50)
- ◯ Yes, but don't know when introduced (please go to question 50)
- ◯ No (please go to question 51)

Section Five: Informal Surveillance and Design

50. How often has the anti-graffiti paint been updated?

Section Five: Informal Surveillance and Design

RSSB Station Security Survey PDF version

51. Does a Rapid Removal Policy for Graffiti operate on this station?

- ◯ Yes, for all graffiti (please go to question 52)
- ◯ Yes, for offensive graffiti only (please go to question 52)
- ◯ No (please go to question 54)

Section Five: Informal Surveillance and Design

52. When was the Rapid Removal Policy Introduced?

- ◯ Less than 12 months ago (please go to question 54)
- ◯ More than 12 months but less than 2 years ago (please go to question 54)
- ◯ Between 2-5 years ago (please go to question 53)
- ◯ More than 5 years ago (please go to question 53)
- ◯ Don't know when implemented (please go to question 54)

Section Five: Informal Surveillance and Design

53. If introduced more than two years ago, has the policy been updated?

- ◯ Yes
- ◯ No
- ◯ Don't Know

Section Five: Informal Surveillance and Design

54. Has protective/defensive planting been introduced to the landscaping at the station?
For example ivy to prevent graffiti or bushes to prevent access.

- ◯ Yes, introduced less than 12 months ago (please go to question 55)
- ◯ Yes, introduced more than 12 months but less than 2 years ago (please go to question 55)
- ◯ Yes, introduced between 2-5 years ago (please go to question 55)
- ◯ Yes, introduced more than 5 years ago (please go to question 55)
- ◯ Yes, but don't know when introduced (please go to question 55)
- ◯ No (please go to question 57)

Section Five: Informal Surveillance and Design

RSSB Station Security Survey PDF version

55. Please describe the type of landscaping introduced.

56. How often is landscaping at the station maintained?

Section Five: Informal Surveillance and Design

57. Other than those described above, have any other measures been introduced to improvements station security?

- ◯ Yes (please go to question 58)
- ◯ No significant other improvements (please go to question 64)

Section Five: Informal Surveillance and Design

58. Please describe what you think are the most important improvements (up to three) made over the last five years.
Improvement 1:

59. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

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G0. Please describe what you think are the most important improvements (up to three) made over the last five years.

Improvement 2:

G1. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

G2. Please describe what you think are the most important improvements (up to three) made over the last five years.

Improvement 3:

G3. Approximately when was this improvement implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Six: Activity Support

RSSB Station Security Survey PDF version

64. Is real time train timetable information available at this station?

- ◯ Yes, via electronic information screens
- ◯ Yes, via passenger announcements
- ◯ Yes, via electronic information screens and passenger announcements
- ◯ No

65. If the station is unstaffed at any time, is an emergency help point(s) connected to a remote monitoring site.

- ◯ Yes
- ◯ No
- ◯ Not applicable (always staffed)

If Yes, what is the procedure for responding

Section Seven: Partnership working

66. In the last 12 months has your station conducted any targeted operations with the British Transport Police (BTP) or the Home Office Police?

- ◯ Yes (please go to question 67)
- ◯ No (please go to question 69)
- ◯ Don't know (please go to question 69)

Section Seven: Partnership working

67. Please indicate which personal security issues these operations were designed to address

RSSB Station Security Survey PDF version

68. Please indicate if these were evaluated and with what results

Section Seven: Partnership working

69. Is your station represented on the local Crime and Disorder Reduction Partnership (CDRP) sometimes known as Community Safety Partnership of any of their working groups?

- ◯ Yes
- ◯ No
- ◯ Don't know

70. As far as you know, is tackling crime at your station included in the local crime and disorder strategy?

- ◯ Yes
- ◯ No
- ◯ Don't know

71. During the past 12 months how many Anti Social Behaviour Orders have you provided evidence for?

72. Does an 'Adopt a Station Scheme' operate at this station?

- ◯ Yes
- ◯ No
- ◯ Don't Know

73. Is there a passenger user group at the Station?

- ◯ Yes
- ◯ No
- ◯ Don't Know

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74. Do you have any further comments on partnership working?

Section Eight: Access Control

75. How many entrances/exits are there into the station?

76. Are there automatic ticket barriers to the station concourse?

- ◯ Yes (please go to question 77)
- ◯ No (please go to question 79)

Section Eight: Access Control

77. When were they introduced?

- ◯ Less than 12 months ago (please go to question 79)
- ◯ More than 12 months but less than 2 years ago (please go to question 79)
- ◯ Between 2-5 years ago (please go to question 78)
- ◯ More than 5 years ago (please go to question 78)
- ◯ Don't know when implemented (please go to question 79)

Section Eight: Access Control

78. Have they been modified or improved since their introduction?

- ◯ Yes
- ◯ No

Section Eight: Access Control

79. Are there automatic ticket barriers to the station platforms

- ◯ Yes (please go to question 80)
- ◯ No (please go to question 82)

RSSB Station Security Survey PDF version

Section Eight: Access Control

80. When were they introduced?

- ◯ Less than 12 months ago (please go to question 82)
- ◯ More than 12 months but less than 2 years ago (please go to question 82)
- ◯ Between 2-5 years ago (please go to question 81)
- ◯ More than 5 years ago (please go to question 81)
- ◯ Don't know when implemented (please go to question 82)

81. Have they been modified or improved since their introduction?

- ◯ Yes
- ◯ No

Section Eight: Access Control

82. Approximately what proportion of throughput of passengers are checked for tickets during Peak hours?

- ◯ less than 25%
- ◯ 25 to 50%
- ◯ 51 to 75%
- ◯ More than 75%

83. Approximately what proportion of throughput of passengers are checked for tickets during Off Peak hours?

- ◯ less than 25%
- ◯ 25 to 50%
- ◯ 51 to 75%
- ◯ More than 75%

Section Nine: Other Comments

RSSB Station Security Survey PDF version

84. Do you have any other comments about personal security at this station?

Appendix 4: Online Survey: Car Park Module

RSSB Car Park PDF Version

Introduction

Introduction:

This survey has been sent to you as part of research being undertaken for the Rail Personal Security Group (RPSG), in order to evaluate measures to improve personal security (crime and incidents of anti-social behaviour) and the value of their benefits.

The aim of the survey is to gather additional information about security, facilities and procedures at stations, which will help us to conduct an analysis of the influence of specific measures on crime levels and passenger outcomes. We are asking 300 stations to take part. This survey asks you to outline the measures that your organisation has put in place at the station car park you work at/are responsible for.

Please note that for this research we are defining a station car park as: a car park that the Train Operating Company or Network Rail own and manage – or pay a contractor to manage on their behalf.

The survey should only take 15-20 minutes to complete.

Thank you in advance for your responses.

If you have any questions about the survey or encounter any problems with it, please contact:

Michelle Rogerson
m.rogerson@hud.ac.uk

Section One: General Information

1. Please enter name of station and name of car park:

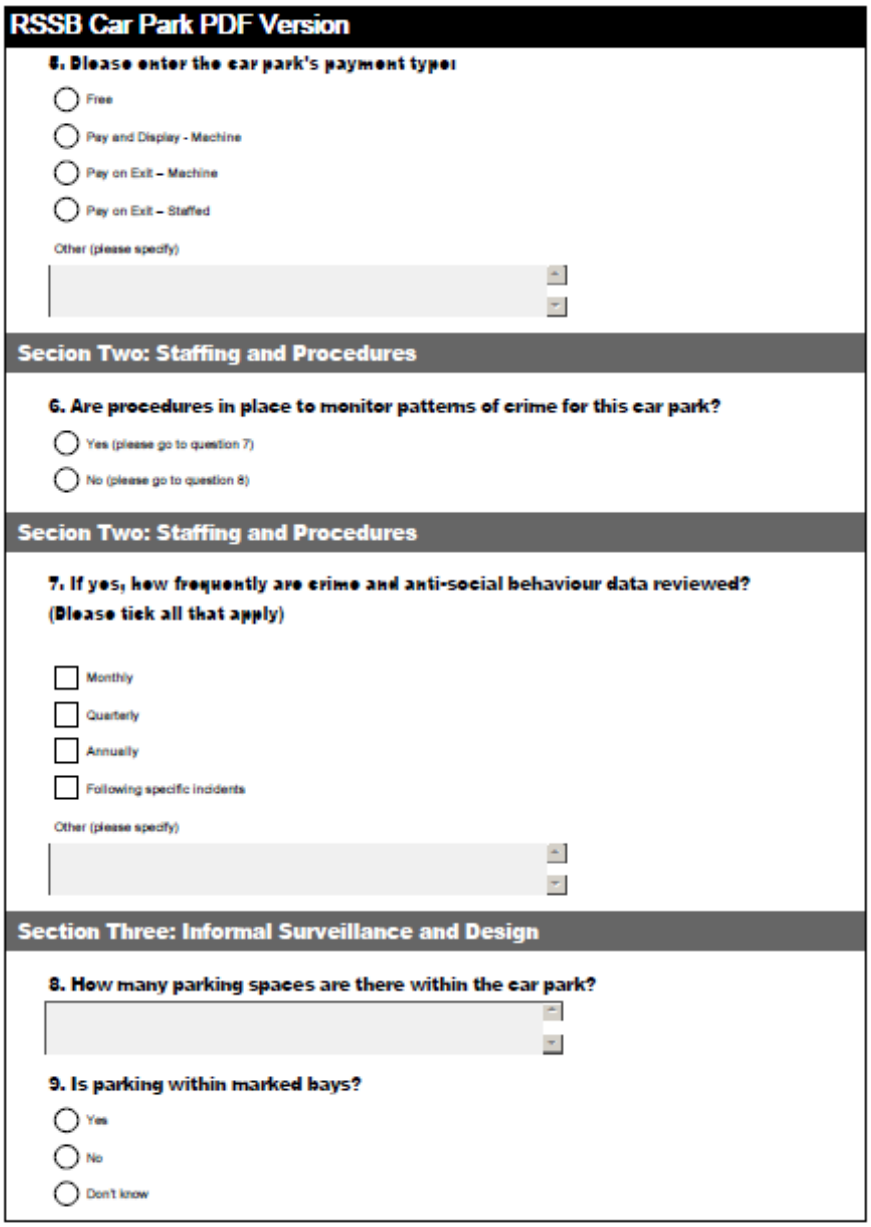
2. Please describe your role:

- ◯ Station manager
- ◯ Car park contractor
- ◯ Car park manager

Other (please specify)

3. Please enter the name of the organisation responsible for car park management:

4. What are the car park's hours of operation:



RSSB Car Park PDF Version

5. Please enter the car park's payment type:

- ◯ Free
- ◯ Pay and Display - Machine
- ◯ Pay on Exit – Machine
- ◯ Pay on Exit – Staffed

Other (please specify)

Secion Two: Staffing and Procedures

6. Are procedures in place to monitor patterns of crime for this car park?

- ◯ Yes (please go to question 7)
- ◯ No (please go to question 8)

Secion Two: Staffing and Procedures

7. If yes, how frequently are crime and anti-social behaviour data reviewed? (Please tick all that apply)

- ☐ Monthly
- ☐ Quarterly
- ☐ Annually
- ☐ Following specific incidents

Other (please specify)

Section Three: Informal Surveillance and Design

8. How many parking spaces are there within the car park?

9. Is parking within marked bays?

- ◯ Yes
- ◯ No
- ◯ Don't know

Page 2

RSSB Car Park PDF Version

10. Have any modifications or alterations been made to the car park to improve or expand lines of sight? (For example, correcting corners, changing wide pillars and recesses, improving passageways, subways, stairways adding mirrors to blind corners of vegetation removal).

- ◯ Yes (If Yes please go to question 11)
- ◯ No (If No please go to question 17)

Section Three: Informal Surveillance and Design

11. Please describe what you think are the most important modifications/improvements (up to three) introduced over the last five years.
Improvement 1:

12. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

13. Please describe what you think are the most important modifications/improvements (up to three) introduced over the last five years.
Improvement 2:

RSSB Car Park PDF Version

14. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

15. Please describe what you think are the most important modifications/improvements (up to three) introduced over the last five years.
Improvement 3:

16. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Three: Informal Surveillance and Design

17. Are lighting levels consistent across the car park?

- ◯ Yes
- ◯ No

Section Three: Informal Surveillance and Design

18. Are there any areas of the car park that require improvements to lighting?

- ◯ Yes
- ◯ No

RSSB Car Park PDF Version

19. Have there been any significant improvements or upgrades, beyond ongoing maintenance, to lighting in the car park in the last five years?

- ◯ Yes (If Yes, please go to question 20)
- ◯ No significant improvements made (If No, please go to question 26)

Section Three: Informal Surveillance and Design

20. Please describe what you think are the most important improvements (up to three) made over the last five years.
Improvement 1:

21. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

22. Please describe what you think are the most important improvements (up to three) made over the last five years.
Improvement 2:

RSSB Car Park PDF Version

23. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

24. Please describe what you think are the most important improvements (up to three) made over the last five years.

Improvement 3:

25. Approximately when was this change implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Three: Informal Surveillance and Design

26. Is secure parking available for bicycles and or motorcycles?

- ◯ Yes (If Yes, please go to question 27)
- ◯ No (If No, please go to question 29)

Section Three: Informal Surveillance and Design

27. How many bicycles / motorcycles can be accommodated?

Number of Bicycles that can be accommodated

Number of Motorcycles that can be accommodated

28. Please describe the type of stand provided for

Bicycles

Motorcycles

RSSB Car Park PDF Version

Section Three: Informal Surveillance and Design

29. What measures are in place to protect payment machines, and those using them? (Please tick all that apply)

- [ ] Located in the busiest areas
- [ ] Covered by CCTV
- [ ] Regularly emptied
- [ ] Not Applicible (no payment machines)

Other (please specify)

30. Do you have any further comments on the design of the car park?

Section Four: Access Control

31. How many vehicle exit/entrances are there into the car park?

32. Are entrances/exits (Please tick all that apply).

- [ ] controlled by barriers?
- [ ] covered by CCTV?
- [ ] staffed?
- [ ] clearly signposted?

33. How many pedestrian exit/entrance points are there into the car park?

RSSB Car Park PDF Version

34. Are these entrances/exits (Please tick all that apply)

- ☐ Covered by CCTV?
- ☐ Staffed?
- ☐ Clearly signposted?

35. Is the car park surrounded by a boundary fence or wall

- ◯ Yes (If Yes, please go to question 36)
- ◯ No (If No, please go to question 37)

Section Four: Access Control

36. Is the boundary in good order and clearly defined?

- ◯ Yes
- ◯ No

Section Five: Formal Surveillance

37. To what extent is the car park manned during hours of operation?

- ◯ Manned during all hours of operation (go to question 38)
- ◯ Manned for part of the time (go to question 38)
- ◯ Not manned (go to question 39)

Section Five: Formal Surveillance

38. Do staff undertake regular patrols of the car park?

- ◯ Yes
- ◯ No

If Yes, how often?

Section Five: Formal Surveillance

39. Is CCTV installed at the car park?

- ◯ Yes (If Yes, please go to question 40)
- ◯ No (If No, please go to question 52)

Section Five: Formal Surveillance

RSSB Car Park PDF Version

40. How long ago was the CCTV installed

- ◯ Less than 12 months ago (go to question 42)
- ◯ More than 12 months but less than two years ago (go to question 42)
- ◯ Between 2-5 years ago (go to question 41)
- ◯ More than 5 years ago (go to question 41)
- ◯ Don't know when installed (go to question 42)

Section Five: Formal Surveillance

41. Have there been any significant improvements or upgrades to CCTV at the station in the last two years

- ◯ Yes
- ◯ No
- ◯ Don't know

Section Five: Formal Surveillance

42. Approximately, what proportion of the car park is covered by CCTV?

- ◯ More than 75%
- ◯ 51 to 75%
- ◯ 25 to 50%
- ◯ Less than 25%

43. Does CCTV cover (please tick all that apply)

	All	Some	Not Covered	Not Applicable
Entrances/Exits	◯	◯	◯	◯
Payment Machines	◯	◯	◯	◯

Other (please specify area and extent of coverage)

44. Is there real time monitoring of CCTV?

- ◯ Yes
- ◯ No
- ◯ Don't know

RSSB Car Park PDF Version

45. Is the quality of CCTV images sufficient to enable i) facial recognition and ii) to read a vehicle registration plates during the day time (Tick all that apply)?

- ☐ Yes- Facial recognition
- ☐ Yes – Vehicle registration
- ☐ No
- ☐ Don't know

46. Is the quality of CCTV images sufficient to enable i) facial recognition and ii) to read a vehicle registration plates during the night time (Tick all that apply)?

- ☐ Yes- Facial recognition
- ☐ Yes – Vehicle registration
- ☐ No
- ☐ Don't know

47. Are CCTV cameras moveable e.g. pan, tilt and zoom?

- ◯ Yes
- ◯ No
- ◯ Don't know

48. Are cameras adequately protected from damage by vandalism?

- ◯ Yes
- ◯ No
- ◯ Don't know

49. Is lighting in the car park sufficient to support the effectiveness of CCTV?

- ◯ Yes
- ◯ No
- ◯ Don't know

50. Does ANPR (automatic number plate recognition) technology operate at this car park?

- ◯ Yes
- ◯ No
- ◯ Don't know

RSSB Car Park PDF Version

51. Do you have any further comments on CCTV in the car park?

Section Six: Crime Prevention

52. Have any targeted crime prevention initiatives operated in the car park in the last five years?

- ◯ Yes (If Yes, please go to question 53)
- ◯ No (If No, please go to question 59)

Section Six: Crime Prevention

53. If yes, please describe main initiatives (up to three) and provide the approximate date of implementation

Initiative One:

54. Approximately when was this implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

RSSB Car Park PDF Version

55. If yes, please describe main initiatives (up to three) and provide the approximate date of implementation

Initiative Two:

56. Approximately when was this implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

57. If yes, please describe main initiatives (up to three) and provide the approximate date of implementation

Initiative Three:

58. Approximately when was this implemented?

- ◯ Less than 12 months ago
- ◯ More than 12 months but less than 2 years ago
- ◯ Between 2-5 years ago
- ◯ More than 5 years ago.
- ◯ Don't know when implemented.

Section Seven: Further Comments

RSSB Car Park PDF Version

59. Do you have any other comments about personal security, crime and anti-social behaviour in this car park?

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Appendix 5: Summary of sources of cost/benefit to victims of crime, rail users and new users respectively

Table A5.1: Costs of crime

Source of cost/benefit	Impacts of cost/benefit								Source of evidence
	Household						Industry	Government	
	User			Staff		Non-user			
	Victim of crime (pax)	Witness to crime (pax)	Pax using station	Victim of crime (staff)	Staff at station				
Defensive expenditure	a						j		HO30/05 Costs of Crime
Physical and Emotional Impact on Direct Victims	b			g					
Net Value of Property Stolen	c						k		
Property Damaged/Destroyed	d						l		
Lost Output	e			h					
Health Services								o	
Victim Services								p	
Criminal Justice System								q	
Lost Output							m		Risk Solutions' model
Delay							n		
VPF (value of reducing objective risk of a crime)	$f\left(\equiv a+b+c+d+e\right)$			$i\left(\equiv g+h\right)$					
TOTAL UNIT COSTS PER PAX CRIME = $A+D$	(A) TOTAL UNIT COSTS TO VICTIM (PAX) = $a+b+c+d+e\left(\equiv f\right)$							(D) TOTAL UNIT COSTS TO GOVERNMENT = $o+p+q$	
TOTAL UNIT COSTS PER STAFF CRIME = $B+C+D$				(B) TOTAL UNIT COSTS TO VICTIM (STAFF) = $g+h\left(\equiv i\right)$			(C) TOTAL UNIT COSTS TO INDUSTRY = $j+k+l+m+n$	(D) TOTAL UNIT COSTS TO GOVERNMENT = $o+p+q$	

Table A5.2: Benefits of intervention to existing users

Source of cost/benefit	Impacts of cost/benefit							Source of evidence
	Household					Industry	Government	
	User		Staff		Non-user			
	Victim of crime (pax)	Pax using station	Victim of crime (staff)	Staff at station				
Cost of Secure Station (including fixed and variable costs over asset life)						X		RSSB/Steering Group
Expected Perceived Benefits		$r\left(\equiv a+b+c+d+e+s\right)$		$t\left(\equiv g+h+u\right)$	v			Game 2
Risk Premium (value of reducing fear of crime)		s		u	w			Game 2
TOTAL NET BENEFIT OF SECURE STATION = $E+F+G+H$		(E) TOTAL WTP TO PAX = r		(F) TOTAL WTP TO STAFF = t	(G) TOTAL WTP TO NON-USER = v	(H) TOTAL COST TO INDUSTRY = X		

Table A5.3: Benefits of intervention to new users

Source of cost/benefit	Impacts of cost/benefit							Source of evidence
	Household					Industry	Government	
	User		Staff		Non-user			
	Victim of crime (pax)	Pax using station	Victim of crime (staff)	Staff at station				
Change in consumer surplus			y					Ticket sales analysis
Change in ticket revenue						z		Ticket sales analysis
TOTAL CHANGE IN WELFARE AS A RESULT OF PATRONAGE INCREASE = $I + J$			(I) TOTAL CHANGE IN CS = y			(J) TOTAL CHANGE IN PS = z		

Appendix 6: Analysis of missing data within the intervention database

Table A6.1: Missing data in the intervention database

Number of Cases for which information is available (322 Stations)	Station Variables	Impact on sample bias (Missing for
≈322	Staffing levels; Tickets Gates (yes/no); Automatic ticket machines (yes/no); Automatic help points (yes/no); Informal surveillance via retail activity (yes/no); Informal surveillance to waiting rooms (yes/no); Secluded approach to station (yes/no); Cycle storage (yes/no); Number of pedestrian entrances.	n/a
270	CCTV on station (yes/no)	5% of Secure Stations 32% of non-accredited stations
≈200	Lighting quality; Improvements to lines of sight,	25% of Secure Stations 55% of non-accredited stations
183	Improvements to CCTV during analysis period	48% of Secure Stations 52% of non-accredited stations
139	CCTV monitoring (yes/no)	15% of Secure Stations 53% of non-accredited stations
138	Extent of CCTV coverage	57% of Secure Stations 50% of non-accredited stations.
≈125	CCTV Quality/Proportion of Ticket Checks	60% of Secure stations 60% of non-accredited stations.
118	BTP Operations	63% of Secure Stations 65% of non-accredited stations
Number of Cases for which information is available (231 car parks)	**Car Park Variables**	**Impact on sample bias**

174	Payment Type	23% of SCPs 25% of non-accredited car parks
145	CCTV in Car Park	31% of SCPs 42% of non-accredited car parks
140	Car park manned/car park patrolled	32% of SCPs 47% of non-accredited car parks
126	Car park boundary	41% of SCPs 50% of non-accredited car parks
114	Car park lighting	33% of SCPs 60% of non-accredited car parks

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