TRAIN OPERATOR COMPENSATION FOR POSSESSIONS: COMPENSATION FOR LOSS OF PASSENGER REVENUE

Final Report

August 2007

Prepared for:

Policy Group

Prepared by:

Steer Davies Gleave
28-32 Upper Ground
London
SE1 9PD

+44 (0)20 7919 8500
www.steerdaviesgleave.com

Contents

FIGURES

TABLES

APPENDICES

B MOIRA BRIEFING NOTES

C MINUTES FROM 9TH JULY WORKSHOP

1. INTRODUCTION

Aim & Objectives

1.1 Steer Davies Gleave has undertaken a review of potential mechanisms to compensate passenger train operators for revenue lost as a result of possessions. This study supports a wider programme of work, initiated by ORR and undertaken by the Possessions Compensation Policy Group (the Policy Group), to develop revised compensation arrangements for consultation with the rail industry in or before September 2007.

1.2 As part of this study Steer Davies Gleave were tasked with the following:

- Complete a comprehensive review of the existing literature in this area;
- Complete further quantitative research in order to develop and expand on current findings; and
- Develop a set of recommendations to revise Schedule 4 in order to make the compensation mechanism more effective and efficient.

1.3 The aim of this report is to summarise our work in these areas and present our conclusions.

Background

1.4 There has been a long held view within the industry that the mechanisms to compensate Train Operating Companies (TOCs) for possessions are not working as efficiently or as effectively as they should. The ORR letter of the 5th of January to the Economic and Contractual Framework Industry Steering Group (ISG) details the following issues:

- Confusion around the boundaries between Schedule 4 and Part G of the Network Code;
- An inconsistent approach to compensating train operators for the effects of possessions;
- Concerns over the accuracy of compensation arrangements and the resulting economic signals;
- A lack of transparency in Part G and the Schedule 4 process; and
- Unnecessarily high transactions costs.

1.5 To deal with the issues identified in the ORR letter, the ISG has set up the Policy Group, which comprises representatives of passenger and freight train operators; Network Rail; the Department for Transport; and ORR.

1.6 The Policy Group commissioned Steer Davies Gleave to review the potential mechanisms to compensate passenger train operators for fares revenue lost as a result of possessions. It should be noted that the scope of this work includes all Restrictions of Use, and we are using "possession" as shorthand

Structure of Report

1.7 The rest of this report is organised as follows:

- Section 2 provide a literature review;
- Section 3 presents the results from the quantitative analysis conducted for this study;
- Section 4 discusses the key conclusion from the literature review and quantitative analysis;
- Section 5 discusses options for change to Schedule 4; and
- Section 6 provides a summary of our main conclusions.

1.8 We also provide the following appendices to this report;

- Appendix A gives a detailed review of the individual papers reviewed for the literature review;
- Appendix B reproduces the MOIRA briefing notes used for the MOIRA analysis; and
- Appendix D provides the minutes to the 9th July workshop.

2. LITERATURE REVIEW

Introduction

2.1 This chapter provides a literature review of the key papers that considered the issue of estimating revenue loss due to possessions. The literature review focuses on four areas:

- Measuring the Actual Effect of Possessions;
- Possessions Modelling
- Model Assumptions; and
- Validation & Calibration.

2.2 W have reviewed the following papers:

- "Cost Benefit Appraisal of EEA Possession Strategy", NERA – July 2006 (hereafter referred to as NERA 2006);
- "Demand Effects of changed Possession Patterns", Steer Davies Gleave – June 2004 (hereafter referred to as the EEA study); and
- "Demand Effect of Possessions", Steer Davies Gleave – May 2006 (hereafter referred to as the Steer Davies Gleave 2006).

2.3 We have also considered the recommendations contained within the PDFH and the papers that these recommendations are based upon.

Measuring the Actual Effect of Possessions

2.4 Ideally any model of revenue loss due to possessions should be calibrated and validated against observed historical estimates. The EEA study and Steer Davies Gleave 2006 study for ATOC attempted to measure the historical effect of possessions. Neither study was successful in developing a statistically robust estimate. A number of reasons were given for this:

- A lot of low volume flows were analysed which were subject to a high degree of volatility;
- Large network wide effects were present in the LENNON data, which caused difficulty particularly for the possessions monitoring work (e.g. the possessions analysed occurred a couple of months after the London bombing);
- Difficulty in identifying suitable comparator flows; and
- Period data was too aggregate to identify weekend possessions but daily and weekly data was subject to a high degree of volatility – this caused a problem because a number of weekend and bank holiday possession were analysed.

2.5 There is therefore, a significant gap in the literature in understanding the actual effect of possessions and the degree to which modelled estimates reflect reality.

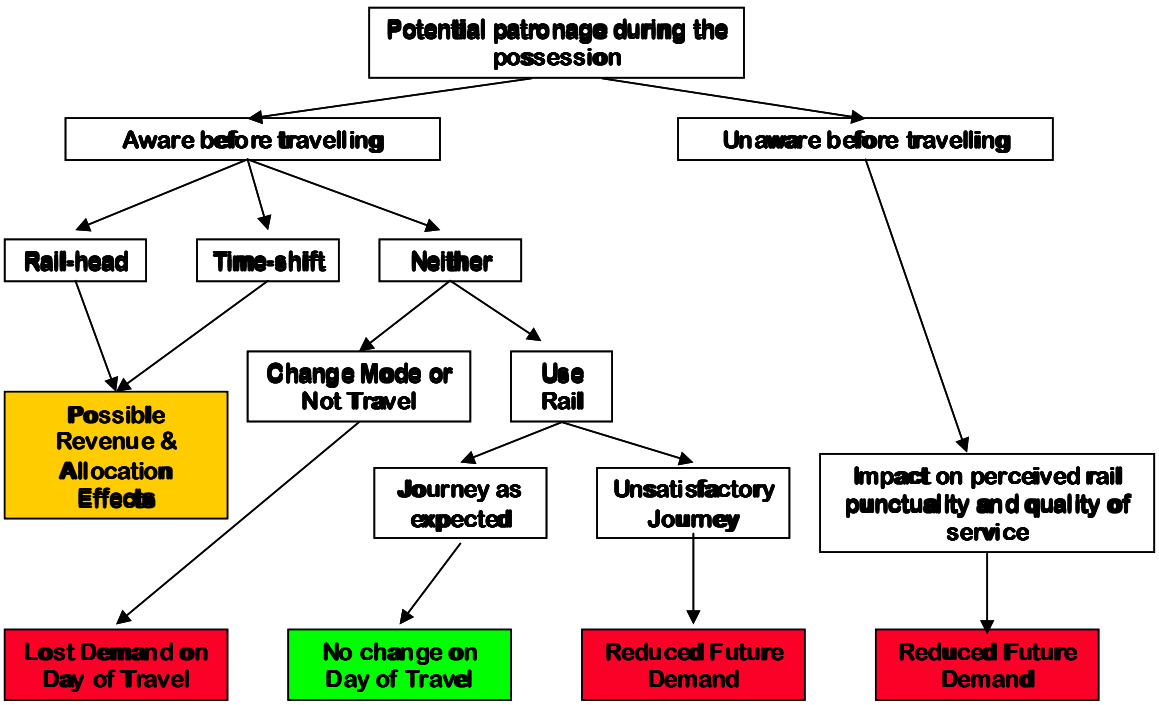
Possessions Modelling

2.6 The basis for possessions modelling is the recommendation within the PDFH on service disruption. The relevant section (B4.5) recommends the following:

"*Delays advertised in advance (e.g. weekend engineering work) should be treated as scheduled journey time for those people who were aware at the start of the journey. For all other passengers the delays should be considered in the same way as other delays.*"

2.7 This basic framework for modelling possessions was developed and refined by Steer Davies Gleave in our EEA and 2006 studies. Figure 2.1 sets out the proposed structure. The process divides the potential travelling population during periods of the possession into a number of segments for which different effects may be expected: The possible outcomes are colour coded; green for no demand effect, red for a net loss of demand, and orange for no change in demand but by possible revenue impact through allocation changes between TOCs or purchase of different ticket types.

FIGURE 2.1 STEER DAVIES GLEAVE FORECASTING PROCESS



Modelling the aware segment

2.8 As stated above, the PDFH recommend approach to modelling the demand response of the aware traveller is to treat the journey time change from the possession as a scheduled journey time change. The PDFH approach to modelling scheduled journey time changes is to calculate the change in generalised journey time and then apply a generalised journey time elasticity. Generalised journey time (GJT) is composed of the actual in vehicle travel time and "penalties" for interchange and for service intervals.

2.9 The PDFH approach to estimating the demand response to scheduled journey changes

are built into the MOIRA timetable evaluation software, which uses them to calculate the demand impact of service changes on a matrix of station-to-station flows. (MOIRA also estimates the ORCATS revenue allocation of each flow to individual services, from which TOC earnings can be derived by aggregation.)

2.10 The assumption on interchange penalties is of relevance to modelling possessions. MOIRA assumes that all interchanges are train to train, however during possessions there are likely to be interchanges that are between train and coach. There are a number of factors that affect interchange penalties, which include walking and waiting time (conventionally weighted double in-vehicle time in the GJT measure), ease of interchange, familiarity with the station, and facilities (e.g. waiting facilities). All of these will contribute to penalties being higher than average when connecting to a coach link outside the station. However, during possessions the train to/from coach interchange is often guided to a dedicated service. So this may mean that the interchange penalty is actually lower than normal. A further issue is that MOIRA does not take account of passenger preferences of travelling by coach and by train.

2.11 The EEA study investigated the interchange and journey time penalties associated with coach replacements – essentially it found that for a 40 minute coach journey the overall weighting to be applied to the coach journey is in the range 1.36 to 1.55 depending on journey purpose and distance[1] plus a 6 minutes interchange penalty. The EEA study developed an external model to MOIRA which enabled them to make this adjustment.

2.12 The NERA 2006 study investigated the effect of using these assumptions relative to the standard MOIRA assumptions and found no significant difference between the results - the 6 minute interchange penalty is significantly lower than the standard MOIRA interchange penalty, but under standard MOIRA assumptions no extra penalty is placed on bus time v rail time, which has an offsetting effect.

2.13 There are two behavioural effects that MOIRA does not model that may occur during the period of the possession:

- Passengers choosing to travel via a different route and/or operator, and switching their origin and/or destination station (rail-heading); and
- Passengers changing the day of travel.

2.14 The impact of changing day of travel on rail demand is most likely to be small. Steer Davies Gleave's 2006 study estimated that only 1% of travellers would actually change the day of travel. The effect on revenue is likely to be even smaller - transfer of passenger demand from one day to another does not mean that overall any demand will be lost, the only effect it will have on revenue will be through the availability (or not) of reduced fares on the day the passenger has actually travelled.

2.15 The importance of rail-heading will be dependent on the availability of alternative routes and will therefore be location specific. At an industry level this effect will be

[1] Note that this is less than the PDFH recommended value of 2.

small as no demand is lost from rail, however at a TOC level the effect may be important. Steer Davies Gleave's 2006 study recommended that a default assumption of 10% of demand diverting be used. However, it did note that there could be a considerable amount of rail-heading if access to another station by car or public transport is good, together with the train journey time from the alternative station being similar to the train journey times of the affected station.

2.16 In order to estimate the effects of rail-heading and time shifting it will be necessary to develop a separate model to MOIRA, as was done in the EEA study.

Modelling the unaware segment

2.17 For the unaware segment, disruption is unexpected so is treated as if it were an unexpected delay. The standard way to model unexpected delays is to calculate the weighted percentage increase in generalised journey time and then apply the standard generalised journey time elasticity. The weight is used to reflect people's preference for certainty. The PDFH recommended value is 3 (i.e. each additional minute of journey time caused by a delayed train is actually equivalent to 3 minutes of generalised journey time).

2.18 There area 2 main issues around this modelling approach:

- PDFH notes that in the empirical work used as a basis for the recommended value of 3 there is considerable variation, with a general range of 1 to 6. The highest results were found for long distance intercity and airport access trips and the lowest results were found for non-London based services.
- The modelling framework for unexpected delay is based on train service average lateness (usually average minute lateness (AML)). This is a probabilistic measure reflecting the delay that can be expected "under normal circumstances", whereas for possessions we are dealing with specific delays which are often larger, but only apply for a defined period.

2.19 One further issue exists with the modelling approach around the time lags and the effect possessions have on future trips, and we discuss this issue in the "Model Assumptions" section.

2.20 There is also no facility in MOIRA to apply the weighting factor described above and any calculation using it needs to be done externally to MOIRA (albeit drawing on MOIRA for estimating GJT changes).

General Discussion of Modelling Approach

2.21 There is a significant theoretical issue with the modelling approach outlined above – both the modelling of the aware and unaware passengers is based around changes that are permanent (or at least semi-permanent). Possessions are in the main temporary, while performance and timetable changes, which are the basis for modelling unaware and aware passengers, involve moving from one level of service quality to another, and there is no expectation of a revision to the original state after a period of time.

2.22 The significance of this theoretical issue can only be determined by attempting to validate the model against actual data. We discuss attempts to validate this modelling

approach in paragraph 2.43 to 2.47.

Model Assumptions

2.23 From the discussion above it is clear that a key assumption made when modelling possessions is the level of passenger awareness.

Awareness

2.24 The PDFH recommends, in the absence of detailed survey data, awareness of major engineering works should be assumed to be 25%. The source for this split is a 1995 study on "Big Delays" by Steer Davies Gleave. Since this original work there have been two significant pieces of market research work undertaken, relating passenger behaviour and possessions – the EEA study and Steer Davies Gleave 2006 study.

2.25 The EEA study surveyed passengers during a Sunday possession between Chelmsford and Liverpool Street in East Anglia and found that 66% of travellers were aware of the possession. The study identified a relationship between awareness and the level of pre-planning, trip frequency and journey distance. This awareness proportion excluded those who were aware and decided to travel by an alternative route or mode or who decided not to travel at all. As a consequence this estimate may understate the level of awareness. However, the possession had been in place for some time and this may have increased levels of awareness.

2.26 Steer Davies Gleave's 2006 study, which surveyed passenger's during a number of different types of possession and at a number of different locations, found that 47% of travellers were aware of the possession. The study attempted to correct this estimate in order to take account of passengers that were aware but decided not to travel. To do this the stated intentions of the unaware passengers were used (if they had been aware of the engineering works). Any bias in the stated intentions of the unaware passengers was corrected by using the difference in response between the unaware passengers and the proportion of the aware passengers who planned to change their behaviour given their actual experience of the journey. It was estimated that 23% of aware passengers would change routes, day, or mode. Using this figure a total level of awareness of 53% was estimated.

2.27 The NERA 2006 study questioned whether a level of awareness of 53% was actually consistent with the revenue loss observed. They argued that revenue losses of 50% from possessions are frequently observed. If only 53% of passengers were aware of the disruption, this would imply that almost all aware passengers change their travel behaviour. This, they noted, would appear to be inconsistent with the survey evidence; the EEA study found that only 25% of passengers would either probably or definitely travel if a coach replaced the train for the entire journey and approximately 40% would probably or definitely still travel if a coach was used for part of the journey.

2.28 In order to generate an assumption on the level of passenger awareness, NERA looked at the empirical evidence on the awareness of passengers travelling during possessions, the proportion of aware passengers that would not travel during a possession, and the loss of revenue during possessions. They then calculated levels of passenger awareness that were consistent with the empirical evidence. They concluded that the calculations implied that over 75% of all passengers are aware of possession in advance of their journey. Table 2.1 presents awareness assumptions by the different sources.

TABLE 2.1 ASSUMED LEVEL OF AWARENESS BY STUDY

	Aware	Unaware
PDFH	25%	75%
EEA Study	66%	34%
Steer Davies Gleave (2006)	53%	47%
NERA (2006)	75%	25%

2.29 The level of awareness recommended by the PDFH is much lower than both the Steer Davies Gleave and the NERA recommendations – this may be due to the original possession being atypical, but it is also likely that the levels of awareness have improved given increased availability and use of web and telephone based services (as found in the Steer Davies Gleave 2006 market research results).

2.30 The reason for the difference between EEA study and the Steer Davies Gleave 2006 study results is most likely to stem from the fact the 2004 survey took place after the possession had been in place for several Sundays and this may have increased the general level of awareness. The surveys for the 2006 study took place on the 1st day of the possession and after the possession had been in place for several days. Further it should be noted that the EEA study result was based on one possession while the Steer Davies Gleave 2006 study results were based on a number of different possessions.

2.31 There are a two possible reasons for the difference between NERA and Steer Davies Gleave recommendations:

- The actual level of revenue loss for a typical possession is much lower than the 50% assumed in the NERA study. The possessions on which this number was based were reasonably large and therefore may have been subject to a higher than average level of awareness; and/or
- The proportion of passengers opting to travel by the same route is much lower than calculated in the Steer Davies Gleave 2006 study.

2.32 On the second point there is considerable difficulty in estimating the actual revenue loss due to possessions and therefore there will be a high degree of uncertainty around any estimate. However, given that the short term revenue loss is determined by the proportion of aware passengers that decide not to travel - the implied short term revenue loss of Steer Davies Gleave's 2006 study is 12% (53% of aware passengers x 23% of aware passenger that decide not to travel), does seem to be a relatively low impact.

2.33 We can re-calculate the adjustment made to estimate total awareness from the 47% of travellers on the day of the possession (see para 2.26 above). If we assume that 60% of aware passengers will change route, day, or mode (which is comparable to the stated intentions results from the EEA study when there is a bus replacement service for part of the journey) then the estimated level of total passenger awareness is 69%[2]. This number is more comparable with the recommendation put forward by NERA.

2.34 Therefore we believe that one reason for the difference between the NERA and the Steer Davies Gleave 2006 recommendation is due to the assumption of a high proportion of aware passengers continuing to travel, at least for large possessions. This may be due to biases in the stated intention of unaware passengers about what they would have done if they had been aware. The passengers surveyed were already travelling during a possession so may have been more inclined to say that they would have still travelled even if they had been aware of the possession. Alternatively, they may simply differ in their likely responses as compared with aware passengers, e.g. those who seek out information on possessions may be more prepared to act on the resulting information. This conclusion suggests that results from the EEA study on the proportion of aware passengers who decided not to travel (60%) are more robust than those from the Steer Davies Gleave 2006 study.

2.35 However, it may also be the case that there is a correlation between the size of a possession, the level of awareness and the proportion of aware passengers who choose not to travel. The possessions for which we have empirical results tend to be the largest possessions, where the measured demand impacts are of the order of at least 35% and sometimes higher than 50% (as we note later). In these cases the above analysis demonstrates that levels of awareness must be very high to generate an impact of this magnitude. However, for smaller possessions both the levels of awareness and short-term demand impact may be lower, also making their effect more difficult to measure.

Long Term Effect

2.36 There is little empirical evidence on the long term effect of possessions on demand; however there is some evidence on the demand response time to changes in train service performance and timetables. This evidence suggests that demand can take between 6 months for performance change and 2 years for permanent timetable changes (longer for commuting) to completely feed through (source: PDFH). It is likely that the response of the unaware passengers would be similar to passengers experiencing poor performance and therefore this evidence may be applicable to possessions.

---

[2] To calculate this 69% figure we used the same logic as was used in Steer Davies Gleave 2006 study. If 60% of aware passengers would not travel during the possession then this implies that the observed aware passengers represent 40% of the total potential aware passengers. Since the aware segment represents 47% of sampled passengers, we can deduce that the ratio of unaware to aware passengers is:

Unaware: Aware = 53:(47/0.40) = 0.45:1

From this we can calculate the total potential market for the during possession survey segments into 31% unaware passengers and 69% aware.

2.37 Research by Steer Davies Gleave for the Rail Industry Forecasting Framework (RIFF) provides some insight into the possible longer term effects. This showed that travellers often have "default" travel modes and require a stimulus to consider alternative travel options. This stimulus may be external to the rail network, such as a change of job or house move, or it may be a rail service improvement or major periods of disruption. In the case of a reduction in the quality of the rail service, losses of traffic could be quite rapid (depending on the availability of alternative options) but recovery will depend on another stimulus occurring. This evidence suggests that the effects could be very long term or even permanent.

2.38 While this research may be applicable to medium and long term blockades, it seems likely that the recovery time for a short one-off possession would be almost instantaneous. It is probable therefore that recovery time is not a simple linear function of the duration of the possession.

2.39 Some evidence of the impact of possession on future travel behaviour is provided from the Steer Davies Gleave 2006 market research work. This identified two effects:

- The level of satisfaction with the journey is lower among the unaware than the aware.
- Propensity to travel by rail less, avoid Sundays and avoid travelling during works all increase with both the level of dissatisfaction and the level of awareness. However, from the survey, while dissatisfied unaware passengers reacted more negatively than dissatisfied aware passengers, there was little difference in future use of rail by either aware or unaware satisfied passengers.

2.40 The research did not give any indication of how much less respondents would travel by rail – although even if it had it is questionable how reliable any result would have been. The situation is further complicated by the possibility of a reduction (or otherwise) in this effect over time, as it is offset by more positive experiences of rail travel (or further encounters with possessions). Overlaid on this is the effect of churn in the market, with some passengers ceasing to use rail and others coming into the market.

2.41 It should be noted that if there is general avoidance of Sundays, this implies that possessions may have a cumulative effect. Currently the Schedule 4 regime only provides compensation for the incremental effect of possessions. Given that it is likely that the cumulative effect of reduced Sunday demand is taken into account in franchise bidders revenue forecasts, this is probably not a significant issue. However, it may be an issue when considering options for the compensation regime going forward.

Validation & Calibration

2.42 As mentioned above, there has been no definitive study on the validation of the actual revenue losses as compared with modelled estimates. However, the literature does provide some indication of whether the approach does validate against observed revenue loss.

MOIRA vs. Actual Data

2.43 The EEA study and the NERA study both attempted to a very limited degree to validate modelled estimates of loss with actual losses. Neither study provided a validation that was statistically robust.

2.44 The EEA study developed a demand model that attempted to fully model the process described in Figure 2.1. In order to validate the model the study looked at 2 years' of LENNON data for a selection of key flows affected by a possession between Chelmsford and Liverpool Street. It also used a demand model to estimate the effect of the possession. Because of the reasons described in paragraph 2.4 it was not possible to develop a statistically robust estimate of the loss but through observation there appeared to be a 50% reduction in revenue for full price tickets and a 30% reduction for reduced tickets - as this possession occurred on Sunday the largest portion of revenue came from reduced tickets. This compared with estimated revenue loss from the demand model of approximately 35%.

2.45 To estimate revenue loss the NERA study used MOIRA, with allowances made for level of awareness. The NERA study looked at the losses reported in the Steer Davies Gleave 2006 report and identified eight observations that were sufficiently robust to provide a general view on the loss incurred by the type of possession they were analysing – these observations of revenue loss were 21%, 24%, 42%, 43%, 48%, 72%, 74% and 81%. The median fall of these observations is 45%. The report also noted some anecdotal evidence that approximately 50% of passengers are lost during severe disruption.

2.46 NERA 2006 compared the 45% actual revenue loss to their modelled estimate of 33% - note that they were not comparing the same possession here but were attempting to compare similar types of possessions. They then further argued that because they were looking (in their MOIRA estimate) at the total industry loss, while the actual loss looked at the loss over affected flows, it was necessary to factor down the actual revenue loss in order to take account of rail heading and day switching. Adjusting for this, the actual revenue estimates were considered to be around 34% to 38%, comparing favourably with the estimated MOIRA loss.

2.47 It should be emphasised that neither of these validation exercises are robust but they do potentially help form a view about the accuracy of MOIRA estimates.

Schedule 4 vs. MOIRA

2.48 The EEA study provided a comparison between modelled estimate of loss and Schedule 4, for a set of possessions on the Great Western route. The model used in this study was a full application of the forecasting process described in Figure 2.1 – with MOIRA used to estimate the effect on aware passengers. The unaware passengers were assumed to treat the possession as if it were an unexpected delay. As detailed in Table 2.1 the study assumed 66% of passengers were aware.

2.49 The high level comparison provided in the study is reproduced in Figure 2.2 – note "Base Plan" refers to possessions undertaken with a traditional possession strategy and "EEAS Replan" refers to the same set of possessions but undertaken with an Efficient

Engineering Access strategy.

TABLE 2.2 GREAT WESTERN RENEWALS BASE VERSUS REPLAN

	Total estimated revenue loss (from model)	Total Schedule 4 costs
Base Plan	£2,942,206	£6,399,788
EEAS Replan	£3,005,531	£7,643,868

2.50 The headline result is that the model estimate is approximately half of Schedule 4. The study also looked at the correlation between Schedule 4 and MOIRA for individual possessions, and this analysis is re-produced in Figure 2.2 below (the second chart looks at revenue loss estimates of less than £100k). The charts show that the two measures are not well correlated, with Schedule 4 both significantly higher and significantly lower than the revenue loss estimates for individual possessions.

FIGURE 2.2 REVENUE LOSS ESTIMATES VS. SCHEDULE 4 COSTS BY POSSESSION

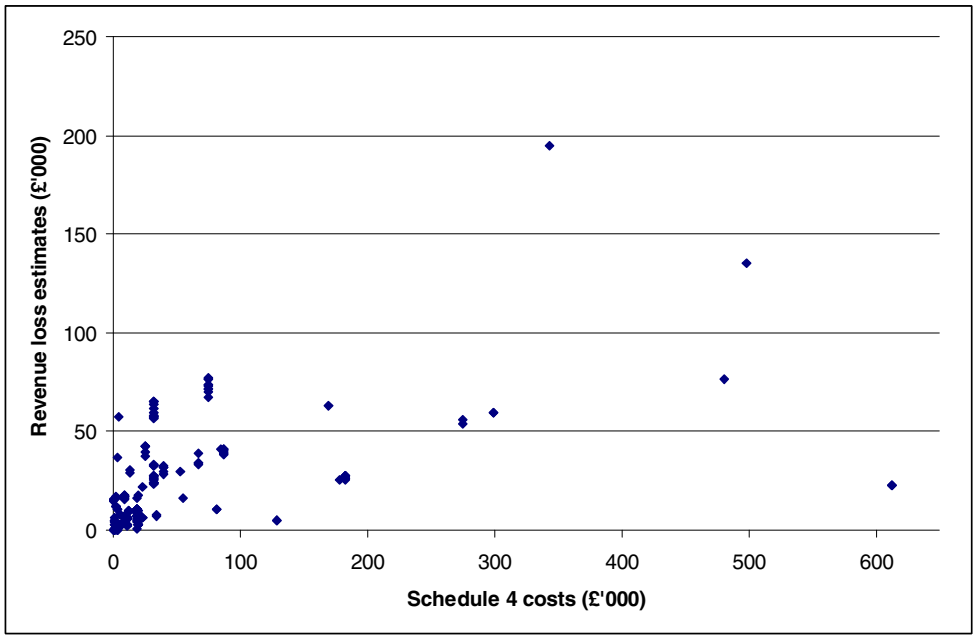
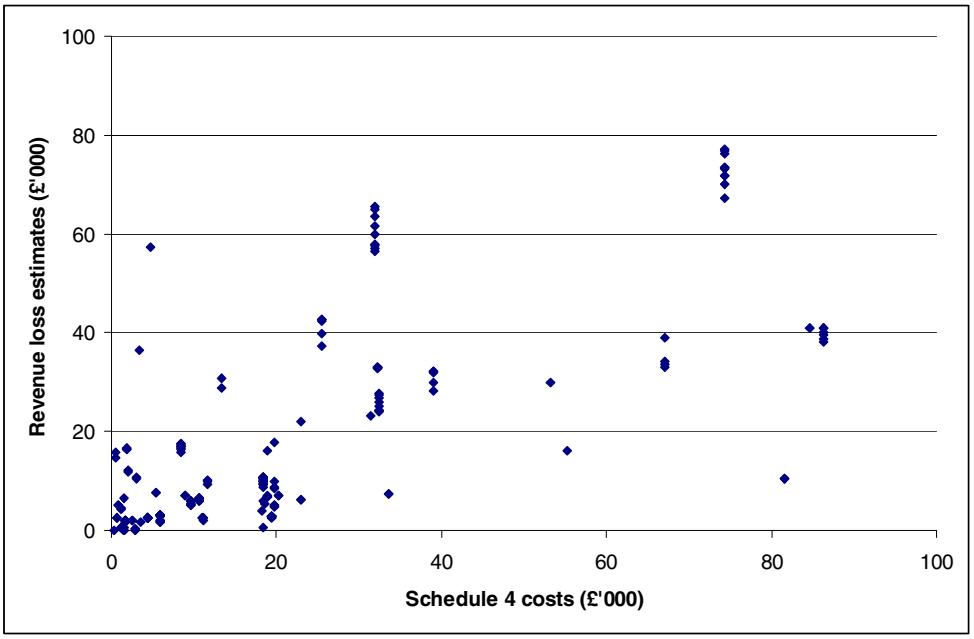


FIGURE 2.3 REVENUE LOSS ESTIMATES VS. SCHEDULE 4 COSTS BY POSSESSION (ESTIMATES OF LESS THAT £100K)



2.51 This analysis suggests that there is little correlation between Schedule 4 and MOIRA estimates of revenue loss for individual possessions, though in aggregate Schedule 4 estimates were higher than the model (possibly unduly influenced by the very largest possessions). However, the following caveats apply:

- The results focus on one area;
- The results involve a limited set of TOCs; and
- It is not clear how representative the possessions examined are – e.g. in terms of duration, level of notification etc.

Conclusion from Literature Review

2.52 From the literature review we draw the following conclusions:

- There is a significant issue around the lack of empirical understanding of the actual effect of possessions;
- While the empirical research is limited, for a week long possession and series of Sunday possessions the median loss seems to be around 45%;
- There is a well developed methodology for estimating the effect of possessions, which is largely based on MOIRA and PDFH;
- There is little understanding of the long term effect of possessions, which could be significant in some cases; and
- The estimates of revenue loss generated for the modelling framework seems consistent with our understanding of the actual loss from possessions.

3. QUANTITATIVE ANALYSIS

Introduction

3.1 This section provides details on the analysis we have conducted in order to complete the work items, which we refer to as tasks, detailed in the ITT. The results from following tasks are reported below:

- Task 3 – Validation of MOIRA Demand Profiles;
- Task 4 – Comparison between actual revenue loss and modelled revenue loss;
- Task 5 – Validation of model assumptions; and
- Task 6 – Comparison between MOIRA estimates of loss and Schedule 4 estimates of loss.

Task 3 Validation of MOIRA Demand Profiles

3.2 Where the Schedule 4 algorithm is not considered an appropriate method to calculate the amount of compensation payable, it is common to use the industry standard MOIRA model to provide an estimate of revenue loss due to a possession. However, as with any model, there are likely be discrepancies between estimated and actual demand. The analysis presented in this section aims to validate MOIRA demand profiles against actual on-train count data.

3.3 We have received count data from three train operating companies:

- TOC 1 (Regional operator);
- TOC 2 (Intercity operator); and
- TOC 3 (London and South East operator).

3.4 The data for all three TOCs covers both weekdays and weekends. TOC 1's count data is for September 2006, and TOC 2's count data cover the period from December 2006 to May 2007. Both TOC 1 and TOC 2 provided count information for individual trains. The data for TOC 3 is a lot less comprehensive than that received from TOC 1 and TOC 2. TOC 3's count data only covers two routes and was only provided by hour band. As a consequence of this we present TOC 3's results on a slightly different basis than the results for TOC 1 and TOC 2.

3.5 In order to extract comparable data to the counts, only the relevant service groups were selected in MOIRA, and then loads were extracted by service and leg for weekdays, Saturday and Sunday separately. Different versions of MOIRA were used for the data extraction for the three TOCs.

MOIRA passenger loads by day of the week

3.6 Figure 3.1 and Figure 3.2 show the average train load across all TOC 1 and TOC 2 services by day of week, for both MOIRA and actual counts. Figure 3.3 shows the total average number of passengers on one of TOC 3's key routes by day of the week.

FIGURE 3.1 AVERAGE TOC 1 LOADS BY DAY OF WEEK - MOIRA VS COUNTS

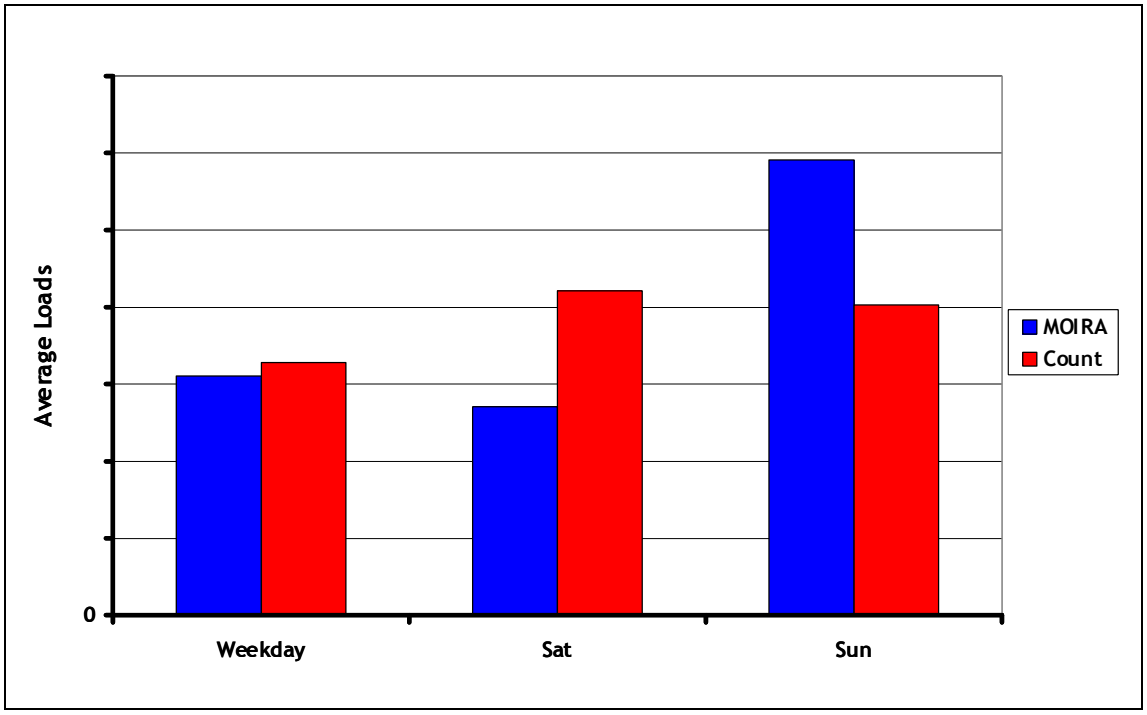


FIGURE 3.2 AVERAGE TOC 2 LOADS BY DAY OF WEEK - MOIRA VS COUNTS

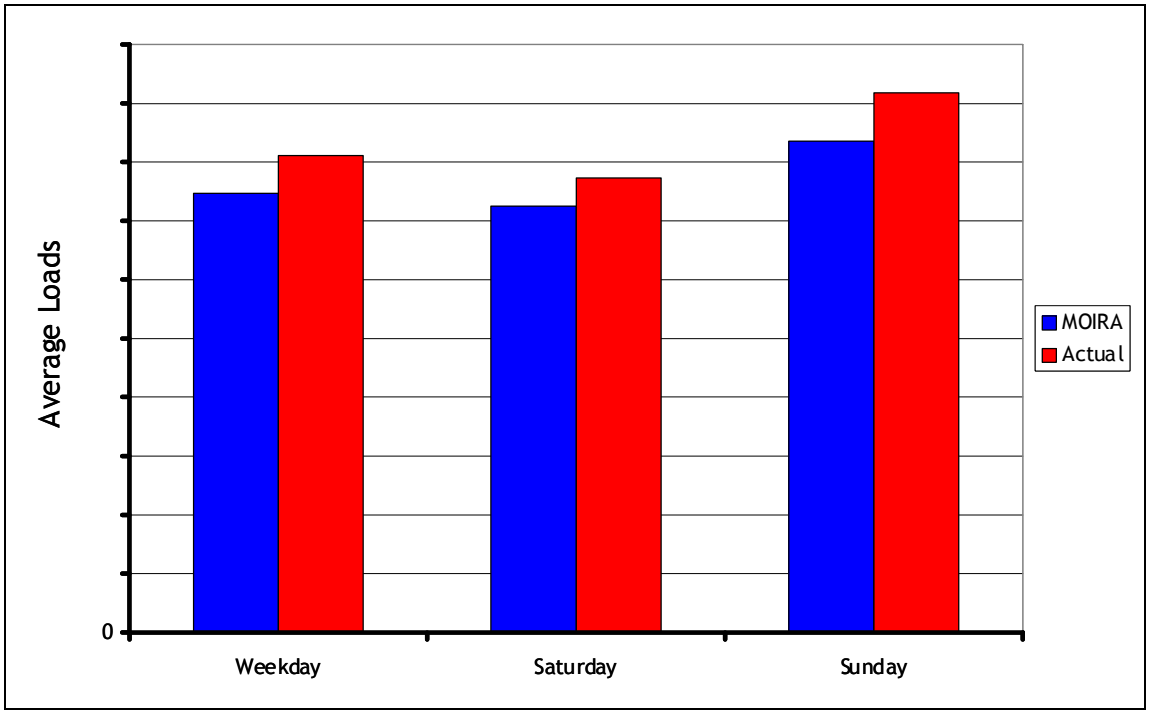
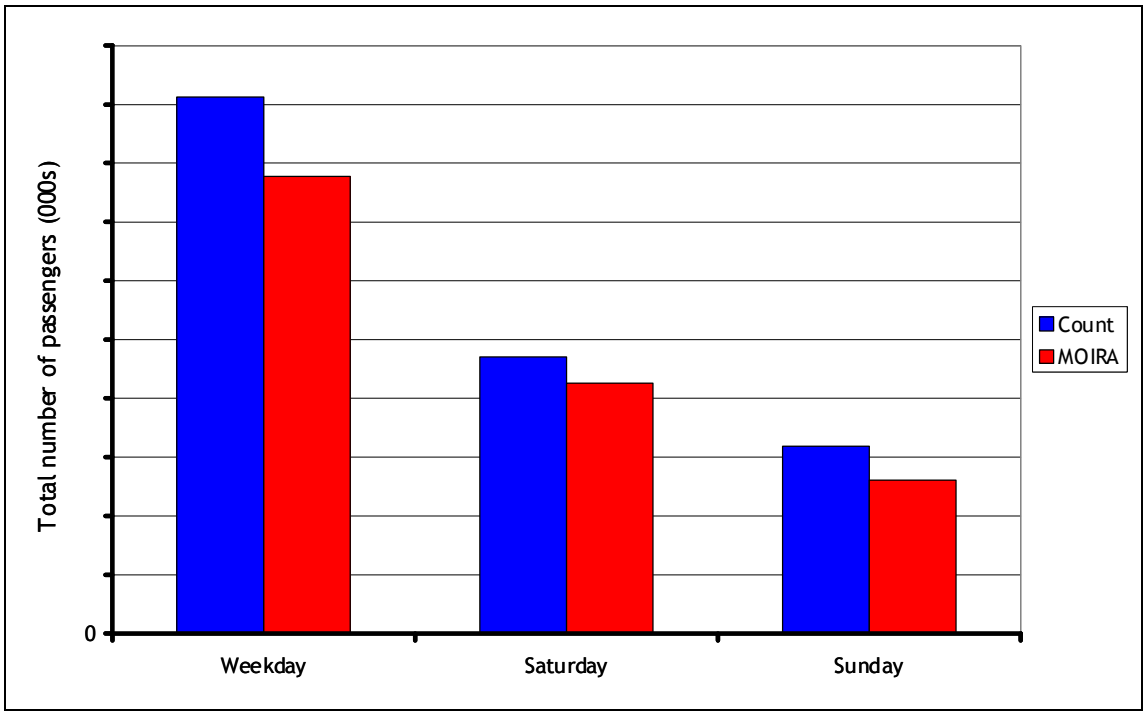


FIGURE 3.3 TOTAL PASSENGERS ON KEY ROUTE BY DAY OF WEEK FOR TOC 3 - MOIRA VS COUNTS



3.7 For TOC 1 MOIRA provides a reasonable estimate of loads on weekdays. However, there are significant differences between modelled and actual loads at weekends, with Saturday loads underestimated by MOIRA, and Sunday loads surprisingly overestimated. For both TOC 2 and TOC 3, while MOIRA is consistently below the actual data it captures the distribution between weekday, Saturday and Sunday reasonably well. The reason that MOIRA will usually be below the actual data is likely to be a consequence of the journey information not included in MOIRA's base matrix (e.g. fare evasion, free passes, and, less applicable to these routes, TfL-sold travelcards and PTE tickets).

MOIRA Passenger Loads through the day

3.8 To investigate the accuracy of MOIRA demand profiles throughout the day for TOC 1 and TOC 2, average train loads were derived for all services at a number of key stations on each TOC's network. These loads were then plotted by time of departure from the station, and compared to the average loads observed on the corresponding services in the count data. A similar process was completed for TOC 3 but instead of calculating average loads, due to the lack of rolling stock information, we calculated the total number of passengers per day arriving and departing from selected key stations. This analysis for all three TOCs was carried out separately for weekday, Saturday and Sunday demand.

3.9 Below we present the analysis for three key stations:

- Station A (TOC 1);
- Station B (TOC 2); and
- London Terminus (TOC 3).

3.10 For both Station A and Station B we present the analysis for all trains departures. For London Terminus we present the analysis for passenger arrivals travelling on one of the key routes that we have count data for.

3.11 The graphs below show the estimated and actual demand profiles for each of the stations above, by day of week. Where there were gaps in the count data (i.e. missing services or stops), the corresponding service/stop in MOIRA was excluded. This means that the profiles of estimated and actual demand are like-for-like comparisons in terms of the trains sampled.

Station A

3.12 The comparison of MOIRA's demand profile and the demand profile from the count data is presented in Figure 3.4 to Figure 3.6 below. Overall, the profile of MOIRA loads is understated for departures after 11:00 from Station A on weekdays, although the evening peak is significantly underestimated. The same is true for Saturday with a very sharp peak in the actual data at around 20:00-21:00. The sample of count data is fairly small for Sundays and only for half a day. MOIRA understates demand in the early morning and overstates demand in the late morning.

FIGURE 3.4 STATION A DEPARTURES - MOIRA VS COUNTS (WEEKDAY)

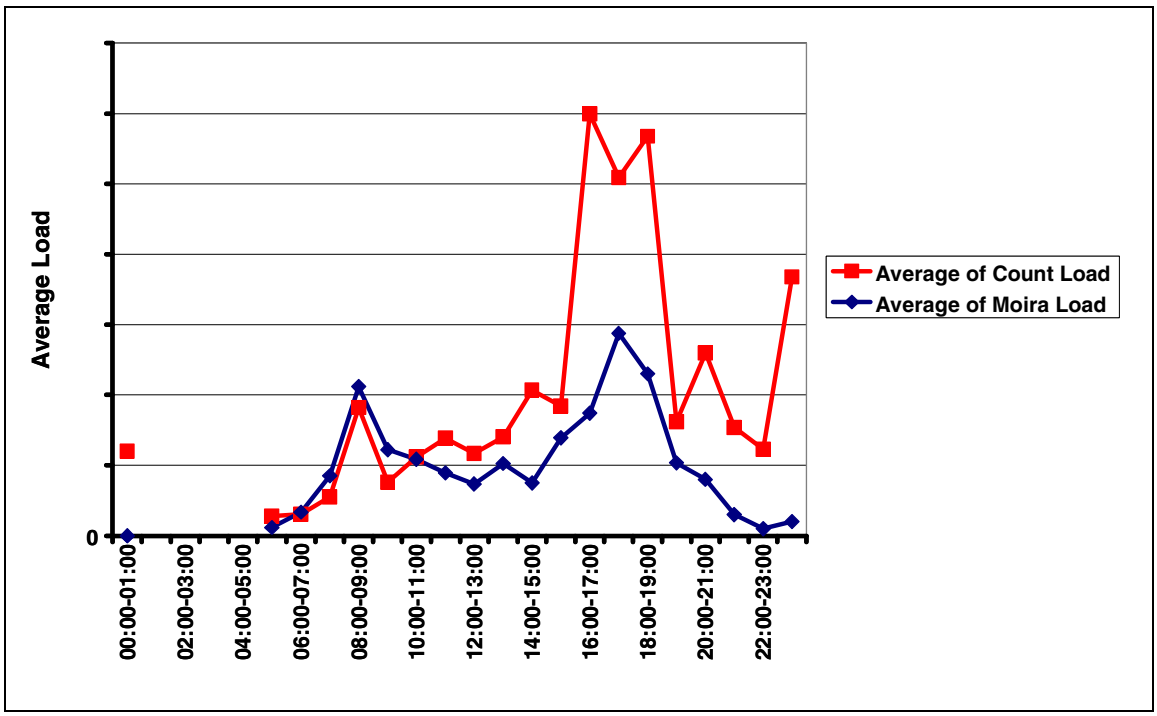


FIGURE 3.5 STATION A DEPARTURES - MOIRA VS COUNTS (SATURDAY)

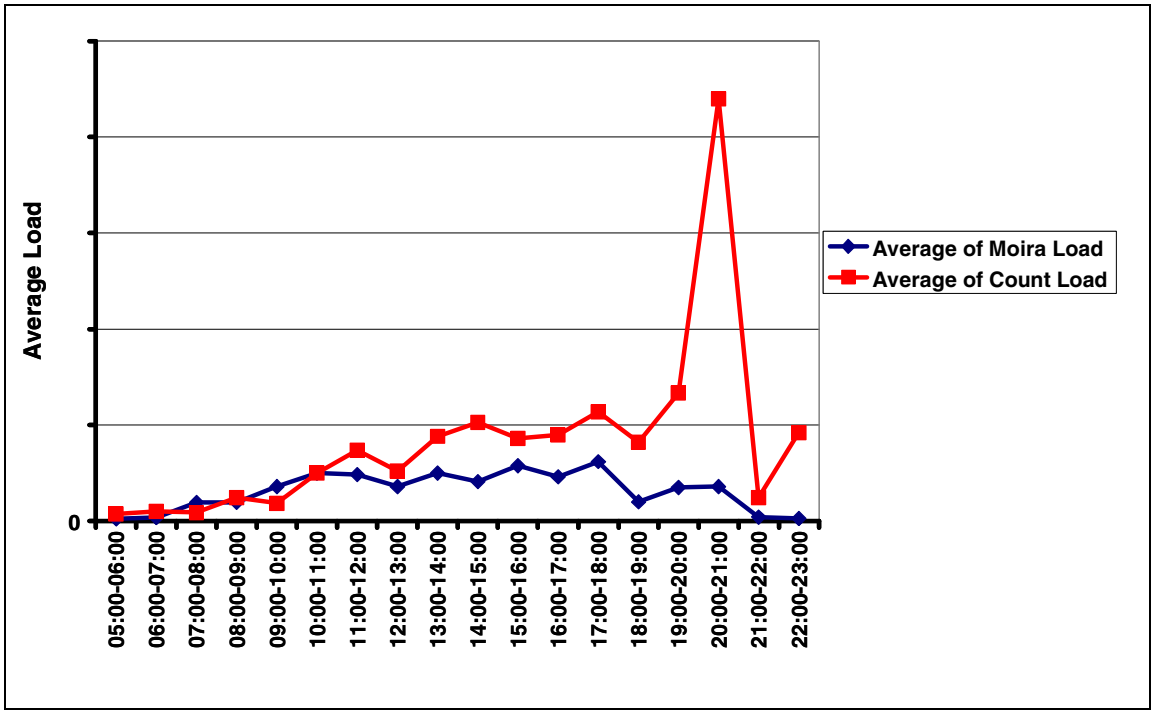
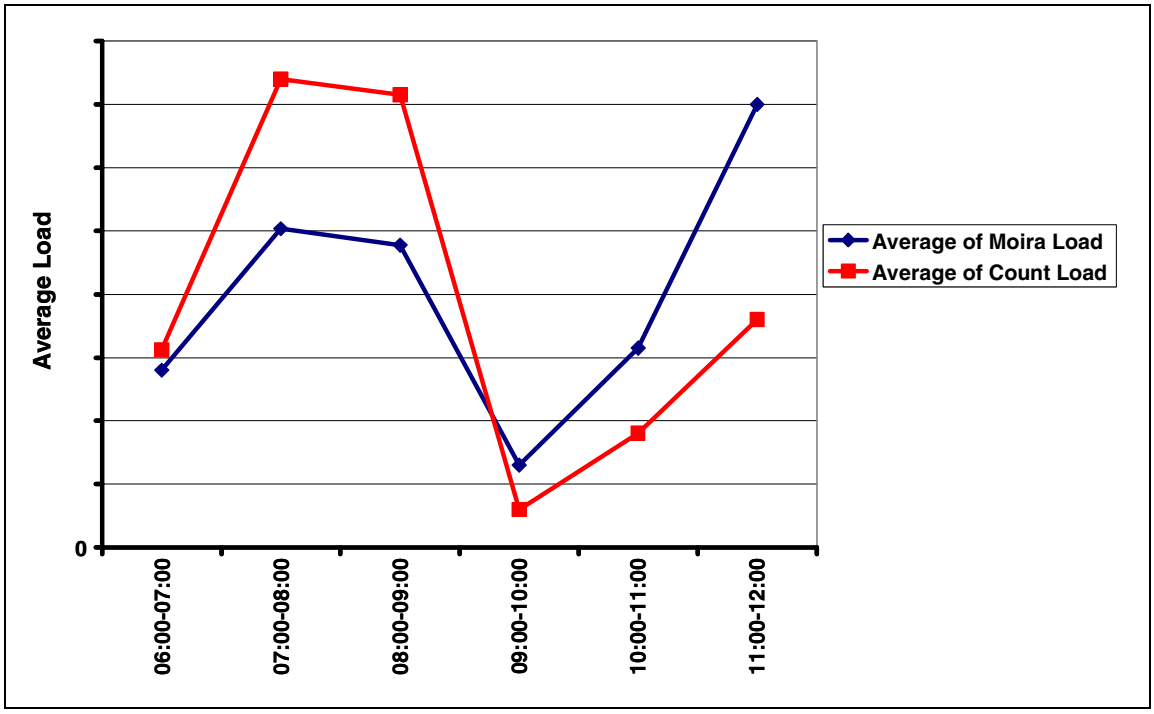


FIGURE 3.6 STATION A DEPARTURES - MOIRA VS COUNTS (SUNDAY)



Station B

3.13 The MOIRA weekday profile is far more "peaky" than the actual count data, with too much demand in the AM and PM peaks and too little demand in the inter-peak period. It is also interesting to note that MOIRA significantly underestimates the demand after

the PM peak for both the weekday profile and the Saturday profile. For Sunday demand (Figure 3.9), while the shape of MOIRA's demand profile is similar to the count data there are significant discrepancies between the two.

3.14 Given that a significant number of possessions occur late at night, if MOIRA does consistently understate the evening demand then it will underestimate the revenue loss of possessions which take place during this period. As the Schedule 4 algorithm is based on average revenue across the day it may be the case that for evening possessions the algorithm provides a more accurate estimate of revenue loss.

FIGURE 3.7 STATION B DEPARTURES - MOIRA VS COUNTS (WEEKDAY)

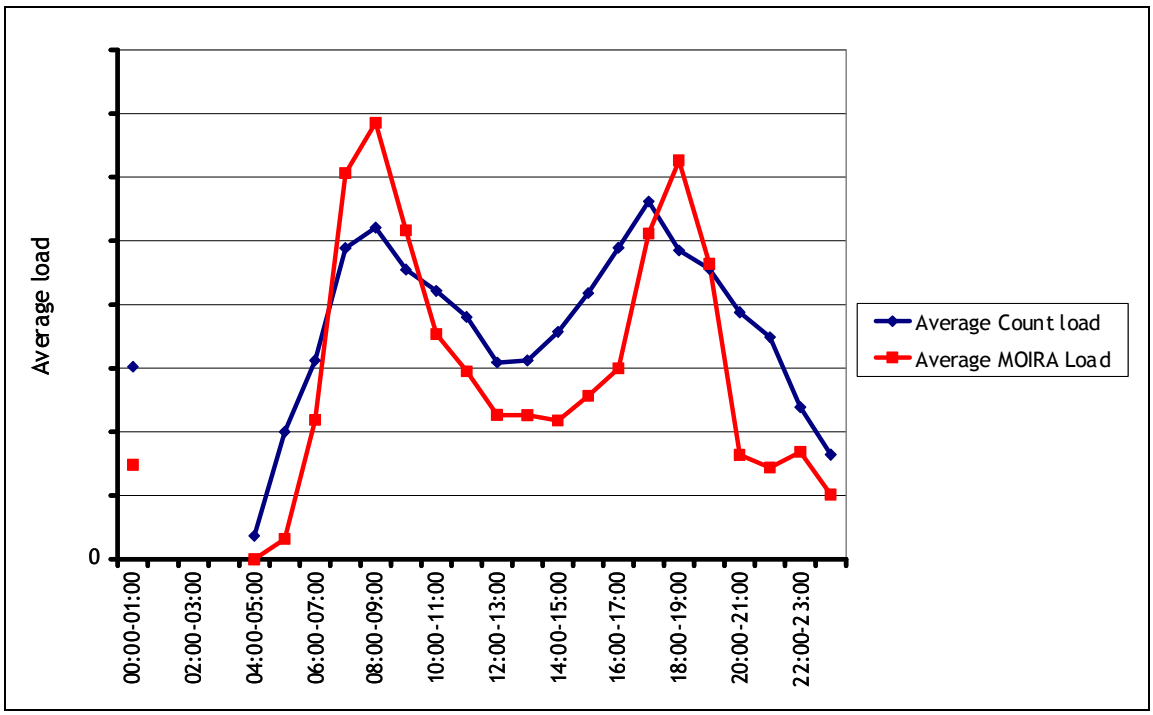


FIGURE 3.8 STATION B DEPARTURES - MOIRA VS COUNTS (SATURDAY)

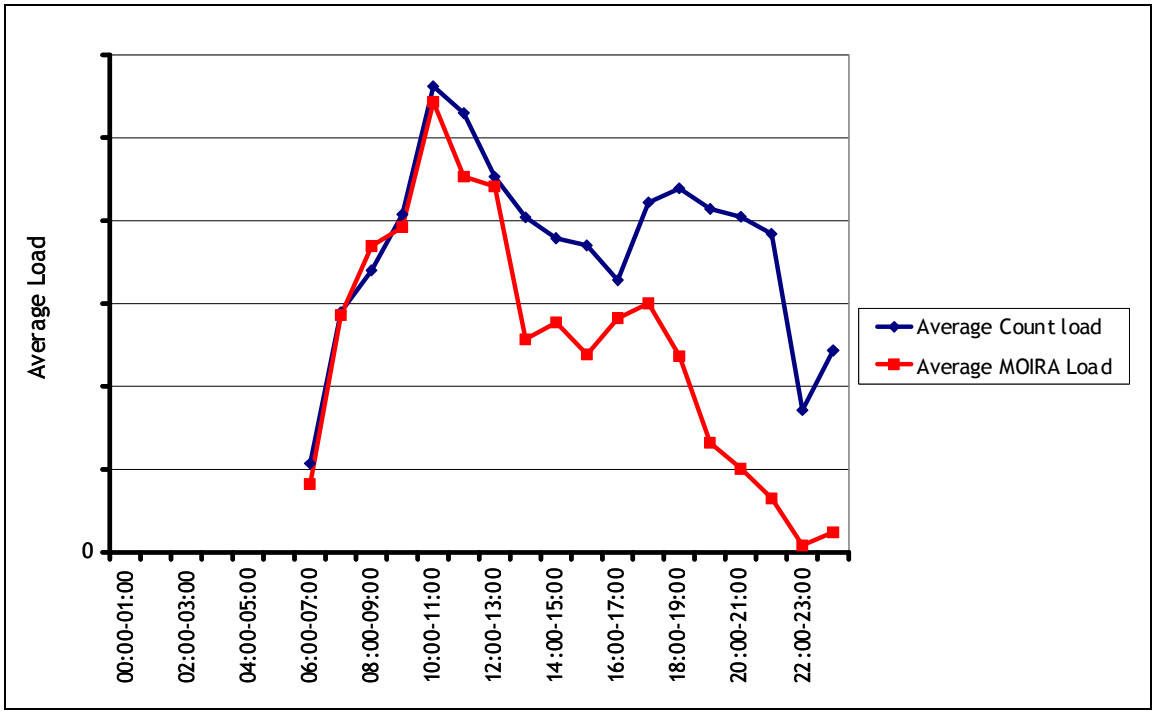
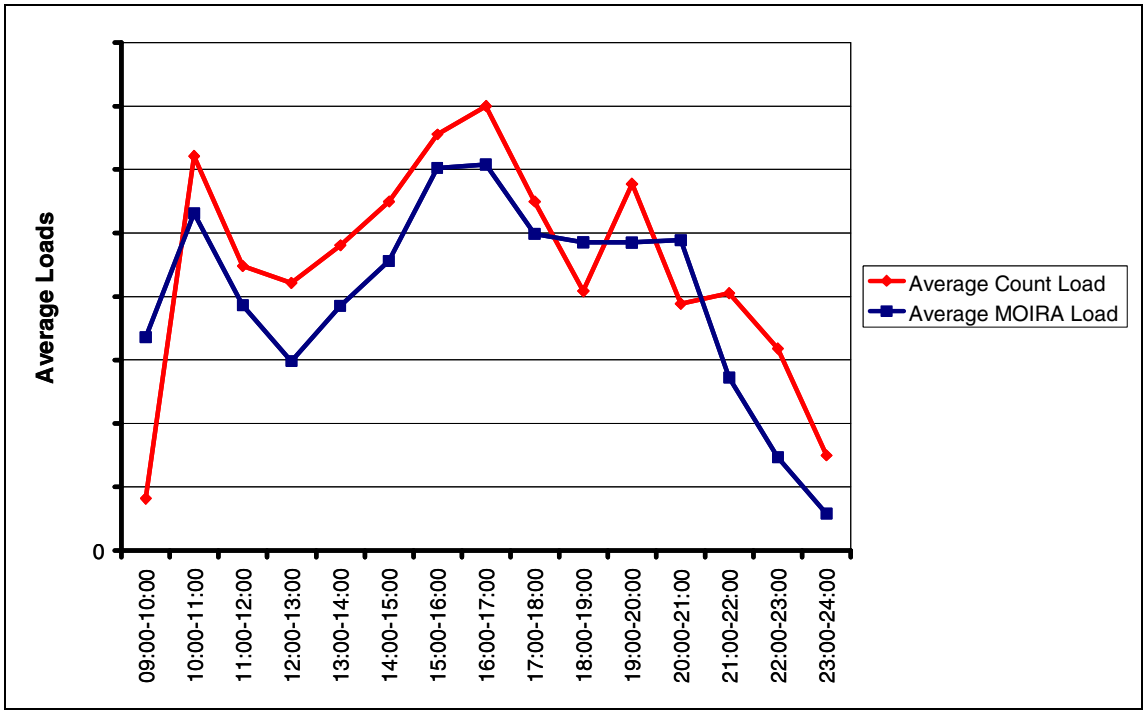


FIGURE 3.9 STATION B DEPARTURES - MOIRA VS COUNTS (SUNDAY)



London Terminus

3.15 As shown in Figure 3.10 and Figure 3.11, MOIRA's demand profile for arrivals into the London terminus validates reasonably well against the count data. There is a significant discrepancy between MOIRA and the count during the AM peak, however this may be due to data issues (there appeared to be a surprising amount of volatility in

the data and the sample size used was unclear) rather than any real difference. The comparison of the Sunday demand profiles presented in Figure 3.12 shows significant discrepancies between MOIRA and the count data. Again this may be due more to the robustness of the count data rather than any underlying difference.

FIGURE 3.10 LONDON TERMINUS ARRIVALS (FOR A KEY ROUTE) - MOIRA VS COUNTS (WEEKDAY)

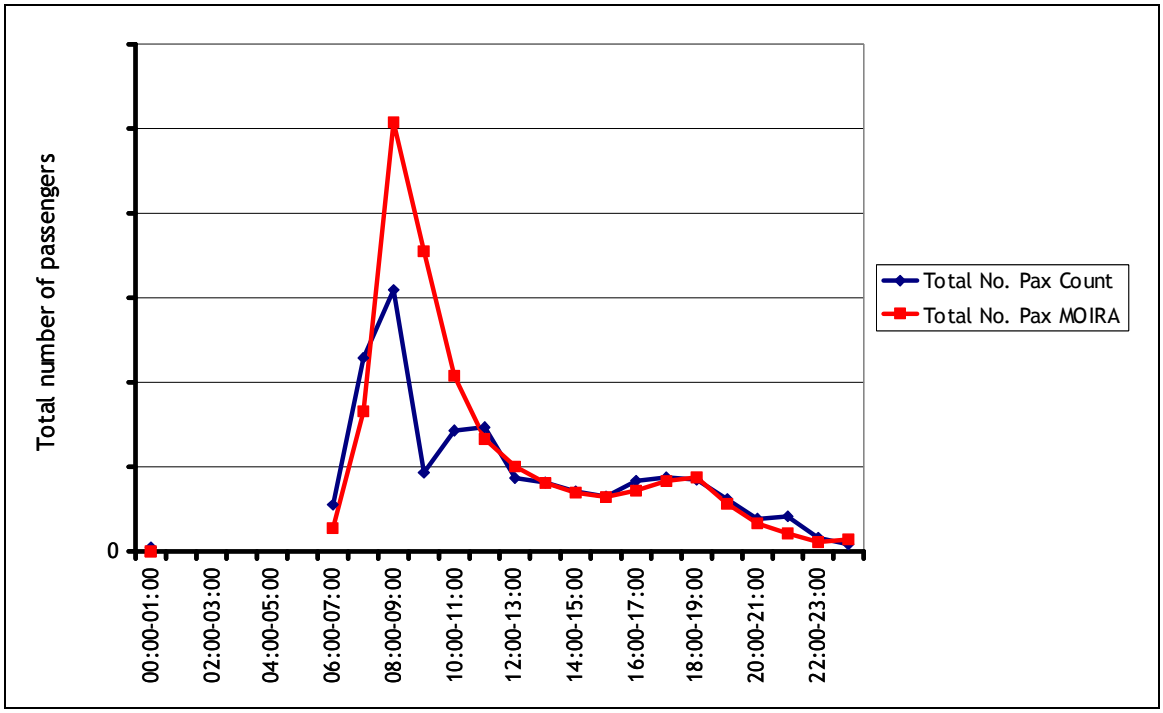


FIGURE 3.11 LONDON TERMINUS ARRIVALS (FOR A KEY ROUTE) - MOIRA VS COUNTS (SATURDAY)

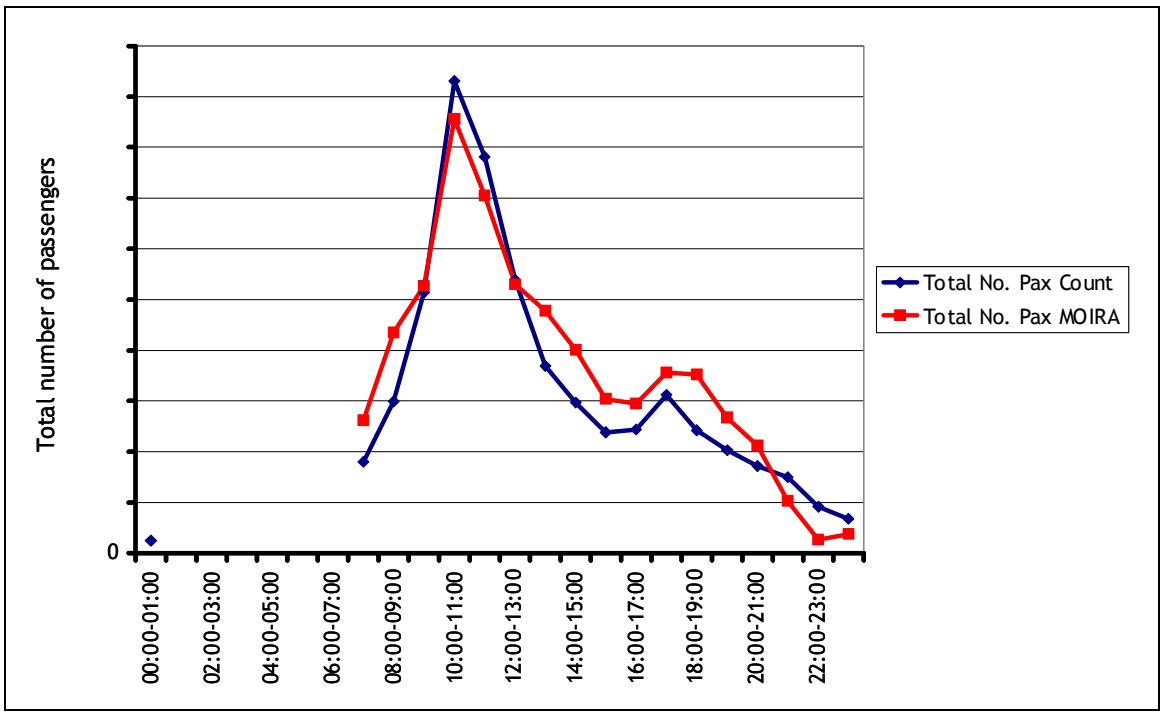
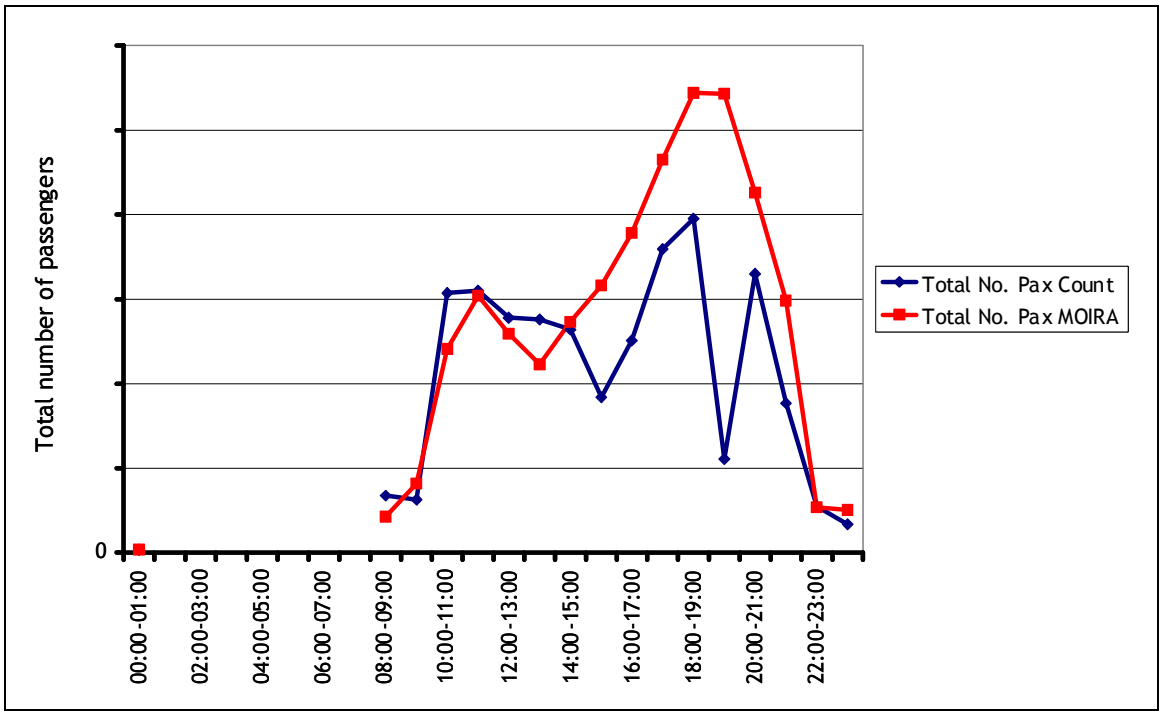


FIGURE 3.12 LONDON TERMINUS ARRIVALS (FOR A KEY ROUTE) - MOIRA VS COUNTS (SUNDAY)



Conclusion from Validation of MOIRA Demand Profiles

3.16 There are widespread anecdotal reports that MOIRA tends to understate demand for times when possessions generally occur, e.g. late evening Monday to Friday, Saturday evening and Sunday morning. While the evidence presented above is not conclusive it does appear to support this view.

3.17 The table below summarises are main findings from the key station analysis.

TABLE 3.1 SUMMARY OF KEY STATION ANALYSIS

	Weekday	Saturday	Sunday
TOC 1	MOIRA under-predicts the amount of demand in the PM peak	Sharp peak in actual data around 20:00 to 21:00 which is not represented in MOIRA.	MOIRA understates demand in the early morning and overstates demand in the late morning.
TOC 2	MOIRA demand profile too “peaky” and too little demand in the inter-peak period	MOIRA significantly underestimates demand in the evening	MOIRA’s demand profile is similar to the actual data.
TOC 3	MOIRA validate reasonably well against actual data.	MOIRA validates reasonably well against actual data.	Significant discrepancies between MOIRA and actual data.

Task 4 Actual vs. Modelled

3.18 The best way to measure the accuracy of modelled estimates of the revenue loss is to compare estimates of revenue loss based on historic data and modelled estimates of loss. However, as discussed in the Literature Review it has proved difficult to accurately measure revenue loss by direct analysis of revenue data, because of the difficulty of isolating the impact of the possession from the impact of other factors, and the level of "noise" in the data.

3.19 As discussed in the ITT it was felt that commissioning further econometric work was likely to encounter the same problems as previous work and therefore this was excluded from the scope of this study. However the ITT did request that some analysis be conducted on the relationship between actual and modelled using possessions where train operators and Network Rail have agreed compensation based on actual revenue loss. We have reviewed two case studies where Part G negotiations have been completed:

- Strood Tunnel closure (closed during whole of calendar year 2004); and
- Ipswich Tunnel closure (2 months during summer 2004).

Strood Tunnel Closure

3.20 Strood Tunnel was originally constructed for a canal which opened in 1824. It was converted into a railway tunnel in 1847 by infilling the canal. Approximately 60% of the tunnel was brick lined and the remainder was unlined exposed chalk. Numerous chalk falls were recorded in the unlined section. In June 2000, a tunnel shaft collapsed and the tunnel was closed for six weeks while repairs were undertaken. The tunnel was re-opened with a temporary speed restriction (TSR) of 20mph. This was converted into a permanent speed restriction (PSR) in November 2000, after Railtrack had carried out a Network Change consultation. It was eventually decided to close the tunnel during 2004 in order to rebuild the tunnel so the PSR could be removed.

3.21 The revenue compensation claim that resulted from the closure of Strood Tunnel was settled through Part G of the Network Code. During the process of the Part G negotiation three different approaches to estimating the revenue compensation payable were used: the Schedule 4 algorithm, MOIRA, and analysis of historic LENNON data.

3.22 From reviewing the documentation on the Part G claim it is not clear precisely the MOIRA methodology used. In particular, it is not clear whether SET took any account of unaware passengers or just used simple MOIRA. However, the revenue loss SET calculated through MOIRA was 75% higher than the loss calculated using the Schedule 4 algorithm.

3.23 In order to validate the MOIRA claim SET looked at the top 12 flows affected by the possession. For these flows MOIRA gave a 47.3% decrease in revenue. SET then looked at the percentage change for periods 2-5 in 2003/4 and 2004/5 for journeys on Cheap Day tickets – they calculated an average decrease for the 12 flows of 42.6%. Using these numbers would suggest that 84% of the MOIRA projected loss had occurred.

3.24 Network Rail decided to pay the larger MOIRA claim (minus the money already paid through the normal Schedule 4 process). The reason Network Rail gave for paying the larger amount was that SET were not asking to be compensated whilst their business was recovering after the tunnel re-opened.

Ipswich Tunnel Closure

3.25 Ipswich tunnel was closed from the 11th July to 6th September in order to upgrade the tunnel's ability to allow freight trains to pass through it. Bus replacement services were provided between Ipswich and Harwich/Mistley. Two Norwich to London Liverpool Street services each way were diverted via Cambridge to the Lea Valley.

3.26 From reviewing the Ipswich Tunnel file it appears that MOIRA was not used to provide an estimate of the revenue loss. The revenue loss calculation was based on comparing the revenue outturn for the affected periods with the income budget for the same periods - ONE received compensation equal to the shortfall between the two. From the file it would appear that ONE received further compensation for loss due to any lagged recovery. This methodology produced a revenue loss estimate nearly double that of the Schedule 4 estimate.

Conclusions from Task 4 Actual vs. Modelled

3.27 From the analysis of the two case studies it is not possible to draw any robust conclusions about how MOIRA and Schedule 4 validates against estimates of loss based on historic LENNON data. In both cases the settlement was approximately double the schedule 4 estimate, so there is some evidence that Schedule 4 may underestimate the revenue loss for large possessions. However, it may be the case that the under-estimation is not to do with the "size" but to do with the nature of the possessions.

Task 5 Validation of Model Assumptions

3.28 The main purpose of this workstream was to investigate the issues surrounding passengers' level of awareness of possessions. This is largely done by revisiting survey data from the 2006 Steer Davies Gleave study.

3.29 The first part of this section investigates the links between key characteristics of a passenger's journey and their level of awareness, based on survey data collected from a range of different possessions. We then go on to compare this survey data with Network Rail data for the same set of possessions, in order to look into the relationship between Notification Factors and levels of passenger awareness.

Journey Characteristics and Awareness Level

3.30 The 2006 study carried out by Steer Davies Gleave included a series of passenger surveys focussing on nine separate possessions at different locations throughout the country. The surveys were conducted while engineering works were in progress and a replacement bus or coach service was in operation. The possessions included in the survey are shown in Table 3.2.

TABLE 3.2 STEER DAVIES GLEAVE 2006 STUDY - POSSESSIONS SURVEYED

No.	TOC	Type	Location
1	Silverlink	> 1 week	Gospel Oak/South Tottenham to Barking
2	Merseyrail	Series of Sundays	Hunts Cross to Garston, Hamilton Square to Birkenhead North
3	First Scot Rail	Series of Sundays	Carlisle to Kilmarnock
4	One Railway	Series of Sundays	Bury St Edmunds to Ely
5	Arriva Trains Wales / Central Trains	Series of weekends	Cardiff to Gloucester
6	South West Trains	Series of weekends	Surbiton to Effingham Junction, Virginia Water to Weybridge
7	First Great Western / Wessex	Series of weekends + Bank Holiday	Swindon to Gloucester/Cheltenham
8	GNER / WAGN	Bank Holiday Weekend	Stevenage to Hatfield / Welwyn Garden City
9	Transpennine Express	Bank Holiday Weekend	Scunthorpe to Cleethorpes

3.31 The survey was administered as a self-completion questionnaire, and contained a range of questions relating to each passenger's journey, including journey purpose, ticket type and frequency of travel. There were also questions relating to how the passenger planned their journey, including the location and time of purchase, the level of planning that took place, and the sources of information used. However, the key piece of information in terms of this work is the passenger's stated level of awareness of the possession affecting their journey.

3.32 Passengers were given six options when asked to say when they first became aware of the engineering works affecting their journey:

- Some weeks ago;
- Some days ago;
- Just before setting out;
- On arrival at station;
- On-board train / replacement bus;
- Not aware until participation in survey.

3.33 For the purposes of the analysis that follows, we aggregated the above responses so that passengers in the first three groups are treated as being "aware", while passengers in the last three groups are treated as "unaware".

3.34 The following sections present the relationship between key characteristics of a passenger's journey and the measure of awareness described above. Clearly, some of these characteristics will be related to each other (for example, a passenger whose journey purpose is "travel to work" will be more likely to use a Season ticket).

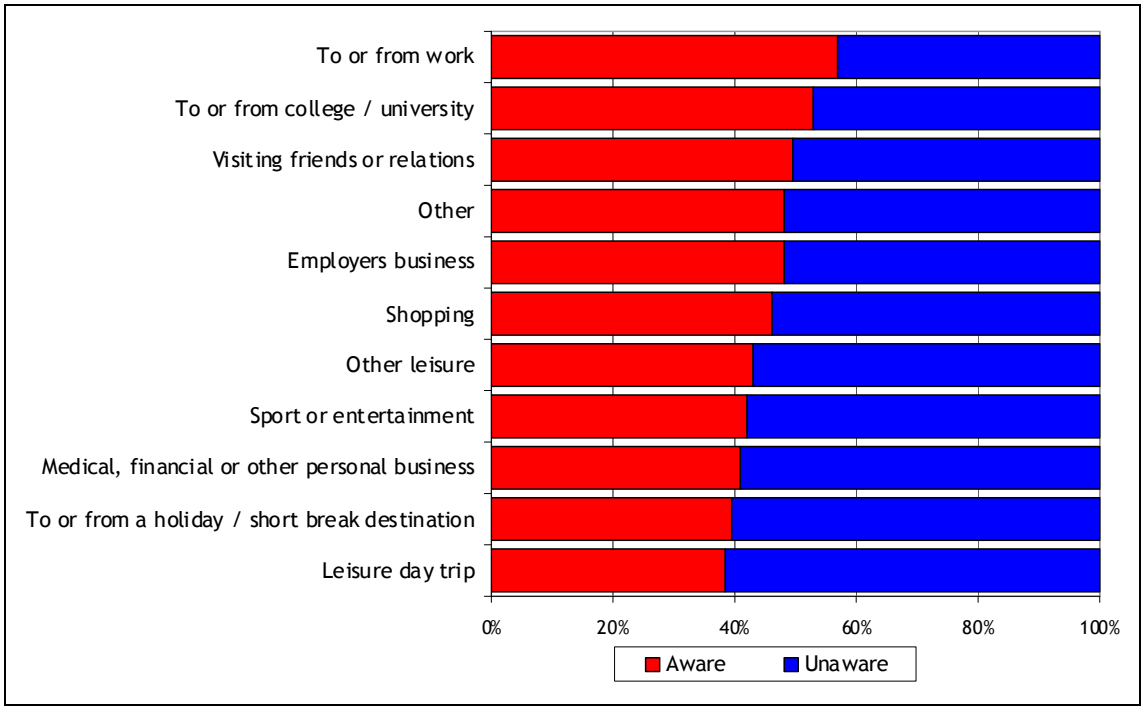
3.35 It should be emphasised that the proportion of aware relative to unaware passengers quoted below refers to the proportion of passengers that were aware of the possessions and **that decided to travel** relative to proportions of passengers that were unaware of the possession. Overall awareness will be higher as 100% of those who decided not to travel must have been aware of the possession. The average level of awareness that

the 2006 study found was 47% (this is without correcting for aware passenger that decided not to travel).

Journey Purpose

3.36 Passengers were asked to state their journey purpose from a list of options. Figure 3.13 shows the proportion of aware passengers in each category.

FIGURE 3.13 LEVEL OF AWARENESS BY JOURNEY PURPOSE



3.37 The only journey purpose segments that contain more than 50% of passengers who were aware of the possession are those involving travel to work (57% aware) or place of study (53% aware). The fact that these journey purposes have the highest proportion is not surprising, given that these passengers are likely to make the trip on a regular basis and would therefore be more exposed to information at stations and on trains.

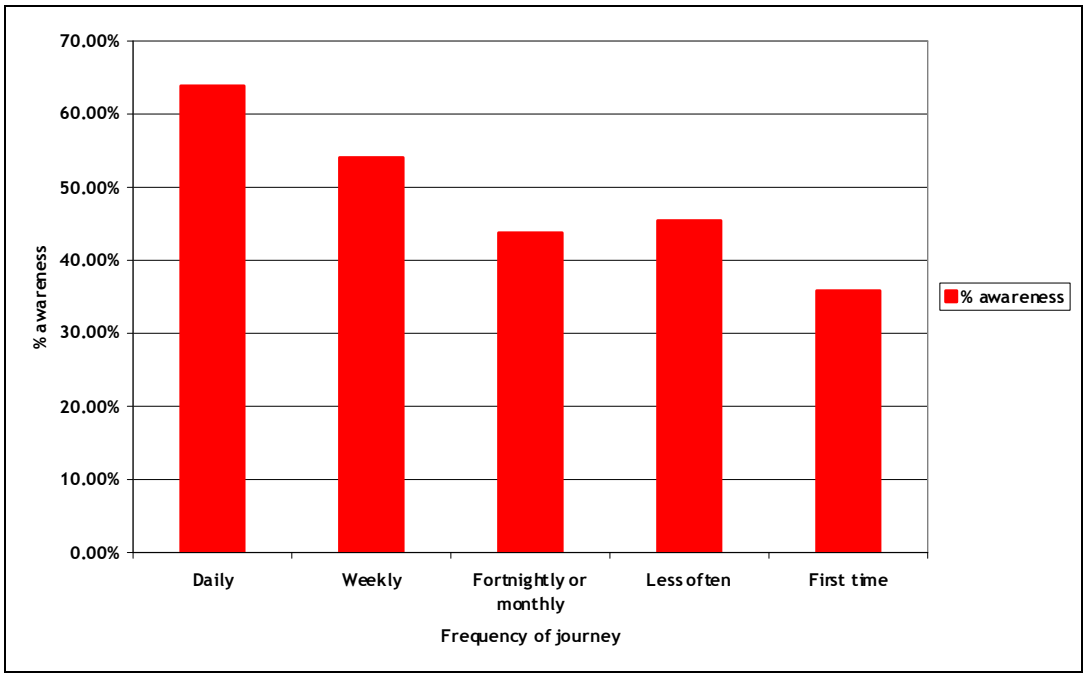
3.38 At the other end of the scale, passengers making leisure day trips were the least aware segment, with only 38% of passengers being aware of a possession before they arrived at the station. Again, this is likely to be related to the frequency of travel and the corresponding lack of exposure to station and onboard information. Also these type of trips will be more spontaneous and are likely to be short distance trip were there is generally less need to pre-plan.

Frequency of Trip

3.39 In order to reinforce the hypothesis above (i.e. that the relationship between journey purpose and awareness could be related to how often passengers in each journey purpose segment make a particular journey), Figure 3.14 shows that trip frequency does seem to be an important driver of awareness. Passengers were asked how often

they made their current journey, with options ranging from 'daily' to 'first time'.

FIGURE 3.14 AWARENESS BY TRIP FREQUENCY

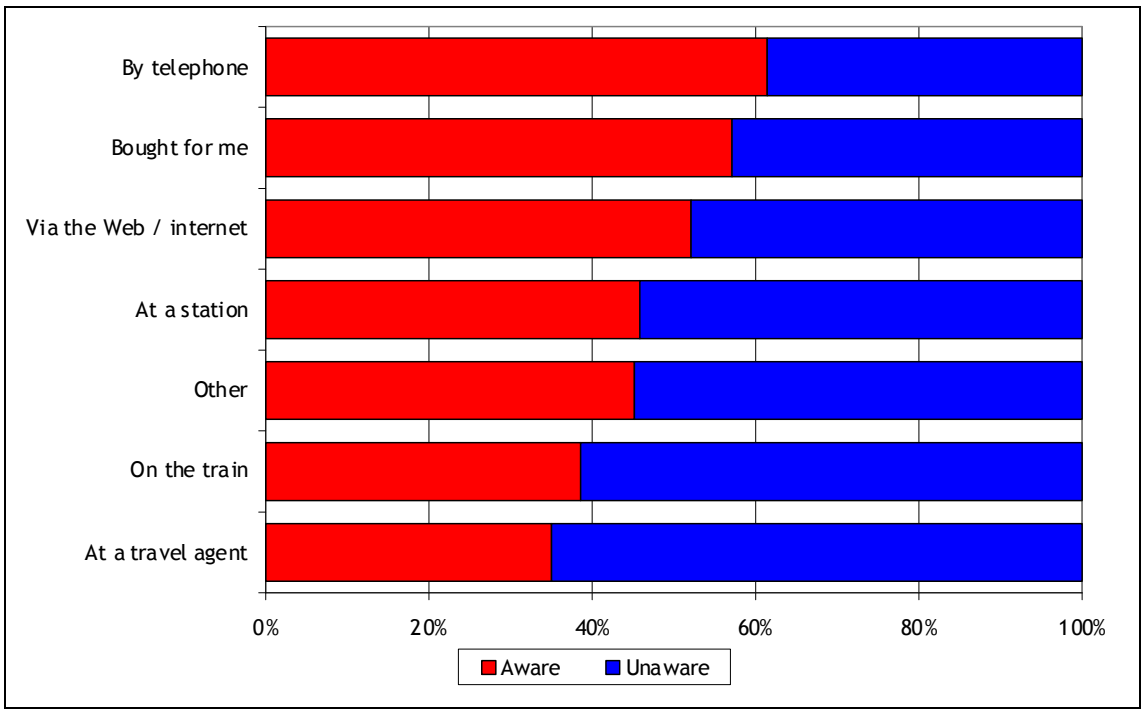


3.40 Almost 65% of passengers who make the trip daily were aware of the possession, whereas those whose trip frequency is fortnightly or longer had an awareness percentage of around 45%. As expected, passengers who were making the trip for the first time were likely to be the least aware (only 36% of these passengers were aware of the possession).

Ticket Purchase Location & Sources of Information

3.41 The survey results for journey purpose and trip frequency suggest that frequent rail users are more likely to be aware of possessions than infrequent users. As stated earlier, this may be due to the increased exposure to information on engineering works at stations and onboard trains (posters, leaflets etc.). However, Figure 3.15 clearly shows that point of sale also has a large effect on awareness.

FIGURE 3.15 AWARENESS BY TICKET PURCHASE LOCATION

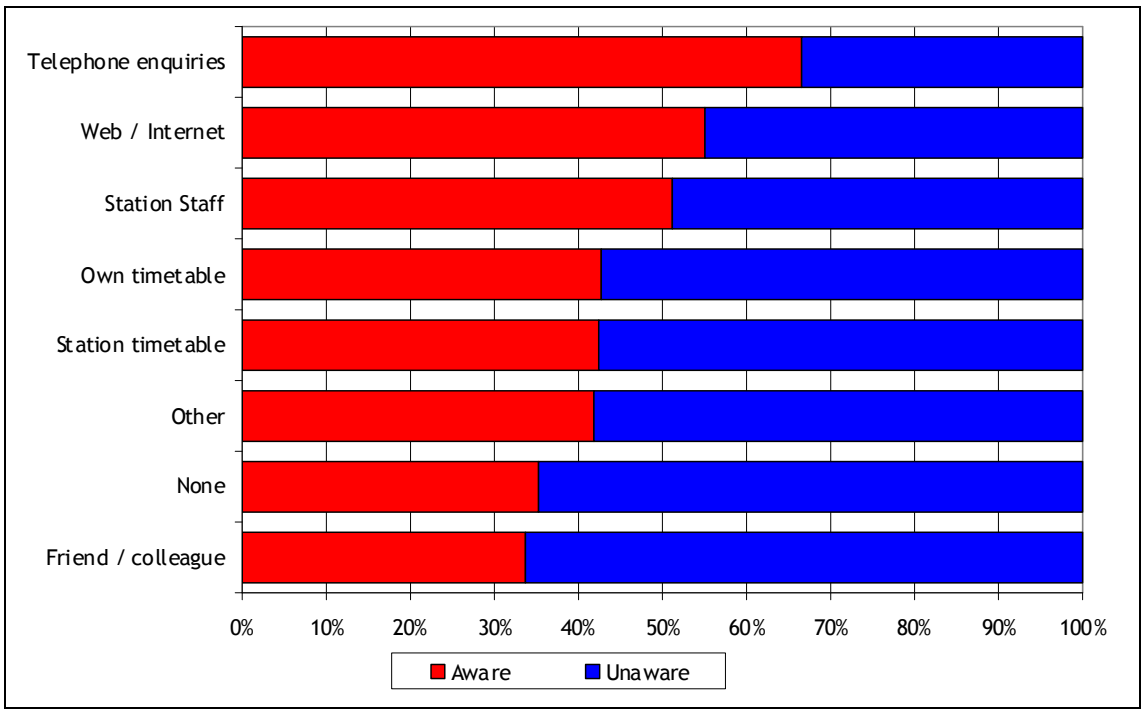


3.42 Over 61% of passengers who purchased their ticket over the telephone were aware of the possession affecting their journey, as were 52% of those who purchased over the internet. This compares favourably with the 47% level of awareness associated with passengers who bought their ticket at a station. There was also a high level of awareness amongst passengers who had their ticket bought for them (57% aware). It may be the case that these types of trip are planned more carefully than an average journey, although it should be noted that the sample size for this segment is relatively small.

3.43 The lowest level of awareness was associated with passengers who booked through a travel agent (35% aware), although again the sample was relatively small for this segment.

3.44 The higher levels of awareness associated with telephone and internet purchases are reinforced by the Figure 3.16. Passengers were asked whether they sought information about their journey at a time other than when they purchased their ticket. The graph shows the relationship between levels of awareness and the type of information source.

FIGURE 3.16 AWARENESS BY INFORMATION SOURCE



3.45 The results show that passengers who obtained journey information via telephone were by far the most likely to be aware of a possession (67% aware, compared to 35% aware if no information sought). Awareness levels were also relatively high for passengers who looked for information on the internet and from speaking to station staff (55% and 51% awareness levels respectively).

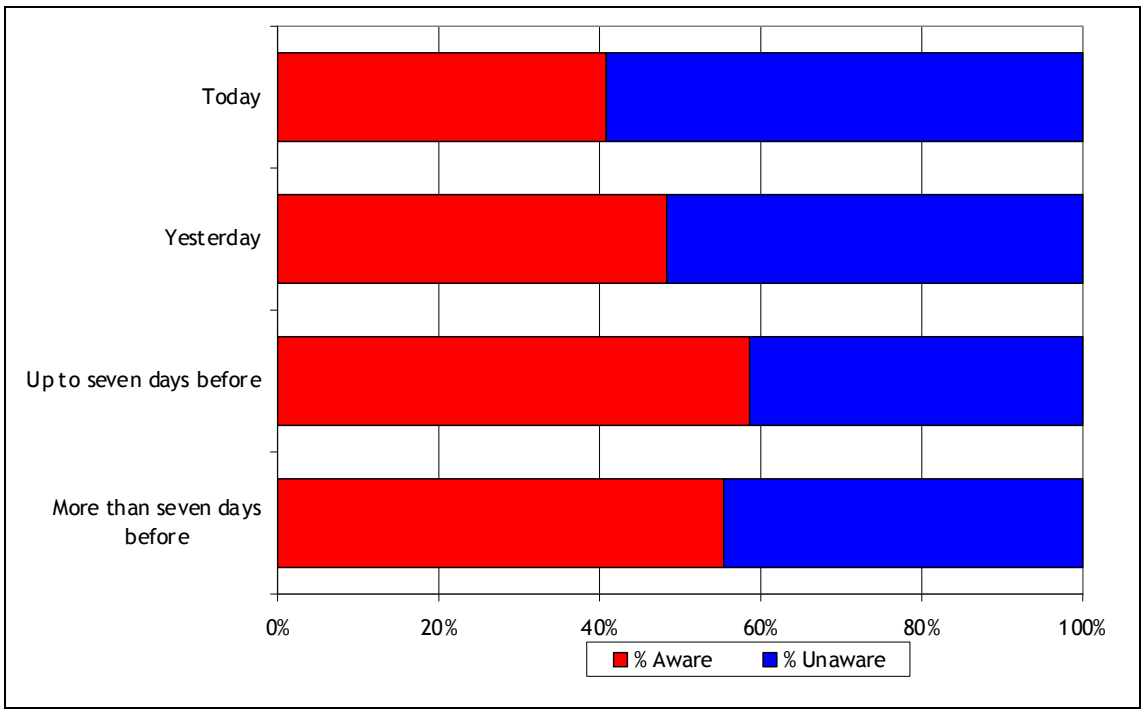
3.46 Passengers who used either the information in their own personal timetable, or from the station timetable, also showed a level of awareness greater than that of passengers who sought no information (42% in both cases).

3.47 The results suggest that the information provided by national rail enquiries and through the internet is an effective way of increasing awareness of possessions.

Time of Purchase

3.48 One reason for the fact that telephone and internet purchases appear to contribute to a higher level of awareness could be due to the fact that these purchases are always made in advance. Figure 3.17 shows how awareness varies depending on how far in advance a passenger buys their ticket.

FIGURE 3.17 AWARENESS BY DATE OF PURCHASE

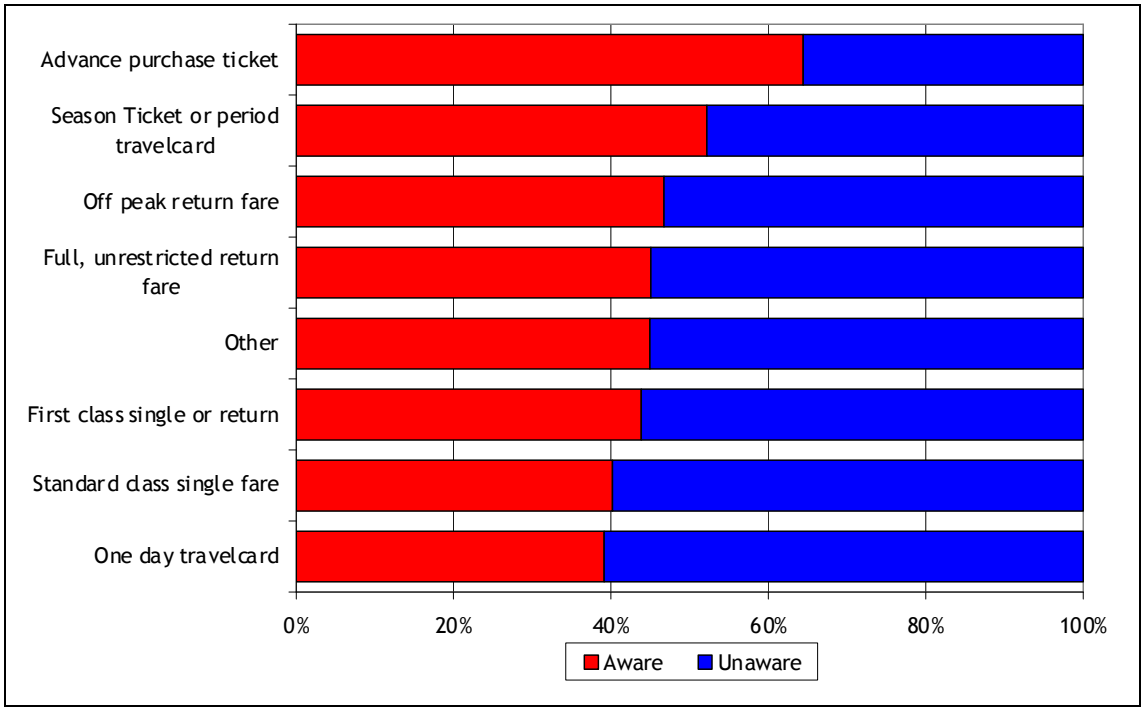


3.49 It is clear that passengers who purchase their ticket in advance are more likely to be aware of possessions than those who buy a ticket immediately prior to travelling. On average, 41% of passengers who bought on the day of travel were aware of the possession affecting their journey, compared to 48% of those buying one day in advance. This rose to 59% awareness amongst passengers who purchased a ticket up to one week in advance.

Ticket Type

3.50 The type of ticket that that a passenger purchases can often be treated as a proxy for some of the journey characteristics described above. For example, a passengers whose journey purpose is 'travel to work' is more likely to purchase a Season ticket, and therefore the higher level of awareness observed for 'travel to work' in the journey purpose analysis should be reflected in the level of awareness for Season ticket users. Figure 3.18 shows levels of awareness by ticket type.

FIGURE 3.18 AWARENESS BY TICKET TYPES



3.51 As shown in the graph, 64% of passengers using Advance Purchase tickets were aware of the possession affecting their journey, the highest proportion of all ticket types. This seems credible, as these tickets are (by definition) bought before the day of travel and are more likely to be bought over the phone or on the internet.

3.52 Seasons were the only other ticket type where more than half of passengers were 'aware' (52%). Again, this is not surprising given that this ticket type is characterised by a frequent trip rate and a travel to work journey purpose.

3.53 The lowest level of awareness was observed on One Day Travelcards (39% aware). This reflects the fact that these tickets are purchased on the day of travel and are likely to have a journey purpose such as 'leisure day trip', which had the lowest level of awareness of all journey purposes.

3.54 It should be noted that the various journey characteristics (to which awareness is correlated) are themselves likely to be correlated. We have conducted some simple regression analysis in order to identify which correlations hold after controlling for other factors. We found that the date the ticket was purchased and the frequency of travel are the main drivers of awareness. Most of the other factors had no significant effect after controlling for these two factors.

Awareness and Notification Factors

3.55 The Notification Factor is a discount factor within the Schedule 4 algorithm, and is used to scale compensation payments according to the period of notice that Network Rail provides a TOC for a planned possession. For a possession where the maximum period of notice is given, the discount factor will typically take a value of between 0.15 and 0.4. As the notice period gets nearer to the possession date, the Notification

Factor increases up to a maximum of 0.8, meaning that where possessions are scheduled at very short notice, the TOC will be eligible for 80% of the compensation amount calculated in the rest of the algorithm.

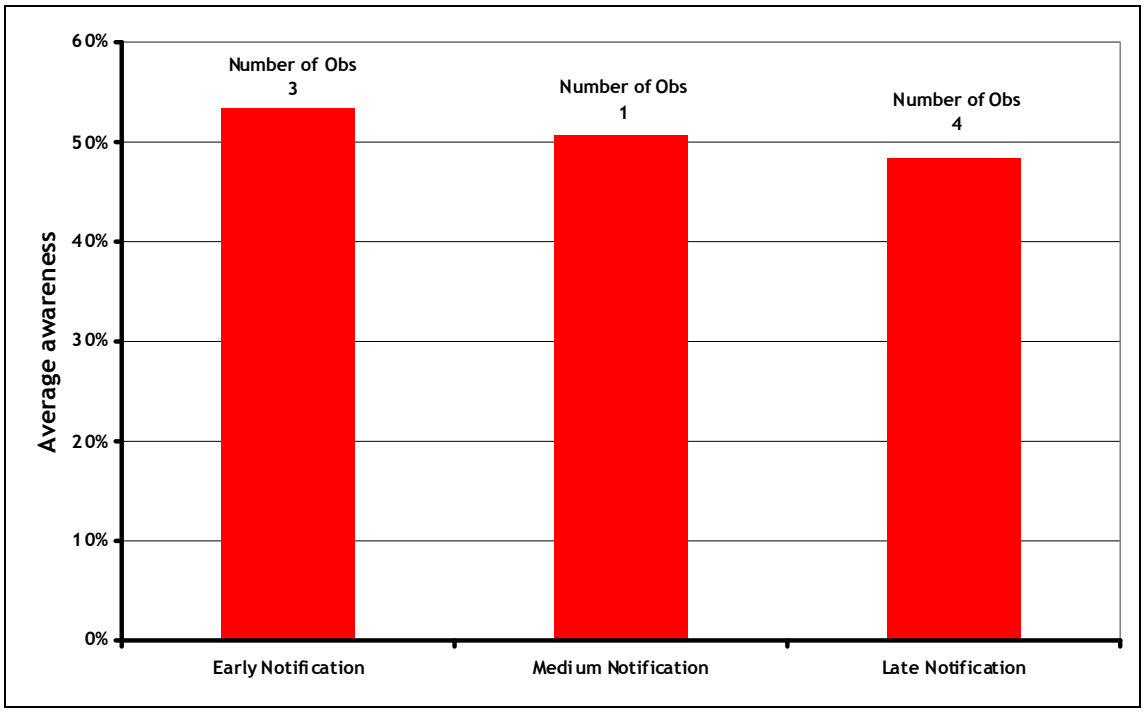
3.56 One would assume that a short notification period for a possession would result in a lower level of passenger awareness than for a possession which is scheduled a long time in advance. However, the notification factor simply refers to the period of notice that Network Rail provides to the TOCs; it is then up to the operating companies to pass this information on to the customer.

3.57 From the survey data it is possible to investigate the relationship between the Notification Factor of a possession and passengers' levels of awareness. Using data provided by Network Rail, each possession in our survey was matched to the Notification Factor used in the corresponding Schedule 4 compensation calculation, with the exception of the South West Trains possession where we were unable to match the possession with records in the Schedule 4 database. Possessions were grouped into three categories based on their Notification Factor:

- Early notification;
- Medium level of notification; and
- Late notification.

3.58 The average levels of awareness for possessions within each of these three categories are shown in Figure 3.19.

FIGURE 3.19 AWARENESS BY NOTIFICATION FACTOR



3.59 The sample size is too small to enable us to come to any firm conclusions. However,

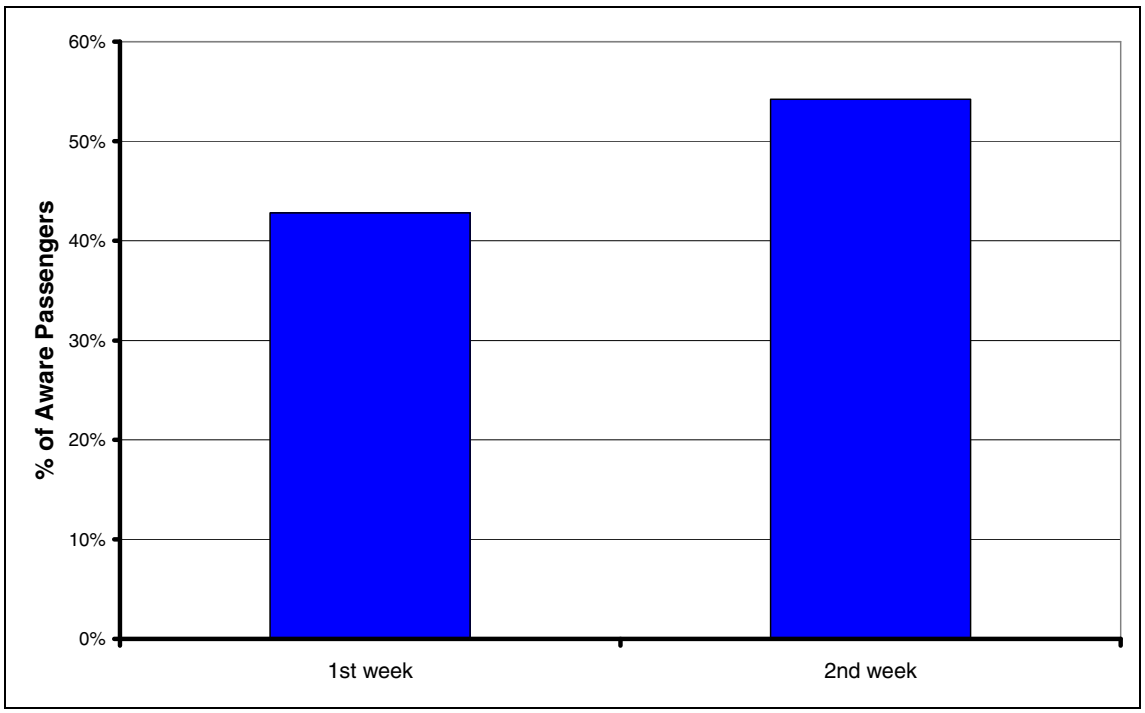
there is no evidence in Figure 3.19 that awareness and the notification factor is not correlated. There is a 53% level of awareness for possessions where the maximum notice period is given by Network Rail (i.e. more than 12 weeks). This falls to a 48% level of awareness for possessions where the lowest level of discount (i.e. a Notification Factor of 0.8) applies.

Duration of Possession

3.60 The majority of the possessions included in the survey represent a series of weekends/Sundays. Where this was the case, possessions were surveyed over more than one weekend, allowing us to analyse how the level of awareness changes throughout the life of a possession.

3.61 Figure 3.20 shows the average level of awareness over all applicable possessions in the 2006 survey[3].

FIGURE 3.20 AVERAGE AWARENESS BY WEEK OF POSSESSION



3.62 It is clear that for ongoing possessions (e.g. those that are carried out over a series of weekends), the level of awareness increases through time. The survey data shows that the average level of awareness increased from 43% to 54% between the first and second week of the possessions.

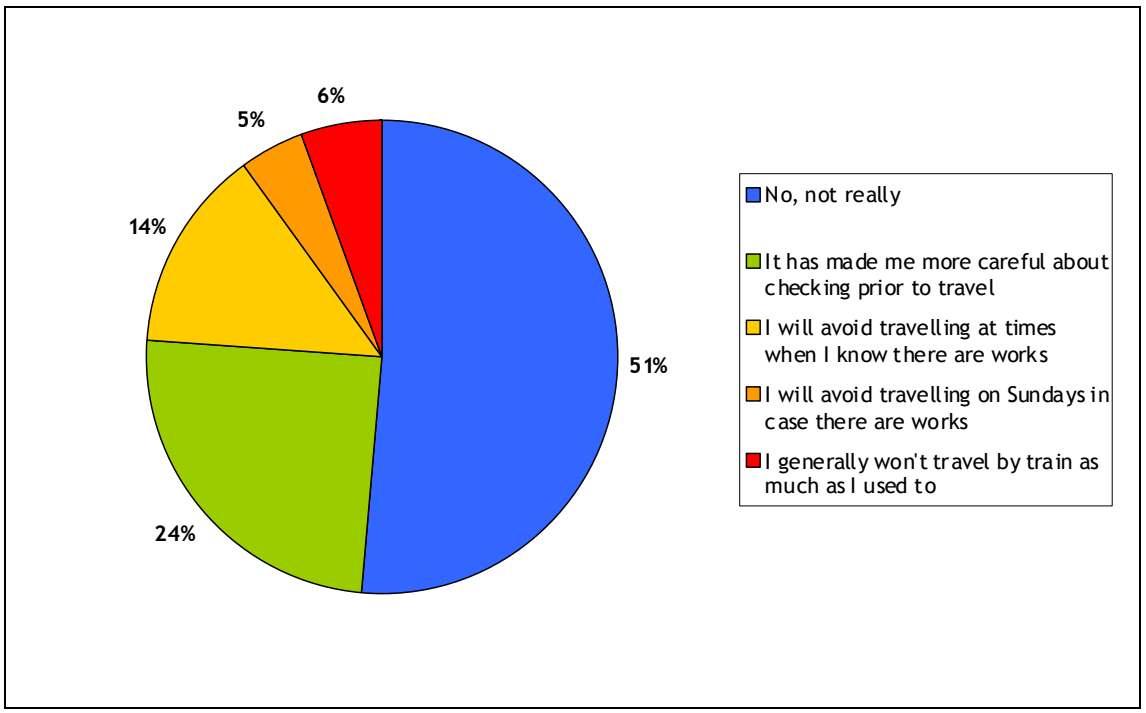
[3] With reference to the table of possessions at the start of this section, the GNER/WAGN and Transpennine Express possessions are not included as they were carried out over a single Bank Holiday weekend. The First ScotRail possession is not included because while it was a series of Sundays we only surveyed on one Sunday . The South West Trains possession is excluded from this analysis because surveys were not carried out on the second of the three weekends.

Response of Unaware Passengers

3.63 A key issue around the revenue loss from possessions is the response of unaware passengers. Clearly there is no revenue loss from unaware passengers on the actual day that the possession occurred, if there is to be any revenue loss from unaware passengers it must therefore be as a consequence of the experience of travelling during the possession on future travel behaviour. While there is a reasonable understanding of the long term effect of performance there is little understanding on how possessions affect travellers' future behaviour.

3.64 There is one question in the 2005 survey that may provide some limited insight into this area - do you think that today's experience of engineering works has affected your future use of rail? We have analysed the response of unaware passengers in order to attempt to gain some insight into how the experience of the possession will affect their future travel behaviour.

FIGURE 3.21 FUTURE USE OF RAIL BY UNAWARE PASSENGERS AS A CONSEQUENCE OF THE POSSESSION



3.65 As shown Figure 3.21 approximately half of the unaware passengers claimed that their experience of the possession would have no influence of their future travel behaviour, approximately a quarter said they would be more careful about checking before travelling and a quarter said that the experience would change their use of rail.

Summary

3.66 Passenger survey data from Steer Davies Gleave's 2006 possessions study was analysed to investigate key drivers of awareness. The results suggest that the following factors have a significant influence on a passenger's level of awareness:

- Commuters have a higher level of awareness of engineering works than

passengers with a leisure journey purpose;

- Passengers who make a trip regularly (i.e. once a week or more) are much more likely to be aware of engineering works than passengers who make the trip infrequently or who are new to rail;

- Passengers who use telephone or internet services to either purchase their ticket or to look for travel information generally have a high level of awareness;

- Passengers using Advance Purchase products, or those who buy their ticket before the day of travel, have a much higher level of awareness than those who buy tickets immediately prior to travel.

3.67 The survey data was also used to investigate whether the level of awareness varied depending on the Notification Factor applied to a possession, as well as how the level of awareness changed throughout the life of a possession. The results showed that:

- Possessions with a low Notification Factor (i.e. where the possession is reflected in the timetable at T-12) have a slightly higher level of awareness than possessions where a high Notification Factor is applied (i.e. short-notice engineering works); and

- Where engineering works run over more than one week (e.g. a series of weekends), the level of awareness increases throughout the course of the possession.

Task 6 Model vs. Schedule 4

3.68 The objective of this workstream was to compare the Schedule 4 possessions compensation amounts with estimates of lost revenue derived from MOIRA. MOIRA is the standard industry tool for estimating the impact of timetable change on revenue and can, with suitable modification, be used to estimate the revenue loss due to a possession. In practice, when bespoke methods are used to estimate revenue losses, MOIRA is one of the tools often used.

3.69 As discussed in the proposal to this project in order to produce a large sample for comparisons we designed a process for running CIF files through MOIRA. Ultimately in order to upload the CIF files into MOIRA it was necessary to utilise some in-house software to convert the CIF files to SPG files specified for the service codes affected by the possession. Details on the MOIRA process carried out are provided in Appendix C.

3.70 In order to understand the nature of such a comparison, it is necessary to understand both how Schedule 4 calculates costs and how MOIRA can be used to do this.

Schedule 4 Calculation

3.71 The Schedule 4 calculation is set out in [paragraph 3.4] of the schedule. The compensation amount for a given period is:

- $\Sigma((WACM + NREJT) \times BF \times MRE \times NF)$

where NREJT means the extended journey time due to the possession and WACM is the impact on journey time of cancellations; BF is a measure of the busy-ness of the day, MRE is the marginal revenue effect and NF is the "notification factor", which reduces the compensation amount by a factor ranging from 0.2 to 0.8, dependent on the amount of notice the TOC was given of the possession.

3.72 The Schedule 4 formula is similar in form to the Schedule 8 compensation formula for lateness, with the extended journey time replacing average minutes lateness. The effect of the notification factor is to reduce the impact of the MRE factor (which is the same in both Schedules), which can be justified by noting that the MRE is uplifted (generally by a factor of 2.5) to take account of the unscheduled nature of the extended journey time compared to the base timetable. Since passengers can be made aware of the possession, if notified sufficiently early, it can be argued that the effect on passengers due to a possession is lower than that for the unscheduled delay handled in Schedule 8. Currently notification factors vary according to the timetable in which the possession is communicated to the TOC.

3.73 Notification factors, as discussed above, logically should depend on the level of awareness that passengers have of the relevant possession. However, based on the evidence in Figure 3.19 above, in practice there does not appear to be a very close relationship between them.

Use of MOIRA

3.74 MOIRA estimates the impact of timetable changes on demand, and hence revenues, taking account of "opportunities to travel" between passengers' origins and destinations (the data for which is based on LENNON sales information) and using a choice algorithm to allocate passengers to individual train services. When the timetable is changed, for example due to a possession, the revised timetable (including replacement bus services) leads to changed overall levels of demand (driven by elasticity to changes in GJT) and to changed allocations. With a possession, journey times are likely to be extended significantly, leading to reduced levels of demand and hence revenue (as indeed is observed).

3.75 There are a number of assumptions that need to be made for MOIRA to estimate the impact of schedule changes:

- The annual LENNON sales data need to be converted into the demand for an average weekday, Saturday or Sunday;
- The resultant daily passenger origin and destination data needs to be allocated to particular times of day using a demand profile; and
- The impact of use of alternative transport modes for part of the journey (in particular use of replacement bus) on passenger demand, compared to the use of rail throughout the journey.

3.76 The first two of these are discussed under Task 3 above, which showed that while overall MOIRA validated reasonably well against actual data there were significant discrepancies at station level.

3.77 The third issue has been discussed at some length in the literature review. Consistent

with the NERA 2006 work we have not explicitly modelled the effect of bus replacement services on demand. The NERA work argued that the overall result of correcting MOIRA's bus penalties and interchange penalties was not materially different from modelling the possession using MOIRA with standard interchange penalties as if the bus journey segment was actually completed by train.

3.78 MOIRA results, even when properly calibrated, cannot be used directly. This is because MOIRA models the response of passengers to known timetables. While it may therefore give reasonable results for the impact of a possession on passengers who are aware of the alternative timetable operating, it cannot, in principle, estimate the impact on passengers who are unaware of the possession.

3.79 For "unaware" passengers, we can regard the changed timetable due to a possession as a form of disruption, and hence model it as unscheduled delay. The normal approach to train performance monitoring is to treat the additional "lateness" caused by the delay as an increase in (generalised journey time), upweighted by a factor (usually set at three) to reflect the additional inconvenience. It is possible to use the MOIRA results for "aware" passengers to calculate this effect (by working backwards from the reduction in demand estimated by MOIRA to the implied GJT increase, applying the upweighting factor to the GJT increase, and then re-estimating the demand impact for the upweighted GJT increase).

3.80 Using this approach, it is possible to calculate the revenue loss due to the delay as the weighted sum of the MOIRA result for aware passengers and upweighted MOIRA result for unaware passengers. Clearly it is necessary to know the level of passenger awareness in order to do this.

Establishing the level of Awareness

3.81 Overall awareness of a possession is based on two groups of people:

- Those who were planning to travel but, having been made aware of the possession chose not to use the relevant service (they may have used an alternative rail route, used the car or not travelled at all); and
- Those who were aware of the possession and nevertheless travelled.

3.82 The first group (those choosing not to use the service) can be estimated either based on survey information (e.g. from the Efficient Engineering Access Study, SDG, 2004), or, alternatively, by using MOIRA results (since MOIRA tells us how demand of passengers who know about the new timetable changes).

3.83 The second group (those who travel while aware of the possession) can be estimated from a survey of awareness among all passengers travelling on the replacement services during a possession, for example that carried out in the SDG 2006 Study.

3.84 We can define variables as follows:

- A – percentage of those originally planning to travel who are aware of the possession;
- ANT – percentage of those originally planning to travel who choose not to

because of knowledge of the possession;

- TA – percentage of travellers during a possession who were aware of the existence of the possession before they started their journey (1-TA is the percentage of travellers who were unaware).

3.85 A is the result we need in order to calculate the impact of the possession on revenue using MOIRA, using the following formula:

- Impact of possession = A x (MOIRA impact of possession)
  + (1-A) x (upweighted MOIRA impact of possession for unaware passengers)

3.86 Starting with the base of those originally planning to travel, splitting these into those who are aware and those who are not, and further splitting those who are aware into those who travel and those who do not, it can be shown that:

- A = TA / (TA + (1-TA)x(1-ANT))

3.87 Since we can establish the values of ANT (see paragraph 3.82 above) and of TA (paragraph 3.83) either from surveys or from use of MOIRA itself, we can derive a value for A (the percentage of potential travellers who are aware of the possession), and hence use the MOIRA results to calculate an effective revenue impact of the possession.

3.88 We have used the following results for awareness in our calculations:

- Percentage of travellers who were aware of the possession, TA = 47% (SDG 2006 study)
- Percentage of those who were aware who chose not to travel (based on survey), ANT1 = 60% (SDG 2004 EEA study)
- Percentage of those who were aware who chose not to travel (based on MOIRA results), ANT2 = (varies for each possession, but on average) 11%.

3.89 This gave resultant values of overall awareness, A, (in the pool of those originally intending to travel), of:

- A1 (using surveyed value ANT1) – 69%; and
- A2 (using MOIRA values for ANT2) – 50%.

Discussion of Sample

3.90 In the proposal for this work we planned to produce 72 MOIRA runs – in the end we selected 120 different possessions, and we were successful in running 64 of these through MOIRA, all of which produced results which were logical (i.e. negative estimates of loss).

3.91 We originally planned to compare MOIRA and the Schedule 4 algorithm for both "small" and "large" possessions, however in the final sample there are very few "large" possessions. This is mainly as a consequence of the difficulty we encountered modelling possessions around Public and Bank Holidays, which is when most of the "large" possessions occur. Essentially, we found that around Public and Bank Holidays it was not possible to identify all the trains that were run on these days and

therefore MOIRA overstated the loss.

3.92 It should be noted that in the original proposal we planned to look at possessions with early, medium and late notification - however we only received "Informed Traveller" timetables so were not able to look at possessions that had a late notification.

Discussion of Results

3.93 The table below summarises the aggregate MOIRA results compared against the aggregate Schedule 4 results. We present the MOIRA results with three different assumptions about the level of awareness:

- Simple MOIRA - with 100% awareness;
- MOIRA based purely on survey data – with 70% awareness; and
- MOIRA based awareness estimates – with an average awareness of 50%.

3.94 The results are considerably influenced by one very large observation, where the Schedule 4 value is approximately double the MOIRA value. We have looked at the MOIRA timetable used to generate this result and cannot identify any obvious error in the timetable. In the table below we present the result with and without this observation.

TABLE 3.3 SUMMARY RESULTS- SCHEDULE 4 VS. MOIRA (£'S THOUSANDS)

	Schedule 4	Simple MOIRA	MOIRA 70%	MOIRA based Awareness
All Observations	2,200	1,727	2,412	2,856
Excluding Outlier	1,852	1,575	2,201	2,608

3.95 Regardless of whether the outlier is included or excluded overall the Schedule 4 algorithm produces a larger estimate of loss than simple MOIRA (27% larger if the outlier is included and 18% larger if the outlier is excluded). When the MOIRA results is adjusted for awareness, MOIRA overall is higher than Schedule 4 whether the outlier is included or excluded.

3.96 The four charts below analyse the correlation of MOIRA and Schedule 4, using simple MOIRA, a 70% awareness assumption and the MOIRA calculated assumption figure (as described above). Figure 3.22 compares simple MOIRA against the Schedule 4 algorithm with the outlier included. Figure 3.23 reproduces this chart but with the outlier excluded. It can be seen that removing the outlier has a significant effect on the relationship between MOIRA and Schedule 4, increasing the ratio of these two measures from 0.59 to 0.79. As shown in Figure 3.22 and Figure 3.23 while overall the Schedule 4 algorithm revenue loss estimate is higher than simple MOIRA, this hides a pattern where simple MOIRA is greater than Schedule 4 for some possessions and less for others.

3.97 In this study while we have in effect picked a random sample of possessions, we have only selected these possession from four months of possession in the S4CS database (December 2006 to March 2007). It may be the case that a particular type of possession was disproportionately represented in these four months, which has

influenced the overall result. Further a number of the possessions we have looked at are on the same day or are on adjacent days, which may mean that we do not have 64 independent observations and therefore have a smaller sample that would first appear. Given these reservations about the sample it is not possible to conclude anything more than overall Schedule 4 and MOIRA are a similar order of magnitude and for some possession Schedule 4 will be greater than MOIRA and for other less.

3.98 For the 70% awareness and the MOIRA based awareness results we only present the results with the outlier excluded (Figure 3.24 and Figure 3.25). These figures show similar results to the simple MOIRA case, where Schedule 4 is sometime greater than MOIRA for some possessions and less for other.

3.99

FIGURE 3.22 MOIRA VS. SCHEDULE 4 ESTIMATES OF REVENUE LOSS – SIMPLE MOIRA WITH OUTLIERS INCLUDED

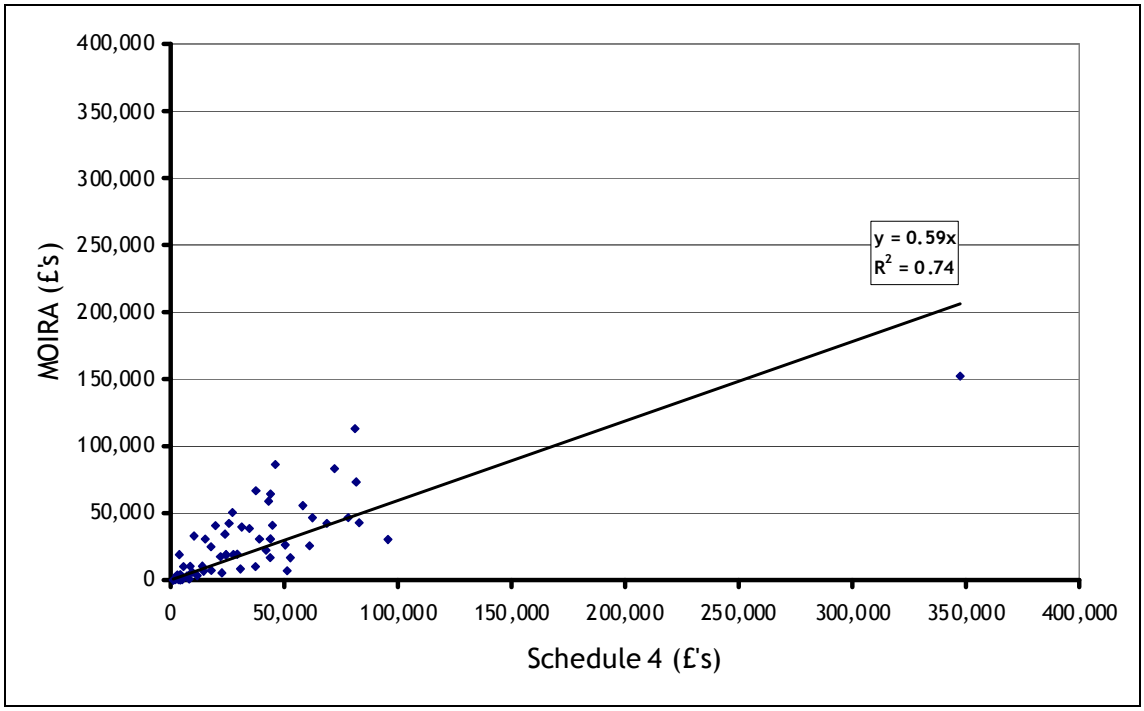


FIGURE 3.23 MOIRA VS. SCHEDULE 4 ESTIMATES OF REVENUE LOSS – SIMPLE MOIRA WITH OUTLIERS EXCLUDED

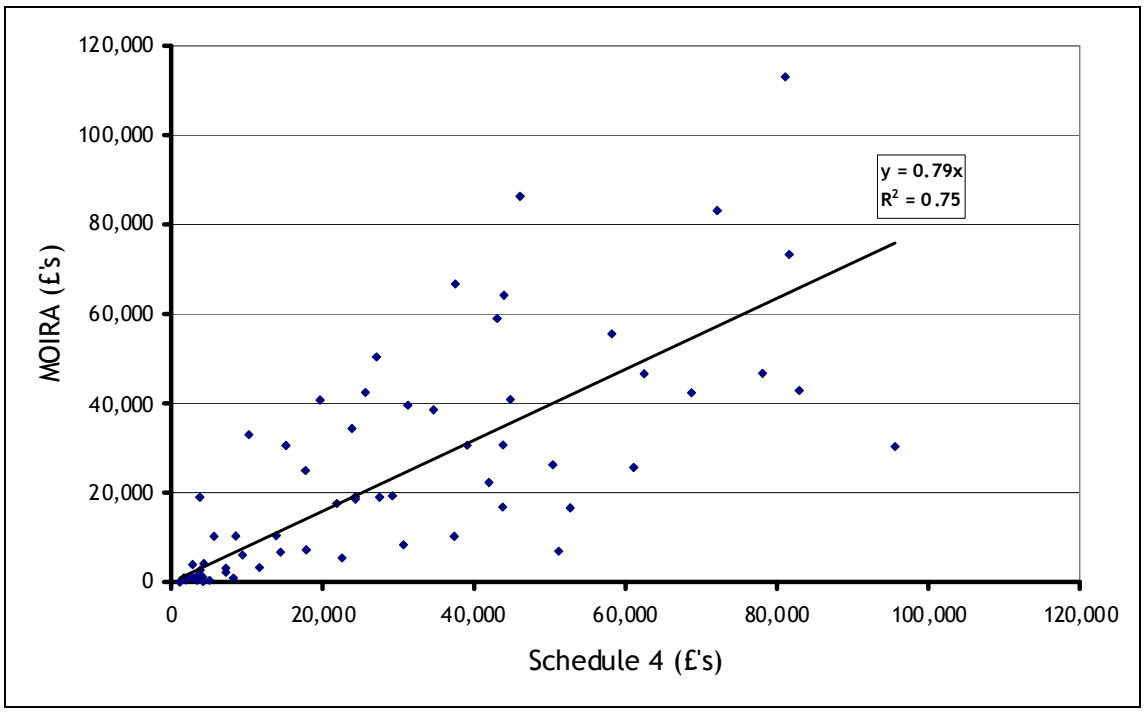


FIGURE 3.24 MOIRA VS. SCHEDULE 4 ESTIMATES OF REVENUE LOSS – 70% AWARENESS WITH OUTLIER EXCLUDED

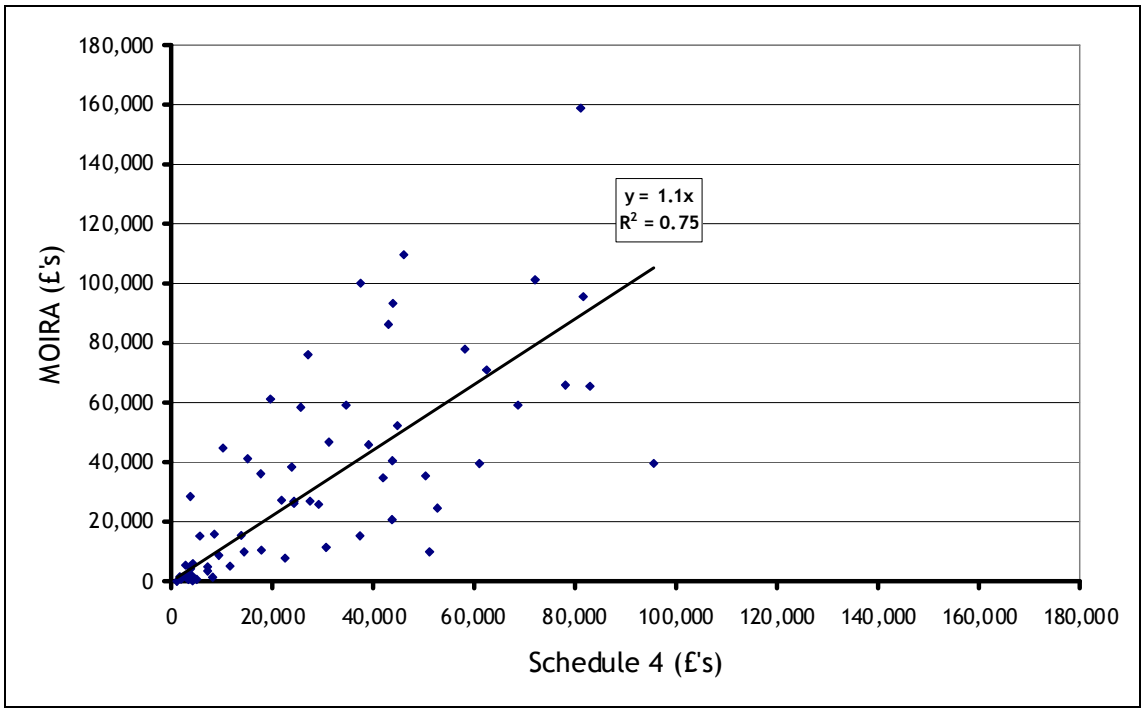
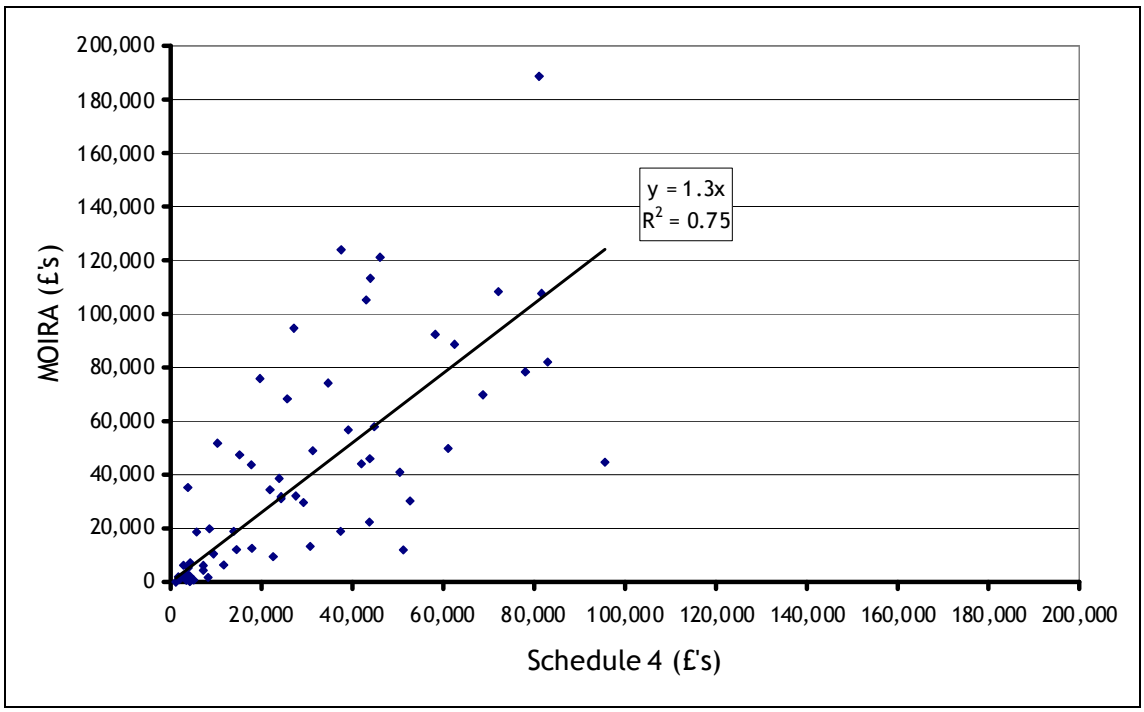


FIGURE 3.25 MOIRA VS. SCHEDULE 4 ESTIMATES OF REVENUE LOSS – MOIRA BASED AWARENESS WITH OUTLIER EXCLUDED



Conclusion from MOIRA vs. Schedule 4

3.100 The analysis presented above shows that while there can be significant discrepancies between MOIRA and the Schedule 4 algorithm, the Schedule 4 algorithm does not systematically underestimate or overestimate the loss compared to MOIRA. We further concluded that given some reservations about the sample it was not possible to conclude anything more than MOIRA and the Schedule 4 algorithm overall produce results of similar order of magnitude.

3.101 The sample we have used for this work has very few "large" possessions so it is not possible to come to a view whether this relationship holds for possessions with a Schedule 4 algorithm value greater that £100k

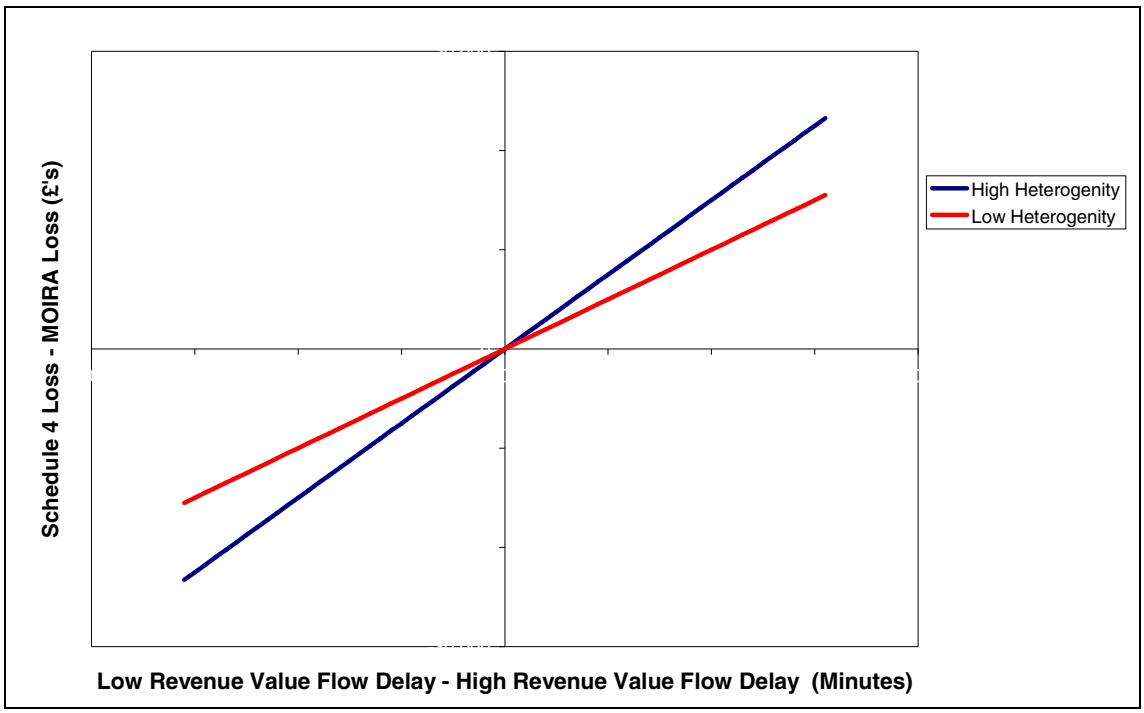
MOIRA Methodology vs. Schedule 4 Algorithm Methodology

3.102 MOIRA and the Schedule 4 algorithm are based on research summarised in the Passenger Demand Forecasting Handbook (PDFH). However, a key difference between the MOIRA and the Schedule 4 algorithm is that the latter applies a marginal revenue effect (MRE) figure which is the sum of all the flows' individual "marginal revenue effects" in a service group and then applies it to the total extended journey time that the service group experiences from the possession. The important thing to note is that the Schedule 4 algorithm calculates the revenue loss at a service group level. MOIRA performs a similar calculation at a flow level and then aggregates the individual flows in order to calculate the total service group effect.

3.103 In order to illustrate the consequence of this difference we have looked at the case

where a service group is made up of two flows - a high value flow and a low value flow (in terms of revenue per journey). We have set up a simplified model of the Schedule 4 algorithm and MOIRA (ignoring busyness factor, notification factor and any difference in the way extended journey time is calculated). The results from this model are presented in Figure 3.26.

FIGURE 3.26 COMPARISON BETWEEN SCHEDULE 4 & MOIRA LOSS - 2 FLOW CASE



3.104 The results from this two flow example show that (all else held constant) if the extended journey time from the low value flows is greater that then extended journey time from the high value flow the Schedule 4 algorithm estimate will be higher than the MOIRA estimate. The results further show that as the difference between the high value and low value flow increases, in terms of their individual marginal revenue effect, the difference in the estimated loss will increase.

3.105 The results from this simple model suggest that if a possession mainly affects flows with a small amount of revenue relative to the revenue on other flows in the service - then Schedule 4 will overestimate the loss relative to MOIRA. However if a possession disproportionately affects high revenue flows relative to the revenue on other flows in the service group the Schedule 4 will underestimate the loss relative to MOIRA. It should be emphasised that this result does not take account of differences in the way the way the extended journey time is calculated and assumes that the level of awareness is consistent between the two approaches.

3.106 As you increase the difference between the high and low revenue flows in terms of revenue per journey, the sensitivity of the results is increased. This is shown in by the increase in the slope of the "High Heterogeneity" line (with a large difference in the

revenue per journey on the high value and low value flows) and the "Low Heterogeneity" line (with a small difference in the revenue per journey on the high value and low value flows).

3.107 We also constructed a six flow model and the basic results from the two flow case were confirmed.

3.108 Above we have discussed one factor that will cause the Schedule 4 algorithm to differ from MOIRA. There are further factors that will cause the revenue loss estimated by the Schedule 4 algorithm to differ from revenue loss estimates generated from MOIRA, which concern the treatment of extended journey time and train cancellation:

- The Schedule 4 algorithm only captures the impact of cancelled stops on passenger arrivals, whereas cancellations also impact on departures. For example if an Edinburgh to London train, due to a possession, only ran from York to London but arrived in London as scheduled then the fact that this train only ran for part of its scheduled journey would not be reflected in the Schedule 4 calculations. This will result in Schedule 4 under-predicting relative to MOIRA.
- The Schedule 4 algorithm uses the "cancellation weighting" of 1.5 multiplied by the service frequency that applies to unplanned delays. While this may be appropriate for unaware passengers, for aware passenger the appropriate penalty is more likely to be the change in frequency penalty. This will cause Schedule 4 to over-predict relative to MOIRA.
- If the train services are only cancelled for part of the day, Schedule 4 treats losses as linear with disruption, whereas in reality they are likely to be non-linear. It will depend on the nature of the possession whether this will result in Schedule 4 under or over predicting relative to MOIRA.
- Schedule 4 implicitly measures the extended journey time for the entire train's journey. It then assumes that every passenger will suffer this extended journey time even if they travel on the train for only part of its journey which may or may not be affected by the possession. This will cause Schedule 4 to over predict relative to MOIRA.

3.109 Like Schedule 8, Schedule 4 measures the increase in journey time not at stations by at monitoring points. Monitoring points are a simplification of the network so are less frequent that stations. It is not clear what effect this will have on the accuracy of the Schedule 4 algorithm but could result in it being higher or lower than MOIRA.

3.110 In summary, from a theoretical/mathematical point of view there are good reasons why Schedule 4 may give higher or lower answer than MOIRA, in particular cases. This analysis would suggest that the nature of the possession will be a major driver of whether Schedule 4 gives higher or lower answer relative to MOIRA

Conclusion from Quantitative Analysis

3.111 There are significant caveats around the sample size used in the quantitative analysis, however, we would offer the following conclusions from the quantitative analysis:

- There are some concerns over MOIRA demand profiles.
- There is no robust evidence that MOIRA-based calculations are supported by actual revenue losses. However the only evidence available to us (which is

limited) suggests that MOIRA validates reasonably well against estimates based on historic LENNON data (this comes from 1 case study and the 2 limited validation exercises conducted in the literature).

- In both the Strood Tunnel and Ipswich Tunnel case studies the Schedule 4 algorithm produced estimates which were half the final settlement. This may be as a result of the duration of the possession or because of the nature of the possession;
- Passenger awareness is correlated with various factors, including time of ticket purchase and frequency of travel;
- The sample size used to investigate the relationship between awareness and notification is too small to come to any firm conclusions, however there is no evidence presented in this study that awareness and the notification factor is not correlated;
- There is no evidence to suggest that Schedule 4 systematically under-estimates (or overestimates) revenue loss compared to MOIRA;
- Overall MOIRA and the Schedule 4 algorithm produce results of a similar order of magnitude; and
- There are several theoretical/mathematical reasons why depending on the nature of the possession Schedule 4 will under or over predict when compared to MOIRA.

4. DISCUSSION OF LITERATURE REVIEW & QUANTITATIVE ANALYSIS

Introduction

4.1 The aim of this chapter is to discuss the conclusions from literature review and quantitative analysis and asses their relative weight.

Modelling Framework

4.2 Both the MOIRA methodology and Schedule 4 algorithm are based on the modelling recommendations in the PDFH. The framework that has been developed is to separate potential passengers into two categories – travellers that are aware of the possession before travelling and travellers that are unaware of the possession before travelling. The PDFH approach to modelling the effect of possessions on aware travellers is to treat the possession as a scheduled journey time change. For unaware passengers the possession is treated as an unexpected delay.

4.3 The literature review observed that there is a significant theoretical issue with this modelling approach – both the modelling of the aware and unaware passengers is based around changes that are permanent (or at least semi-permanent). Possessions are in the main temporary. While there are legitimate concerns over the PDFH approach it is, however, the only one available.

Validation of Modelling Framework

4.4 There is very limited evidence whether a complete application of the PDFH framework validates against actual losses. This is as a consequence of the difficulty of isolating the impact of a possession from the impact of other factors, and the level of "noise" in historic LENNON data.

4.5 The EEA and NERA studies, which both developed comprehensive applications of the PDFH modelling framework, attempted to validate their modelled estimate of loss with actual losses. While neither of the validation exercises were robust they did find that their modelled estimates of loss were of the same order of magnitude as actual loss based on historical LENNON data.

4.6 In the quantitative analysis we looked at two case studies, Strood Tunnel and Ipswich Tunnel, in an attempt to gain further insight into whether the PDFH framework validates against actual data. Only one of these case studies, Strood Tunnel, provided a comparison of revenue losses based on the PDFH approach (as applied by MOIRA) and actual revenue losses. We found for this case the actual revenue loss and the modelled estimate of loss matched reasonably well.

4.7 It is not possible to draw any definitive conclusions from the evidence available to us. However, based on the little evidence available there is indication that the PDFH framework gives answers that are not an order of magnitude different from actual losses.

Application of the PDFH Framework

4.8 The next question concerns the application of the PDFH framework. There are two issues here:

- How to estimate the demand impact on aware passengers; and
- How to apply an overlay/adjustment to take account of unaware passengers.

Aware Passengers

4.9 Looking at how to estimate the demand impact on aware passengers – the choice is between MOIRA and the Schedule 4 algorithm. The Schedule 4 algorithm is a more simplified application of the PDFH approach than MOIRA. Therefore, MOIRA should in principle provide a more accurate estimate of revenue loss. There is one exception to this general rule: MOIRA demand matrices exclude TfL-sold travelcards and many PTE tickets, whereas the Schedule 4 payment rates (MRE) are uplifted so that they are based on full industry revenue. In the quantitative analysis chapter we noted a number of mathematical factors that would cause the Schedule 4 algorithm and MOIRA to differ. Overall these mathematical factors could lead to the Schedule 4 giving higher or lower estimates than MOIRA, depending on the nature of the possession.

4.10 The conclusions that we have drawn from a comparison of the theoretical differences between MOIRA and the Schedule 4 algorithm seems to be confirmed by the two sets of evidence available to us: the EEA study and the work done for this report. Both sets of evidence have their weaknesses. The sample of possessions in the EEA study relates to renewals work on a particular part of the network, the Great Western route. The current work is based on a random sample but has a smaller sample than the EEA study and has very few "large" possessions.

4.11 For "small" possessions, of which each sample has a reasonable number, there is a pattern of Schedule 4 being greater than MOIRA for some possessions, less for others, with the overall results being of a similar order of magnitude. Both sets of evidence provide less information about "large" possessions. In the EEA study the Schedule 4 algorithm estimate of large possessions tended to be higher than MOIRA, which had a big influence on the overall result that the Schedule 4 algorithm produces estimates that are higher than MOIRA. In the current study the Schedule 4 estimate for the one large possession was also significantly higher than the MOIRA estimate. These results may point to overestimation by the Schedule 4 algorithm for large possessions but the evidence is weak as it is based on a very limited sample size.

4.12 The evidence available therefore suggests that for both small and large possessions, estimates from the Schedule 4 algorithm will sometimes be higher than MOIRA and sometimes lower, and in our view there is insufficient evidence to suggest in that in aggregate the results are of a different order of magnitude.

Unaware Passengers

4.13 Notification factors for possessions notified by the FWT, are currently set to be the reciprocal of the delay multiplier used in calculating the MRE for the corresponding service group. So for a service group with a delay weighting factor of 2.5, the FWT notification factor is set at 0.4. This, therefore, "cancels out" the delay weighting factor and implicitly assumes that possession with early notification can effectively be modelled as timetable changes. In other words it assumes that 100% of passengers are aware for possession with early notification. Given that currently most possessions are notified to the TOC well in advance, this implies a very high overall average level of awareness.

4.14 The survey data presented in the Steer Davies Gleave 2006 study and revisited in this report, combined with the discussion in the NERA study would suggest the following conclusions:

- The level of awareness (taking account aware non-travellers) seems to be typically of the order of 50%-70%;
- The level of awareness varied much less than implied by the current notification factors; and
- The sample size used to investigate the relationship between awareness and notification is too small to come to any firm conclusions, however the correlation is in the expected direction, although it appears to be weak.

4.15 The main conclusion from this work for informing the development of options is that the early notification discount factor is too low, given that most possessions over the last couple of years have obtained the maximum discount factor.

5. OPTIONS FOR CHANGES TO COMPENSATION MECHANISM FOR LOSS OF REVENUE

Introduction

5.1 The purpose of this chapter is to consider the various options for changing the existing possessions revenue loss compensation mechanisms and to propose preferred alternatives for the regime to operate during CP4. This will support the Policy Group in developing revised compensation arrangements for consultation with the rail industry in or before September 2007.

5.2 The ORR has stated that it is seeking to incorporate all possessions compensation arrangements within Schedule 4, removing the scope for agreeing compensation under the Network Change provisions of the Network Code (Part G). In addition, the Policy Group identified three different approaches to determining compensation that might be included within the scope of a revised Schedule 4, namely:

- A formulaic approach, such as the existing Schedule 4 algorithm, which could be applied to "small" possessions;
- An approach based on MOIRA analysis, possibly suitable for "larger" possessions that invite more specific investigation using industry-recognised modelling techniques: and
- Analysis and negotiation potentially embracing a number of techniques, including both MOIRA analysis and examination of actual revenue data, which would be applied to the "largest" possessions.

5.3 These distinctions provide a useful starting point for the development of revised compensation arrangements, and we refer to them throughout this chapter for ease of reference, but they raise specific questions concerning how they might be defined within the contractual provisions of Schedule 4. In particular, the Policy Group has asked us to consider:

- Whether the Schedule 4 algorithm should be modified;
- Whether there should be an explicit requirement to use MOIRA in certain circumstances, and if so how prescriptive the requirement should be; and
- How the boundaries between the different mechanisms for determining compensation should be defined.

Existing contractual provisions

5.4 The existing contractual provisions governing the determination of compensation are as follows

- All possessions are covered by the Schedule 4 algorithm specified in Section 3 of Schedule 4;
- Certain possessions are classified as "Significant Restrictions of Use", generally over 60 hours (or longer if a Bank Holiday weekend is involved), but this classification normally only affects compensation for costs, with revenue loss compensation following the standard algorithm; and
- For those possessions that are undertaken under a Network Change notice

(generally the largest possessions), revenue loss compensation is to be agreed between the parties, based on best estimates of the losses incurred, using Part G of the Network Code (however, the Schedule 4 algorithm is still applicable, with its result subtracted from the bespoke calculation).

5.5 The current system suffers from a number of disadvantages. In particular:

- There is an opportunity for "gaming" by train operators, who can apply for revenue loss compensation under Schedule 4 and Part G, receiving whichever provides the larger amount; and
- The SRoU definition, key to compensation for costs, is not generally used for revenue losses, so that there is a lack of consistency between the two regimes.

Potential contractual changes

5.6 The removal of possessions compensation arrangements from Part G presumably could be achieved through an explicit reference to the exclusion of possessions in the definition of a Network Change. There would also need to be some modification of Schedule 4, in particular the removal of paragraph 2.5 (which refers to Part G Restrictions of Use) and the reference to Major Project Notices resulting in compensation under Part G (in paragraph 2.7). While this process appears to be relatively straightforward there may be more consequential changes involved (in particular with respect to clause 18.1/schedule 9) and there may be issues around the exact definition of a "possession". Legal advice will need to be sort in order for the Policy Group to gain a full understanding of these changes.

5.7 Potentially more complex changes would follow from a redefinition of the boundaries between the different methods of determining compensation. It would not be necessary to define "small" possessions, as the algorithm would apply as the default method, as now. However, it would be important to define clear contractual triggers for the use of other methods, such that the appropriate method to be applied in specific circumstances was unambiguous. We discuss the possible definition of "larger" and "largest" possessions, in the sense used by ORR, in paragraph 5.67.

5.8 The question of whether there should be an explicit requirement to use MOIRA for calculating compensation is discussed in paragraph 5.44. However, we suggest that, regardless of the techniques identified as being most appropriate for estimating revenue losses, there would be merit in providing greater clarity on the approach to calculation in circumstances where the Schedule 4 algorithm did not, or might not, apply. In particular, from our review of two major possessions (the Ipswich and Strood Tunnel blockades), we have concluded that the industry would benefit from a greater level of guidance on the application of techniques for estimating revenue loss in cases where bespoke arrangements are required.

5.9 Based on the analysis we have undertaken in the study, as well as from comments made during the stakeholder workshop, we believe it is appropriate to make some modifications to the parameters within the Schedule 4 algorithm. In accordance with the guidance that we have received from the Policy Group these would take the form of changes to the Notification Factors defined in Schedule 4, taking account of passenger awareness and hence passenger behaviour affecting the level of revenue

loss. This issue is discussed further in paragraph 5.21 below.

5.10 Figure 5.1 provides a high level illustration of a possible future framework for determining possessions compensation. We believe there is merit in a three level structure, with:

Compensation for typical possessions being calculated according to a (revised) Schedule 4 algorithm;

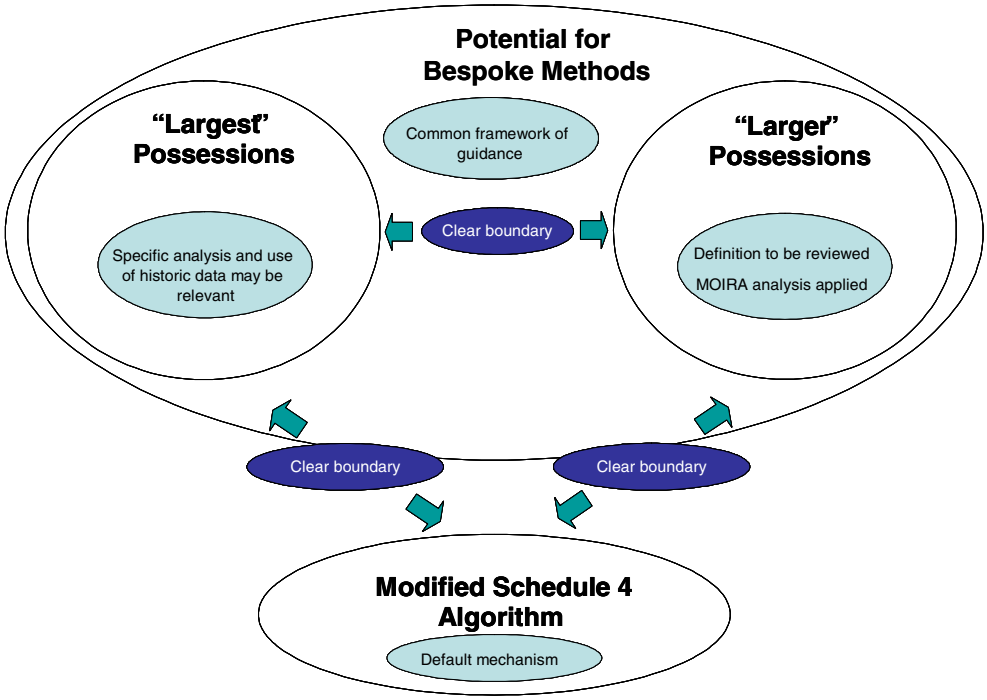
- "Larger possessions", beyond a defined threshold, would by default have compensation calculated using the Schedule 4 algorithm, but there would be scope to use alternative methods should the train operator produce *prima facie* evidence that the algorithm was likely to underestimate the level of revenue loss; and
- "Largest possessions", beyond a second threshold, would have compensation calculated using bespoke methods (although the Schedule 4 algorithm would be calculated by default, and would form a "floor" to the level of compensation).

5.11 Although it could be argued that, in practice, there would be little distinction between the "larger" and "largest" categories, we believe there is merit in distinguishing between those cases where an alternative calculation mechanism is considered exceptional (the "larger" possessions) and those where it is the default option (for "largest" possessions). We believe that the changes we propose below to the basic Schedule 4 algorithm will make it easier to maintain this distinction (hence reducing the number of complicated transactions), as it will reduce operators' incentives to deviate from the use of the algorithm.

5.12 In either of the second two cases, the guidance described above would be available in the form of a Possessions Compensation Guide, to be cross-referenced in Schedule 4. In preparing estimates of revenue loss from possessions in either the Larger or Largest category, both Network Rail and train operators would be required to demonstrate consistency with guidance provided, although the latter would be framed to support an appropriate degree of discretion and judgement.

5.13 The Possessions Compensation Guide itself could have a similar status to the Delay Attribution Guide and Data Accuracy Code, in the sense that it would be part of the suite of contractual documents governing track access but could be updated and modified as new information became available. It could therefore evolve in line with changes to possessions strategy and planning, for example following the full introduction of the "7 Day Railway", and consequent changes in travel behaviour.

FIGURE 5.1 POSSIBLE FUTURE ARRANGEMENTS



Calculation Mechanisms

Revised Schedule 4 Algorithm

5.14 As noted above, we have not been asked to undertake a detailed assessment of all aspects of the existing Schedule 4 algorithm. However, we have sought to determine whether the Notification Factors used in the formulaic calculation of compensation adequately reflect passenger awareness, a key determinant of behaviour and hence revenue impacts.

Notification Factor values

5.15 In presenting the result for Task 5, "validation of model assumptions", we have outlined the results of a survey of passengers' awareness of possessions undertaken by Steer Davies Gleave in 2005. This showed that awareness is strongly correlated with journey purpose, ticket type and distribution channel, as well as by date of purchase date (relative to travel date). The levels of awareness, across each of these dimensions varied between approximately 40% and 60% of those travelling. In contrast, passenger awareness was only weakly correlated with the type of notification factor applicable to the relevant possession, and the sample size was too small to draw firm conclusions.

5.16 It should be emphasised that variation of awareness referred to in the paragraph above refers to the variation in the aware passengers that chose to travel. If the propensity to still travel during a possession also varies by any of the characteristic analysed then the variation in awareness of all passengers may be greater than is stated above.

5.17 It is important to note that the current Schedule 4 algorithm assumes, for possessions notified before the First Working Timetable (FWT), that all passengers are aware of

the possession. This is strongly at variance with the evidence of the surveys, and seems in any case theoretically unachievable – not all passengers can be expected to know about the changes to the service, however effectively the operator tries to communicate this information.

5.18 As discussed in the literature review, following the guidelines in the PDFH (as we have done when estimating revenue losses using MOIRA), the impact on passenger demand (and hence revenue) is calculated differently for "aware" and "unaware" passengers:

- The impact on "aware" passengers is treated as if a timetable change; and
- The impact on "unaware" passengers is treated as if a worsening of performance.

5.19 The timetable change effect is based on elasticity of demand to the change in generalised journey time (GJT), while performance impacts are calculated by, firstly, applying a "delay multiplier" to the additional GJT, and then using the same elasticity to GJT as is used for timetable change. The delay multiplier depends on the service group and varies, in the calculation of the MRE parameters from Schedule 8 that are used within Schedule 4, from 2.5 to 6.5.

5.20 In the current Schedule 4 algorithm, notification factors for possessions notified by the FWT, are set to be the reciprocal of the delay multiplier used in calculating the MRE for the corresponding service group. Thus, for a service group whose MRE incorporates a delay weighting factor of 2.5, the FWT notification factor is set at 0.4. Effectively, this "cancels out" the delay weighting factor, reducing the impact of the possession to that due solely to timetable change (rather than worsening performance). It is in this sense that the current Schedule 4 algorithm effectively assumes full awareness among passengers.

5.21 In order to modify Schedule 4 to take account of actual levels of awareness, we can simply take a weighted average of the "aware" and "unaware" cases. As noted, for the aware case, the notification factor would be the reciprocal of the delay weighting factor, while for the unaware case, the notification factor should be unity, since the delay weighting factor is already incorporated in the MRE inherited from Schedule 4. Thus, the overall notification factor on a service group with a given level of awareness, can be calculated as:

- Notification factor = Awareness % x (1 / Delay weighting factor)
  + (1 – Awareness %).

5.22 In order to calculate the values of the notification factor, it is important that the appropriate measure of awareness is used. We need to consider the awareness among all people who were intending to travel during the possession. This will include some who, having discovered that the service is altered, choose not to travel (so that the surveyed percentage of aware passengers will always be lower than the true percentage of those who were aware). As noted in the previous chapter, with knowledge of the percentage of actual travellers who were aware of the possession (from surveys) and knowledge of the percentage who, being aware, choose not to travel (from surveys, or calculated from MOIRA), it is possible to establish the true level of awareness among potential passengers. See paragraphs 3.81 to 3.89.

5.23 The table below shows notification factors for a set of values of surveyed awareness among actual passengers, and the corresponding true level of awareness among all potential passengers, assuming that 40% of those who are made aware of a possession choose not to travel (based on an intermediate value between that implied by MOIRA, 30% in our sample, and from our survey, which implied 60%). This calculation has been undertaken for each of the (implied) levels of delay weighting factors underlying the MRE values for service groups within the set of over 2.500 possessions provided to us by Network Rail, namely 2.5 (default), 4.2 (long distance service groups), 5.2 (long distance with significant leisure travel) and 6.5 (airport).

TABLE 5.1 IMPLIED NOTIFICATION FACTORS BASED ON PASSENGER AWARENESS

		Delay weighting factors underlying MRE			
% travellers aware	*% total aware*	2.5	4.2	5.2	6.7
100%	100%	0.40	0.24	0.19	0.15
90%	94%	0.44	0.29	0.24	0.20
80%	87%	0.48	0.34	0.30	0.26
70%	80%	0.52	0.39	0.36	0.32
60%	71%	0.57	0.46	0.42	0.39
50%	63%	0.63	0.52	0.50	0.47
40%	53%	0.68	0.60	0.57	0.55
30%	42%	0.75	0.68	0.66	0.65
20%	29%	0.82	0.78	0.76	0.75
10%	16%	0.91	0.88	0.87	0.87
0%	0%	1.00	1.00	1.00	1.00

5.24 It should be noted that the first row in this table represents the levels of the FWT Notification Factors currently used in Schedule 4.

5.25 As an example of how this data might be used, if we assume, as implied by our surveys, that the highest level of awareness achieved among passengers is 60% (corresponding to 71% awareness among those originally intending to travel), then the notification factor for the earliest possible notification (i.e. by FWT) would, for service groups where the MRE was derived using a delay weighting factor of 2.5, be 0.57 (rather than the current value of 0.4).

5.26 Similarly, if we assume that passenger awareness, where notified after T-12, averages 40% (the lower end of the observed values in our surveys), then the relevant delay weighting factor would be 0.68 (compared to the current corresponding value of 0.8 for "late notification" possessions. It is noticeable that this value is significantly closer to the FWT notification factor than in the current scheme.

5.27 It would be possible to adopt a more sophisticated approach, taking account of the variation in passenger awareness between different service groups, either using information from existing surveys, or undertaking new surveys targeting this information. Using the same base information for each service group (i.e. the delay weightings used for the MRE calculation for the service group) and the survey information would generate a unique set of notification factors for each service group. We do not necessarily think this would be worthwhile, but if undertaken, the results of the work would be relatively simple to implement.

Implications of the changes to notification factors

5.28 The adoption of the change to the FWT notification levels suggested here would of course have a significant effect on the level of payments made by Network Rail to train operators (increasing them by the order of 50%). The justification for this comes mainly comes from the theoretical considerations of passenger awareness outlined above. It is, however, also supported by three other strands of evidence:

- Our analysis of compensation calculated using MOIRA indicated that Schedule 4 did understate revenue loss when MOIRA was adjusted to take account of passengers awareness, although MOIRA was only 20% to 40% higher in our analysis;
- Our analysis of actual losses for the Ipswich and Strood tunnel possessions implied that these were close to twice the Schedule 4 values; and
- At the stakeholder workshop, operator representatives indicated that revenue losses, on possessions where they had looked at actual values, were significantly higher than those calculated using the Schedule 4 algorithm.

5.29 While none of these indicators is definitive (the MOIRA vs. Schedule 4 analysis was based on a relatively modest sample size, for example), they do give additional weight to the validity of an increase to the (FWT) notification factors.

5.30 Although changes to notification factors would increase NR's payments under the scheme, this increase could be estimated and incorporated in the Access Charge Supplement charged to TOCs under the regime, so that, overall, it would be financially neutral to Network Rail for any given pattern of possessions.

5.31 A further issue is that, by reducing the "spread" of notification factor values (depending on the timeliness of notification), it could be argued that Network Rail's incentive to notify as soon as possible would be reduced. However, during the workshop, operators suggested that NR did not, in practice, take very much account of the level of payment in determining when operators were notified, so that the use of varying notification factors as an incentive was not clear. In any case, it is open to the Policy Group to select any values they feel appropriate from Table 5.1, deviating from strict "compensation-based" levels for notification factors (i.e. taking account of actual levels of awareness), in order to increase the level of incentivisation for Network Rail as required.

Number of notification factor levels

5.32 In addition to looking at the level of the FWT notification factors, we have also considered whether the number of notification factor levels (for a given service group) is appropriate. Currently, for each service group, the notification factors are set as follows:

- Lowest level, where possession incorporated into the FWT (generally at T-22);
- Middle level, where possession incorporated into timetables between FWT and the T-12 timetable; and
- Highest level, where possession notified after the T-12 timetable (but in time to be included in the Applicable timetable).

5.33 One point that was made consistently during the stakeholder workshop was that T-12 appeared to be relatively early in the process for informing passengers to be used as the last breakpoint in setting the notification factors. The view also expressed that Network Rail should have a greater incentive to notify TOCs as soon as possible, even if this were after T-12.

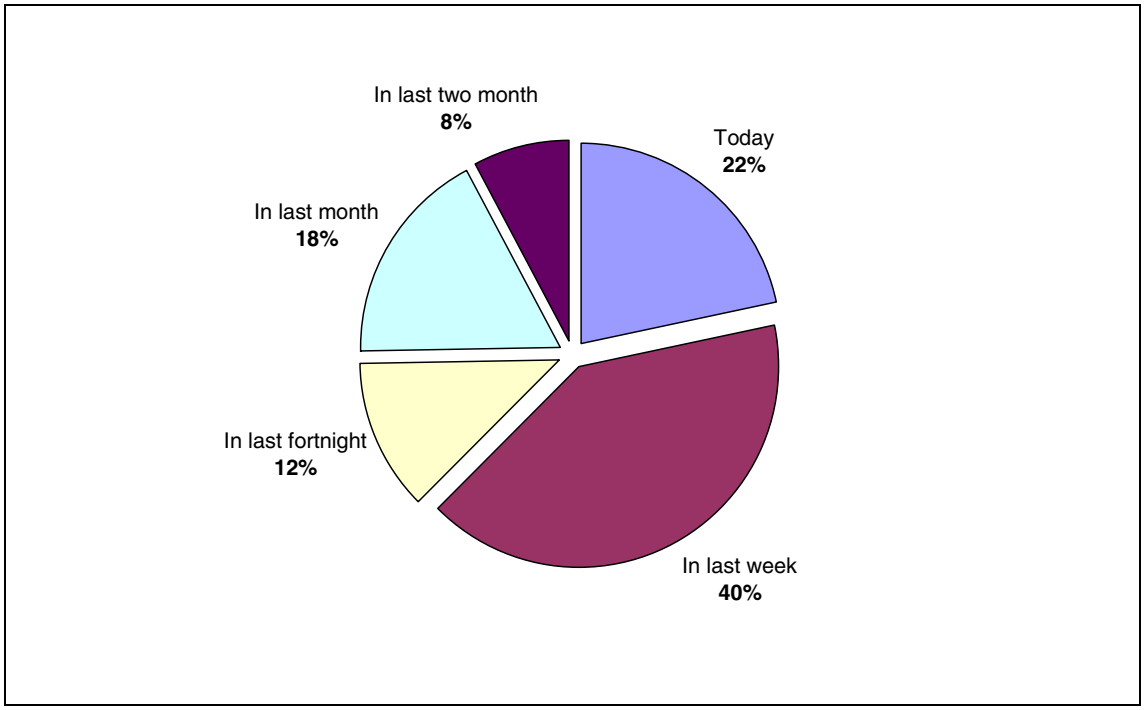
5.34 We have done some investigation of the evidence available on when tickets are purchased. The only evidence we found in the public domain is from the National Passenger Survey (NPS). The NPS asks passengers when they bought their ticket, and it offers the following five responses:

- Today;
- In last week;
- In last fortnight;
- In last month; and
- In last two months.

5.35 If the passenger does not select any of the five answers, it is recorded in the data as "don't know/no answer". In the last wave, spring 2007, approximately 25,000 correctly completed questionnaires were returned. The results on the survey are weighted be reflective of the national total. In the last wave of the NPS 70% of the weighted respondent did not provide an answer to this question. Figure 5.2 presents the results for the respondents that provided an answer.

5.36 Given the level on non-response to this question it is not possible to draw any definitive conclusions. However, the evidence suggests that the vast majority of passengers, over 90%, buy their ticket within the month of travel.

FIGURE 5.2 PASSENGER'S BOOKING HORIZON - NPS SPRING 2007



5.37 Since a convincing argument has been made that the stages in the timetable development process are well-defined points to use as breakpoints in the scheme, a possible modification to the scheme using a similar approach, would be to introduce a fourth level of notification factor closer to the date of travel (the option of removing the earliest trigger point, FWT, appeared not to have the support of TOCs given the operational planning benefits of early notification).

5.38 Before introducing another break point it will be necessary to consider the practical implications of doing so, in particular whether a clear notification point exist that can be made legally tractable. In the Network Statement (2008) a possible breakpoint appears to be at T-4, corresponding to the published timetable being available on the NR website. An additional breakpoint at this point gives Network Rail a further incentive to inform TOCs at least four weeks out (and hence give TOCs the opportunity to warn their customers), and also coincides with the provision of timetable information to the customer (and hence to passenger awareness).

5.39 As was mentioned in paragraph 5.31 in coming to a decision on what level the notification factors should be set at the Policy Group will need make a judgement to the degree the notification factors are set to compensate the TOCs and the degree they are set to incentives Network Rail. Table 5.1 provides a range of possible values that the Policy Group are free to choose from. In order to facilitate discussion in Table 5.2 we provide a "straw man" of the notification factors for a pure compensation regime and for an incentive regime. These notification factors are for a service group with a delay multiplier of 2.5. The compensation regime notification factors are based on the conclusion from the quantitative analysis that awareness varies between 50% and 70%.

TABLE 5.2 PROPOSED NOTIFICATION FACTORS (FOR SERVICE GROUP WITH A DELAY WEIGHT OF 2.5)

	1st Level	2nd Level	3rd Level	4th Level
Compensation Regime	0.60	0.63	0.66	0.70
Incentive Regime	0.60	0.65	0.70	0.80

5.40 For the compensation regime in Table 5.2 for the 1st level and 4th level notification points, we have taken the notification factors associated with 71% awareness and 53% awareness. We rounded these notification factors to the 1st decimal point. For the 2nd level and 3rd level notification points we took a simple linear interpolation between the 1st and 4th level points. For the incentive regime, we structured it around penalising Network Rail for late notification rather that rewarding it for early notification – so if Network Rail notifies the TOC it time to obtain the 1st level notification factor it pay the TOC sufficient money to only compensate for revenue loss. However, if Network Rail notifies the TOC by T-4 it compensates the TOC for the revenue loss due to the possession and pays a penalty for late notification.

5.41 It should be emphasised that the numbers in Table 5.2 are only provided as a "straw man" to enable discussion within the Policy Group.

Larger possessions

5.42 The Policy Group has raised the question of whether there is a case for requiring MOIRA analysis of "larger" possessions, however defined. In this context they have raised two specific issues, namely:

- What adjustments to MOIRA might be required? and
- Should the use of the model and adjustments be specified mechanistically or should some degree of discretion be permitted?

5.43 The case for making explicit reference to the use of MOIRA in Schedule 4 derives from the fact that it is a standard, widely recognised tool for analysing the impacts of timetable changes. As it is based on research described in the Passenger Demand Forecasting Handbook (PDFH), and updated periodically to reflect the latest passenger count data, it is arguably the best tool available for assessing possessions impacts.

5.44 However, in our view considerable caution should be exercised when making explicit reference to models and modelling techniques in contractual documents. While there are clear precedents for this approach (for example, as in the case of rail franchise financial models linked to Schedule 9 of the template franchise agreement, and the Journey Time Capability model which forms part of the London Underground PPP contracts), the models concerned satisfy a number of criteria, namely:

- They are subject to careful version control and often held in escrow;
- Inputs, outputs and calculations are typically subject to a detailed audit before a model is accepted for contractual purposes; and
- They are only used mechanistically when precisely defined input values have changed, resulting in the triggering of relatively tightly drawn contractual provisions.

5.45 Moreover, even where such models are employed, they may be used to inform discussions and negotiations rather than to mechanistically generate monetary values, at least where the amounts involved are substantial.

5.46 Considered against these criteria, MOIRA suffers from a number of shortcomings. Input values (for example, passenger demand profiles) are updated on an ad hoc rather than a systematic basis, and while there is version control, identifying the appropriate version to use at any point in time may be problematic. In addition, there are number of particular problems with the application of MOIRA to possessions analysis, notably:

- While it estimates impacts on daily demand, it does so on the basis of annual demand profiles, and outputs therefore require adjustment where there is significant seasonal variation in travel volumes;
- Although it can take account of differences between the summer and winter timetables, and between weekdays, Saturdays and Sunday, it makes no allowance for differences in travel behaviour between Monday and Friday;

- Dedicated ticket and Zonal tickets are not very well modelled in MOIRA and the adjustment of MOIRA to account for these tickets is done on an informal basis; and
- The base timetable, against which possessions impacts are estimated, may itself include possessions, with the result that careful examination of the model assumptions and inputs are required before any reliance can be placed on the outputs.

5.47 In any case it is quite likely that the MOIRA software will be upgraded or replaced during CP4 so that it would not be appropriate formally to rely on this piece of software.

5.48 We note that the latter problem is a particular concern when estimating the impact of possessions on Sunday services, not least because of the frequency of planned engineering activities at the weekend. In practice, MOIRA-generated estimates of revenue loss due to the disruption of Sunday services are likely to be particularly poor, and hence a mechanistic application of the tool in this case would be inadvisable in our view.

5.49 This observation raises broader issues relating to the operation of Schedule 4 in the context of Network Rail's vision of a "7 Day Railway", since the realisation of the vision would probably result in travel behaviour very different to that observed in the past. Estimating revenue loss from possessions in these circumstances would necessarily involve judgement until such time as robust demand profiles reflecting a more available railway were available. The resolution of this issue goes beyond the scope of this study, but we recognise the need to take account of a possible change in Network Rail's possessions strategy in framing our conclusions.

5.50 Given the limitations of MOIRA analysis, we suggest that references to the use of the model in the contractual framework governing possessions compensation should take the form of guidance rather than prescriptive requirements for its application, as discussed from paragraph 5.8 above.

The largest possessions

5.51 If a Possessions Compensation Guide were to be introduced, it would seem appropriate to include guidance on how the impacts of the largest possessions, however defined, should be assessed. This would need to cover a number of potentially relevant issues including:

- The application of MOIRA in cases involving an extended blockade, and how factors such as awareness should be estimated and adjusted for in such circumstances;
- How actual revenue data might be used in conjunction with MOIRA analysis to provide more robust estimates, taking account of other factors that might have affected demand over the period in question; and
- The means by which any subsequent ramp-up of demand towards steady-state levels might be estimated.

5.52 The Possessions Compensation Guide would have the following incremental benefits over and above the PDFH:

- The guide would be able to provide much more detail than the PDFH, which currently only gives limited advice on the modelling of possessions;
- The guide could not only discuss how possessions should be modelled from a theoretical perspective but also provide practical guidance, for example if it was felt that MOIRA was understating the loss due to it demand profiles, the guide could provide guidance on how the demand profiles could be modified;
- It could provide information about when the Schedule 4 algorithm is most likely to underestimate revenue loss; and
- The updating of the guide could be co-ordinated better with change in the industry.

5.53 The main purpose would be to increase the transparency of bespoke negotiations and reduce the transaction cost of those negotiations.

5.54 An approach involving the development of guidance covering a broad range of possessions may appear to remove the need for a contractual definition of "the largest", as distinct from "larger" possessions. However, there is a case for distinguishing between situations where a bespoke method of calculation *might* be used (but the default is to continue to use a formulaic approach) and situations where the impact of the possession is sufficiently large that there should be a presumption that a bespoke method *should* be used. This approach preserves flexibility, while encouraging use of the simpler, formulaic method, whenever there is no strong case to move away from it.

5.55 We discuss below how the boundaries between normal, "larger" and "largest" possessions might be set.

Boundary Issues

5.56 As noted above, we envisage that the (revised) Schedule 4 algorithm would continue to be the default mechanism for calculating compensation, and would be applied to the vast majority of possessions included in S4CS. With the changes to Schedule 4 envisaged, there is no evidence that using the algorithm would significantly bias the results to the detriment of either party. However, for larger possessions, the amount of money at stake is sufficiently large that bespoke methods of calculation may be necessary.

5.57 During the study, and at the stakeholder workshop, we have considered a number of approaches to determining the boundaries between the categories of possession. These include:

- Using the definition of the Significant Restriction of Use (SRoU) in Schedule 4;
- Basing boundaries on the duration of a possession (but not using the SRoU definition);
- Basing boundaries on the amount of Schedule 4 compensation for a possession; and
- Taking account of repeated possessions.

5.58 The definition of an SRoU in Schedule 4 is any possession over 60 hours, unless it includes a weekend with a Bank Holiday (in which case it is 84 hours, or 108 hours with two Bank Holidays, e.g. Easter). One benefit of using the SRoU boundary as a definition of "larger" possessions would be to bring the revenue and cost compensation elements of Schedule 4 into line.

5.59 However, while the majority of (approximately 97%) of possessions are in fact shorter than this we nevertheless believe that the SRoU boundary is too low to be suitable for use in defining "larger" possessions. This is because the relevant levels of compensation under Schedule 4 are relatively low (under £100,000), and as we have demonstrated, not likely to be significantly out of line with estimates derived using MOIRA (particularly with the proposed changes to Schedule 4 described above). Possessions that just classify as SRoUs are also unlikely to show up reliably in actual revenue data.

5.60 As an alternative to using the SRoU, a different, larger, minimum time period could be used. This is in principle an attractive approach, and is discussed in more detail below.

5.61 A further possibility is to use the level of compensation using the (revised) Schedule 4 formula to determine the boundary for the possible application of bespoke methods. However, conceptually, this suffers from the disadvantage of using the results of a calculation to determine when the calculation is not valid, so that any perceived problems with the calculation method might not properly be addressed.

5.62 Finally, the issue of serial possessions is recognised as being important. In many situations, a possession will be put in place on a number of consecutive occasions (usually at weekends). Currently, these are treated as individual cases (and compensated accordingly), but it can be argued that the impact on customers may be significantly greater than the corresponding number of one-off possessions. The market is likely to get the impression that the service does not operate at all at weekends, and demand may stay suppressed for a considerable period of time.

5.63 The argument to have a mechanism to account for serial possessions does not depend on a belief that the revenue impact of a series of possession is greater than the sum of the individual impacts (though it is certainly strengthened by it). Even if the impact of possessions is linear (i.e. the impact of ten possessions is equal to ten times the impact of a single possession) there is still an argument that a series of possessions should be treated the same as a single possession of equivalent duration.

5.64 At the stakeholder workshop, train operators suggested that an appropriate approach would be to look, not simply at possessions repeated in a single location, but at all possessions that affected a given service group (since from the customer's perspective the location of the problem causing delay is not particularly relevant).

5.65 We have therefore considered an approach looking at the impact of possessions on service groups over a given period of time, and we have tried to give an indication of the likely parameters of such an approach based on the dataset of possessions covering three rail periods provided by Network Rail for analysis in this study. The concept is that possessions would be regarded as being in the "larger" or "largest" category, if:

- The duration of possessions affecting a given service group was greater than a threshold cumulative number of hours within any consecutive series of a given number of rail periods.

5.66 The advantages of this approach are:

- It allows for the thresholds to be set at levels that are practical (i.e. allow flexibility where bespoke methods may be necessary, but do not include too many straightforward cases where application of a formula would give a reasonable answer);
- It caters for both long blockades and serial possessions, both of which are likely to impact demand in a way that may not match a formulaic approach, and which are likely also to affect actual demand sufficiently to be identifiable in historical revenue data after the event;
- It allows possessions along the same line of route ("spatially serial" possessions), which affect passengers on a given set of services, even where the physical works are in different locations, to be identified as potentially having a significant effect on demand, over and above that calculated by the basic formula; and
- Importantly, the data required to identify the thresholds of "larger" and "largest" possessions already exist within the S4CS database, so that, while some software development might be needed to operate the new system, it would be relatively minor.

5.67 In order to allow particularly large individual possessions to fall into the "larger" category (as opposed to a set of serial possessions cumulatively breaching a given threshold), we also propose that a threshold for such individual possessions, above that currently defining SRoUs, be set.

5.68 From analysis of the possessions dataset, we suggest that for cumulative possessions, the boundaries of "larger" possessions (those where train operators may choose to demonstrate that a bespoke calculation method would be appropriate) and of "largest" possessions (those where it is automatically presumed that a bespoke approach would be appropriate), could be as follows:

- "Larger" possessions defined as those where a given service group is affected by possessions in a particular location with a cumulative duration of 300 hours over any consecutive three rail periods; and
- "Largest" possessions defined as those where a given service group is affected in a particular location by possessions with a cumulative duration of 700 hours over any consecutive 7 rail periods.

5.69 The implication of these boundaries, based on the dataset we have available, is that approximately 0.5% of possessions (grouped by service group and location affected) would fall into the "larger" category, and approximately 0.25% (extrapolating from our limited data set) would fall into the "largest" category.

5.70 The numbers presented above are mainly for illustration, further calibration using a larger dataset would need to be completed before finalising the boundary points.

5.71 For the individual possession threshold, we suggest that a minimum duration of 120 hours would be appropriate (i.e. five full days, clearly encroaching into the working

week). Based on the dataset available, this would add a further 14 possessions not already covered by thresholds for cumulative possessions. This represents a further 0.9% of (individual) possessions. We suggest that possessions that breach this threshold also be categorised as "larger" possessions.

5.72 The contractual basis for these distinctions, particularly the distinction between the last two categories of possessions, would need to be developed based on legal advice. The objective of the boundary enabling TOCs to submit evidence that the algorithm provided insufficient compensation is to allow some flexibility in specific circumstances, while minimising the risk of large numbers of claims for additional compensation and the potential for associated disputes. The distinction between these and the largest possessions, for which the algorithm would generally be regarded as an inappropriate means of determining compensation, could be reinforced by requiring Network Rail to use best or reasonable endeavours to agree bespoke estimates in the case of the last category. Such a proposal would clearly need to be tested with legal advisers, although we note that the requirement to use best endeavours is already included in the existing Schedule 4 provision relating to bespoke arrangements for determining cost compensation in the case of a SRoU.

Other Contractual and Commercial Issues

5.73 Since rail industry restructuring in the mid-1990s, franchise contracts have included provisions for a franchise review to compensate for the financial effect on the operator of a regulatory review. The relevant provision in the franchise contract is generally referred to as "clause 18.1". While clause 18.1 is mainly designed to protect TOCs from the financial effects of changes in access charges, it also covers other elements of the track access charging framework, notably for this work Schedule 4. Therefore, any changes to Schedule 4 could, in principle, lead to "no net loss, no net gain" adjustments under clause 18.1 between the Department for Transport and the train operators. We are conscious of concerns expressed at the workshop that any changes should not lead to protracted and onerous negotiations between these parties.

5.74 Currently Part G negotiations are currently excluded from clause 18.1. As discussed in paragraph 5.6 it is the intention to remove possessions from the Part G compensation mechanism and for Schedule 4 to deal with all compensation related to possessions. This process would constitute a change in the rules of the access charging structure. In order to calculate the no net loss/gain position for rule changes it may be necessary to compare the current position with a counter-factual past position. This would need to be done on a case by case basis.

5.75 It should also be noted that any change to the compensation arrangements that changes incentives is potentially difficult. Even changing the algorithm could be problematic if Network Rail is likely to act differently in the future. In order to quantify the financial impact of the changes it may not be as simple as changing the parameter values for a given pattern of possession and calculating the difference. The pattern itself might well change under different incentives.

5.76 While it is difficult to predict the outcome of our proposals, in terms of their financial impact, in all cases, we suggest that they would be unlikely to lead to complex negotiations. We do not believe it will be necessary to take into account changes in

Network Rail behaviour as a result of changes to the Notification Factors, and this, therefore, could be calculated mechanistically using standard modelling techniques (much as the impact of changes to Schedule 8 benchmarks can be calculated). In addition, while the adoption of revised boundary definitions might result in a different approach to calculating compensation in individual cases, we note that the number of possessions subject to negotiations would be limited, as now. Indeed, precise boundary definitions would need to be determined with a view to ensuring that this number was manageable going forward. Hence, in practice, the changes we propose, while providing clarity, would probably not result in a material change to the number and types of possessions covered by bespoke arrangements.

5.77 We also note that a "no net loss, no net gain" adjustment may only be justified where the change, had it been made before an operator submitted a franchise bid, would have significantly affected the price offered. From our experience of franchise bidding, working for both DfT and franchise bidders, we suggest that such an adjustment would not normally be justified, at least in principle, since bidders do not generally factor explicit projections of possessions and associated Schedule 4 payments into their bid price. Rather, they look to Schedule 4 to ensure that, once the franchise is in operation, any deviation from their bid revenue line caused by a possession is adequately compensated. Hence, any change to the Schedule 4 regime resulting in more accurate levels of compensation, while it should provide operators with greater reassurance, would not necessarily result in a significant change to the economic and regulatory framework taken into account when the original franchise bid was submitted. Although the position would need to be considered on a case-by-case basis

5.78 The main focus of our work has been on reviewing the existing evidence in this area, conducting additional research and developing options for the modification of the current Schedule 4 regime. We have not focussed on the transitional costs to the new regime and further work will need to be done on this before selecting a preferred option. However, we would suggest that the boundary thresholds could be calibrated to minimise the change in TOCs financial position.

Summary

5.79 The table below sets out a summary of our proposals.

TABLE 5.3 SUMMARY OF PROPOSALS

	Option	Comments
1 Calculation mechanisms		
1.1	Revise Schedule 4 algorithm	Increase the value of the notification factors for earliest possible notification (i.e. by FWT), taking into account expected levels of passenger awareness
1.2	Later notification factors	The notification factors for notification after the FWT should be set taking into account the expected lower levels of passengers awareness, resulting in values closer to the FWT level than at present
1.3	Additional notification factor level	Introduce a fourth notification factor level, at T-4, to provide greater incentives for NR to inform TOCs even if the T-12 breakpoint is missed
1.4	"Larger" and "Largest" Possessions	Bespoke methods may be appropriate for "larger" possessions and will be appropriate for "largest" possessions. These methods are likely to involve use of MOIRA and/or historical revenue data.
1.5	Possessions Compensation Guide	Formal guidance, in the form of a "Possessions Compensation Guide", should be introduced to help NR and train operators in the estimation of compensation for "larger" and "largest" possessions.
2 Boundary issues		
2.1	Categories of possession	There should be three categories of possession – normal, "larger" and "largest"
2.2	SRoU	The Significant Restriction of Use definition does not provide a suitable boundary for Larger possessions
2.3	Serial Possessions	Serial possessions (either in terms of temporal sequence, or a spatial sequence) may affect demand more than the corresponding number of independent possessions, and should be included in the definition of "larger" and "largest" possessions
2.4	"Larger" Possessions	"Larger" possessions are those where a given service group in a particular location is affected by possessions with a cumulative duration of 300 hours over any consecutive three rail periods
2.5	"Largest" Possessions	"Largest" possessions defined as those where a given service group in a particular location is affected by possessions with a cumulative duration of 700 hours over any consecutive seven rail periods

6. SUMMARY

Scope of work

6.1 The work undertaken in this study was a literature review, complimentary quantitative analysis and the development of a set of recommendations for the modification of Schedule 4

Literature Review & Quantitative Analysis

6.2 The ITT specified four work items that need to be completed in order to inform our understanding of the accuracy of different methods of estimating revenue loss. These work items, which we labelled "tasks", were:

- Comparison of demand profiles predicted by MOIRA against actual train count data (Task 3);
- Comparison of modelled revenue loss with actual revenue loss (Task 4);
- Comparison of the assumptions made (implicitly or explicitly) by modelled approaches regarding passengers' level of awareness of possessions (Task 5); and
- Comparison of the results of models based on the Schedule 4 algorithm, with the results of models based on MOIRA (Task 6).

6.3 From the work completed in this study we suggest the following conclusions to each of theses work items:

Comparison of MOIRA demand profiles against actual train count data

6.4 From both the NERA 2006 work and the quantitative work carried out for this study we concluded that there are, at a station level, significant discrepancies between MOIRA and actual data. These discrepancies would affect the accuracy of MOIRA estimates of revenue loss

Comparison of modelled revenue loss with actual revenue loss

6.5 There is generally a lack of evidence about the actual revenue impact of possessions. Nevertheless, we have identified that:

- From the literature review and the Strood Tunnel case study there is no evidence to suggest that MOIRA estimated loss does not validate against the revenue losses based on historic data; and
- In both case studies the Schedule 4 algorithm estimated loss was half the final settlement.

Comparison of assumption made (implicitly or explicitly) by modelled approaches regarding passengers' level of awareness of possessions

6.6 We noted in the proposal to this work that there was a significant discrepancy between the level of passenger awareness assumed in the NERA study and the Steer Davies Gleave 2006 study. We have concluded that this difference was most likely due to the use of a too high percentage of aware passengers that would still choose to travel in

the Steer Davies Gleave 2006 study.

6.7 From the analysis of the 2005 survey data we found that awareness varied with various factors, including journey purpose and distribution channel. We also examined how awareness varied with Notification Factors, while the sample size was too small to make any firm conclusions we found no evidence to suggest that awareness did not increase with increased level of notification.

Comparison of MOIRA and Schedule 4 estimates of revenue loss

6.8 While there are reservation around the analysis comparing MOIRA and Schedule 4, we have conclude the following:

- Schedule 4 does not systematically overestimate or underestimate revenue loss compared to simple MOIRA (and also for MOIRA adjusted to take account of passenger awareness); and
- There is some evidence that the notification factor apply too high a discount for early notification.

Recommendation for Modification to Schedule 4

6.9 The ITT specified the following key questions that need to be addressed in proposing revised Schedule 4 arrangements for passenger revenue loss:

- Should the existing Schedule 4 algorithm be kept unchanged, or should it be revised; and if so how?
- Is there a case for including compensation based on MOIRA within a revised Schedule 4?
- How should the "boundaries" between different modelling approaches be defined?

6.10 We propose:

- Re-calibrating the Notification Factors to be more consistent with our understanding of the levels of passenger awareness;
- Introduce a fourth level of notification in order to give Network Rail further incentive to notify TOCs after T-12;
- Not to use MOIRA formally within a revised Schedule 4;
- The introduction of a Possession Compensation Guide giving formal guidance on the evaluation of revenue losses in "larger" and "largest" possessions;
- Allow for repeated possession in the definition of the categories of possession requiring bespoke analysis; and
- Define the boundary for bespoke analysis around the duration of possessions affecting a given service group being greater than a threshold cumulative number of hours within any consecutive series of a given number of rail periods.

APPENDIX A

LITERATURE REVIEW - PAPERS REVIEWED

A1. EVIDENCE IN THE PDFH

References

A1.1 The recommendation provided in the PDFH, which are mainly on service reliability rather than possessions, are based on the following papers:

- "Train Service Reliability on BR Intercity Services", Cranfield Institute of Technology - 1984
- "Big Delays", Steer Davies Gleave – July 1995;
- "The Investigation of Punctuality and Reliability", Bates et al. – Feb 2000; and
- "Recalibration of Rail Operational Performance Regimes", KPMG for ORR – Jul 2000.

PDFH Recommendations

A1.2 There is little direct evidence in the literature, and in particular in the Passenger Demand Forecasting Handbook (PDFH) about the effect of engineering works on demand. However, there is a wealth of information on the effects of rail journey times, interchanges, and delays, and also some information on how people value time spent on buses compared to time spent on trains, and the time that the market takes to respond to changes.

A1.3 The PDFH itself draws on a wide range of studies and from these makes recommendations about parameters to be used for demand forecasting. We have not listed below all the individual studies that contribute to the PDFH's recommendations, but where additional evidence is drawn upon, specific references are given.

Scheduled Timetable Changes

A1.4 Most empirical work has focused on measuring "penalties" for interchange and for service intervals (in the latter case reflecting not being able to depart or arrive at the precise time desired by the traveller and hence involving waiting time and/or a requirement to plan the journey), and measuring the elasticity of demand to "generalised journey time" (GJT), comprising actual journey time combined with these penalties. The penalties have been derived from both observed passenger behaviour (e.g. choice of trains) and stated preference (SP) market research[4]. The demand elasticities are mainly based on measuring the effects of timetable changes while controlling for other influences on demand (e.g. in econometric studies)

A1.5 The PDFH recommendations are built into the MOIRA timetable evaluation software, which uses them to calculate the demand impact of service changes on a matrix of station-to-station flows. (MOIRA also estimates the ORCATS revenue allocation of each flow to individual services, from which TOC earnings can be derived by aggregation - see below.)

[4] The most recent study used both approaches: "Strategic Rail Authority Interchange Study", Institute for Transport Studies, University of Leeds, May 2001.

A1.6 Large time savings have been shown to lead to higher GJT elasticities in the case of high speed rail – mainly in situations where there is opportunity for diversion from air. While this is hardly the case in the context of these blockades, it is nevertheless possible that large time penalties may also result in different elasticities. In particular, if the overall rail journey becomes very unattractive compared to the road alternative, most of rail's market share will be lost, which may imply higher elasticities than recommended in the PDFH.

A1.7 A wide range of factors will affect interchange penalties and MOIRA uses average values that increase with the length of the overall journey – typical values of 10-15 minutes apply for journeys of around 15 miles. Commuters tend to be more prepared to make interchanges, being more familiar with the journey, and this is reflected in lower interchange penalties for journeys on season tickets in MOIRA.

A1.8 However, four other factors that affect interchange penalties are walking and waiting time (conventionally weighted double in-vehicle time in the GJT measure), ease of interchange, familiarity with the station, and facilities (e.g. waiting facilities). All of these will contribute to penalties being higher than average when connecting to a bus link outside the station. Anxiety will also come into play – even for experienced travellers – when awaiting a bus link compared to a train. To some extent these concerns are addressable by ensuring the logistics at the rail/bus interface work smoothly, but their influence can probably not be eliminated entirely. They could easily add another 5-10 minutes to the MOIRA interchange penalties – more if there is a long wait for the bus connection or onward rail connection (and bus timings will need to allow some "buffer time" for delays en route to ensure connections are made). However, there is evidence in the PDFH that the interchange penalty when there is a guaranteed connection, as may be the case with coach replacement services, is substantially reduced

Delays

A1.9 The effect of service reliability (in its most general sense, including both punctuality and cancellations) has attracted much research since the mid-90s. Up until then, the main evidence came from a study undertaken by Cranfield Institute of Technology for InterCity in 1984[5]. On the basis of this the PDFH recommended that each minute of delay was equivalent in its effect on demand to 2.5 minutes of scheduled journey time.

A1.10 The most recent edition of the PDFH reports on more recent studies[6] that looked at the theory and literature on this complex area of consumer behaviour and undertook SP market research to measure the effects. In particular, the new research took account of the discrete nature of train services, which means that travellers cannot match their ideal arrival times exactly. This was shown to increase the impact of delays, and the latest edition of the PDFH recommends that each minute of delay should be treated as

[5] "Train Service Reliability on BR InterCity Services", Cranfield Institute of Technology, 1984.

[6] "The Investigation of Punctuality and Reliability", John Bates, Peter Jones, John Polak and Andrew Cook, February 2000. Also "Evaluation of Reliability and Punctuality Improvements on Rail Services", MVA for Shadow Strategic Rail Authority, August 2000.

equivalent in its effect on demand to 3 minutes of scheduled journey time. Wide variations were found between different customer types, journey times and services, and while there is some evidence supporting lower values for regional services, very much higher values are recommended for airport journeys and long distance high speed services.

A1.11 The PDFH also references the "Big Delays" research, undertaken by SDG[7], which focused on delays of 30 minutes or more on suburban routes and an hour or more on inter-urban routes. Apart from producing a range of valuations for delays consistent with the other studies reported above, this study included a simple trade-off exercise aimed at valuing delays from engineering work and how these can be reduced by advertising in advance. It found that respondents valued unexpected engineering delays at about 3 times scheduled journey time. However, those aware of the delay before starting their journey treated the extra time in the same way as scheduled journey time.

A1.12 The "Big Delays" study also found that the level of passenger awareness of advertised delays was very low: only 11% were aware of the delay before they set out on their journey, and a further 13% were aware by the start of the train journey (e.g. through information displayed at the station). The PDFH recommendation for evaluating the effect of major engineering work, in the absence of detailed survey data, is to treat 25% of travellers as aware of the delay and 75% as unaware. The effect on demand for the "aware" segment should be evaluated as a journey time and interchange effect, whereas for the "unaware" segment the effect should be evaluated as a delay, with the additional journey time weighted by a factor of 3.0.

A1.13 The study also found that, of a sample of customers who had suffered a big delay, 3-4% subsequently stopped using rail altogether and a further 5% reduced their use of rail following the incident. Taking a weighted average of responses, this converted to a loss of 5-6% of rail trips that the sample would have made without the incident. It also found that travellers over-estimated the chances of a delay by a factor of 3 for rail users, 4-6 for non-users, and even higher for those who had experienced a big delay.

Buses

A1.14 Values of time for users of buses, trains and other modes have been measured in a wide range of studies using both revealed preference (observed journey choices) and SP techniques. There is evidence from these studies that, on the whole, bus users have lower values of time than rail users. This to some extent indicates a segmentation of the market by self-selection in that those with lower values of time choose the generally slower and less expensive bus mode, whereas those with higher values of time choose rail. It also reflects differences in the types of journey made by mode, with bus used for local essential journeys and rail for longer commuting, business and leisure journeys (all of which tend to be made by, on average, higher income households). However, most RP and SP mode choice models also show a significant

[7] "Big Delays", Steer Davies Gleave, July 1995.

preference for train over bus, even after the journey time, fare and any other service differences have been accounted for.

Demand Response Times

A1.15 The evidence from significant inter-urban timetable improvements is that the newly generated demand builds up over a period of at least two years. The evidence for suburban line upgrades in the London & South East area is that growth continues much longer than this, due to relocation of the population over a period of time. However, these lags in response reflect the time taken for awareness to build, for new users to be attracted from other modes, or even for relocation effects. Significant service reductions impact immediately on existing users, although there will be a delayed response for infrequent users. There is little empirical evidence of changes in this direction, however.

A1.16 The PDFH reports findings that a change in train service performance takes about six months to feed through to revenue – the case both for deteriorations in reliability and the recovery back to normal[8]. However, in the case of major changes in punctuality at a national level (for example, following the Hatfield derailment in October 2000), the effects may be more immediate.

Longer Term Effects

A1.17 There is no evidence quoted in the PDFH on the longer-term effects of temporary changes to timetables or periods of service unreliability. The implicit assumption is that traffic levels will, eventually, return to former levels

[8] "Performance Perceptions and Revenue", British Rail Operational Research, March 1996.

A2. "DEMAND EFFECTS OF CHANGED POSSESSION PATTERNS", STEER DAVIES GLEAVE 2004

Aims & Objectives of Study

A2.1 Steer Davies Gleave was commissioned by the SRA in August 2003 to examine the effect on rail demand of changes in possessions patterns. In particular the study looked at the passenger revenue consequence of moving to possession strategies consistent with Efficient Engineering Access (EEA).

Overview of Work Completed

A2.2 In order to meet the aims and objectives of this study Steer Davies Gleave undertook the following work:

- Monitoring;
- Development of Demand Model;
- Market Research; and
- Application of Demand Model on 2 test case studies.

Monitoring

A2.3 The objective of the monitoring work was to estimate revenue loss actually experienced on historical possessions. Due to limits of the data made available it was only possible for this work to look at a small number of historical possessions – this significantly reduced the statistical robustness of any finding,

A2.4 In the end the study only looked at three possessions. The study identified significant limitation to monitoring work done and noted that there was a high degree of uncertainty around the revenue loss estimates. As a consequence it is not possible to come to any conclusion from the monitoring work of this study apart from possibly the difficulty of estimating actual revenue loss.

Development of Demand Model

A2.5 In order to estimate the effect of different possession strategies Steer Davies Gleave developed a demand model that was able to analyse the revenue implications of different possession strategies. The demand model took account of the following three effects:

- The immediate impact of each possession on the travel pattern of the affected passengers during the period of the possession, including any rail heading and selection of alternative routes;
- Time-shifting of journeys that may take place to avoid travelling during the period affected by the possession; and
- The longer term impact on travel demand.

A2.6 The model was built in Vensim (a system dynamics software package) with GJT inputs provided on a key flow basis from MOIRA.

A2.7 A key element of the model was the distinction between passengers that had advance knowledge of the possession and those that did not (the so called aware and unaware segments). They used the market research to estimate the proportion of the passenger in each category.

A2.8 For the aware segment they assumed that the reduction in journeys could be estimated be applying generalised journey time elasticity to the change in generalised journey time. They further assumed that there was no long term impact on the aware segment.

A2.9 For the unaware segment, who by definition, make the journey and experience unanticipated delays – Steer Davie Gleave assumed that this delay could be treated as akin to a change in the level of performance. For each pattern of possessions they calculated the increase in average delay and then calculated the demand reduction by applying the normal PDFH approach to changes in delay minutes. They then weighted the demand reduction by the proportion of the market that is unaware. They made no assumption of the distribution of this demand reduction over time.

Market Research

A2.10 Two market research studies were undertaken, one involving general quantitative and qualitative market research in the East Anglia region based around the test case possession identified in this area and the other comprising stated preference research in the Great Western region.

A2.11 The objective of the East Anglia market research was to understand the factors affecting passengers' travel decision with respect to possessions, and the effect of their experience on perceptions and longer term behaviour and to understand. The East Anglia Surveys were conducted on days that were unaffected by possessions and days that were affected by possession – over 2,500 interviews were achieved. The objective of the Great Western stated preference research was to examine passengers' attitudes towards service disruption caused by engineering works, and to provide information about their preferences and priorities.

A2.12 The East Anglia research found that of the passengers travelling on the day of the possession 66% claimed that they were aware of the possession before starting their journey. Analysis of the survey data identified a relationship between awareness and the level of pre-planning, trip frequency and journey distance. The table below tabulates the relationship which was found between the second and third factor and awareness.

APPENDIX: TABLE A2.1 PERCENTAGE OF AWARE PASSENGERS BY TRIP FREQUENCY AND JOURNEY DISTANCE

Trip Frequency	Distance (miles)		
	Under 20	20-75	More than 75
Frequent	56%	48%	71%
Regular	56%	48%	74%
Infrequent	56%	58%	72%

A2.13 In order to put the above table into operation in the demand model a trip frequency to ticket type lookup was created from National Passenger Survey data.

Application of Demand Model on 2 test case studies

A2.14 The East Anglia test case looked a historical possession between Chelmsford and Liverpool Street. From analysis of LENNON data the estimated actual revenue decrease was 50% for full price tickets and 30% for reduced tickets. However, it was not possible to robustly identify these numbers. This actual revenue loss compared reasonably well to a modelled loss of 35%.

A2.15 The Great Western study was a more theoretical exercise focussing on the maintenance and renewals workbank for the second half of 2005. Initially planned using traditional access patterns, the work was rescheduled under EEA principles. The study looked at estimates of revenue loss for both the traditional pattern of possession and for the EEA pattern of possession. It compared both modelled and Schedule 4 estimates of loss, the high level numbers are presented in the table below

APPENDIX: TABLE A2.1 GREAT WESTERN RENEWALS BASE VS. REPLAN

	Total estimated revenue loss (from SDG model)	Total Schedule 4 costs
Base Plan	£2,942,206	£6,399,788
EEAS Replan	£3,005,531	£7,643,868
Percentage difference	2%	19%

A2.16 The model estimated revenue loss to be under half the Schedule 4 costs estimates. Whilst overall this was the case the study found that there was no clear relationship when the individual possessions were compared.

A3. "DEMAND EFFECT OF POSSESSIONS", STEER DAVIES GLEAVE 2006

Aims & Objectives of Study

A3.1 The objectives of this study were to provide a robust and complete set of parameters for modelling the demand effect of possessions, and to produce a series of instructions for deriving forecasts

Overview of Work Completed

A3.2 The study was divided into two streams of work, a market research workstream and a time series analysis workstream.

Market Research

A3.3 The aim of this market research was to examine awareness levels amongst passengers and to obtain information on the way travellers perceive and respond to possession in general. There were two separate survey exercises undertaken: the 1st monitored travellers while a possession was in operation; and the 2nd (which was not based around specific possession) surveyed the general rail travellers about their views on severe disruptions.

Awareness

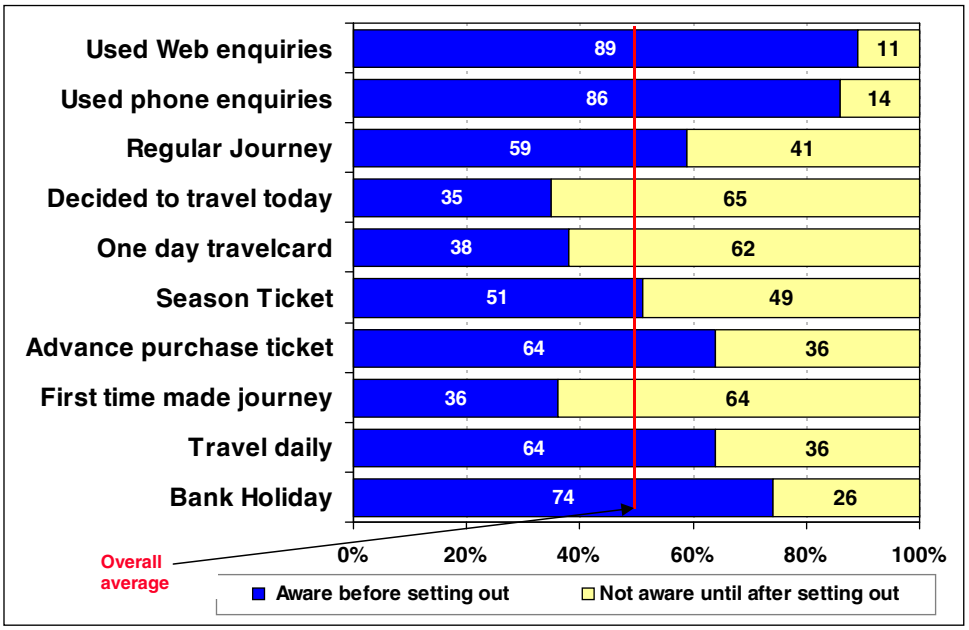
A3.4 The raw survey result on awareness was that 47% of passengers were aware of the possession. However, a key limitation to this result was that the aware passengers that decided not to travel on the day of the possession were omitted from this number. In order to take account of these passengers in the percentage of aware passengers they estimated the proportion of travellers who were aware but who did not to travel using the stated intentions of the unaware passengers. This resulted in a calculated level of awareness of 53%. The overall breakdown of aware/unaware and the type of travel response to the possession that this study estimated are tabulated in the table below.

APPENDIX: TABLE A3.1 ESTIMATED OVERALL SEGMENTATION OF MARKET

Action during possession	Aware Segment	Unaware Segment	Total
Still travel by Rail on the day	41%	47%	88%
Use different rail route	6%		6%
Travel on different day	1%		1%
Change Mode/Not Travel	5%		5%
Total	**53%**	**47%**	**100%**

A3.5 The surveys also looked at the key factors which influence level of awareness. The surveys found that the most important influence was whether or not phone or web enquiry services were used to obtain information before setting out. The figure below present the result from this area of the study

APPENDIX: FIGURE A3.1 KEY FACTORS WHICH INCREASE OR DECREASE AWARENESS



Source: During Possessions Survey 2005. Sample size = 2306

Passengers Response to Possession

A3.6 The market research work did provide some evidence of the impact of possessions on future travel behaviour. The market research identified two effects:

- The level of satisfaction with the journey is lower among the unaware than the aware.
- Propensity to travel by rail less, avoid Sundays and avoid travelling during work all increase with both the level of dissatisfaction and the level of awareness. However, in the survey while dissatisfied unaware passengers react more negatively than dissatisfied aware passengers, there was little difference in future use of rail by either aware or unaware satisfied passengers.

A3.7 The research did not give any indication of how much less respondents would travel by rail – although even if it did it is questionable how reliable any result would be.

Time Series Analysis

A3.8 There were two streams of time series work the 1st (historical monitoring) looked at a set of historical possessions and the 2nd (possession monitoring) looked at LENNON data for the possessions that were surveyed in the market research workstream. The main aim of the time series work was to investigate lags and to validate proposed modelling methodology and parameters. It was concluded in the report that these two workstreams were not successful, and a number of reasons were given for this:

- A lot of low volume flows were analysed which were subject to a high degree of volatility;
- Large network wide effects were present in the LENNON data, which particularly for the possession monitoring work caused difficulty (the possession

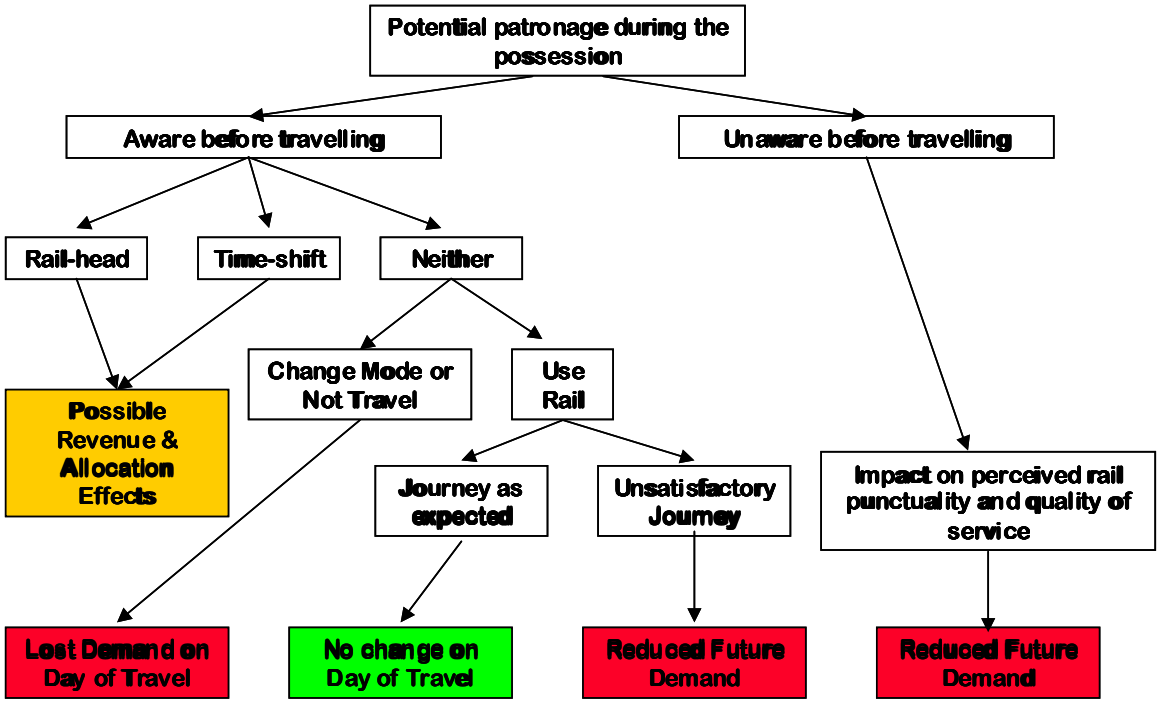
analysed occurred a couple of months after the London bombing);

- It was very difficult to identify a suitable comparator flow; and
- Period data was to aggregate to identify weekend possession but daily of weekly data was subject to a high degree of volatility.

Suggested Forecasting Procedure & Recommendations

A3.9 As part of this study Steer Davies Gleave proposed a forecasting process to estimate the revenue effect of possession, reproduced in the figure below. The process developed was largely based on the 2004 work; except for the possibility of reduced future demand by those aware of the possession has been introduced. The process divides the potential travelling population during the period of the possession into a number of segments for who different effects may be expected: the possible outcomes are colour coded: green for no demand effect, red for a net loss of demand, and orange for a possible reduction in demand accompanied by possible allocation changes between TOCs.

APPENDIX: FIGURE A3.1 PROPOSED FORECASTING PROCESS



A3.10 In the report the they state that from the results of the market research they felt that the impact of changing day of travel on rail demand and revenue will be very small and they therefore recommended that its effect should be ignored.

A4. "COST BENEFIT APPRAISAL OF EEA POSSESSION STRATEGY", NERA 2006

Aims & Objectives of Study

A4.1 The main of this study was to provide a cost benefit analysis of different types of possession strategies. In particular it compared possession strategies that were "Engineering Friendly" and possession strategies that were termed "Passenger Friendly"

Overview of Work Completed

A4.2 The study assessed the costs and benefits of alternative possession strategies over a significant part of Network Rail's Great Western region. The engineering options that were analysed were called the "Engineering Friendly" option and the "Passenger Friendly" option. The engineering friendly option had longer possession for track renewals, longer weeknight maintenance possessions, daytime maintenance patrolling, and reduced reliance on Christmas blockades. The basis behind the passenger friendly option was a desire to run as near as possible to a full service on Sunday afternoon.

A4.3 The study base it cost estimate largely on estimate provided from Network Rail. The revenue estimates were largely based on a similar demand modelling exercise as that suggested in Steer Davies Gleave's 2006 report, however this study did make a number of innovations to this process that are of interest.

Modelling Approach

A4.4 The NERA study used MOIRA to estimate the revenue effect of possessions. They took no account of rail heading or day switching in their modelling framework – arguing that these effects do not materially affect train operators' revenue.

A4.5 Consistent with the approach used in the Steer Davies Gleave studies they distinguished between aware and unaware passengers. The possession effect of aware passengers was modelled using MOIRA. The possessions effect on unaware passengers is calculated by assuming the possession has the same effect as a normal service disruption. To reflect this they used the standard PDFH approach for modelling service disruption i.e. calculate the additional journey time and then weight this additional journey time by a value of 3.

A4.6 This modelling approach is essentially a simplification of the approach recommended in the Steer Davies Gleave 2006 study.

MOIRA Calibration

A4.7 The NERA report argued that a weakness of the MOIRA model when analysing weekends is that its assumed distribution of demand throughout the day (its demand profiles) is based on data from the early 1990s, since when the pattern of demand has changed. To overcome this issue the NERA study carried out a process of calibration using train counts supplied by FGW.

A4.8 The method they used to adjust MOIRA demand profiles was as follows – using the train counts they derived average number of passengers for each High Speed service on arrival or on departure at Paddington. They then compared these predictions for the same trains in MOIRA. In particular, they compared numbers of passengers departing/arriving each hour and then changed the demand profiles to get numbers to match

A4.9 From the NERA report it is not completely clear how they adjusted the demand profile. One train load modelled in MOIRA will be a function of a number of different types of demand profiles, so making any adjustment will not be straight forward.

Assumption on Awareness

A4.10 The NERA study decided to assume a much higher level of awareness of the possession than was recommended in the Steer Davies Gleave 2006 study – NERA assumed 75% of passengers were aware compared to the 53% assumption recommended in the Steer Davies Gleave study.

A4.11 The argument the study provided on their assumption on awareness was that a level of awareness of 75% was more consistent with the observed level of revenue loss and percentage of passengers travelling during possession than the recommended Steer Davies Gleave number.

Model Validation

A4.12 NERA compare their model results to the observed reduction in revenue reported in the Steer Davies Gleave 2006 study – of which the median fall was 45%. After adjusting for awareness NERA MOIRA run on a selected group of flows was around 33%. They argued that if you adjusted the actual revenue loss figure to take into account switching day of travel and rail heading (which could account for 25% of revenue) the actual revenue loss may be around 34% to 38% which compares well to the 33% figure derived from MOIRA.

APPENDIX B

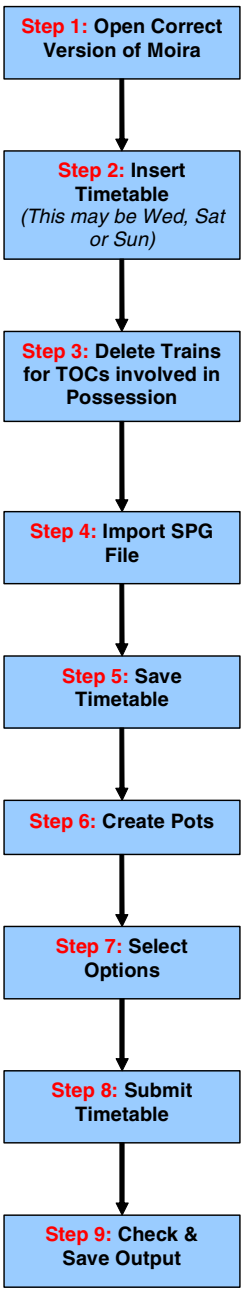
MOIRA BRIEFING NOTES

B1. TEMPS BRIEFING NOTES

Overview

B1.1 The Figure below provides an outline of the step that need to be completed in order to produce one MOIRA runs.

APPENDIX: FIGURE B1.1 PROCESS MAP FOR MOIRA RUNS



Step 1: Open MOIRA

B1.2 There are 11 versions of MOIRA:

i. OR02;
ii. OR11;
iii. OR14;
iv. OR16;
v. OR17;
vi. OR18;
vii. OR19;
viii. OR25; and
ix. OR23.

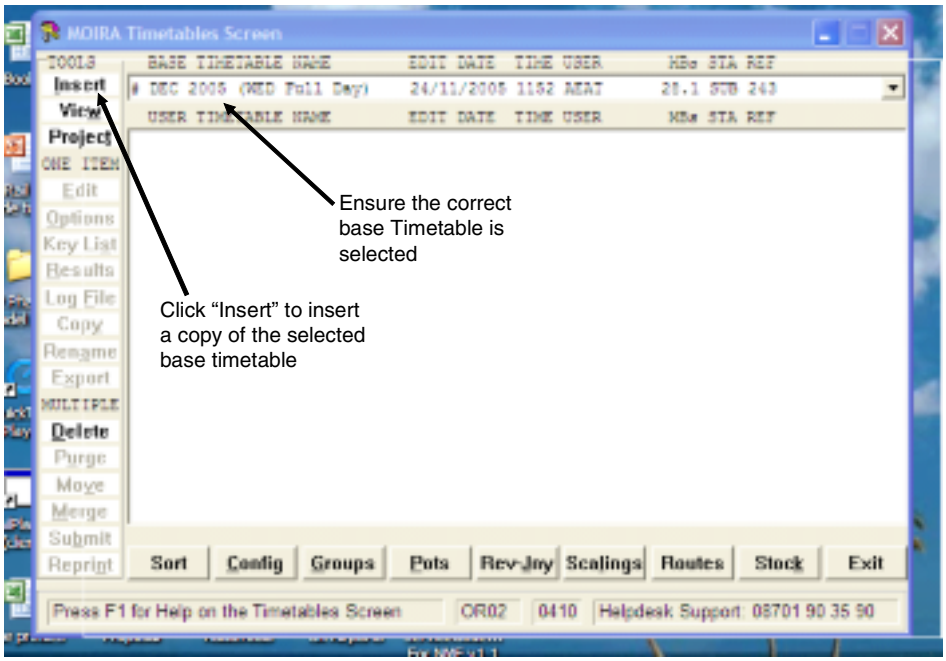
B1.3 For each possession we look at it will be necessary to use the most appropriate version of MOIRA.

Step 2: Insert New Timetable

B1.4 In the timetable manager screen first select the base timetable that is to be used in this possession run. There are 3 base timetables that we may use:

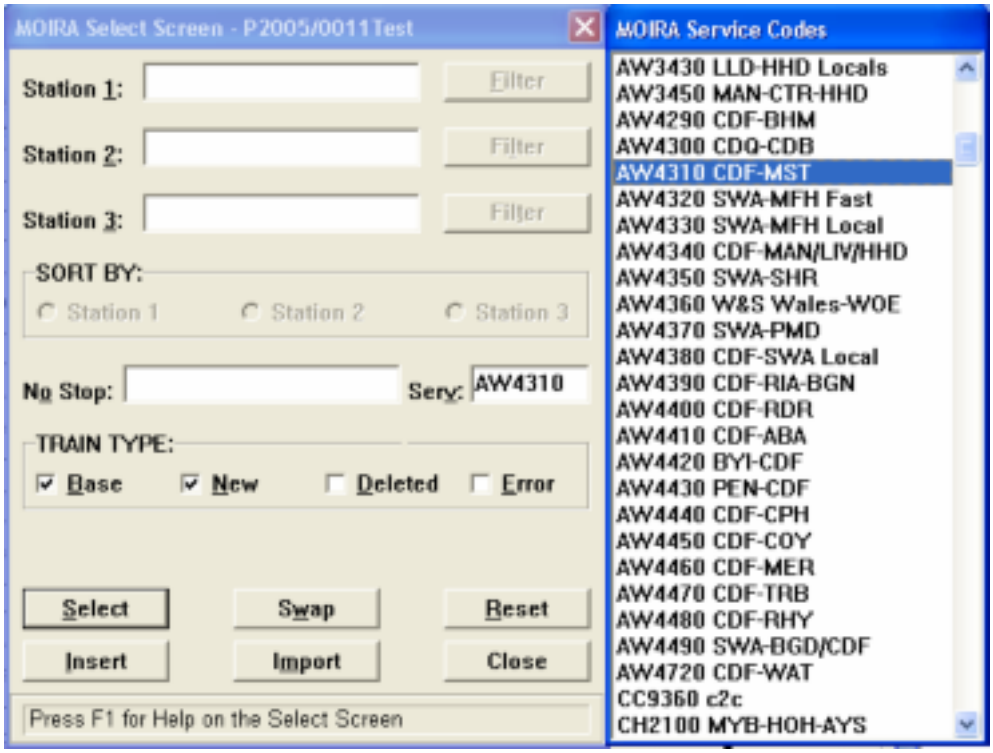
i. Dec 2006 (WED Full Day);
ii. Dec 2006 (SAT Full Day); and
iii. Dec 2006 (SUN Full Day).

B1.5 Next click "**Insert**" and enter the possession reference I.D name e.g. P2006/689292



Step 3: Delete TOCs Trains

B1.6 Next double-click on the inserted timetable – this will bring up the **MOIRA Select Screen**. In this screen you will need to select in turn the trains that need to be deleted for the possession run. For example, if you need to delete the trains for Arriva Trains Wales service code 4310, enter AW4310 into the **Serv:** box and then click **Select**.



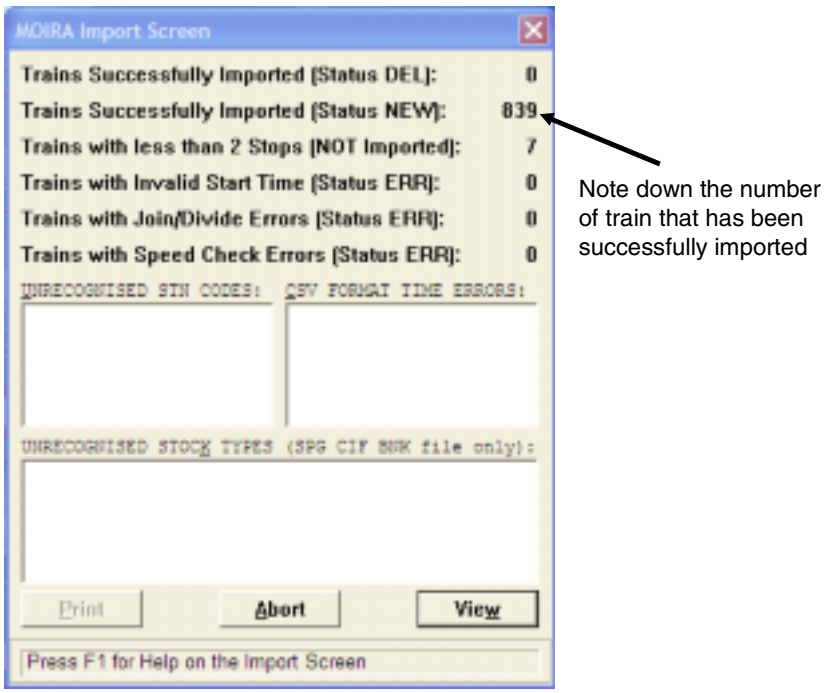
B1.7 This will bring up the **MOIRA Train Select** screen. In this screen highlight all the trains and then press delete on your keyboard. The next screen will ask you if you wish to delete the **Whole Train**, click **OK**. Then return to the **MOIRA Train Screen** by clicking **Save**.

B1.8 In the **MOIRA Train Select** there is a count of the number of trains that you have selected – note down the number of **Base** trains.

B1.9 Repeat the above process for all the service codes to be deleted for the possession. Make sure to select and delete all trains for all the service codes that lie within the range given in the list, for example, for codes 3380 and 3388 both lie within the 3380-3389 range, therefore the process must be done for both these service codes.

Step 4: Import Timetable

6.11 Click the **Reset** button in the **Select Screen**, and then click **Import**. This will bring up the **MOIRA Import Screen**. In this screen click on the **SPG** button and then navigate to the folder where the timetable files are saved and then double click on the timetable that is to be imported e.g. if you are running the possession P2006/689292 then double click on the timetable which has been named P2006/689292.



B1.10 If the import of the new timetable has been successful the number of trains that have been successfully imported should be of the same order as the number of trains that you have deleted. If is not contact Jessica Booth or Philip Dobson.

B1.11 Next click **View** which will take you to the **MOIRA Train Screen**, briefly visually inspect the new trains that have be imported and check that they are consistent with the trains that you have deleted. After you have finished checking the imported trains click **Save,** which will take you to the **MOIRA Select Screen** and then click **Close** in this view.

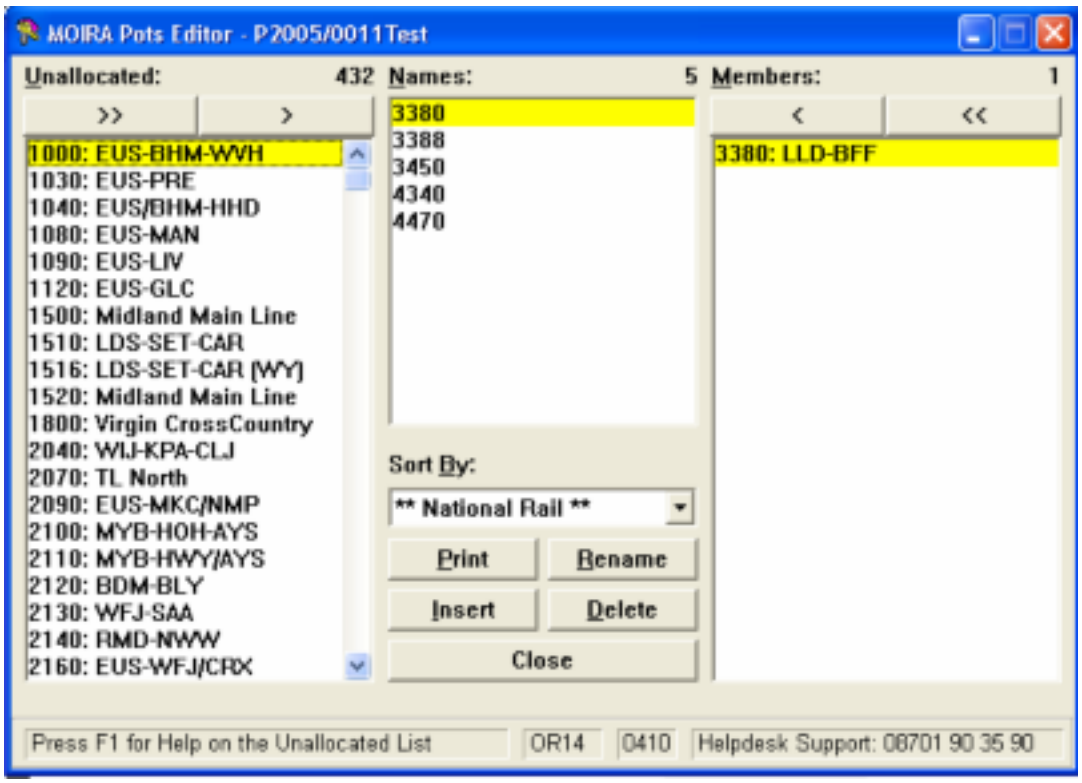
Step 5: Create Pots

B1.12 Next we have to add "pots". This is done through the **MOIRA Timetable Screen**. We need to add a pot which lists all the service codes that have been affected by the possession we are analysing in this MOIRA run.

B1.13 First select **Pots** from the options along the bottom of the **MOIRA Timetable Screen-** this will take you to **MOIRA Pots Screen**.

B1.14 Insert a new pot by pressing **Insert**. Call your pot the name of the possession, e.g. P2006/689292. Now double click on the pot you have created – this will open the **MOIRA Pots Editor.** If there is already a pot in the **Names** field click on that pot and then click on **Delete**.

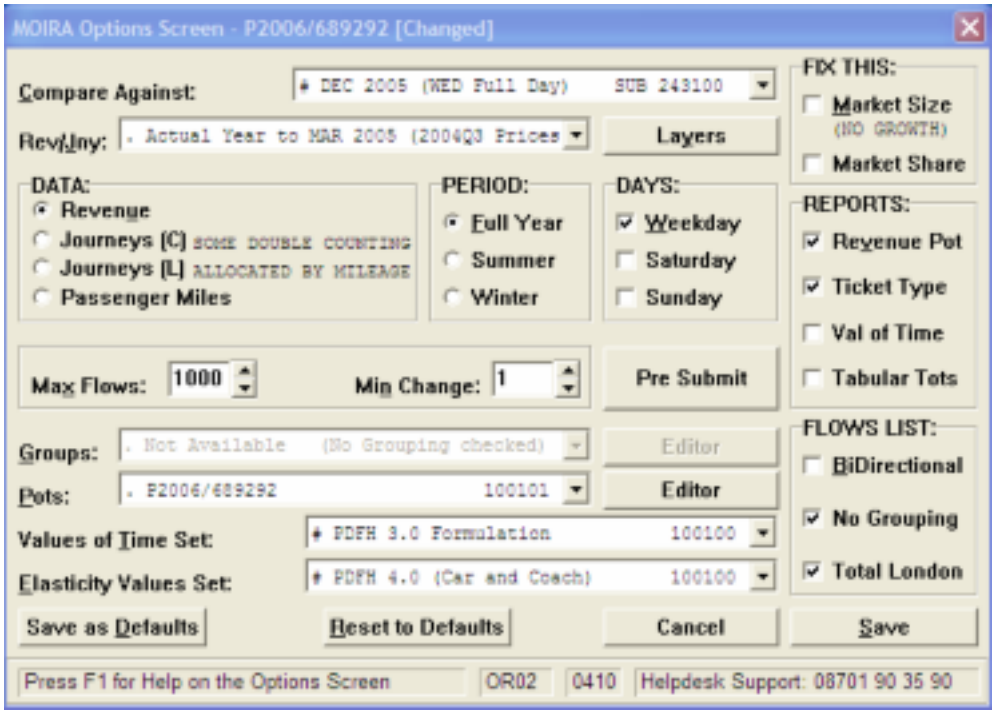
B1.15 Next click on **Insert** and call the sub-pot the name of the first service code you have deleted. Select the relevant service code to put in the sub-pot – you do this by highlighting the appropriate service code in the **Unallocated** field and then clicking on the single chevron (**>**). Keep inserting sub-pots and repeat this process until all the service codes that are affected by the possession have their own sub-pot in the **Names** field.



B1.16 Save these edits once they are complete and then return to the **MOIRA Timetable Screen**.

Step 6: Select Options

B1.17 Select the current possession and choose **Options** from the list on the LHS of the **MOIRA Timetable Screen**. The settings here are as displayed below.



B1.18 Set **Compare Against** to be either Dec 2006 (WED Full Day), Dec 2006 (SAT Full Day); or Dec 2006 (SUN Full Day) depending on what kind of possession you are looking at

B1.19 Set **DATA** to be Revenue.

B1.20 Set **PERIOD** to be Full Year

B1.21 Set **DAYS** to be the day your possession relates to.

B1.22 Set **Max Flows** to be 1000.

B1.23 Set **Min Change** to be 1.

B1.24 Set **FLOWS LIST** to be No Grouping and Total London.

B1.25 In **Pots** select your newly created Pot.

B1.26 Save this option selection

Step 7: Submit Timetable

B1.27 First click on the **Key List** tab from the top of the LHS list of options. Move everything from the RHS to the LHS using the double chevron key, so that all the stations are in the Key Stations column. Click **Save**.

B1.28 Next go to the **Submit** tab on the LHS to submit the timetable. Check that in the Timetables to Submit Now there is just the one possession you have been working on. Click **OK** to submit the timetable. This will take about 10 minutes, depending on the size of your possession.

B1.29 Submitting the timetable will create a series of CSV files in the folder MOIRA3D\User\ORXX. There will be a MP, an MV and a MT file. They will be named using the MOIRA automated numbers of the timetables that it compares. For example, MP119142 compares 119, which is Possession 85 SA Fixed, with 142, Sunday base 4.

Step 8: Check & Save Output

B1.30 We only need to consider the MP file. Copy the MP******.CSV file to the new folder in Possessions and rename it to be the number of your possession.

B1.31 Open this CSV file in its new location. It shows the top 1000 flows that have changed comparing one timetable to the other. Check that this makes sense, e.g. the new timetable should have less revenue that the old timetable.

B1.32 This ends the process for this possession. Now you can start on the next possession! Please ask either Jessica Booth or Philip Dobson if you have any questions or need clarification at any point.

B1.33 Thank-you!

APPENDIX C

MINUTES FROM 9TH JULY WORKSHOP

C1. INTRODUCTION

Objectives of Workshop

C1.1 A workshop was held on 9 July 2007 at Network Rail's offices at 40 Melton Street, London, to allow interested industry parties (train operators, ATOC, Network Rail, regulators and government) to contribute to the development of an industry position on possessions compensation for train operators in the next regulatory period (CP4, 2009-13).

C1.2 The main purpose of the workshop was to allow participants to comment on and contribute to work on compensation for revenue losses (undertaken by SDG). This work has considered the current regime, which allows for revenue loss compensation under Schedule 4 of Track Access Agreements and, in certain cases, under Part G of the Network Code, and has compared this with alternative methods of calculation and various options for changing the scheme. In addition, Faber Maunsell gave a presentation of the status of the recently started study into compensation for costs.

Agenda

C1.3 The Agenda of the session was as follows:

- Introduction
- Work on possessions costs (Faber Maunsell)
- Should the existing Schedule 4 algorithm be revised, and if so, how?
- Is there a case for including compensation based on MOIRA within a revised Schedule 4?
- How should the boundaries between the different mechanisms for determining compensation be defined?
- 7-day railway and repeated possessions
- Next Steps

Participants

C1.4 The following is a list of the participants:

Name	Organisation
Mike Vila	London Line
Chris Dellard	Arriva Train Wales
David Walker	Southern
Paul Hadley	ORR
John Beer	First Capital Connect
Robert Hodgkinson	Virgin West Coast
James Angus	Network Rail
Lanita Masi	Midland Mainline
Themis Agathocleous	Network Rail
Kai Hills	ATOC
Tim Griffiths	ORR
Colin Greenslade	ORR
John Ellard	ORR
Ian Marlee	Network Rail
Richard Wall	Network Rail
Jim Morgan	First Group
Richard Fisher	Faber Maunsell
Tim Smith	Faber Maunsell
Jane Thomas	DfT
Philip Dobson	SDG
Simon Ellis	SDG
Peter Wiener	SDG
David Shilton	SDG
Kevin Dadswell	SDG
Neil Wilson	Northern Rail
Simon Coppen	Burges-Salmon

C2. SHOULD THE SCHEDULE 4 ALGORITHM BE MODIFIED?

Issues raised in consultants' presentation

C2.1 The current Schedule 4 compensation formula is used for the compensation of revenue losses for all possessions, except those that are handled under Part G of the Network Code (which refers to network change, and tends to relate to the larger possessions). The ORR has proposed that all possessions should be compensated under a single scheme in CP4 (i.e. there would be no separate Part G methodology), although there might be different mechanisms for different types of possession within the revised scheme. Currently, while Schedule 4 uses a mechanistic formula to determine compensation, Part G allows for negotiation between the parties.

C2.2 The current Schedule 4 algorithm is related to the Schedule 8 formula for the compensation for poor train service performance (attributed to Network Rail) and, in particular, uses the same marginal revenue effect (MRE) parameters for each service group. The MRE represents revenue lost due to an additional one minute of "average lateness" on the service group, calculated by, firstly, applying a weighting factor to uplift the additional journey time caused by the delay and, subsequently, calculating the effect on demand based on passengers' elasticity to (generalised) journey times. The weighting factors, which represent the additional deterrent effect on passengers of unscheduled rather than scheduled delay, vary between 2.5 and 6, depending on the service group (higher for long distance and airport services).

C2.3 In the Schedule 4 formula, a "notification factor" is applied, which reduces the result of the calculation. The notification factor varies with the working timetable through which Network Rail notified the operator of the forthcoming possession. For the earliest notification (by the First Working Timetable), the notification factors are set, effectively, to cancel out the weighting factors in the MRE parameter, to take account of the fact that the TOC has been given sufficient time to make passengers aware of the change to the timetable. Thus, for service groups with an MRE calculated using a weighting factor of 2.5, the notification factor applicable when the TOC is notified by the FWT is 0.4. For later notification by Network Rail higher notification factors apply, increasing the level of compensation to be paid.

C2.4 The Schedule 4 compensation formula, therefore, implicitly assumes that, if TOCs are notified sufficiently early, their passengers can be regarded as fully aware of the possession, and are further presumed to react to this as if it were a timetable change (as opposed to a disruption to the normal timetable, for which the weighting factors are applicable). It is therefore relevant to look at passengers' actual levels of awareness of possessions.

C2.5 SDG presented some analysis of travellers' awareness of possessions from survey work. This showed that while passenger awareness did vary by a number of factors, including date of purchase (compared to date of travel), ticket type and journey purpose, their levels of awareness varied very little when compared with the actual notification factor applied, based on when Network Rail notified the TOC of the possession.

C2.6 SDG suggested that a key issue for discussion was therefore whether the notification factors applied within the possessions compensation formula should be modified.

Discussion

C2.7 A number of themes arose during the discussion, as described below.

Incentivisation vs. compensation

C2.8 More than one speaker noted that the revenue compensation formula in Schedule 4 could be regarded as trying to do two different things. Firstly, to compensate TOCs for revenue losses due to possessions, and secondly, to incentivise Network Rail to minimise possessions while maximising the amount of notice given for them. It is not clear that the same mechanism is able successfully to do both.

C2.9 The three levels of the notification factor which apply, depending on when the possession is included in the working timetable provided to the TOC, mean that there is no change in the level of compensation paid by Network Rail if it misses the T-12 milestone (so long as the change is notified in time to be reflected in the Applicable Timetable). Therefore, there is no further incentive to notify TOCs early, once T-12 has been missed.

C2.10 It was pointed out, however, that notification by T-12 was a licence condition, so that NR should be motivated by the need not to be in breach of its licence conditions.

C2.11 There appeared to be agreement among the operator representatives that the effectiveness of the compensation mechanism as an incentive for Network Rail was questionable, as none "had met an engineer who took S4 into account in planning possessions".

C2.12 However, NR said that it had "woken up" to Schedule 4 in the last couple of years, and was taking more account of the costs involved as part of its planning.

C2.13 More generally, it was stated that it was harder to design a successful incentive scheme than one focussing on compensation.

Need for early notification

C2.14 There was a discussion about whether TOCs, or their passengers, actually needed the amount of notice of possessions (by the FWT) required for Network Rail to minimise its compensation payments through use of the lowest level of notification factor in the compensation formula. In particular, NR asked whether it would make any difference to TOCs if they were informed about possessions at the Informed Traveller stage rather than the FWT.

C2.15 There appeared to be a feeling that one year's notification was unnecessary for most passengers, who tended to book closer to travel (or not book at all). Some leisure travellers would want to book many months in advance as part of arranging a holiday. The question was asked as to whether there was research on when passengers started to book. It was felt that this information might be available through NRES, or TOCs'

own booking systems – in either case, ATOC seemed likely to be the most appropriate body to get this information.

C2.16 In contrast, operators emphasised that TOCs *do* need to have information on possessions by the FWT (although a distinction was made about being informed by NR, which was felt to be essential, and having a full revised timetable, which might be less so). This was to enable TOCs to plan for the possession, e.g. to start organising replacement bus services.

C2.17 There was a debate as to whether the early (FWT) notification would actually affect TOCs' revenues (as in general passengers did not book so early), or whether the impact would be more likely to be in the area of reduced costs for the TOCs.

Levels of notification factors

C2.18 It was noted by an operator representative that the incentivisation effect of the changing levels of notification factors were reasonable, with the important exception that there should be a further breakpoint after T-12 to encourage NR to provide information as soon as possible.

C2.19 Network Rail appeared reasonably comfortable with the number of levels of notification factor, but were willing to consider whether the actual values were appropriate. In particular, the ratio between the earliest and latest notification factor values (often 0.4 and 0.8 respectively), might be too large.

Other points

C2.20 The question was raised as to whether the methodology underlying the Schedule 4 calculation, which was established when there was a pattern of more frequent, shorter, possessions was still appropriate for the current practice of longer block possessions (and full blockades). In particular, were the elasticities used (to GJT) still valid? [It should be noted that this point relates to some of the issues discussed below in relation to aware and unaware passengers, and to the impact of serial possessions].

C2.21 In this context, ORR mentioned that possessions blocks had, in fact, been less frequent than anticipated.

C2.22 The concept of serial possessions (e.g. on successive weekends) is discussed below. However, possessions can also occur in series in a spatial sense (i.e. along the line of route), and where any one such possession remains in place, the service will be disrupted. TOCs need to know when such possessions will take place, as the impact on the service, particularly for TOCs such as Cross Country, can be severe.

C2.23 Currently Schedule 4 has a provision defining a "significant" restriction of use or possession (SRoU) – generally a possession over 60 hours (84 at Bank Holidays). For SRoUs, TOCs and NR are supposed to agree compensation in advance. Operators generally agreed with the point put forward that in practice it was much easier to work off historical information on what had actually happened (i.e. the timetable that actually operated), after the event, than to try to anticipate the losses on the basis of an anticipated modified timetable that might yet be changed on the day itself.

A1. USING MOIRA WITHIN A REVISED SCHEDULE 4

Issues raised in consultants' presentation

Comparison of MOIRA and Schedule 4 calculations

C2.24 One of the major workstreams in the study undertaken by SDG has been to compare the results of using MOIRA (suitably adjusted) to calculate revenue losses due to possessions with the corresponding values from the current Schedule 4 formula.

C2.25 The adjustment to MOIRA is to take account of passengers' levels of awareness, with the revenue losses for "aware" passengers treated as similar to that from a timetable change, while the revenue loss for "unaware" passengers was based on the standard PDFH approach for the revenue impact of delays. This is similar, in principle, to the approach used in the Schedule 4 calculation, although the level of route aggregation is different. Also, as already noted, for the case where the possession is notified by the FWT, the Schedule 4 approach effectively assumes that all passengers are aware of the possession.

C2.26 The consultants presented some top-level results from this analysis. In order to get meaningful results from the sample of 83 examined, it was necessary to exclude a relatively large number of "outliers" where the results between the two methods differed wildly (by more than a factor of 5, it being assumed that in these cases there may be defective data invalidating the comparison). The outliers were concentrated in the small and large possessions, with the middle-sized possessions apparently better behaved.

C2.27 It was also noted that some of the assumptions underlying the MOIRA calculations were themselves less than perfect: in particular, looking at data for one TOC (all that was available), it appeared that MOIRA's estimates of loads were inaccurate at weekends (although reasonable during the week), while the profile of demand during the day, while showing the right general shape, was not particularly accurate.

C2.28 Taking account of these limitations, the analysis appears to show that Schedule 4 does not systematically underestimate revenue loss relative to (adjusted) MOIRA. Looking at possessions with a revenue loss estimated by Schedule 4 as under £100,000, the analysis showed that MOIRA gave, on average, about a 30% higher estimate, and the correlation statistic (R-squared) was 0.47, which shows a reasonable, but not close, degree of relationship between the methods. With slightly different sample sets, the MOIRA result came in slightly under the Schedule 4 value (on average), so overall, there is no particular reason to regard the two methods as giving significantly different results.

Use of MOIRA to calculate payments vs. Possessions Compensation Guide

C2.29 It has been suggested that MOIRA might be used as part of the calculation methodology in a revised Schedule 4 formulation. SDG pointed out that MOIRA as a tool was, however, not particularly well suited to use in such a formal way. It is essentially a decision support tool, with data regularly updated, and with different versions available to each TOC, for reasons of confidentiality. Therefore, it would be

hard to produce unambiguous results from MOIRA, even given well defined timetable changes, since the two parties might have different versions. Furthermore, during the study, one problem that has been identified in using MOIRA is that the base timetable within MOIRA may itself contain possessions, so that comparisons with a revised timetable would not be accurate.

C2.30 As an alternative to using MOIRA, SDG therefore suggested that, where the existing (or a modified version of the existing) formula was not felt to be appropriate for a category of possessions (e.g. for particularly large possessions), specific guidance could be produced explaining the appropriate approach to calculating revenue losses. This might in practice involve MOIRA, but in the context of a negotiation, where both parties could converge on a mutually acceptable solution. This guidance could be incorporated within a "Possessions Compensation Guide", a formal document referred to within the regulatory framework, which the parties would be free to use (but also free to ignore in particular cases where a mutually agreed alternative approach seemed preferable).

Discussion

C2.31 A number of comments were made (by operator representatives) about the use of MOIRA. One stated that in his experience, it was hard to use MOIRA to estimate revenue losses, and that where MOIRA estimates had been checked against actual losses, they had generally underestimated losses, often by a factor of two. Another comment concerned the difficulty of ensuring that the correct timetable was used – in particular, it was only worthwhile if the finalised timetable was used. The deficiency of the data in London (Travelcard) and in PTE areas in MOIRA was also noted.

C2.32 It was also stated that possessions usually follow one another (i.e. occur in a series), and it was questioned to what extent the MOIRA approach was able to take account of this.

C2.33 On the issue of the development of a Possessions Compensation Guide there was general support that such a document might be useful, if fit for purpose. The question was raised as to what such a document would add beyond what is already stated within the Passenger Demand Forecasting Handbook (PDFH), but it was pointed out that a PCG would be much more detailed – PDFH only has a single paragraph on the subject.

A2. DEFINING BOUNDARIES BETWEEN THE DIFFERENT MECHANISMS FOR DETERMINING COMPENSATION

Issues raised in consultants' presentation

C2.34 Currently the formulaic approach to revenue loss compensation is used for all possessions compensated under Schedule 4: although a distinct category, the Significant Restriction of Use is defined, the distinction only applies in practice to compensation for additional costs incurred by the TOC, and not to compensation for revenue losses. Separately, in the case of network change, Part G of the Network Code applies, permitting a different mechanism whereby the parties agree to assess the revenue loss incurred by the TOC, and compensation is based upon the agreed level of losses (i.e. a negotiated, rather than formulaic, approach).

C2.35 In setting out the brief for the study into compensation for revenue losses due to possessions the Possessions Compensation Policy Group recognised that there might need to be different mechanisms for calculating the compensation in different circumstances, despite the clear desire, as set out by the ORR, to unify the Schedule 4 and Part G schemes. In order for any new scheme to be practicable, the boundaries between the different mechanisms would need to be clearly defined.

C2.36 The consultants had set out, as a straw man, distinctions between normal possessions, to which the (possibly revised) Schedule 4 algorithm would apply, "larger" possessions, for which the adapted MOIRA-based analysis would be used, and "largest" possessions, which would be subject to detailed analysis using historical data (i.e. based on an analysis of actual revenues). This approach still begs the question as to where the boundaries between the categories should lie.

C2.37 Although not necessarily fully representative, it is worth noting that in the sample of possessions examined by SDG, only 3% had a duration of over 60 hours (the definition, outside Bank Holidays, of a "Significant" Restriction of Use). The consultants also observed a breakpoint in the average level of compensation paid under the Schedule 4 formula at about 60 hours (although there was another breakpoint at 40 hours).

C2.38 Various options exist for defining the boundaries between categories of possession, including:

- Duration of the possession;
- Amount of compensation under the Schedule 4 formula;
- Treating a series of possessions as a single possession, possibly pushing the series into a higher category; or
- The impact on a TOC (or service group) in terms of extended journey times and cancellations.

C2.39 A number of issues were considered to be worthy of discussion:

- The possibility that any boundary could produce perverse incentives; and
- Consistency with the SRoU boundary currently applicable for cost compensation.

Discussion

C2.40 It was generally recognised that the reason that a high percentage of possessions are under 60 hours is simply that this represents the length of a weekend, and most possessions are set up to fit within a weekend to minimise disruption during the working week. While some operators were therefore comfortable with avoidance of the working week as a potential boundary between different kinds (and severity) of possessions, long-distance TOCs felt that weekends were becoming increasingly important, and were therefore less comfortable with this distinction.

C2.41 In the case of some Community Railways, it was suggested that it might even be better to have possessions during the working week rather than at weekends.

C2.42 It was pointed out that the purpose of the discussion was to identify the point at which the Schedule 4 formula could no longer be considered reliable (and that therefore an alternative method was necessary). This suggestion led to a number of comments from operators (see below) implying that the Schedule 4 compensation may not be adequate, whether or not the possession was a large one.

C2.43 For longer possessions, one TOC representative stated that they had approached Network Rail on the basis that revenue losses were not just incurred on the day of the possession, but also subsequently.

C2.44 Another TOC representative stated that, for a 14-week possession, an operator had found that it took six months for revenues to recover. In this particular case, compensation had been paid under Part G of the Network Code. Had compensation been paid as if for an SRoU under Schedule 4 (i.e. using the formula), it "would have left us woefully short".

C2.45 Similarly it was observed that on the West Coast Main Line, since 1999, Schedule 4 compensation has been far short of the losses identified by examining actual revenues.

C2.46 In response to these opinions from operators, it was suggested that in some case inadequate compensation might arise from the imperfect level of detail for recording extra journey time, because of monitoring points being situated inappropriately to capture the effect of the possession. Some TOCs had in fact suggested in a number of cases that additional monitoring points be put in place to rectify this deficiency.

C2.47 Network Rail raised the question as to whether TOCs' concerns on the adequacy of the level of Schedule 4 compensation might be mitigated by changing the notification factors to account for actual levels of awareness among passengers.

C2.48 NR also suggested that the SRoU boundary (60 hours during a normal weekend, 84 at a Bank Holiday) might be appropriate to distinguish "normal" possessions from those where a more sophisticated compensation mechanism was necessary.

C2.49 ORR emphasised that its objective was to remove compensation from Part G and put this into Schedule 4. [Obviously this would make some of the TOCs' concerns about the level of compensation under Schedule 4 more significant].

C2.50 ATOC warned that there was a danger that any change in regime proposed (such as removing compensation from Part G) might lead, in the light of there being relatively few new franchises during CP4, to potential claims or disputes under Schedule 9 of franchise agreements, based on a change to the regulatory regime. If this were the case, the effect of the change would simply be to convert an issue between TOCs and Network Rail into one between the TOCs and DfT. Clearly there would be little benefit in doing this.

A3. SERIES OF POSSESSIONS AND "7-DAY RAILWAY"

Issues raised in consultants' presentation

Series of possessions

C2.51 One issue that has become apparent during the study is the treatment of repeat, or serial, possessions, most typically when a section of route is restricted on a series of consecutive weekends. The current Schedule 4 regime takes no account of repeat possessions, with each instance of the possession treated as a separate event for the purposes of the Schedule 4 formula calculation. Thus a series of weekend possessions over, say 10 weeks, would each be treated as a normal possession, whereas a single possession lasting over 60 hours (and hence affecting the working week), would be treated as a "significant" restriction of use. It is arguable that the cumulative effect of the repeat possessions may, however, have a larger impact than the one-off, longer restriction.

C2.52 If it were decided to recognise the possibly greater impact of serial possessions on revenue, it would be necessary to establish a clear definition of what constituted a series of possessions (and such a definition would need to be able to be easily managed within information systems). Examples of possible definitions include a series at the same location within a given time period, a series at the same location on the same day of week, a series at the same location resulting in Schedule 4 formula compensation above a given threshold and a series affecting the same service code within a given time period.

C2.53 Once serial possessions were identified, an approach for calculating losses would need to be adopted. This might either take the form of modifying the Schedule 4 formula for such possessions (for example by modifying notification factors of later possessions), or might be used to identify the series as sufficiently large, collectively, to be worthy of bespoke evaluation (and negotiation between the parties).

7-Day Railway

C2.54 Network Rail have set a goal to achieve a "7-Day Railway" operation during CP4. The objective is to have the infrastructure always available, so that, on a four-track section, two tracks will always be available, even during a possession, and on a two-track section, on track will always be available. Complete closures would be for periods no more than eight hours.

C2.55 This could lead to different travel patterns over time and change perceptions of availability of the network on, particularly, Sundays. It might be necessary to change the Schedule 4 formula to account for such changes. However, without any historical data on the operation of such a system, evaluating the impact will be difficult.

Discussion

C2.56 It was noted that the MML TA agreement has a Schedule 4 with a special category of "CTRL possession", relating to the major works in bringing the CTRL into St Pancras. For such CTRL possessions, the effect of seriality of possessions is specifically

incorporated into the compensation formula, with factors rising from 1 to 4 by the 40th consecutive disruption.

C2.57 It was suggested that, in the general case, the definition of a series of possessions should be based on whether it disrupts the same markets (passenger flows), rather than on the physical location of the works. One approach would be to base the definition on the number of times a given service group was affected by the possessions. Alternatively, it could be based on the cumulative length of time a service group was affected (say within a reporting period), or on the total amount Schedule 4 compensation relating to a service group within a given period of time.

C2.58 Separately, it was suggested that, in contrast to the MLL case described above, the definition of seriality of a set of possessions should be used as a trigger for the use of a bespoke approach (as in Part G at present), rather than establishing a new or modified formula for serial possessions.

C2.59 Network Rail noted that operators appeared to be less exercised by the issue of serial possessions than they had expected.

C2.60 With regard to the 7-Day Railway, there would be serious challenge in setting appropriate notification factors in the Schedule 4 formula. It was suggested that, for possessions conforming with the concept of the 7-Day Railway, notification factors might be changed to reduce compensation; conversely, where a possession did not follow the 7-Day Railway prescription, they should be changed to increase compensation. It was also suggested that the 7-Day Railway might negate the need to deal with serial possessions.

CONTROL SHEET

Project/Proposal Name:	TRAIN OPERATOR COMPENSATION FOR POSSESSIONS: COMPENSATION FOR LOSS OF PASSENGER REVENUE
Document Title:	Draft Final Report
Client Contract/Project Number:	NR/OA/2007/3
SDG Project/Proposal Number:	207459

ISSUE HISTORY

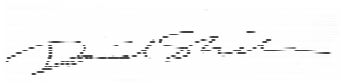
Issue No.	Date	Details
01	**20/07/07**	**Draft Final Report**
02	**06/08/07**	**Draft Final Report v.2**
03	**29/08/07**	**Draft Final Report**
04	**05/09/07**	**Final Report - Anonymised**

REVIEW

Originator: PTD, PDW

Other Contributors: SCE

Review By: Print: DXS

Sign: 

DISTRIBUTION

Clients: James Angus, Tim Griffiths, Kai Hills

Steer Davies Gleave:	David Shilton, Simon Ellis, Peter Wiener, Kevin Dadswell