Yorcard

Yorcard Research Folder - Phase 2

Open system, first observations: Touch on only Folder

RES721 - Page 5 Boarding Time Study

This Folder is the second in a series of six folders and two reports that form the research outputs funded by the Department of Transport, Technology and Standards Division which complement the Yorcard Smart Ticketing Pilot. All folders in this series of six, comprise of a number of discrete and stand alone reports. Each report has been written so it can be read in isolation, giving the reader a detailed view of a specific subject matter or be read in conjunction with other reports in the same folder or other folders. Consequently there is a considerable amount of common information across reports, which the reader, if intending to read more than one report may wish to skip. There are three reports and one data book that make up this folder.

This report has been produced by Newcastle University for South Yorkshire Passenger Transport Executive under a contract with the Department for Transport. Any views expressed in this report are not necessarily those of the Department for Transport.

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The complete list of folders are as follows :

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Phase 2 Open system, first observations : Touch On only

Phase 3 Open system, full operational system : Touch On Only

Phase 4 Closed system, Touch On Touch Off

Phase 5 Additional Management Data

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RES721 Phase 2: Boarding Time Study

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This report has been produced by Newcastle University for South Yorkshire Passenger Transport Executive under a contract with the Department for Transport. Any views expressed in this report are not necessarily those of the Department for Transport.

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Glossary

Alighting Passengers - These are passengers who are getting off the bus. They are also referred to as Alighters in the report.

Alighting Time (1) (A(1)) - Time taken for passengers to alight from the bus (measure from when the first passenger steps off the bus to when the doors close). This is used to measure the Alighting Time for one alighting passenger.

Alighting Time (2) (A(2)) - Time taken for 2 alighting passengers or more to disembark from the bus (measured from when the first passenger steps off the bus to when the last passenger steps off the bus).

Boarding Passengers - These are passengers who are getting onto the bus. They are also referred to as Boarders in the report.

Boarding Time (1) (B(1)) - Time taken for boarding passengers to carry out their boarding transaction with the driver (measured from when the first passenger steps onto the bus to when the doors close). This is used to measure the Boarding Time for one boarding passenger.

Boarding Time (2) (B(2)) - Time taken for 2 boarding passengers or more to carry out their boarding transaction with the driver (measured from when the first passenger steps onto the bus to when the last passenger steps onto the bus).

Bus Stop Boarding/Alighting Time (B/A Time) - Time taken for the driver to operate the doors and to allow passengers to load and alight at the stop (measured in this study from doors opening to doors closing).

Bus Journey Time Total service time between defined points and linked to Pilot Acceptance Criteria 2, Reduced Journey Times

Bus Running Time - Bus Journey Time – Bus Stop Dwell Time

Bus Stop Dead Time - Time at bus stop attributable to operation of doors and pulling in and out of the stop.

Bus Stop Dwell Time (often referred to as Dwell Time in the text) Bus Stop Dead Time + Bus Stop Boarding/Alighting Time + Bus Stop Recovery Time
This is the total time that the bus spends at the bus stop - (measured in this study from the time the bus stops at a bus stop to when bus leaves the bus stop)

Bus Stop Recovery Time - Estimate of time spent at stop for the purposes of adhering to schedule / regulating the service.

Customer Ticket Types
Adult cash: any non-concessionary transaction where cash is handed to the driver including 'swipe and pay' using a smartcard

Child cash: any payment of 40p using a MegaTravel concessionary pass including 'swipe and pay' using a smartcard

Non-cash: any use of a period ticket as a 'flash pass' by an adult or a child with a free child pass

Smartcards: adult or child smartcard use with no payment

Concession: senior and disabled concessions travelling free and either using a 'flash pass' or swiping a smartcard

Flash pass - Passengers who must show their smartcard or paper ticket to the driver to gain access to the service

No Alighting Passengers - Times calculated when no passengers alighted a bus at the stop and there were only boarding passengers

No Boarding Passengers - Times calculated when no passengers boarded a bus at the stop under observation and there were only alighting passengers

No Other Factors - Data, which have Other Factors recorded, removed when calculating Times

Other Factors - Factors observed and noted by the surveyors when collecting the data which may affect the times calculated for this and subsequent phases. These are defined as either scheduling factors, such as driver change over, or passenger factors, such as passengers boarding with a buggy,

Pilot Acceptance Criteria - A number of targets and measurements that have been set prior to the collection of data that will inform business cases and future development of the Yorcard project

Swipe and Pay - Passengers using a smartcard and then paying cash

Total	Boarding Passengers	Alighting Passengers	Buses Observed
Phase 1	2944	2936	1049
Phase 2	2500	3086	1212

Measurement Description		Phase 1 Mean Time – sec (Standard Deviation)	Phase 2 Mean Time – sec (Standard Deviation)	Phase 3 Mean Time – sec (Standard Deviation)	Phase 4 Mean Time – sec (Standard Deviation
Bus Stop Dwell Time:	per bus	28.66 (68.06)	40.77 (60.69)		
	per boarding and alighting passenger	7.08 (9.98)	12.35 (26.69)		
Bus Stop Boarding/ Alighting Time:	per bus	23.78 (34.95)	33.14 (51.95)		
	per boarding and alighting passenger	5.76 (9.22)	9.08 (13.33)		
Boarding Time (1) [when only one passenger boards]:	per bus	10.47 (23.82)	19.81 (36.71)		
	per boarding passenger [no alighting passengers – see section 3.5]	9.51 (19.21)	17.71 (32.07)		
Boarding Time (2) [when 2 or more passengers board]:	per bus	19.79 (37.63)	25.88 (50.96)		
	per boarding passenger [no alighting passengers – see section 3.5]	2.91 (2.37)	4.90 (6.82)		
Alighting Time (1) [when only one passenger alights]:	per bus	9.34 (6.32)	14.04 (15.65)		
	per alighting passenger [no boarding passengers -see section 3.6]	7.57 (1.83)	4.62 (1.44)		
Alighting Time (2) [when 2 or more passengers board]:	per bus	18.95 (10.76)	9.00 (10.24)		
	per alighting passenger [no boarding passengers -see section 3.6]	2.44 (0.76)	1.38 (0.71)		

Table 1. Summary of the boarding/alighting/bus dwell times

All the mean values and standard deviations of the alighting time in phase 1 were obtained from the second boarding/alighting time survey (N=255).

Executive Summary

The Yorcard Project is intended to deliver a multi-modal, multi-operator public transport smartcard scheme to be trialled on certain buses in Sheffield and on the local train service between Sheffield and Doncaster and intermediate stations.

This report presents the findings from the Phase 2 Baselining Boarding Time Survey and the purpose of this study was to capture the key time components that form the Bus Stop Dwell Time. This will be used to assess the effect of Yorcard on journey times, and therefore the impact upon the operator, which will then feed into the Yorcard Business Case. Dwell Time is a composite of many factors; these factors have been analysed in this report in order to determine how each contribute to the Dwell Time and to isolate the components of Dwell Time which are directly affected by the introduction of Yorcard, namely the boarding and alighting times.

This study has determined a Dwell Time, Boarding Time and Alighting Time per passenger to compare and contrast with the results from Phase 1, and the subsequent results from Phases 3 and 4. Boarding Time is seen as a key element of the stakeholder business cases and could help shape the development of many parts of the Yorcard project.

The purpose of this document is to provide the results of this phase and, therefore, the main details of this study, such as the introduction and background of the project, can be found in the Phase 1 Boarding Time Study and will not be repeated in this report. This report presents the results (which are also summarised in the Table of Statistics) required for comparing the effect of smartcards on Boarding, Alighting and, ultimately, Dwell Times (as defined in the Pilot Acceptance Criteria) with the results collected in later phases and demonstrates the impact at this stage upon the Yorcard and Department for Transport (DfT) objectives and the final business case.

The following tables present a summary of the overall results from this Phase 2 Boarding Time study in comparison to the Phase 1 results.

Introduction

This report will present the results from the Phase 2 Boarding Time Study. Introductory details including background, objectives and Pilot Acceptance Criteria can be found in the Phase 1 Boarding Time Study. As with the Phase 1 report, this document will address both the relevant Yorcard and DfT objectives, and the Pilot Acceptance Criteria in the conclusion.

Method of Recording Boarding & Dwell Times

The data collection for Phase 2 took part in 2 stages to account for the dates in which the operators installed the new equipment. The methodology initially adopted and described in Phase 1 was used for the first stage of data collection for phase 2. However, following the results from the ticket type regression study, in October 2008, the methodology for boarding time had to be changed slightly as it was found that the level of ticket type information was not adequate to carry out meaningful analysis of the impact of ticket type upon boarding time. Therefore, the methodology employed by each of the three surveyors for the second stage of the Phase 2 data collection has altered slightly to enable ticket type to be recorded whilst passengers are boarding. Apart from a slight change to the data each surveyor collects, the methodology remains identical to Phase 1 and each surveyor collects the following information:

1st Surveyor:

- Start the stopwatch when the bus has come to a halt
- Press the lap counter when the doors are open
- Press the lap counter when the first passenger boards the bus
- Press the lap counter when the last passenger boards the bus
- Press the lap counter when the doors close
- Press the lap counter when the bus departs
- Record each time in a matrix and reset the stopwatch

2nd Surveyor:

- Start the stopwatch when the bus has come to a halt
- Press the lap counter when the doors are open
- Press the lap counter when the first passenger alights the bus
- Press the lap counter when the last passenger alights the bus
- Press the lap counter when the doors close
- Press the lap counter when the bus departs
- Record each time in a matrix and reset the stopwatch
- Record the number of passenger alighting
  - Smartcard[1]
  - Non-smartcard[2]

3rd Surveyor:

- Record details of the boarding/ alighting event including:
  - Bus ID
  - Time of observation
  - Day of week
  - Operator
  - Route number
  - Vehicle Type
  - Ticket type[3] as: Adult/Cash/non-smartcard; Adult/Cash/smartcard[4] ; Adult/Non-Cash/non-smartcard; Adult/Non-Cash/smartcard; Child/Cash/non-smartcard; Child/Cash/smartcard; Child/Non-Cash/non-smartcard; Child/Non-Cash/smartcard; and Concessions[5]

[1] This would apply to Phase 4.
[2] This would apply to Phase 4.
[3] This would mainly apply to Phases 3 and 4 as the number of smartcard adult users was very small at this stage.
[4] includes concessionaries travelling before 9:00am who swipe their card and pay cash
[5] seniors and disabled people

Results & Analysis

3.1 Summary of Analysis

The results presented in this section are relating to 4 key measurements that have been captured by the methodology in accordance with the Pilot Acceptance Criteria: Dwell Time; Boarding/Alighting Time; Boarding Time; and Alighting Time. These times are illustrated in Figure 1 in Appendix 1.

Justification and explanation of each of the components listed are included in the Phase 1 report.

3.1.1 Summary of Results

For reference, the results (see Table 2) for this phase are presented below. As was recommended in the methodology document for this phase, the results are summarised without Other Factors (see glossary). The impact of Other Factors is studied in Section 3.9. These results will also feed into the overall business case, and will be used to inform the relevant DfT and Yorcard objectives.

Measurement Description		Mean Time (sec)	Standard Deviation
Bus Stop Dwell Time:	per bus	40.77	60.69
	per boarding and alighting passenger	12.35	26.69
Bus Stop Boarding/ Alighting Time:	per bus	33.14	51.95
	per boarding and alighting passenger	9.08	13.33
Boarding Time (1) [when only one passenger boards]:	per bus	19.81	36.71
	per boarding passenger [no alighting passengers – see section 3.5]	17.71	32.07
Boarding Time (2) [when 2 or more passengers board]:	per bus	25.88	50.96
	per boarding passenger [no alighting passengers – see section 3.5]	4.90	6.82
Alighting Time (1) [when only one passenger alights]:	per bus	14.04	15.65
	per alighting passenger [no boarding passengers -see section 3.6]	4.62	1.44
Alighting Time (2) [when 2 or more passengers board]:	per bus	9.00	10.24
	per alighting passenger [no boarding passengers -see section 3.6]	1.38	0.71

Table 2: Summary Statistics of Phase 2 Baselining Boarding Time Study (see Glossary for definitions)

3.2 Sample Size

The boarding time study for Phase 2 was carried out over a period of approximately 7 days in 2 stages, one in May 2008, and the other in November 2008. The number of days has increased from Phase 1 to take into account the operators entering Phase 2 at different times. However, as a result of the difference, it was not possible to meet the sample size required for boarding passengers. Despite this the sample size was met for alighting passengers. All the data required for this report have now been collected, entered into a database and cleaned for data coding errors, inconsistencies and missing information. This cleaning process resulted in 6% of data being rejected.

Data have been collected from 1212 buses at 18 different bus stops in a variety of locations from inner city to suburbs along the main corridor of the pilot scheme (please see Appendix 1 for the list of boarding/alighting points and an overview of their locations). This information accounts for 2500 boarding passengers and 3086 alighting passengers collected during the following times and days (see Table 3):

	Boarding	Alighting
Mon-Fri 07:30-09:30	445	740
Mon-Fri 10:00-13:00	739	1075
Mon-Fri 15:00-18:00	710	486
Weekends	606	785
TOTAL	2500	3086

Table 3: Summary of the number of boarding/alighting passengers observed

The mean values obtained from Phase 1 are used as the threshold for a better understanding of the changes of the boarding times. Two-sample t-tests were carried out to establish if there were any significant differences between the means obtained from phase 1 and phase 2. The outcomes of the t-tests were reported in section 3.7.

Please note that some of the Tables referred to in the text in this section have been placed in Appendix 2 as they are too large to be placed in the text. However, for consistency the Tables are numbered chronologically and as they are referred to in the text.

Definitions for all subsections below can be found in the Glossary.

3.3 Bus Stop Dwell Time

Boarding time analysis has revealed that the overall average Dwell Time per bus is 40.77sec with a standard deviation of 60.69 (see Table 4 in Appendix 2). This has increased from Phase 1 but the standard deviation shows that the overall variability in the data set has reduced.

Disaggregating the Dwell Time identifies the average Dwell Time per bus stop (see Table 5 and Figures 2 and 2a in Appendix 2). Figure 2 and Figure 2a show that as with Phase 1, the majority of bus stops have comparable dwell times; however there are a number of stops, such as bus stop 15 and to a lesser extent 16, which have much higher dwell times due to volume of passengers and operational factors that are common to these stops. Despite high dwell times at bus 15, this stop has little overall effect on the average Dwell Time because of the small number of observations at this stop (see Table 5).

The effect of the number of passengers boarding and alighting on average Dwell Time is presented in the third column of Table 4. Analysing this through each phase will allow the overall effect of smartcards on Dwell Time to be observed depending upon the throughput of boarding and alighting passengers. Comparing this to Phase 1 is can be seen that again the mean has increased as has the standard deviation.

3.4 Bus Stop Boarding/ Alighting Time

Of particular interest when analysing Bus Stop Boarding/Alighting Time (B/A Time) is the impact that boarding and alighting passengers have on the overall length of the B/A Time (for further analysis of alighting passengers, see section 3.6). As a result the average B/A Time has been calculated per bus, per boarding and alighting passenger and per alighting passenger when there are no boarders. It has also been analysed for boarding passengers when no passengers alight. The results are presented in Table 6 in Appendix 2.
The average B/A Time was 33.14sec per bus with a standard deviation of 51.95; Table 6 gives descriptive statistics for the B/A Time. When the B/A Time is divided by the total number of passengers both boarding and alighting the average B/A Time per passenger is 9.08sec and a standard deviation of 13.33. It can be seen that when no passengers board the B/A Time per alighting passenger is reduced to 5.11sec whereas it is only reduced to 13.87sec per boarding passenger when no passengers alight.

As in Phase 1 this demonstrates that B/A Time is more dependent upon boarding passengers than alighting passengers and analysis is required separately for boarding passengers and alighting passengers, and is elaborated further in this section (and section 3.6). Figure 3 shows that average B/A Time per boarding passenger exhibits a corresponding decrease as the number of passengers increase. Figure 4 displays the effect of the number of passengers alighting on the B/A Time which shows that as the number of alighting passengers increases the average B/A Time increase but at a slower rate.

367 observations were observed with no boarders and these data were used to establish the average B/A Time for alighting passengers only. Table 6 shows this is 16.49sec per bus with a standard deviation of 23.47 and the Average B/A Time per alighting passenger is 5.11sec with a standard deviation of 7.98 which is significantly lower than when passengers are both boarding and alighting. See also section 3.6 for the Alighting Time reporting and analysis.

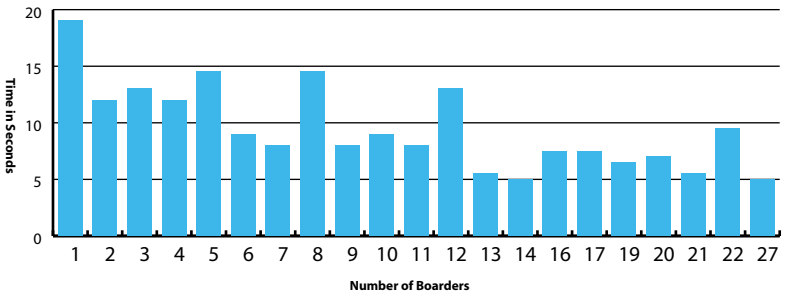


Figure 3: B/A Time per Passenger for the Number of Boarding Passengers (no Alighting Passengers)

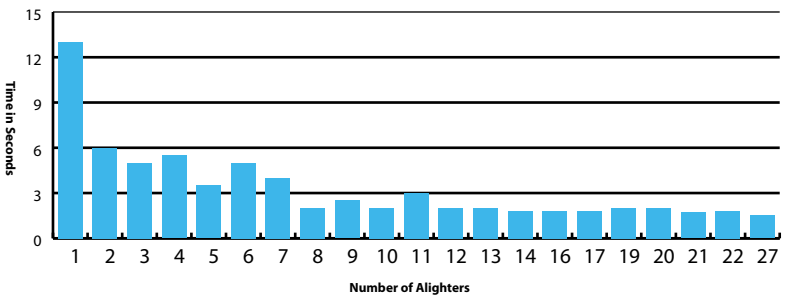


Figure 4: B/A Time per Alighting Passenger (no Boarding Passengers)

3.5 Boarding Time

Boarding Time (1) [B(1)] allows for the analysis of the Boarding Time when only one passenger has boarded, thus all the calculations for B(1) are for 1 boarder only and in this case there are 303 observations of this. Table 7 shows the statistics for the B(1). The overall average B(1) was found to be 19.81sec with a standard deviation of 36.71.

	Average B(1) Time (N=303)	Average B(1) Time when there was no Alighters (N=158)
Mean	19.81	17.17
Standard Deviation	36.71	32.07
Minimum	0.22	0.22
Quartile 1	5.76	5.24
Median	8.82	8.32
Quartile 3	18.17	17.36
Maximum	329.56	329.56
Skewness	5.31	6.70

Table 7: Statistics for Boarding Time (1)

B(1) is also a meaningful calculation when only 1 passenger boards and there are no passengers alighting. There are 158 observations of buses when one passenger boarded and no passengers alighted (see Table 7). The mean value for this is 17.17sec with a standard deviation of 32.07. Compared to Phase 1 both mean values have increased.

The definition of Boarding Time (2) [B(2)] eliminates any analysis of times that are taken when only one passenger boards and so the calculations here are based upon data collected for multiple boarders. It is useful for analysing the effect of 2 or more boarding passengers on the Dwell Time and the average boarding time.

There are 466 observations with 2 or more passengers boarding. The overall average B(2) was 25.88sec with a standard deviation of 50.96, and B(2) per boarding passenger was 4.51sec with a standard deviation of 6.27 (see Table 8 in Appendix 2). Comparing this to the Phase 1 B(2) results, all the B(2) means have increased as well as the standard deviations, which indicate more variability in the data.

B(2) is also calculated when passengers only board. There are 265 observations of buses when no passengers alight. The average B(2) was 26.25sec with a standard deviation of 38.86 and the B(2) per boarding passenger was 4.90sec with a standard deviation of 6.81 seconds (Figure 5 demonstrates the variation of B(2) per boarding passenger as the number of passengers boarding increases). In Phase 1 the calculations made when there were no alighting passengers were slightly lower than the B(2) calculations (with alighting passengers). In this phase both results increase slightly with no alighting passengers. Although both results continue to suggest that alighting has little to no effect on B(2), it should continue to be monitored in Phase 4.

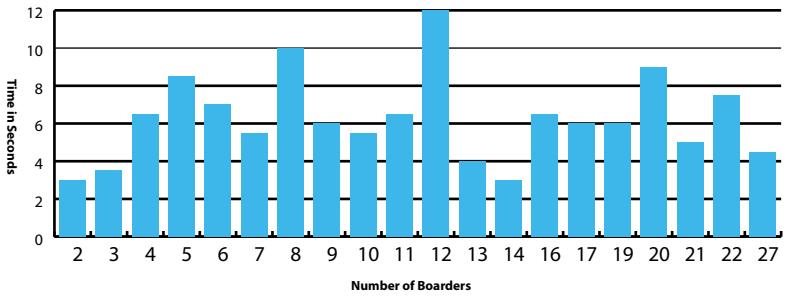


Figure 5: B(2) Time per Boarding Passenger (no Alighting Passengers) as the number of passengers boarding increases

3.6 Alighting Time

Alighting Time (1) [A(1)] analyses the Alighting Time when only one passenger has alighted. There are 199 observations of this case. The overall average A (1) was 14.04sec with a standard deviation of 15.65 (see Table 9 in Appendix 2).

A special case of A(1) is that only 1 passenger alights with no passenger board. There are 89 observations out of 199 are in this case. The mean value of A(1) with no boarders is 4.62sec with a standard deviation of 1.44 (see Table 9).

The definition of Alighting Time (2) [A(2)] eliminates any analysis of times that are taken when only one passenger alights and so the calculations here are based upon data collected for multiple alighters. It is useful for analysing the effect of 2 or more alighting passengers on the Dwell Time and the average boarding time.

There are 497 observations with 2 or more passengers alighting. The overall average A(2), is 9.00sec with a standard deviation of 10.24, and A(2) per alighting passenger was 1.44sec with a standard deviation of 1.36 (see Table 10 in Appendix 2).

A(2) is also calculated when there are only alighting passengers. There are 264 observations out of 497 of this case. The average A(2) was 8.38sec with a standard deviation of 6.95 and the A(2) per alighting passenger was 1.38sec with a standard deviation of 0.71 seconds (see Table 10 in Appendix 2).

3.7 Average Boarding & Alighting Time

Comparison between Phase 1 and Phase 2

To examine the changes of the boarding and alighting (B/A) times from phase 1 to phase 2 (just after the Yorcard equipment had been installed in the buses), 2-sample t-tests were carried out using the data collected from phase 1 and phase 2.

B/A time per Passenger Test (include both boarding and alighting)
The first test was to examine the null hypothesis that the B/A time per passenger of phase 2 does not differ from the B/A time per passenger of phase 1. The distributions of the data collected in phase 1 and phase 2 which were used for this test are shown in Figures 6 and 7 in the Appendix 2 with the aim to distinguish the outliers (in red circles).

The statistical results of the 2-sample t-test indicate that the average B/A time per passenger after the new equipment was installed in the buses is significantly higher than the mean of the B/A time per passenger in phase 1 at a 5% level (p=0.000, see Table 11 in Appendix 2). The time was increased by 3.17sec in Phase 2.

However it is unclear whether the increase in the B/A time was caused by the passengers boarding or the passengers alighting. Therefore, four more tests were undertaken to clarify this issue by comparing the following times used in Phase 1 to Phase 2:

- the time which was spent per boarding passenger;
- the time which was spent per alighting passenger;
- the time for the last boarding passenger to the doors closing; and
- the time for the last alighting passenger to the doors closing.

The results are reported below:

B/A time per Boarding Passenger Test (when there were no passengers alighting)
This test aimed to examine the null hypothesis that the B/A time per boarding passenger in phase 2 does not differ from the B/A time per boarding passenger in phase 1, when there were no passengers alighting. The distributions of the data collected in both phases which were used for the test are shown in Figures 8 and 9 in the Appendix 2 with the aim to distinguish the outliers (in red circle).

The statistical results of the test indicate that the average B/A time per boarding passenger in phase 2 is significantly higher than the average B/A time per boarding passenger in phase 1 at a 5% level (p=0.000, see Table 12 in Appendix 2). The average time per boarding passenger in phase 2 increased by 4.74sec compared to the time taken in phase 1.

B/A time per Alighting Passenger Test (when there were no passengers boarding)
This test was to examine the null hypothesis that the B/A time per alighting passenger in phase 2 does not differ from the B/A time per alighting passenger in phase 1, when there were no passengers boarding. The distributions of the data collection in both phases which were used for the test are shown in Figures 10 and 11 in the Appendix 2 with the aim to distinguish the outliers (in red circle).

The statistical results indicate that the average B/A time per alighting passenger is significantly higher in phase 2 than in phase 1 at a 5% level (p=0.000, see Table 13 in Appendix 2). However, the difference of the B/A time per alighting passenger between phase 1 and phase 2 is only 0.66sec, which is much smaller than the difference of the B/A time per boarding passenger.

The End Leg Tests

There are two types of end legs which are concerned. The first one is the time taken by the last boarding passenger to the door closing when there was no passenger alighting, i.e. EL_B. The second one is the time taken by the last alighting passenger to the door closing when there was no passenger boarding i.e. EL_A.

The EL_B test was to examine the null hypothesis that the time taken from the last passenger boarding to the door closing in phase 2 does not differ from the time taken from the last passenger boarding to the door closing in phase 1, when there was no passenger alighting. The distributions of the data collection in both phases which were used for the EL_B test are shown in Figures 12 and 13 in Appendix 2 with the aim to distinguish the outliers (in red circle).

The statistical results indicate that the time taken from the last passenger boarding to the door closing is significantly increased in phase 2 at a 5% level by 6.24sec (p=0.000, see Table 14 in Appendix 2). It is important to bear in mind that this survey was conducted over a period of time when the traffic was not as heavy as when the same survey was conducted in Phase 1. Therefore, such a significant increase is likely to be created by drivers' recovery time.

The EL_A test was to examine the null hypothesis that the time taken from the last passenger alighting to the doors closing in phase 2 does not differ from the time taken from the last passenger alighting to the doors closing in phase 1, when there were no passengers boarding. The distributions of the data collection in both phases which were used for the EL_A test are shown in Figures 14 and 15 in the Appendix 2 with the aim to distinguish the outliers (in red circle).

The statistical results indicate that there is no significant difference between the average of the time taken by the last alighting passenger to the doors closing in phase 1 and the one in phase 2 at a 5% level (p=0.000, see Table 15 in Appendix 2).

In summary, the outcomes of the five 2-sample t-tests suggest that the B/A time per boarding and alighting passenger in phase 2 is significantly higher than the B/A time per boarding and alighting passenger in phase 1 at a 5% level. The change is mainly reflected by the increase of the time taken by each passenger boarding as well as the last passenger boarding. Possible reasons for such changes are listed below and the supporting information can be found in Phase 2 Equipment User Study report:

1. One operator changed its period product prices two weeks ahead of the boarding time survey. This may have had an impact on the increase of the time per passenger boarding.
2. The newly installed on-board Yorcard equipment may have potentially affected the ticket issuing process. An interim period is required for both the drivers and the users to become familiar with the new ticketing systems.
3. The new system also requires the user to swipe their card on the validator before they show their photo to the driver, an additional step to the previous system which takes extra time (approximately 2.5 seconds – see section 3.8 for details).
4. As the survey was conducted during a less busy period of time, the dwell time may have increased because drivers were on their recovery time.

3.8 Ticket Type Regression Analysis

In order to measure the impact of smartcards on operational performance, a regression analysis (Ordinary Least Squares) was undertaken, attempting to predict the overall dwell time from the different ticket types used. It is important to note that the reported figures are based upon the data collected during this Phase and there are additional factors, such as weather, school holidays and traffic conditions, which also have an impact on overall dwell times but are not included in this regression analysis.

As operators do not currently hold ticket type data at the required level, a surveyor at each stop recorded the individual ticket types for each bus on a stop-by-stop basis. The method of collecting ticket type data was observation-based as it was determined that consulting boarding passengers on ticket types would significantly affect the boarding time. Therefore, the surveyor was asked to initially identify whether the passenger was a child, an adult or a concessionary traveller. For non-concessionary travellers, the surveyor was then asked to observe and distinguish whether the passenger was using cash to buy a ticket (adult cash, child cash), showing something to the driver (adult non-cash, child non-cash) or swiping a card onto a Yorcard reader (smartcard holders). This methodology was tested in both Newcastle and Sheffield to ensure it was a robust method for ticket type observation. The ticket types were therefore divided into nine groups:

- Adult/Cash/non-smartcard;
- Adult/Cash/smartcard;
- Adult/Non-Cash/non-smartcard (includes concessionaries travelling before 9:00am who swipe their card and pay cash);
- Adult/Non-Cash/smartcard;
- Child/Cash/non-smartcard;
- Child/Cash/smartcard;
- Child/Non-Cash/non-smartcard;
- Child/Non-Cash/smartcard; and
- Concessions (seniors and disabled people using flash passes or smartcard).

An initial regression analysis was conducted using the original nine ticket types, plus alighting passengers as an additional factor.

This initial analysis proved inconclusive, as some of the ticket type coefficients relating to the Adult transactions (Cash and Non-Cash) were not sensible and were found to be non-significant. Possible reason for this could be due to discrepancies in the way ticket types were recorded by different surveyors, and also low numbers in the ticket counts for certain ticket types. This resulted in low variation in the data by which the boarding times cannot be fully explained.

To resolve this issue, the individual ticket types were grouped together as follows:

- Adult Cash = (Adult/Cash/non-smartcard) + (Adult/Cash/smartcard);
- Child Cash = (Child/Cash/non-smartcard) + (Child/Cash/smartcard);
- Non-Cash Tickets = (Adult/Non-Cash/non-smartcard) + (Child/Non-Cash/non-smartcard)
- Smartcards = (Adult/Non-Cash/smartcard) + (Child/Non-Cash/smartcard)
- Concessions = (Concessions)

Again, including alighting passengers as an additional factor.

The second regression analysis using this grouped data did generate a better result, with all ticket type coefficients being significant at the 5% level except for the non-cash tickets, which was significant at the 10% level. The resulting regression equation is:

Dwell Time (seconds) = 22.9 + (8.51 Adult Cash) + (6.99 Child Cash) + (2.93 Non-Cash) + (5.55 Smartcard) + (7.27 Concessions) + (0.761 Alighting Passengers)

The result of the second regression suggests that if all other factors (for example, each individual ticket type, alighting time, bus stop dead time and recovery time) remain constant, an extra transaction for each ticket type would increase the boarding time by the following (see Table 16):

Ticket Type	Increase in Boarding Time (seconds)
Adult Cash	8.51
Child Cash	6.99
Non-Cash	2.93
Smartcard	5.55
Concessions	7.27

Table 16: Results of Regression for each Ticket Type

The regression analysis is based upon at least 200 observations for each ticket type, with 705 Adult Cash transactions, so the final figures can be said to be based upon a representative sample of bus users during Phase 2, and therefore the findings are indeed robust.

The difference in times suggests that replacing an adult cash (including 'swipe and pay' with a smartcard) ticket with a smartcard (no cash transaction) would have a net boarding time saving of approximately 3 seconds; replacing child cash (again, including 'swipe and pay' with a smartcard) to smartcard (no cash transaction) would have a net boarding time saving of approximately 1.5 seconds. Non-cash (period tickets and flash passes) tickets would be the only type that would be adversely affected by replacing them with smartcards, with a boarding time increase of approximately 2.5 seconds, which is reasonable given the differences in the way that these tickets are used when boarding.

30.4% of the variation in the boarding time is explained by the grouped ticket types used in the second regression (having adjusted for the number of degrees of freedom). An F-test demonstrates that this is significantly different from 0 and so the regression equation used is therefore explaining the variation in the times. However, as only 30.4% of the boarding time is being explained by only using the ticket types, other factors such as the type of vehicle (single deck or double deck), time of day (AM, PM or off-peak), or the weather conditions may also have a contributing factor to the overall time.

The original proof of concept regression analysis included the vehicle types in the regression analysis; therefore, one further regression was conducted here, this time using the grouped ticket types, the alighting passengers and the type of vehicle as variables. This new analysis indicates that although there is no statistically significant difference between the vehicle types, double deck vehicles add 5 seconds onto the overall dwell time compared to single deck vehicles, which is significant to the general operation of the bus services.

Overall, the regression analysis has shown that the ticket type data can be used in predicting the overall dwell time, allowing for future impacts of the smartcard to be measured and monitored, although at present there are not enough smartcard users to provide enough variation in the data. It is recommended that to further improve the robustness of the survey data, fewer ticket types are recorded to minimise any confusion about certain tickets (e.g. a pre-paid flash pass being mistakenly used as a smartcard) or users (e.g. a concessionary pass holder being recorded as a full adult cash transaction).

3.9 Analysis of Factors Affecting Average Times

Any factors that may have had an impact on the observed times measured were recorded by the survey staff and entered into the database for easy identification of affected data. These factors have been categorised in this study as: factors dependant upon the operation, such as driver changes and recovery time when the bus is ahead of schedule; and factors dependant upon the passenger, such as passengers boarding with buggies, and disabled and elderly passengers. In Phase 1 this section showed that certain factors, both operational and passenger related, can have a large impact upon the results and therefore it was recommended that in phase 2 these data are removed so as not to dilute any significant findings. The removed data has been analysed here.

There were 51 observations where Other Factors were noted and these have been analysed by operational and passenger factors to show that overall there is an increase in key measurements. Table 17 (Appendix 2) shows the statistical results for Operational and Passenger Factors compared to when these are removed and Figure 16 shows this graphically.

As with Phase 1, Operational Factors can have a large impact, more so that Passenger Factors. As with Phase 1, this is likely to be due to time spent waiting at bus stops to adhere to their time tables or taking time to change drivers.

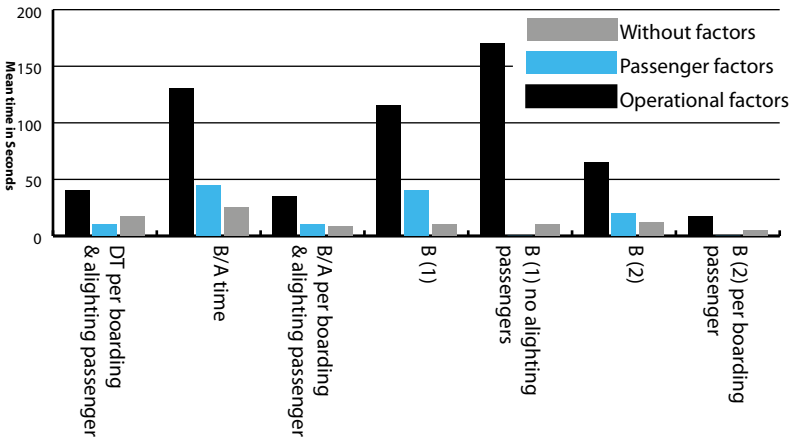


Figure 16: Affect of Other Factors on measurements

3.10 Analysis of Operational Conditions

It is clear from the analysis of this study that there has been an increase in boarding time. It has already been noted that a change to one operator's period product prices 2 weeks before the data collection may have been an affecting factor to overall Dwell Times as people get used to the new fare.

It is possible that change to the environment may have had an effect upon the overall Dwell Time. These changes would include passengers and drivers adjusting to the new smartcard equipment. The Driver Survey Study for Phase 2 has documented the reactions of the drivers to the new equipment and it is clear that some of the tasks have become more onerous, such as, 'scrolling menus or selection tickets', which could be due to the fact that they are not used to the new ETM and have not learned what each of the buttons do yet. If this is the case it should become apparent in Phase 4 when a repeat of the Driver Survey and Focus Groups will be carried out. With regards to the Boarding Time, it is possible that as the drivers are getting used to the new equipment, there will be an overall increase in Boarding Times. Again, this will become apparent if this is the case if Phases 3 and 4.

The Driver Survey also highlighted that there were no apparent issues regarding customers using the smartcard validator. A majority of the drivers stated that they agreed that 'the new validator is easy for customers to use'. Focus Groups with customers and a survey, due to be carried out in Phase 3, will be used to confirm or otherwise if customers feel this is true.

In Phase 1, it was noted that time of day may have an impact upon the Dwell Time. From Phase 2 analysis, Table 18 shows that again, the average Dwell Time increases throughout the day. Comparing this to the number of passengers boarding and alighting during these times it can be seen that although more passengers board and alight as the day progresses, the average mean per boarding and alighting passenger also increases, suggesting that time of day does have an impact upon the Dwell Time. However, the Standard Deviation is still high suggesting a lot of variability; therefore it is still inconclusive and recommended not to be reported in further Phases.

	AM	MID	PM
Number of Observations	312	490	357
Mean	29.36	**37.94**	**46.6**
Average Number of Boarding and Alighting Passengers per Bus	4.47	**5.28**	**5.38**
Mean per Boarding and Alighting Passengers	6.57	**7.18**	**8.66**
Standard Deviation	50.14	**55.14**	**71.69**
Minimum	1.3	**2.38**	**3.48**
Quartile 1	10.31	**12.9**	**13.2**
Median	17.75	**24.16**	**23.33**
Quartile 2	30.72	**40.12**	**44.79**
Maximum	698.69	**561.95**	**593.04**
Skewness	9	**5.6**	**4.13**

Table 18: Statistics for Dwell Time per Time of Day

Summary & Conclusions

4.1 Introduction

The analysis carried out in this report is to directly replicate that which was presented in Phase 1 report to enable a comparison of the results. Overall it can be seen that the measured means have increased and thorough testing has been carried out to analyse the Boarding /Alighting (B/A) time to ascertain whether any increase has been as a result of smartcard use. The outcome of this testing suggests that the B/A time per boarding and alighting passenger in phase 2 is significantly higher than the B/A time per boarding and alighting passenger in phase 1 at a 5% level. The change is mainly reflected by the increase of the time taken per boarding passenger as well as an increase from the last passenger boarding to the doors closing. Alighting passengers have not had an effect on the B/A Time. It is possible that the recent change of the ticket prices may have had an impact on the increase of the time per passenger boarding. Also, the newly installed on-board Yorcard equipment may have affected the ticket issuing process as reported in the Phase 2 Driver Survey Report (RES722). An interim period is required for both the drivers and the users to become familiar with the new ticketing systems.

Regression Analysis has been carried out for ticket types and overall has shown that the ticket type data can be used in predicting the overall dwell time, allowing for future impacts of the smartcard to be measured and monitored. At present it should be noted that there are not enough smartcard users to provide enough variation in the data but in future phases this should not be a problem. There is potential that there may have been some confusion regarding certain tickets types or users which are difficult for surveyors to distinguish between (e.g. a pre-paid flash pass being mistakenly used as a smartcard or a concessionary pass holder being recorded as an adult transaction) and therefore, it is recommended that to improve the robustness of the survey data, fewer ticket types are recorded. Given that the first regression analysis on all ticket types proved inconclusive, using this revised approach would allow for greater confidence in the collected data, and introducing fewer factors into the regression analysis reduces the chances of multi-collinearity occurring (for example, a significant relationship between two individual ticket types) which improves the robustness of the regression analysis without affecting the overall outcomes of the procedure. This will be further tested as part of the Control Study work, which is in addition and to support the findings of Phase 1 Boarding Time Study.

4.2 Limitations

- Due to scheduling of equipment installation, data had to be collected over a long period of time. This resulted in a reduction in the survey sample as some buses were not truly in phase 2 during data collection and could not be included in the results. In addition there is a blurring between phases 2 and 3.
- The first stage of data collection used the methodology recommended in the stage plan. The second stage of data collection took place after it was discovered that the ticket type regression would not be possible with the current level of ticket type data. Therefore, the methodology changed slightly to account for this and enable ticket types to be collected at point of use.

4.3 Objectives

This study has met the criteria of the agreed methodology and has enabled a comparison to the findings of Phase 1. In terms of the pilot acceptance criteria, this study has followed that which is recommended and overall has not shown any reduction in the measurements wished to be observed.

The effects that smartcard technology could have in the future upon the Yorcard Objectives were identified in the Phase 1 Boarding Time report as:

- Reducing the barriers to the use of public transport
- Reducing delays and improving reliability
- Informing the Business Case

At this stage it is difficult to say if this is the case as there has been an increase in time, however, this report has been able to offer a baseline for smartcard technology comparison with other phases, and, in conjunction with the other studies, will form a more rounded picture of the effect of Yorcard on the above qualifiers. Despite this each of the objectives have been studied below.

This report is relevant to the following DfT objectives:

- Analysing the bus boarding times (b(1))
- An assessment of the Operator and PTE expectations (c)

The third DfT objective; to understand the value of new innovative ticketing products (d) will form part of the evaluation in future phases.

These Yorcard and DfT objectives are studied in more detail below in light of the results from this study.

Reducing Barriers to the Use of Public Transport

In Phase 1, it was identified that analysing exactly how the introduction of smartcard ticketing could impact upon Bus Journey Times was an important step in informing the DfT strategic objective to improve accessibility of Public Transport.

Although the Boarding/Alighting comparison between Phase 1 and Phase 2 has shown a significant increase in boarding times in Phase 2, it is possible that both drivers and passengers are still familiarising themselves with the new equipment and ticketing arrangements which would influence the overall boarding process. The regression analysis conducted for this report has shown that smartcard ticketing could have a positive impact on the overall dwell time by reducing the average boarding times for those ticket types involving cash transactions. To better inform the related DfT strategic objective, future monitoring of these impacts will be essential, particularly as the new technology becomes commonplace amongst bus drivers and passengers, as this may result in a decrease in overall Boarding/Alighting times.

Reducing Delays and Improving Reliability

As with the previous objective, the impact of the smartcards on the overall Dwell Time reported in this Phase could contribute towards a reduction in delays and improving the overall reliability of journey times. It will be important to monitor any changes in the variability in Dwell Times and associated factors (individual boarding passengers, etc.) in future phases as these results will inform the DfT strategic objective to improve the punctuality and reliability of Public Transport.

Business Case

The business case for Yorcard is still in an early stage. The results of the regression analysis demonstrate that smartcards could have a positive impact on dwell times by improving the boarding process and reducing the time required for those tickets involving cash transactions. This, in turn, could have a positive impact on overall service operations with the benefit of improving customer satisfaction. It will be important to monitor if and how these impacts change through the different phases, particularly when both touch-on and touch-off are in operation in Phase 4. Nevertheless, these findings, combined with those of future phases, will be useful in developing the business case further.

Analysing the Bus Boarding Time (DfT b.(1))

Changes in the boarding times as a result of the introduction of smartcards will be monitored during the following phases and additional comparisons between the results of each phase will further inform this analysis.

An assessment of the Operator expectations (DfT c.)

The monitoring of the Bus Stop Dwell Time, and its component parts, allows the impact of smartcard ticketing to be assessed and observed. This will essentially allow the overall impact that Yorcard could have on bus operation to feed into an assessment of the operator expectations.

Recommendations

This section outlines the recommendations for subsequent phases:

- All data is collected during the same period of time
- The methodology is repeated
- Fewer ticket types are recorded by surveyors in order to improve the robustness of the data (and therefore the regression) and to avoid confusion regarding certain ticket types or users.

Appendix 1

List of Bus stops & Dwell Time

Components Diagram used in Survey
The following bus stop locations have been alphabetised and the stop number location identifiers (which are referred to in the text, see section 3.3) have been removed for reasons of commercial confidentiality.

Bus Stop Numbers and Locations	Description of Location	Direction of Travel
Crimicar Lane / Castlewood Road	In the suburbs of Sheffield with a collection of convenience shops nearby	Eastbound
Crookes Road / Lydgate Lane (University)	By the University	Eastbound
Fullwood Road / Notre dame school	Outside Notre Dame School	Westbound
Fullwood Road / Ranmoore Park Lane	Outside Notre Dame School	Eastbound
Glossop Road / Clarkehouse Road (Hallamshire Hospital) (into town)	Nearby Hallamshire Hospital	Eastbound
Glossop Road / Hallamshire Hospital (into town)	Outside Hallamshire Hospital	Eastbound
Glossop Road / Hallamshire Hospital (out of town)	Outside Hallamshire Hospital	Westbound
Leopold Street / City Hall	City Centre, many shops nearby. Often many people boarding with extra baggage	Eastbound
Northfield Road / Eastfield Road (Northfield Av)	Suburbs, few convenience stores nearby	Eastbound
Parkside Road/Middlewood	Suburbs, a few convenience stores nearby	Eastbound
Salt Box Lane / Main Street	Suburbs no convenience stores nearby	Eastbound
Sheffield City centre, Church Street	City Centre, many shops nearby. Often many people boarding with extra baggage	Westbound
Sheffield Interchange	City Centre Bus station, common driver change over point	Westbound
Sheffield, Flat Street	City Centre, few shops nearby, common point to wait when ahead of schedule	Westbound
West Street / Rockingham Street	City Centre, many shops nearby. Often many people boarding with extra baggage	Westbound
Western Bank Brook / Favelle Road	Outside Sheffield University	Westbound
Western Bank Brook / Sheffield University	Outside Sheffield University and the Children's Hospital	Westbound
Whitham Road / Broomhill	Broomhill area on outskirts of city centre, busy area for shops	Eastbound

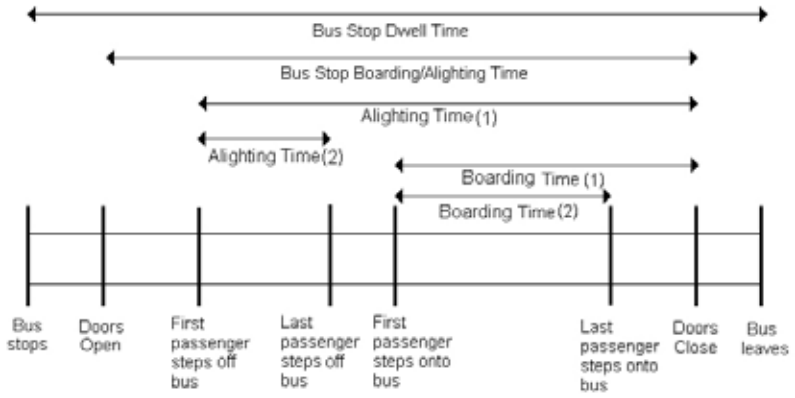


Figure 1: Diagram of Bus Dwell Time components measured in this report.

Appendix 2

Results and Tables

The following tables relate back to the analysis which is presented in section 3, Results and Discussion. These tables are placed here as they are too large to be placed in the text. However, for consistency the tables are numbered chronologically and as they are referred to in the text.

	Dwell Time (Sec)	Dwell Time without bus stop 15 (Sec)	Dwell Time per Boarding and Alighting Passenger
Mean	40.77	39.51	12.347
Standard Deviation	60.69	54.95	26.694
Minimum	2.38	2.38	1.259
Quartile 1	12.47	12.46	3.578
Median	23.22	23.19	6.482
Quartile 3	40.96	40.68	11.188
Maximum	593.04	542.69	338.34
Skewness	4.73	4.3	8.58

Table 4: Dwell Time Statistics

Stop	Number of Observations	Average Dwell Time	Standard Deviation	Median
1	118	25.67	15.18	22.16
2	175	18.59	16.01	13.74
3	20	13.15	9.99	10.25
4	57	32.01	21.88	28.82
5	36	27.09	34.32	17.26
6	59	32.4	25.18	26.71
7	10	22.43	6.66	19.79
8	1	32.69	n/a	32.69
9	1	17.7	n/a	17.7
10	31	14.55	11.77	10.93
11	32	23.44	17.51	18.45
12	22	99.4	59	80.1
13	30	27	21.52	20.84
14	50	33.49	26.63	26.41
15	2	572.5	29	572.5
16	32	156.5	130.1	111.2
17	83	82.74	90.42	41.2
18	89	46.59	48.18	28.81

Table 5: Dwell Time Statistics per Stop

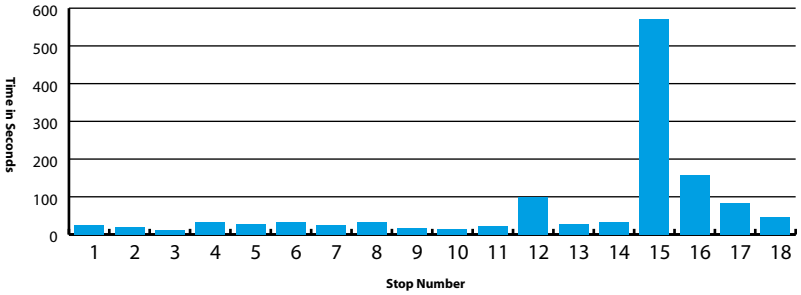


Figure 2: Dwell Time per Bus Stop Location Identifier

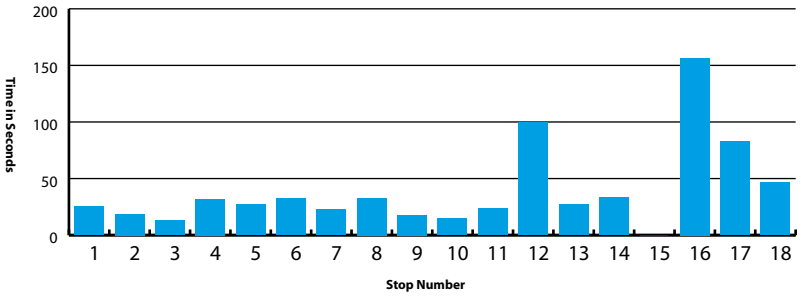


Figure 2a: Dwell Time per Bus Stop Location Identifier (without Stop 15 for scale)

	Average B/A Time (sec)	Average B/A Time (no boarders)	Per Boarding and Alighting Passenger (sec)	Per Alighting Passenger (no boarders) (sec)	Per Boarding Passenger (no alighters) (sec)
Mean	33.14	16.49	9.08	5.11	13.87
Standard Deviation	51.95	23.47	13.33	7.98	16.08
Minimum	1.97	2.24	0.75	0.75	1.97
Quartile 1	18.90	9.50	5.55	3.10	9.34
Median	9.73	5.69	3.10	2.05	6.65
Quartile 3	592.00	257.03	124.07	77.49	123.59
Maximum	34.41	18.28	9.45	4.77	13.50
Skewness	5.81	5.37	4.99	5.81	4.23

Table 6: Boarding/Alighting Time Statistics

	Average B(2) Time	Average B/A Time (no boarders)	Per Boarding and Alighting Passenger (sec)	Per Alighting Passenger (no boarders) (sec)
Mean	25.88	26.25	4.51	4.90
Standard Deviation	50.96	38.86	6.27	6.82
Minimum	0.83	0.83	0.42	0.42
Quartile 1	4.05	4.36	1.61	1.64
Median	10.15	11.29	2.98	3.13
Quartile 3	26.67	34.75	5.23	5.71
Maximum	590.21	376.46	75.29	75.29
Skewness	6.62	3.99	6.43	6.08

Table 8: Statistics for Boarding Time (2)

A(1)	Average A (1) Time (sec)	Average A (1) Time (no Boarders) (sec)
Mean	14.04	4.62
Standard Deviation	15.65	1.44
Minimum	0.38	2.24
Quartile 1	2.71	3.55
Median	7.89	4.56
Quartile 3	18.62	5.45
Maximum	79.59	9.5
Skewness	1.75	0.76

Table 9: Statistics for Alighting Time (1) [A(1)]

A(2)	Average A(2) Time (sec) (N=497)	Average A(2) Time (no Boarders) (sec) (N=264)	A(2) per Alighting Passenger (sec) (N=497)	A(2) per Alighting Passenger (no Boarders) (sec) (N=264)
Mean	9.00	8.38	1.44	1.38
Standard Deviation	10.24	6.95	1.36	0.71
Minimum	0.01	0.35	0.14	0.18
Quartile 1	3.00	3.18	0.97	0.98
Median	6.19	6.40	1.25	1.25
Quartile 3	12.27	12.05	1.60	1.54
Maximum	154.13	39.39	25.69	6.50
Skewness	6.47	1.47	12.47	2.83

Table 10: Statistics for Alighting Time (2) [A(2)]

B/A per Boarding & Alighting	N	Mean	Std. Deviation	P
Phase 1	1301	5.76	9.22	0.000
Phase 2	1139	8.93	13.03	

Table 11. The statistical results of the B/A time per passenger test

B/A per Boarding passenger	N	Mean	Std. Deviation	P
Phase 1	472	8.93	8.00	0.000
Phase 2	421	13.67	15.80	

Table 12. The statistical results of the B/A per boarding passenger test (when there was no passenger alighting)

B/A per alighting passenger	N	Mean	Std. Deviation	P
Phase 1	371	2.92	1.86	0.000
Phase 2	346	3.58	2.23	

Table 13. The statistical results of the B/A time per alighting passenger test

EL_A	N	Mean	Std. Deviation	Std. Error Mean	P
Phase 1	126	7.84	6.51	0.58	0.955
Phase 2	340	7.91	18.85	1.02	

Table 15. The statistical results of the B/A time per alighting passenger test

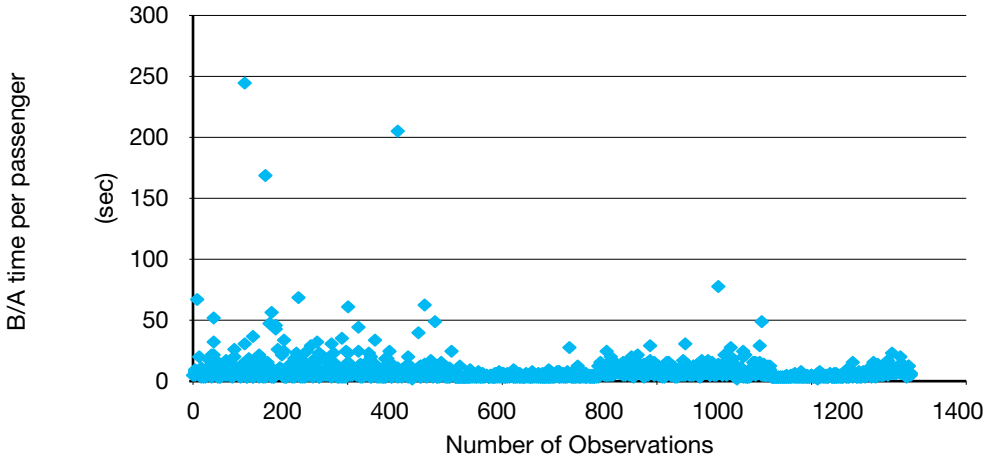


Figure 6. The distribution of B/A time per passenger (Phase 1) (N=1301)

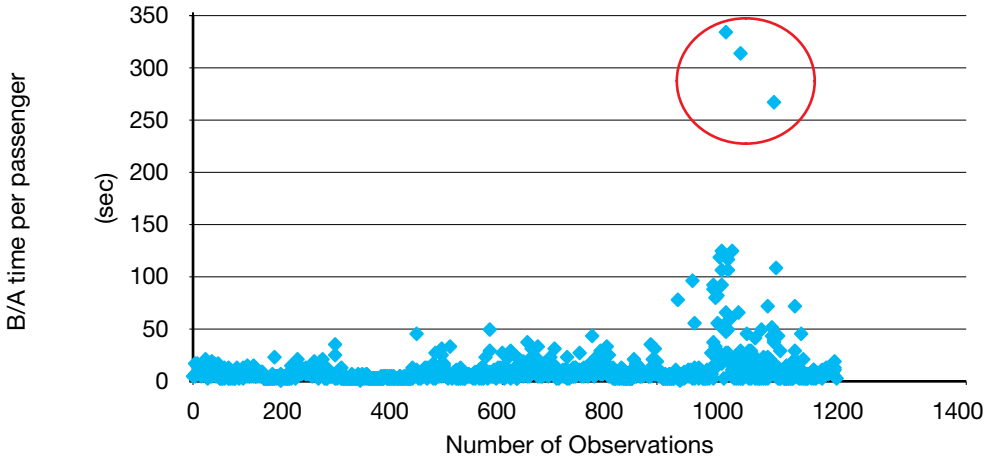


Figure 7. the distribution of B/A time per passenger (Phase 2) (N=1139)

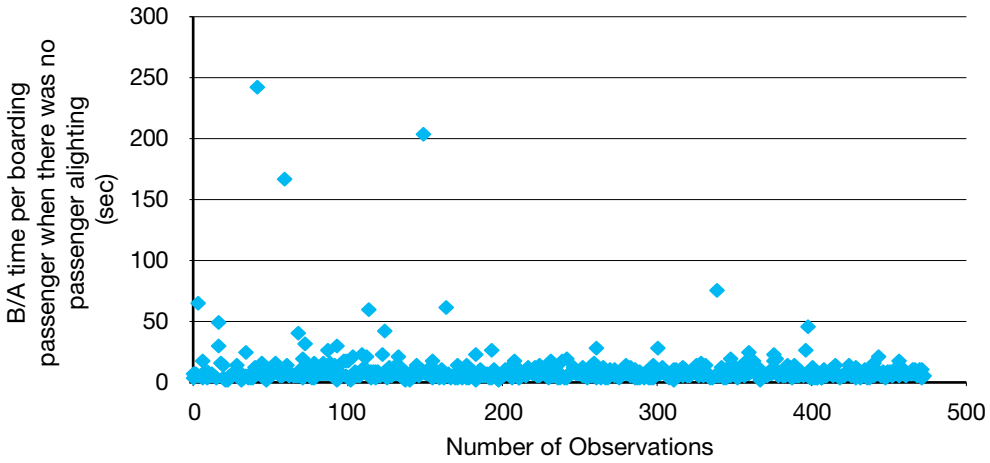


Figure 8. the distribution of B/A time per boarding passenger (Phase 1) (N=472)

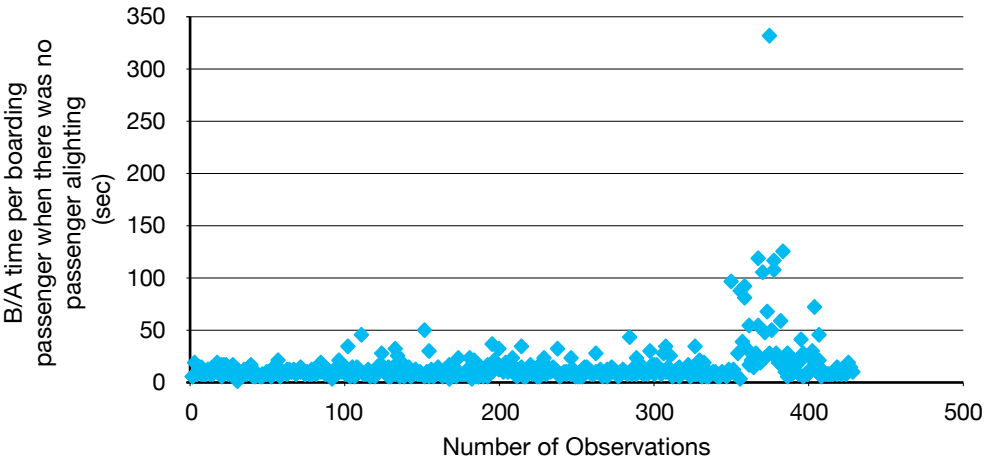


Figure 9. the distribution of B/A time per boarding passenger (when there was no passenger boarding) (Phase 2) (N=421)

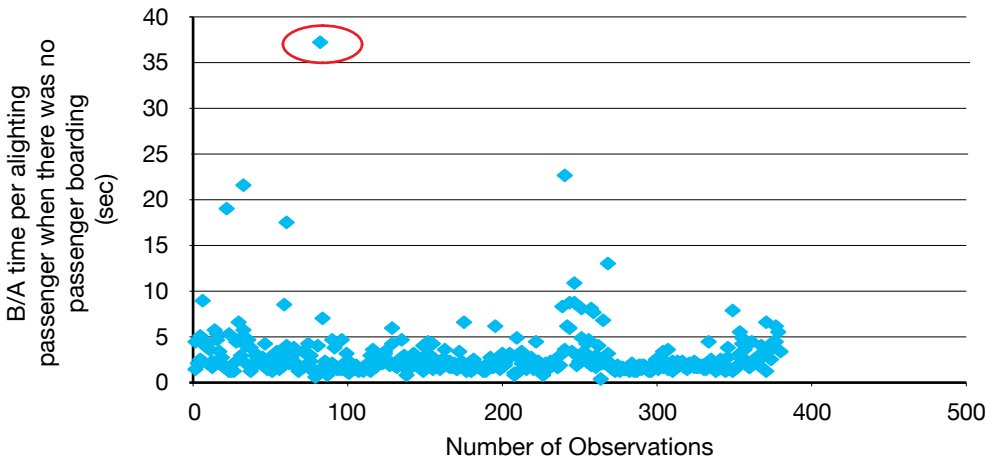


Figure 10. the distribution of B/A time per alighting passenger (when there was no passenger boarding) (Phase 1) (N=371)

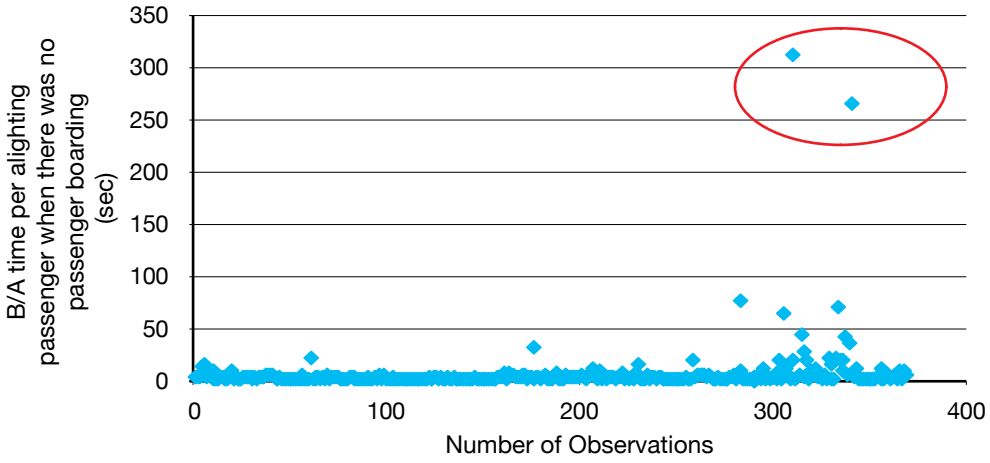


Figure 11. the distribution of B/A time per alighting passenger (when there was no passenger boarding) (Phase 2) (N=346)

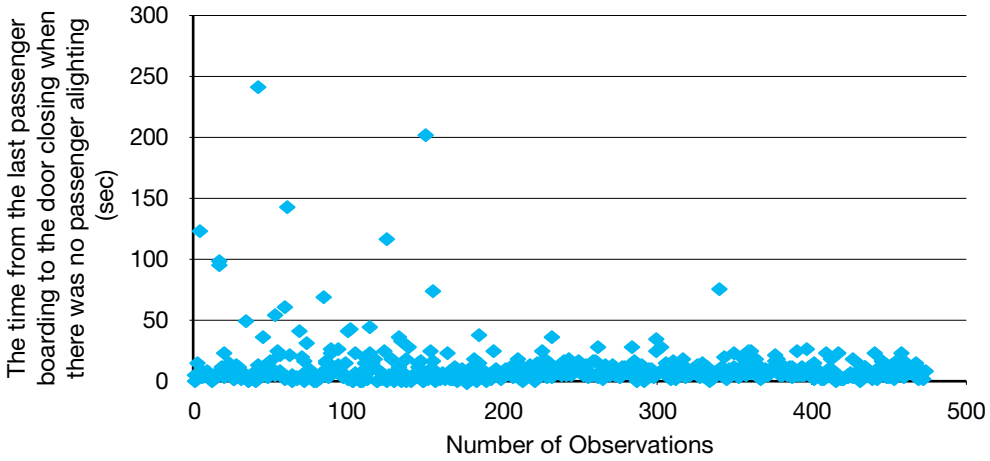


Figure 12. the distribution of EL_B (Phase 1) (N=472)

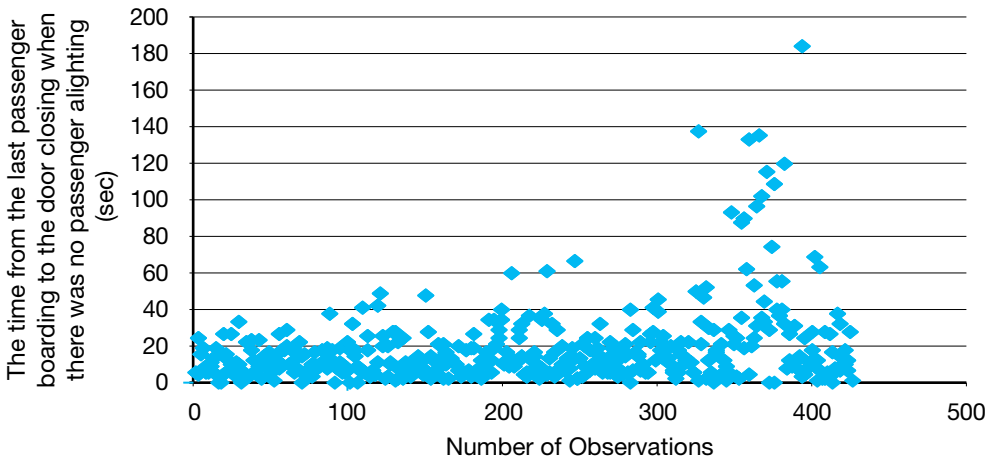


Figure 13. the distribution of EL_B (Phase 2) (N=417)

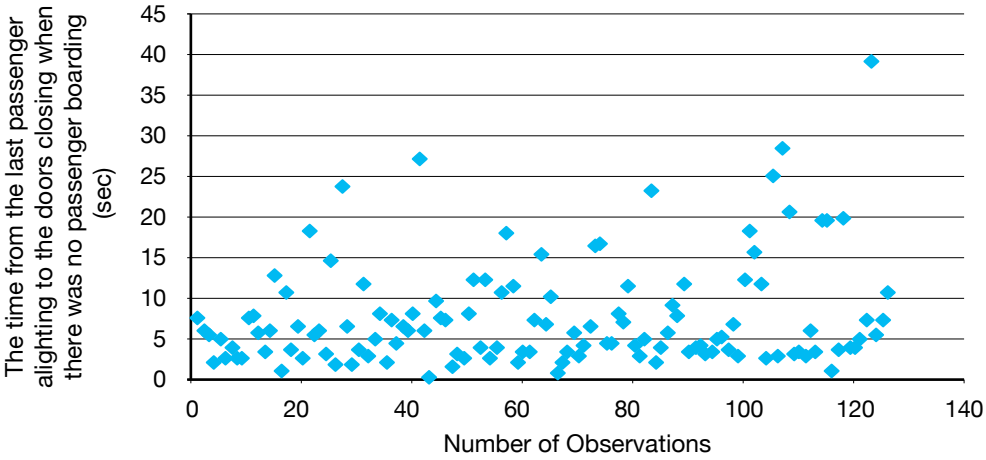


Figure 14. the distribution of EL_B (Phase 1) (N=126)

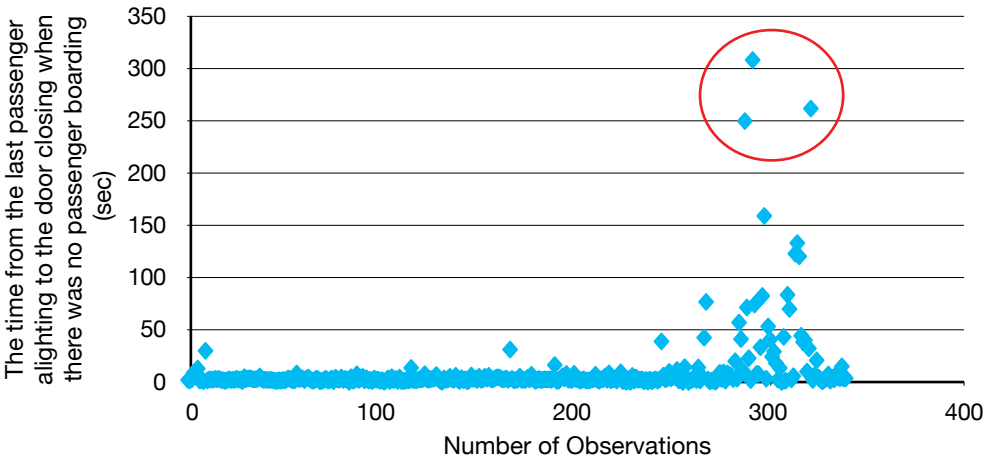


Figure 15. the distribution of EL_B (Phase 2) (N=340)

	Operational Factors		Passenger Factors		Without Factors	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
DT per boarding & alighting passenger	40.5	58.6	11.5	11.82	12.35	26.69
B/A time	129	141.9	44.49	32.48	33.14	51.95
B/A per boarding & alighting passenger	35.9	52.3	11.52	11.09	9.08	13.33
B(1)	113.8	112.9	39.79	32.08	19.81	36.71
B(1) no alighting passengers	172.9	126.2			17.71	32.07
B(2)	63.8	101.3	22.53	22.2	25.88	50.96
B(2) per boarding passenger (no alighting)	16.46	25.97			4.9	6.82

Table 17. Statistics to demonstrate the affects of Other Factors on key measurements

RES722 Phase 2 Reporting: **Driver Survey**

Contents

This report has been produced by Newcastle University for South Yorkshire Passenger Transport Executive under a contract with the Department for Transport. Any views expressed in this report are not necessarily those of the Department for Transport.

4.0 Summary and Conclusions

5.0 Appendix

Executive Summary

The Yorcard Project is intended to deliver a multi-modal, multi-operator public transport smartcard scheme to be trialled on certain buses in Sheffield and on the local train service between Sheffield and Doncaster and intermediate stations.

This report presents the findings from the Phase 2 Driver Survey. The survey was carried out as self-administered questionnaires in Sheffield by the bus drivers from each of the three participating operators. The aim was to create a profile of drivers who have been affected by the introduction of Yorcard to determine their opinion of the new equipment and compare it to the responses given in Phase 1, which was the period prior to the installation of smartcard technology.

The key finding from this Phase 2 study are presented below:

- More drivers felt the new equipment had not made their job easier, however, a significant proportion felt that it had made no difference or that it had actually made their job easier;
- More drivers felt that the new equipment did not help people board more quickly; however, a significant proportion did think that either it had improved boarding speeds or it had no impact;
- More drivers did feel that the equipment was easy for customers to use, and that the equipment (ticket machine and validator) was well placed.
- All of the tasks questioned in the survey were found to be between fairly easy and very easy. The most difficult tasks were seen to be 'issuing paper tickets with wallet', 'scrolling menus or selecting tickets' and 'processing smartcard tickets'.
- All tasks except 'scrolling menus and selecting tickets' and 'issuing paper tickets with a wallet' and 'memorising what the buttons do' were seen to be quick. These tasks have also significantly improved compared to Phase 1. 'Un-jamming the ticket roll' is now seen to be much less time consuming than in Phase 1 when it was one of the most time consuming.
- 'Validating smartcards' and 'processing smartcard tickets' were regarded as neither time consuming nor difficult by the majority of drivers.
- Compared to Phase 1, there was a significant drop in the number of drivers who felt that it was easy to keep to their timetable. The most common cause of delays continues to be customers not having their fare ready. There has been a significant increase in the number of drivers who feel that finding the ticket on the ETM is a cause of delay.
- As in Phase 1, the greatest risk to safety and security was thought to be carrying cash on the bus and the greatest impact to improve safety and security was thought to be less cash-handling, which could be improved with the use of smartcard with embedded tickets and e-purses.
- Compared to Phase 1, the number of drivers stating that they experienced fraud more than 7 times a day has decreased.

As in the previous stage there were certain aspects of smartcard technology that could have an impact upon the equipment users. These were the issuing of tickets off the bus and the validation of tickets and collection of payment by the technology. They could have an impact upon the driver tasks during the boarding process, passenger related delays, safety and security, and fraud. These aspects will be monitored throughout the pilot.

Introduction

1.1 Background

This report will present the results from the Phase 2 Driver Survey. Introductory details including background, objectives and Pilot Acceptance Criteria can be found in the Phase 1 Equipment User Study and the General Reference Document.

At the time of the survey, the equipment on the buses had a reliability issue as the validators were running at about 70-80% reliability[1]. There was also a limited amount of smartcard use as, while ENCTS cards were in use, there were few child and adult (TravelMaster) users.

As with the Phase 1 report, this document will address both the relevant Yorcard and DfT objectives, and the Pilot Acceptance Criteria in the conclusion.

[1] 70-80% reliability is a figure reported daily (on weekdays) by Yorcard. This relates to on-bus surveys conducted by Yorcard at certain times of day for First and Stagecoach routes only. It is measured from a variable sample of buses fitted with new equipment.

Data Collection

2.1 Methodology

The data collection for Phase 2 took part in 2 stages to account for the dates in which the operators installed the new equipment. The live operation of the Yorcard pilot began in January 2008, with the tendered schools operator, MASS. The first commercial routes went live with Stagecoach in April 2008 and First in September 2008. The surveys were collected a while after each installation, between 2 and 8 weeks, to allow time for a 'bedding in' period in which drivers could get used to the new equipment. The data were collected in this phase using a self-administered questionnaire from methodology developed based upon the results and recommendations made in the Phase 1 report (RES703) and defined in the ETM Survey Methodology document (RES203).

Results & Discussion

3.1 Overview

The Driver Surveys were distributed as detailed in section 2. An incentive of £10 in high street vouchers was offered to each driver, plus, the opportunity to win £75 was available by means of one prize draw for each operator to facilitate a high response rate. Newcastle University conducted the prize draw for each operator once their questionnaires were received. The questionnaires were dealt with in the same confidential manner as with Phase 1.

The data have been entered into a database and cleaned for data coding errors and inconsistencies. The total number of questionnaires returned was 132, however, only the useable responses for each of the questions were used to formulate the statistics that are presented in this report (i.e. no answers which were partially complete have been included). The data have been analysed in this report using SPSS and Minitab, which enabled the cross evaluation of responses.

This document will report the findings of the key questions relating to the newly installed smartcard equipment. The questions will be assessed for significant differences compared with the results in Phase 1. This will be reported where appropriate. Further in depth analysis will be carried out to determine the meaning behind certain responses and to establish where error may have crept in due to misunderstanding, question formation, or otherwise.

3.2 Summary of Analysis

Age	Male		Female		Total n =	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
18-24	4%	5%	0%	0%	4	6
25-34	19%	16%	0%	0%	18	20
35-44	29%	36%	100%	33%	31	45
45-59	35%	34%	0%	67%	33	44
60+	13%	9%	0%	0%	12	11
Total n =	95	123	3	3	98	126

Table 1. The distribution of the participating drivers' age

The driver questionnaire is structured in the following order:

Section 1 – questions regarding the driver's employment profile
Section 2 – questions regarding the driver's shift patterns and routes
Section 3 – questions designed to elicit opinions of the new ETM and Validator
Section 4 – questions designed to elicit opinions of time keeping
Section 5 – questions designed to elicit opinions of safety and security
Section 6 – questions designed to elicit opinions of fraud
Section 7 – questions regarding the users' personal attributes

The reporting of the results will be presented in the following sections:

- Sample Profile presenting the profile of the participants; age, gender, year of experience, etc from sections 1, 2 and 7;
- New ETM and Validator presenting the opinions on the new smartcard-enabled technology from section 3;
- Other Factors presenting the resulting answers from sections 4 to 6.

3.2.1 Sample Profile

The total number of questionnaires collected was 132, which was an increase in sample from Phase 1, especially given that the population size has decreased due to a smaller number of drivers who are trained to use the equipment. A representative selection of responses was received from each of the operators; however, this can not be displayed due to commercial sensitivities.

The majority of the participants were male, which is fairly representative of the population of bus drivers and the age distribution is displayed in Table 1 (6 participating drivers did not provide the information on their age and/or gender) as compared with Phase 1. It can be seen that due to the increased incentive, the sample size has increased. About 93% of the 132 participants worked on pilot routes.

A significant proportion of the participants have more than 8 years experience, just over 45% of all participants (see Figure 1 in Appendix 1). 93% of drivers participating in the survey work full time and 74% changed routes on a daily basis. Only 14% worked the same route all the time (see Figure 2).

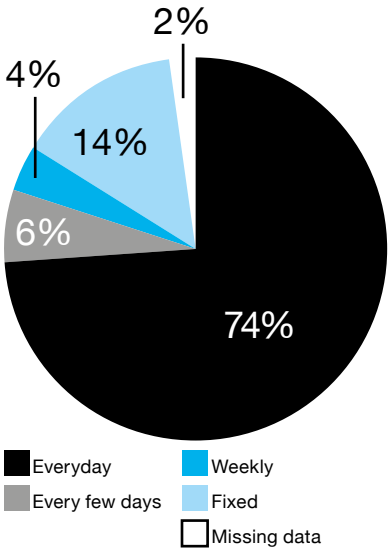


Figure 2. The distribution of the participating drivers' frequency of changing routes (n=132).

3.2.2 New Electronic Ticket Machine and Validator

In section 3 of the questionnaire, drivers were asked to provide their opinions on the new ETM and validator. A list of 6 statements was provided and the participating drivers were asked to weigh their agreements using a 5-point Likert Scale, 1-strongly disagree, 2-disagree, 3-neither, 4-agree and 5-strongly agree. Then they were asked to weight the ease of the ETM tasks and indicate whether the tasks were time consuming or not. They were invited to report any other ETM tasks that were difficult or easy to do. The tasks that have been chosen in this section were as result of the recommendations for progress made in the Phase 1 report and in accordance with the Pilot Acceptance Criteria.

Drivers' view on the new equipment

A list of statements was given to drivers to elicit their views on the new equipment. Drivers were asked to state the level they agreed with each statement:

Statement 1 - I think that the new equipment has made my job easier.

Statement 2 - I think that the ticket machine is well placed in the driver's cab.

Statement 3 - I think that the validator is well placed for me to deal with customers on the bus.

Statement 4 - I think that the new equipment helps people board the bus more quickly.

Statement 5 - I think that the new equipment is reliable and always works as I expect it to.

Statement 6 - I think that the new validator is easy for customers to use.

Figures 3 and 4 demonstrate the distribution of drivers' responses to the statements 1 and 5 which questioned their experience with the new ETM. The results indicate that 36% of the participating drivers agreed or strongly agreed that the new ETM had made their job easier whilst 43% disagreed or strongly disagreed, 21% felt that it had no impact upon the ease of their job (see Figure 3). Figure 4 shows that 26% of drivers agreed or strongly agreed that the new equipment was reliable and always worked as they expected it to, 66% disagreed or strongly disagreed whilst 8% of drivers' opinion was neither positive nor negative.

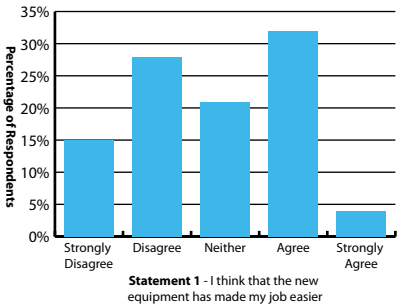


Figure 3. The distribution of drivers' opinions on the statement 1.

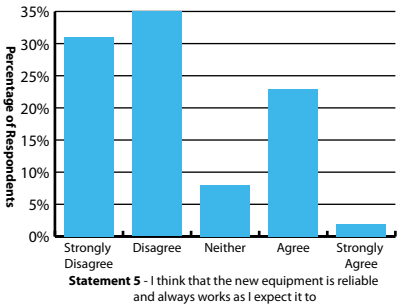


Figure 4. The distribution of drivers' opinions on the statement 5

Figures 5 and 6 demonstrate the distribution of drivers' view on the performance of the new ETM and the validator from the customers' aspect. Figure 5 shows that 26% of drivers agreed or strongly agreed that the new ETM had helped people boarding quickly, 57% disagreed or strongly disagreed whilst 15% felt that it had no impact upon the boarding speed. Figure 6 reveals that over half of drivers agreed or strongly agreed that the new validator was easy for the customer to use, 33% disagreed or strongly disagreed whilst 14% believed that it had no impact upon the customers.

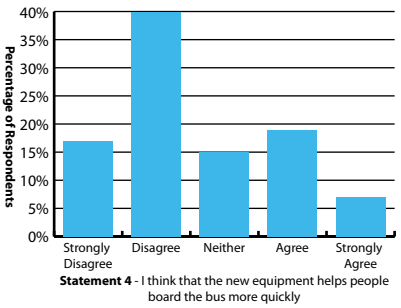


Figure 5. The distribution of drivers' opinions on the statement 4

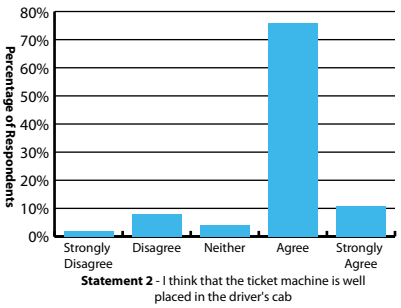


Figure 7. The distribution of drivers' opinions on the statement 2

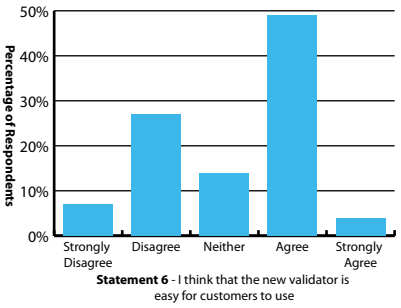


Figure 6. The distribution of drivers' opinions on the statement 6

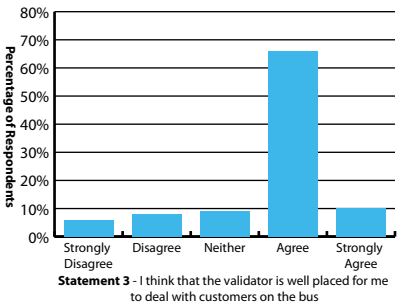


Figure 8. The distribution of drivers' opinions on the statement 3

The distributions of drivers' view on the statements 2 and 3 are shown in Figures 7 and 8 which indicate that the majority of drivers are satisfied with the position of the new equipment and the validator. This suggests that the new ETM and validator have been located in the vehicle properly.

Spearman's rho correlation coefficients are calculated for the further examination of drivers' views on the statements. A 2-tailed Spearman's rho correlation coefficient is calculated to test the null hypothesis that there is no linear relationship between drivers' ages and their views on the ease of using the new equipment and the result shows no significant relationship. Therefore, the null hypothesis is accepted (p=0.731[2], see Table 2 in Appendix 1).

The same technique is used to test the null hypotheses that there is no linear relationship between drivers' views on the performance of the new equipment and (1) whether the new equipment had made their job easier, (2) whether the new equipment had helped people board the bus more quickly and (3) whether the new validator was easy for customers to use. Significant relationships are found at the 1% level between them (P1-5=0.000, P4-5=0.001 and P6-5 =0.000, see Table 3 in Appendix 1). Subsequent 1-tailed tests suggest that if drivers' views on the performance of the new equipment increases, there are corresponding improvements in their view on the benefits of the new technology to both drivers and customers. The findings demonstrate that the performance of the new equipment plays an important role in drivers' views on the benefits of the new technology.

Drivers' views on the ease of the ETM tasks

The second question in section 3 invited drivers to weight the ease of the 12 ETM tasks using a 10-point Likert scale, where 1 is very difficult and 10 is very easy. Because of the introduction of the new technology, two more tasks were added to those in the driver questionnaire in Phase 1: 'validating smartcards' and 'processing smartcard tickets'.

[2]In the statistic tests that follow, a p value will be generated from each test. When p<0.05, it indicates that the result is statistically significant at the 5% level and the null hypothesis is rejected. When p>0.05, it indicates that the result is not statistically significant at the 5% level and the null hypothesis is accepted.

Table 4 shows that none of the weighted mean values is lower than 6 which indicates that the tasks were generally not very difficult. The tasks which were seen to be the easiest were 'updating the fare stage' (mean value=9.06), 'logging on' (mean value=8.68) and 'reading the ETM display' (mean value=8.24). The tasks which were seen overall as being the most difficult were 'issuing paper tickets with wallet' (mean value=6.18), 'scrolling menus or selecting tickets' (mean value=6.31) and 'processing smartcard tickets' (mean value=6.69).

Figure 9 (appendix 1) presents the comparison of drivers' views on the ease of the ETM tasks between the results of Phase 1 and those of Phase 2. As the weighted mean value of each ETM task in Phase 2 is smaller than those in Phase 1, it suggests that drivers' views are generally more negative in Phase 2 than those in Phase 1.

A Mann-Whitney U test[3] is used to examine the null hypothesis that drivers' views on the ease of the ETM tasks in Phase 2 do not differ from those in Phase 1. The results suggest that, statistically, drivers' views on the majority of ETM tasks in Phase 2 do not differ from those in Phase 1 but their view on the following tasks in Phase 2 are significantly different from those in Phase 1 (see Table 5 in Appendix 1 for the following p values):

- Logging on (p=0.021)
- Memorising what the buttons do (p=0.001)
- Issuing paper tickets (p=0.001)
- Issuing paper tickets with wallet (p=0.000)
- Scrolling menus or selecting tickets (p=0.000)

It is possible that the change in the ticket prices two weeks prior to the survey for one operator may have had an impact on the ease of 'issuing paper tickets with and without wallet' and 'scrolling menus or selecting tickets'. Also, the introduction of new equipment may have required an increase of cognitive effort to memorise how to log on and what the buttons do.

Task	mean value
logging on	8.68
updating the fare stage	9.06
reading the ETM display	8.24
pressing the buttons	8.05
memorising what the buttons do	6.80
issuing paper tickets	8.01
issuing paper tickets with wallet	6.18
changing ticket rolls	8.01
un-jamming the ticket roll	6.86
scrolling menus or selecting tickets	6.31
validating smartcards	7.15
processing smartcard tickets	6.69

Table 4. The weighted mean of each task (n=132)

Drivers' view on the time consumption of the ETM tasks

Drivers were then questioned what they felt about the time consumption of the ETM tasks. Figure 10 shows that 'issuing paper tickets with wallet' and 'scrolling menus or searching tickets' were regarded as time consuming by more than half of drivers, whilst 'updating the fare stage', 'reading the ETM display' and 'logging on' were regarded as not time consuming by the majority of drivers. 'Validating smartcards' and 'processing smartcard tickets' were regarded as not time consuming by the majority of drivers.

As recommended in Phase 1, drivers were asked to respond to each statement with a yes or no rather than ranking the level of time consumption (1 being difficult, 10 being easy) to make it easier for drivers to answer. The results from Phase 1 have been converted to yes or no answers (1-5 = yes, 6-10 = no) to allow for comparison. Figure 11 demonstrates the comparison of the percentages of drivers who felt that the ETM tasks were time consuming between Phase 1 and Phase 2. More of drivers in Phase 2 felt that 'scrolling menus or selecting tickets', 'logging on' and 'memorising what the buttons do' were more time consuming than in Phase 1. Again, the recent changes in some ticket prices and the introduction of the new equipment might have had an impact on the time consumption of these tasks. There are fewer drivers in Phase 2 who felt that 'un-jamming the tickets roll' and 'issuing paper ticket' were time consuming than in Phase 1.

[3]A Mann-Whitney U test is used for testing differences between means when there are two groups and different subjects have been used in each group [Source: NORUSIS, M. J. (2004) SPSS 12.0 Guide to Data Analysis New Jersey, Prentice Hall. p388]

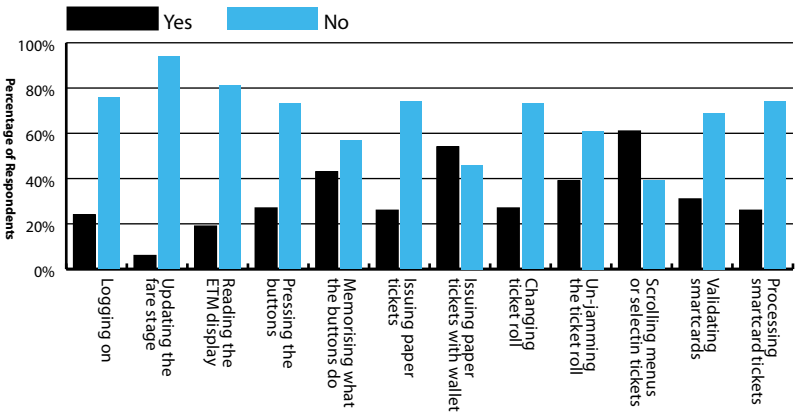


Figure 10. The response percentage of whether drivers found each of the ETM tasks time consuming or not.

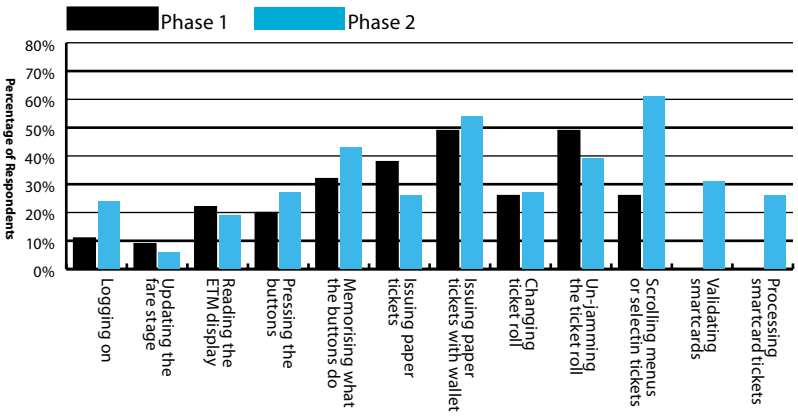


Figure 11. Comparison of the percentage of drivers who felt that the ETM tasks were time consuming between Phase 1 and Phase 2.

Other comments about ETM tasks

In section 3, drivers were offered an opportunity to write down any other ETM tasks that they found difficult or easy to do. Some drivers mentioned that the tickets were easier to read whilst more drivers pointed out that the new equipment has too many multi press functions. For example, it takes 6 presses and 3 menus to issue a particular special offer single ticket. It is likely for the same reason that some drivers stated that it was difficult and time consuming to:

- get into the child menu from the season ticket menu;
- issue day tickets;
- change from adult fares to tickets in wallets and then back to other menus;
- register weekly/daily tickets;
- jump quickly to different menus to log tickets and issue tickets
- switch between different menus/ screens;
- wait for the machine to catch up with inputs that drivers have made whilst waiting for passengers walking on holding passes for drivers to see.

At the moment, there are 32 buttons on the new equipment. However, only 6 single press functions are available, which potentially explains why 'scrolling menus or selecting tickets' and 'memorising what the buttons do' were regarded as time consuming by over half of drivers. Improvements are expected to increase the efficiency of the new ETM and the ease of issuing tickets so that drivers can focus on checking whether a pass or a smartcard is valid.

The second problem reported by drivers is associated with the reliability of the validator which may suggest a contradiction to the project reported reliability of 70%-80% (reported by Yorcard from daily weekday tests on First and Stagecoach buses):

- 3 out of 4 validators do not work;
- whenever switching off the bus on terminus, the validator thinks that the bus goes out of service;
- The ETM sometimes puts drivers on the wrong menu resulting in it issuing the wrong ticket and the driver having to spend time cancelling the ticket.

The third problem reported by drivers is that some of the customers did not show their photos to drivers, so anybody could be using the smartcard.

3.2.3 Other Factors

This section will present the results from sections 4 to 6 of the questionnaire. Sections 4 to 6 were designed to elicit opinions of the factors using smartcards could have an impact on, namely: Time Keeping; Safety and Security; and Fraud. Drivers were asked a number of questions regarding issues in these areas to determine if smartcards have had an overall impact for drivers at this stage in the pilot.

Time Keeping

Drivers were asked if they found it easy to keep to the timetable (disregarding traffic delays). In Phase 1, 73% of drivers (who gave an answer to the question) said 'yes', however in Phase 2 the percentage of drivers who said 'yes' had fallen to 57%.

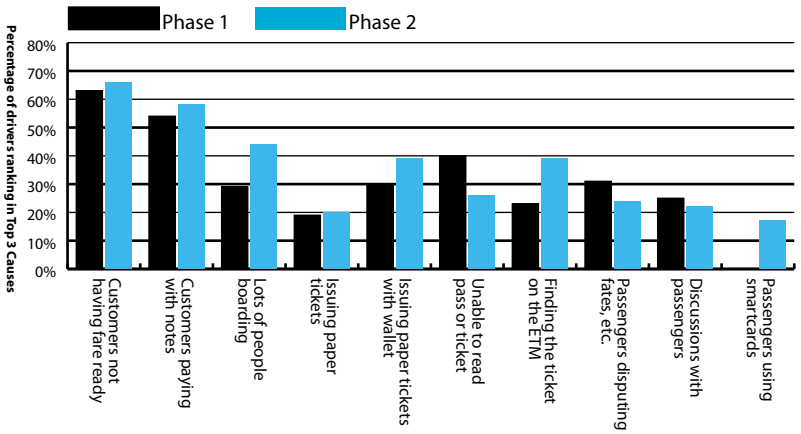


Figure 12. Top Three Perceived Causes of Delay for Phase 1 and Phase 2

To understand the possible reasons for the fall in 'yes' responses, a comparison between the most common causes of delay was undertaken. The Phase 1 survey asked drivers to rank the various factors from 1 to 10, with 1 being the most common cause of delay. The Phase 2 survey asked drivers to pick their top 5 causes of delay and rank them, again with 1 being the most common cause of delay. The responses from both surveys suggests that some drivers did not fully understand the question, as some gave more than one top cause of delay, whilst others ranked all possible causes and did not select their top 5 as requested. Therefore the response rate was higher than the total number of drivers in each survey.

As some drivers might perceive different causes of delay to be of equal value, and to provide a meaningful comparison between the surveys, the percentage of all drivers giving a top three rank to each cause of delay was analysed.

The analysis, presented in Figure 12 and Table 6 (in Appendix 1), shows that fare issues (customers not having their fare ready or those paying with notes) continue to be the most common causes of delay. Comparing the differences between the phases shows that the new ETM installed for Phase 2 (with smartcard readers) appears to have had some impact on the perceived causes of delay. 39% of drivers surveyed in Phase 2 stated that 'finding the correct ticket' was one of their top 3 causes for delay, up 16% from Phase 1. This is potentially due to the 'bedding-in' time required for drivers to learn the functions and layout of the new ETM; however it has been mentioned by drivers that they feel there are more buttons to press to find a ticket which could be impacting upon delays.

Although 17% of drivers stated that smartcards are amongst the top three contributors to delays, the smartcard technologies can offer a solution to the above problems by removing the need for passengers to pay with cash or require large amounts of change when paying with notes. They could also alleviate the problem of drivers having to find the right ticket. This may also explain why 'unable to read a ticket or pass' has reduced as the equipment is able to do this for the driver, however passengers are meant to show their pass to the driver to prove they are the owner of the card. If the photo on the card begins to fade, this may cause problems for the driver to identify the owner.

Safety and Security

One key area in which smartcard technology could have great benefits is in the safety and security of drivers whilst at work. It was identified that 'carrying cash on the bus' was perceived to be the greatest risk by all drivers, but 'passenger confrontation over fares' was also a key issue, particularly amongst younger drivers.

To identify whether the introduction of the new ETM has had any impact on perceived safety risks, a comparison was made between the ranks given by drivers in each Phase. As before, some drivers did not assign a unique rank to each of the safety risks and so the comparison is based upon the percentage of all drivers giving a top two rank to each safety risk.

As the analysis shows, 'carrying cash on the bus' is still the greatest security risk to drivers, but overall there is little change between the Phases in the perceived level of all risks.

Safety & Security Risk	% of Drivers ranking in top 2 risks	
	Phase 1	Phase 2
Carrying cash on the bus	70	75
Carrying cash to the depot	51	48
Carrying cash on a Monday or Tuesday	45	51
Passenger confrontation over fares, etc.	21	21

Table 7. Top Two Safety and Security Risks for Drivers, Phase 1 and Phase 2

Drivers were then asked to state which remedial actions would have the greatest benefit to their overall safety and security. As some drivers stated more than one action as their top priority, percentages do not round up to 100%.

Remedial action	% of Drivers ranking as top action	
	Phase 1	Phase 2
Less cash-handling	64	70
Reliable way to validate a ticket or pass	25	20
Not accepting payment from a large note	28	23

Table 8. Top Remedial Actions for Drivers, Phase 1 and Phase 2

The results of the second analysis confirm the fact that cash-handling is perceived to pose the greatest risk to drivers and that the introduction of smartcards would greatly alleviate the associated problems.

It is interesting to note that following the introduction of the new ETM, there has been an increase of 6% in the percentage of drivers who state that 'less cash-handling' as the top remedial action, which is mirrored by a 5% decrease in the percentage of drivers who state that reliable ticket validation and accepting payment from large notes are the top remedial actions.

These results illustrate the immediate benefits of the introduction of the new ETM, as drivers become accustomed to their operation and the benefits that the machines bring. It is possible that as more drivers experience cashless ticket transactions, this could increase the view that this feature of the smartcards and new ETM could improve the safety of their working environment.

Fraud

In addition to improving the safety and security of drivers, smartcards are also beneficial in reducing the level of fraudulent travel, due to the difficulties of forging a smartcard or successfully using an expired smartcard.

Drivers were initially asked how often (on a daily basis) they encountered passengers trying to use expired or fake tickets and passes. As Figure 13 shows, the frequency of fraudulent ticket use has slightly decreased overall between the Phases, with 61% of drivers experiencing it 0-2 times per day in Phase 2 compared to 58% in Phase 1. 5% of drivers in Phase 2 stated that they experienced significant fraudulent use (7 or more times per day), a figure unchanged from Phase 1.

Calculating the weighted averages confirms the general finding - on average, drivers questioned in Phase 1 experienced fraud 2.5 times per day whereas drivers questioned in Phase 2 experienced fraud 2.3 times per day.

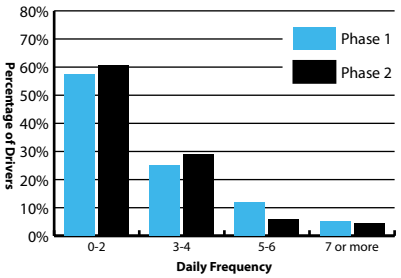
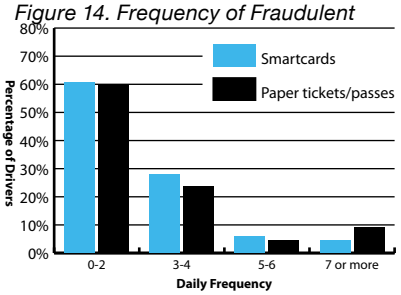


Figure 13. Frequency of Fraudulent Ticket Use Experienced by Drivers, Phases 1 vs. Phase 2

In Phase 2, drivers were also asked to state how often they encountered fraudulent smartcard use, again on a daily basis. As there were no smartcards in operation during Phase 1, a direct comparison was not possible and therefore the frequency of fraudulent ticket use from Phase 2 was the only suitable comparison to make. Figure 14 shows the frequency of fraudulent use for both tickets/passes and smartcards, and reveals some interesting findings. The average time drivers questioned experienced smartcard fraud was 2.3 times a day which is the same for paper tickets and passes.

Figure 14. Frequency of Fraudulent



Ticket Use, Smartcards vs. Paper Tickets/Passes (Phase 2 only)

The most significant finding is that 9% of drivers stated that they experienced fraudulent use of smartcards '7 or more times per day' compared to only 5% of drivers with respect to tickets and passes. This suggests that the new ETM and smartcard readers are having a positive impact on the detection of fraud, as more drivers are now able to detect when invalid smartcards are being used. It must be noted that this result does not account for faulty equipment, valid cards being used erroneously or other possible factors in which a valid card might register as invalid.

As well as asking how often drivers encountered fraudulent ticket use, they were also asked which method of fraud they believed to be the most common amongst passengers. Figure 15 shows the comparison between the two phases for paper tickets and passes.

From this, it is clear that the use of expired tickets continued to be the most common method of fraud experienced in Phase 2, followed by over-riding (travelling further than is permitted by the fare paid or travel pass). The analysis also suggests that drivers were becoming more aware of over-riding and the use of fake tickets in Phase 2, despite the apparent difficulty in identifying both of these practices as highlighted by the Phase 1 focus groups.

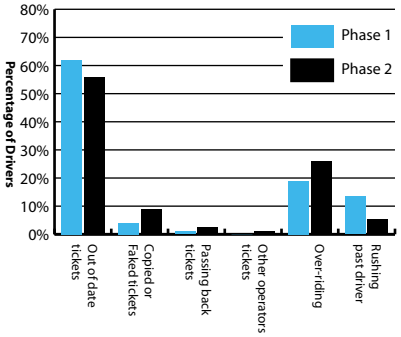


Figure 15. Methods of Fraudulent Ticket Use, Phase 1 vs. Phase 2

For smartcards, the given methods for fraudulent use differed slightly from those for the tickets/passes, so a general comparison with the ticket/passes was only possible for three out of the four methods.

Smartcard Method	%	Ticket/Pass Method	%
Printed dates on Smartcard have expired	31	Out of date ticket	56
Paper counterpart does not match Smartcard	17	Copied or fake ticket	9
Smartcards passed back for others to use	8	Ticket passed back for others to use	2
Invalid Smartcard	45	-	-

Table 9. Comparison of Fraudulent Ticket Methods between Smartcards and Tickets/Passes

The comparison shown in table 9 suggests that there is a difference in how attempts are made to use smartcards fraudulently. Although the use of expired tickets/smartcards has significantly decreased due to the machines identifying expired smartcards, there is a higher incidence of people attempting to use fake or copied smartcards and also more cards are being passed back for others to attempt to use.

It will be important to monitor this situation in further Phases to ensure that the anti-fraud benefits of the smartcard technologies are indeed working. It was noted in section 3.2.2 that some drivers reported that some of the customers did not show their photos to drivers, so anybody could be using the smartcard. This is a fraud and operational process issue (customer/driver training/information) and needs to be investigated during the focus groups in Phase 4.

Summary & Conclusions

4.1 Summary of Results

To date, the data collection for this Phase 2 study has been completed within the timescales stated in the methodology. The resulting data has been entered into a database and cleaned for obvious coding errors. Overall the sample size has increased due to an increase in Driver incentives as recommended in Phase 1.

The results from analysis of the responses are summarised below followed by ways in which the new smartcard technology could make a difference, given these results and in comparison to the statements made in Phase 1. This will be followed by the limitations found at this stage.

The analysis has highlighted where some areas could be improved to enable the collection of a more complete data set in future phases and elicit more useful feedback regarding the new technology. These recommendations will be highlighted later in this section.

The following results were found:

- Each of the pilot routes provided by an operator was driven on by nearly all of that operator's participants.
- More drivers felt the new equipment had not made their job easier, however, a significant proportion felt that it had made no difference or that it had actually made their job easier. A large proportion of drivers felt that the equipment was not reliable and did not always work as expected.
- More drivers felt that the new equipment did not help people board more quickly; however, a significant proportion did think that either it had improved boarding speeds or it had no impact, and more drivers did feel that the equipment was easy for customers to use, and that the equipment (ticket machine and validator) was well placed.
- The findings demonstrate that the performance of the new equipment plays an important role in drivers' views on the benefits of the new technology.
- All of the tasks questioned in the survey were found to be between fairly easy and very easy. The most difficult tasks were seen to be 'issuing paper tickets with wallet', 'scrolling menus or selecting tickets' and 'processing smartcard tickets'.
- Compared to Phase 1, the weighted mean value of each ETM task in Phase 2 is smaller suggesting that drivers' views are generally more negative in Phase 2 than those in Phase 1. However, there is only a statistically significant difference in opinion for 5 of the tasks.
- All tasks except 'scrolling menus and selecting tickets' and 'issuing paper tickets with a wallet' and 'memorising what the buttons do' were seen to not be time consuming. These tasks have also significantly increased in terms of perceived time consumption compared to Phase 1. 'Un-jamming the ticket roll' is now seen to be much less time consuming than in Phase 1 when it was one of the most time consuming.
- 'Validating smartcards' and 'processing smartcard tickets' were regarded as neither time consuming nor difficult by the majority of drivers.
- Compared to Phase 1, there was a significant drop in the number of drivers who felt that it was easy to keep to their timetable. The most common cause of delays continues to be customers not having their fare ready. There has been a significant increase in the number of drivers who feel that finding the ticket on the ETM is a cause of delay, which may be the result of the 'bedding-in' period.
- As in Phase 1, the greatest risk to safety and security was thought to be carrying cash on the bus and the greatest impact to improve safety and security was thought to be less cash-handling.
- Compared to Phase 1, the number of drivers stating that they experienced fraud more than 7 times a day has decreased.

4.2 Limitations

Limitations have been identified and therefore, further discussion and work may be required to elicit certain responses in later phases. The limitations are as follows:

- Due to the staggered entrance into phase 2, drivers from different operators were surveyed at different times and potentially at different times in their learning curves. Although it was attempted to avoid this, drivers may not have been under completely the same test conditions which may have affected the results. In Phase 4 all operators should go live at the same time and therefore this should not be a problem.
- At the time of the survey, the validators on the buses were running at about 70-80% reliability, which is likely to have a negative impact upon drivers' views.
- There was also a limited amount of smartcards in use during the data collection as, while English National Concessionary Travel Scheme (ENCTS) cards were in use, there were few child and adult (TravelMaster) users. Therefore, drivers may only have a limited experience of smartcards at this stage.

4.3 Objectives

This study has met the criteria of the agreed methodology and has enabled a comparison to the findings of Phase 1. In terms of the pilot acceptance criteria, this study has followed that which is recommended and overall has not shown any reduction in the measurements wished to be observed.

The effects that smartcard technology could have in the future upon the Yorcard Objectives were identified in the Phase 1 Boarding Time report as:

- Reducing the barriers to the use of public transport
- Reducing delays and improving reliability
- Reducing fraud
- Informing the business case

At this stage it is difficult to say if these objectives have been met as there has been an increase in the average Dwell Time and its component parts for this phase; however, this report has been able to offer a baseline for smartcard technology comparison with other phases, and, in conjunction with the other studies, will form a more rounded picture of the effect of Yorcard on the above qualifiers. This is also the case for the DfT objectives, which were identified as the following:

- Analysing the system performance (b(2))
- An assessment of the Operator and PTE expectations (c)

Each of the objectives will be looked at briefly below:

Reducing Barriers to the Use of Public Transport

Phase 1 identified that the new technology could have an impact upon the barriers to using public transport. For example, drivers are often the customers' first point of contact, therefore if the equipment is easy to use then this is likely to have a positive impact upon how they deal with customers and potentially reduce perceived barriers to travel. At this stage there was low smartcard usage and generally drivers did not feel the equipment made their job easier. This will be monitored in phase 4 to determine if their job becomes easier when more people have smartcards and the equipment is more reliable. The results for this objective could also inform the DfT objective to improve accessibility of public transport.

Reducing Delays and Improving Reliability

It was identified in Phase 1 that if the new technology is easier and quicker to operate, then this could have a positive impact upon the reduction in delays and improving the overall reliability. In this report and the Phase 2 Boarding Time Study, increased delays and boarding times have been observed. Phases 3 and 4 will be able to determine if this is the result of smartcard technology or if it was the result of a 'bedding in' period. Phase 5 will report the system performance over the pilot period.

4.4 Recommendations

Reducing Fraud of all types
Phase 2 has shown a slight decrease in the amount of fraud experienced by drivers, which is fairly inconclusive. A comparison with phase 4 may be more meaningful as there will be more smartcards in circulation and therefore fraud may be harder as smartcards could be more difficult to replicate or use in other fraudulent ways as the card communicates directly with the ETM and it is possible to 'hotlist' a card so that it can no longer be used.

Business Case
At this stage the business case for Yorcard is still in its infancy and therefore, more results will be needed to provide a concrete business case.

Analysing the system performance (DfT b.(2))
Once again, this study and the process which will be repeated in Phase 4 will feed into the analysis of the system performance as the equipment user opinion of the ease of use of the new technology and its time-saving effects will inform this analysis.

An assessment of the Operator and PTE expectations (DfT c.)
The opinions provided by drivers are likely to enable the collection of information on certain aspects of operator expectations. As is the case in this report, both positive and negative experiences will be collected throughout this pilot process.

This section outlines the recommendations for phase 4 when the study is repeated:

- All parallel studies should be analysed as a collective in order to cross refer reports and document where overlaps may occur particularly if they form part of the business case. This will be documented fully in the end of phase report.
- The methodology detailed in this document should be repeated to ensure consistency.
- The current incentive should be maintained to sustain a high response rate.
- Drivers in Phase 2 felt that a number of tasks were more time consuming than in Phase 1. It should be investigated in the Phase 4 focus groups to determine if this is an ETM layout or bedding in period problem.
- It was noted that if customers do not show their smartcards to drivers, then anybody could be using the card. This is a fraud and operational process issue which needs to be investigated in Phase 4.

Appendix 1

The following tables relate back to the analysis which is presented in section 3, Results and Discussion. These tables are placed here to limit the size of the report. However, for consistency the tables are numbered chronologically and as they are referred to in the text.

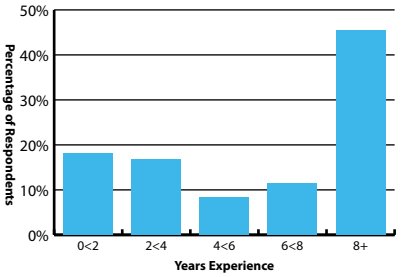


Figure 1. The distribution of the participating drivers' years experience (n=132)

Spearman's rho Corrélation Coefficient	age
I think the new equipment has made my job easier	-.025
p	0.731
N	132

Table 2. The examination of the correlation between drivers' opinions on statement 1 and their age.

Spearman's rho		I think that the new equipment is reliable and always works as I expect it to.
I think that the new equipment has made my job easier.	Correlation Coefficient	0.488 (**)
	P1-5 (2-tailed)	0.000
	P1-5 (1-tailed)	0.000
	N	132
I think that the new equipment helps people board the bus more quickly.	Correlation Coefficient	0.410 (**)
	P4-5 (2-tailed)	0.000
	P4-5 (1-tailed)	0.000
	N	130
I think that the new validator is easy for customers to use.	Correlation Coefficient	0.288 (**)
	P6-5 (2-tailed)	0.001
	P6-5 (1-tailed)	0.001
	N	132

Table 3. The examination of the correlation between statement 5 to statements 1, 4 and 6 .

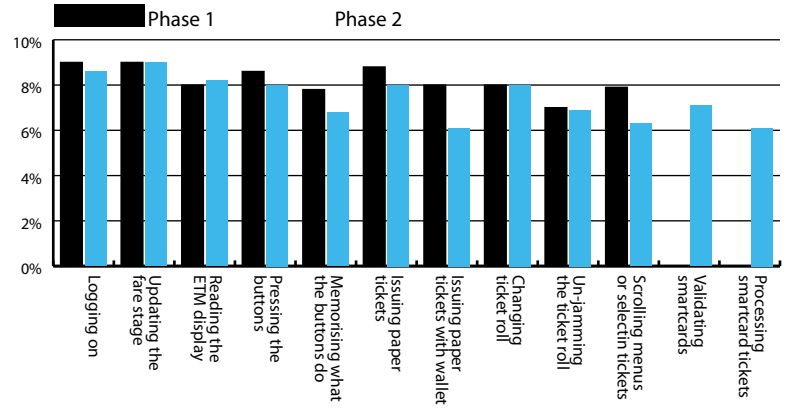


Figure 9. Weighted Mean of the ease of use for each ETM Task

Mann-Whitney U	Logging on	Memorising what the buttons do	Issuing paper tickets	Issuing paper tickets with wallet	Scrolling menus or selecting tickets
P (2-tailed)	0.021	0.001	0.001	0.000	0.000

Table 5. The examination of the difference of the ETM tasks between Phase 1 and Phase 2.

Cause of Delay	% of Drivers ranking in top 3 causes	
	Phase 1	Phase 2
Customers not having fare ready	63	66
Customers paying with notes	54	58
Lots of people boarding	29	44
Issuing paper tickets	19	20
Issuing paper tickets with wallet	30	39
Unable to read passenger's pass or ticket	40	26
Finding the correct ticket on the ETM	23	39
Passengers disputing fares, etc.	31	24
Discussions with passengers about fares, etc.	25	22
Passengers using smartcards	n/a	17

Table 6. Top Three Perceived Causes of Delay for Phase 1 and Phase 2

RES723 Phase 2: End of Phase Report

Contents

1.0 Introduction

2.0 Methodology & Planning Review

3.0 Analysis of Phase 2 Data

This report has been produced by Newcastle University for South Yorkshire Passenger Transport Executive under a contract with the Department for Transport. Any views expressed in this report are not necessarily those of the Department for Transport.

4.0 Summary & Review of Objectives

5.0 Appendices

Executive Summary

The Yorcard Project is intended to deliver a multi-modal, multi-operator public transport smartcard scheme to be trialled on certain buses in Sheffield and on the local train service between Sheffield and Doncaster and intermediate stations.

This report presents:

- A summary of the deliverables forming the contract between DfT and SYPTE
- How each deliverable was completed, and how progress was made throughout Phase 2
- A review of DfT and Yorcard objectives and how objectives have been met
- A review of the methodologies used including the limitations, risks and issues that arose during Phase 2 work
- The findings from Phase 2 that are common across different studies
- Recommendations for the future delivery of the Yorcard research programme

Introduction

1.1 Background

This Yorcard Phase 2 End of Phase Report sets down the outputs forming part of a research contract between the South Yorkshire Passenger Transport Executive (SYPTE) and the Department for Transport (DfT), Transport Technology and Standards Division. An overview of the tender and a full description of the Yorcard pilot can be found in the General Reference Document.

The purpose of this report is therefore to provide an evaluation of the results from the first two Phase 2 reports and determine any cross-over between the findings. It is also the purpose to review the delivery of the Phase and identify any lessons learned from a practical perspective regarding the management of this Phase and how this could be improved in the future.

1.2 Summary of Deliverables

The intention of Phase 2 was to baseline measurements that would be tracked throughout the life of the Yorcard Pilot to enable monitoring of change and evaluation of the scheme. There were 3 primary deliverables in Phase 2:

- A boarding time study
- An equipment user study:
  - With Travel South Yorkshire Information Centres (TICs)
  - With bus drivers
- And this end of stage report

1.3 Review of Progress of Deliverables

The requirement of data collection was that all data must have been collected before any part of the Yorcard technology was being actively used by the public. It was originally planned that there would be a bedding in period before the new technology would be used in smartcard form. This would allow evaluation concerning the impact of the new bus equipment solely in a paper based ticketing environment, and would provide evidence if it was simply a change in ticket machine driving changes in the Yorcard environment, rather than the use of smartcards.

This planned bedding in period did not materialise. The on bus equipment accepted smartcards, albeit limited products, more or less from implementation. The plan was amended as to collect data within 12 weeks of implementation and before any significant volume of smartcard transactions were processed.

Issues with the reliability of on-bus equipment meant that mainly ENCTS transactions were being processed at the time of data collection. However, all targets for data collection for the bus related studies were met.

A knock-on effect of the bus equipment reliability issue was that smartcard sales were not actively promoted at the TICs. This resulted in very few smartcard products being sold. It was agreed by the Yorcard stakeholders that the planned TIC time and motion study would be moved into Phase 4 in order to provide more robust results.

1.4 Review Against Budget

The costs were within acceptable limits for the Phase. To ensure that sufficient data quality was obtained, it was necessary to add incentives to bus drivers of £75 per bus operator (£225 total) by means of a prize draw for all completed questionnaires. As the deadline for returning completed questionnaires approached, it was agreed by the Yorcard Stakeholders to provide a £10 high street gift voucher for all fully completed questionnaires returned. This increased expenditure was within acceptable limits, and led to a high response rate.

1.5 Meeting DfT Objectives

The DfT have stipulated the following objectives as part of the tender specification:

a. All elements of the pilot scheme shall be fully compliant to the prevailing ITSO documentation.
b. Conduct a robust analysis of (1) bus boarding times, (2) Systems performance and (3) passenger reaction to address the concerns of all key stakeholders involved in the rollout of smartcard technologies within a deregulated transport industry. This should provide a comparison of existing performance measures prior to the introduction of smartcards to the pilot area.
c. The research shall assess the Customer Experience and the Operator and PTE expectations and provide recommendations for rollout. Included within this analyses shall be a study of the business case for deployment of similar regional schemes.
d. To understand the value of new innovative ticketing products to the key stakeholders
e. To understand the value of using Citizen Cards as an alternative to transport only smartcards.
f. To ensure that all deliverables are clear, concise, accurate, thorough, of a high technical quality and well written.
g. The research shall complement the Yorcard pilot timetable.

This report must therefore evaluate how the relevant objectives will be met.

1.6 Meeting Yorcard Objectives

It is also important to consider the objectives of Yorcard and its stakeholders. This report will consider how the most relevant objectives are likely to be influenced by Yorcard:

- Reduce barriers to the use of public transport;
- Reduce delays and improving reliability;
- Reduce fraud of all types; and
- Inform business cases.

The remaining objectives are predominantly technical and will be evaluated in other phases of this research work. The list of Yorcard objectives is shorter than that in Phase 1 because there was no consumer survey in Phase 2. Please refer to the General Reference Document for the full list

Methodology & Planning Review

2.1 Introduction

This section reviews the methodology used for each deliverable in this phase and explores how the processes for delivery of future phases of this research project can be improved.

2.2 Review

All studies were conducted in accordance with the agreed methodologies. Recommendations from Phase 1 were also taken into account. The changes to methodology were:

- Increase in the incentive for the bus driver survey. This was required because the response rate was low, and the desired effect of increasing the response rate materialised.
- Changes to the data collection period for the bus driver survey and the boarding time survey because of changes in the implementation of equipment on buses. Although the timescales changed, all data were collected within agreed boundaries.

2.3 Risks and Issues

The following risks were identified as relevant to Phase 2:

- Primary data for the baselining phase could not be collected.

  This was a result of a contract issue with the Yorcard Supplier and the Researchers – CLOSED[1].

The following Issues were identified as relevant to Phase 2:

- The project does not currently have an agreed Project Initiation Document (PID) to inform of measurements to be taken and internal controls

  PID was agreed and controls put in place - CLOSED

[1]This risk was also identified and raised in the End of Phase Report for Phase 1. Although the process for providing contracts was changed, it remained a slow process and should be reviewed for future Phases.

2.4 Lessons Learned

Project based lessons learned relating to the delivery of the Yorcard project in general will be presented in a pilot evaluation report as part of this research work. However, one important lesson learned is worthy of discussion in this report and relates to the use of the technology by the visually impaired. Such users had difficulty in recognising where to scan their passes. A user group, not forming part of the research work, suggested that raised surfaces and contrasting colours would be beneficial to identify the position of the 'target' on the reader. This lesson should be addressed and a solution identified for the rollout depending upon what typre of technology is implemented.

There were no research based lessons learned relating to planning and delivery of the reports, excepting the contracting risk.

Analysis of Phase 2 Data

3.1 Summary of Analysis

The results presented in this section are relating to the findings in Phase 2 reports that reference any impact to other studies, or report common results found in other studies. This is analysed below, and should be monitored in future phases. A summary table of the key findings relative to the Yorcard and DfT objectives is shown at appendix 1.

3.2 Bus Stop Dwell Time

		PHASE 1	PHASE 2
Measurement Description		Mean Time – sec (Standard Deviation)	Mean Time – sec (Standard Deviation)
Bus Stop Dwell Time:	per bus	**28.66 (68.06)**	**40.77 (60.69)**
	per boarding and alighting passenger	**7.08 (9.98)**	**12.35 (26.69)**
Bus Stop Boarding/ Alighting Time:	per bus	**23.78 (34.95)**	**33.14 (51.95)**
	per boarding and alighting passenger	**5.76 (9.22)**	**9.08 (13.33)**

Table 1: headline statistics from the Phase 1 and Phase 2 boarding time studies.

Bus Stop Dwell Time is the total time that the bus is at a particular stop and, in terms of the analysis, the effect of Yorcard on this time could have the greatest impact for the operator. An overview of the headline times is shown in table 1.

The equipment user report identified that there are 3 processes of using the ETM that may impact on Boarding Time and therefore Dwell Time:

- Un-jamming ticket rolls
- Changing ticket rolls
- Issuing paper tickets with wallets

These are all factors that should be monitored in the future with regards to both the changing equipment and any difference in the elements comprising Dwell Time, because these factors could be affected by introducing smartcard technology on buses. There were some changes in driver perceptions of delays in Phase 1 and Phase 2, and these are shown in Table 2. The averages for the various calculations for Bus Stop Dwell and Boarding Times actually increased compared to Phase 1. It is thought that the reason for this increase could be because of one or more of the following:

- A recent fares change meaning more time for drivers advising passengers;
- A reliability issue with the on bus Validator;
- The drivers had not become used to operating the new equipment; and/ or
- That the new ETM itself is actually slower and/or more difficult to use than the previous ones used by the bus operators.

3.3 Perceptions of Delay

Cause of Delay	% of Drivers ranking in top 3 causes	
	Phase 1	Phase 2
Passengers not having fare ready	63	66
Passengers paying with notes	54	58
Lots of people boarding	29	44
Issuing paper tickets	19	20
Issuing paper tickets with wallet	30	39
Unable to read passenger's pass or ticket	40	26
Finding the correct ticket on the ETM	23	39
Passengers disputing fares, etc.	31	24
Discussions with passengers about fares, etc.	25	22
Passengers using smartcards	n/a	17

Table 2: Top Three Perceived Causes of Delay for Phase 1 and Phase 2

There was an agreement in Phase 1 that both the bus driver survey and the consumer survey that 'passengers not having their fare ready' was perceived as being the main cause of delay on the bus, and this did not change in Phase 2. There was also evidence in Phase 2 to suggest that certain tasks associated with operating the new ETM had made the drivers' job worse and slowed down boarding (see table 2).

It is uncertain at this stage if this is a result of equipment not being bedded in, staff training or if certain functions of the ETM are slower than the previous ETM used. This requires careful monitoring in both studies in future phases and could explain the negative impact on Bus Stop Dwell Times. It should also be noted that the implementation of smartcards may not be the catalyst for changing this.

Summary & Review of Objectives

4.1 Introduction

The analysis carried out for this report has enabled the identification of the important calculations to compare throughout this research project. Each of the measurements identified in this report will be taken in turn to highlight and summarise the important findings in relation to the objectives. This will further identify which measurements are important for comparison in future phases this research programme.

4.2 Limitations

Limitations have been identified and therefore, further work may be required to ensure data quality in later phases. The limitations are as follows:

- The results may have been limited by the reliability issue of the on bus Validator. At the time of data collection, Validators were operational for about 70-80% of transactions. This could have led to negativity in the bus driver survey.
- The reliability issue may also have affected the attitudes of drivers and passengers to the equipment and to each other.

4.3 Objectives

It is also important that this report is not taken in isolation and that the data from other research tasks are used to help support these findings wherever possible. This report identifies any cross over and links back to Phase 1.

This Phase set out to meet the objectives of the stakeholders involved in the Yorcard project. In particular, this report documents the headline changes to the baseline measures which have occurred since the introduction of new on-bus ticketing equipment. A full assessment of the impact on objectives is shown at Appendices 1 and 2.

4.4 Advice for the Business Case

The business case remains in its early stages of development and thus, the recommendations for rollout and deployment will be much more obvious as the results for the later phases are analysed. This will follow the identification of which factors Yorcard is likely to be able to influence.

The studies undertaken during Phase 2 have enabled measurements to be compared to the baseline measurements taken in Phase 1. However, it remains unclear which will be the most prominent and reliable measurements that should be used. This will change over time as more evidence is collected regarding the impact of smartcard use.

4.5 Recommendations

To date, the data collection and evaluation for Phase 2 has been completed. The analysis presented in the Phase 2 reports has provided robust results suggesting that the data collected are reliable.

Recommendations appropriate to each deliverable have been made in each respective report.

It is also recommended that there is a more detailed evaluation regarding the impact of the results on a regional scheme roll out once the key measurements have been identified. This is unlikely to be undertaken until phase 4 is underway, and may require more involvement from the Yorcard Stakeholders regarding the impact. Howerver, it but will enable a full and balanced evaluation for the Best Practice Final Report.

Appendix 1

Appendix 1 - Summary of the analysis of Yorcard Objectives

		Study Deliverable		
	Objective	Boarding Time	Equipment User	Consumer
1	Reduce barriers to the use of public transport	There is evidence to suggest that boarding times have increased. This could be because of the new ETM however, external factors could have had an effect.	Most time consuming tasks were again related to paper based tickets and customers not having their money ready.	N/A
2		As (1) above.	As (1) above and that most time consuming tasks were related to paper based tickets and passengers not having their money ready.	N/A
3	Evidence suggests that the new equipment has made some drivers jobs worse. However, equipment reliability could have had an impact on negative responses.	N/A	Smartcard ticketing is potentially a more reliable way of validating tickets.	N/A
4	Reduce delays and improving reliability	See Objective 1 above	See Objective 1 above	N/A
5	Reduce fraud of all types	N/A	Smartcard ticketing is potentially a more reliable way of validating tickets and picking up people using expired tickets. Methods of fraud may be shifting with smartcard use – needs to be monitored.	N/A
6	Enhance the image of public transport	N/A	N/A	N/A
7	Improve MTC revenue distribution by providing more accurate information on journey lengths	N/A	N/A	N/A
8	Prove ITSO compliant equipment and operational protocols in a major scheme	N/A	N/A	N/A
9	Integrate with Real Time Information	N/A	N/A	N/A
10	Inform Business Cases	To be discussed in later Phases.		

Note: N/A in this context (and for the next table) means not applicable in terms of this Phase and study output. The full research programme will deliver against each objective for the Best Practice Final Report in Phase 7.

Appendix 2

Appendix 2 - Summary of the analysis of DfT Objectives

		Study Deliverable		
	Objective	Boarding Time	Equipment User	Consumer
a	All elements of the pilot scheme shall be fully compliant to the prevailing ITSO documentation.	N/A	N/A	N/A
b	Conduct a robust analysis of (1) bus boarding times, (2) Systems performance and (3) passenger reaction to address the concerns of all key stakeholders involved in the rollout of smartcard technologies within a deregulated transport industry. This should provide a comparison of existing performance measures prior to the introduction of smartcards to the pilot area.	The measurements taken in Phase 2 have been compared to the measurements in Phase 1. Tracking of changes will continue in future Phases.	The surveys undertaken have enabled the bus operators to understand some of the concerns relating to staff operations. Further evaluation is required to understand why certain tasks are more time consuming and why some drivers suggest the new equipment makes their job worse.	N/A
c	The research shall assess the Customer Experience and the Operator and PTE expectations and provide recommendations for rollout. Included within this analyses shall be a study of the business case for deployment of similar regional schemes.	As (b) above. Tracking will allow the evaluation of the impact of the use of smartcard technology, and be able to be grossed up to the passenger journeys in the region (or similar).	Some key findings have been presented in the report, particularly regarding time consumption of certain tasks and perceptions of delays, fraud and security that can be monitored in future Phases and will help to provide recommendations for the roll out of similar regional schemes.	N/A
d	To understand the value of new innovative ticketing products to the key stakeholders.	To be discussed in later Phases.		
e	To understand the value of using Citizen cards as an alternative to transport only smartcards.	To be discussed as part of Phases 6 and 7.		
f	To ensure that all deliverables are clear, concise, accurate, thorough, of a high technical quality and well written.	Clear reports have been written based on a template agreed by research stakeholders.		
g	The research shall complement the Yorcard pilot timetable.	All data were collected within the agreed timescales immediately following smartcard technology being installed on bus.		

RES802 The Yorcard Data Book: **Phase 2**

Contents

1.0 Executive Summary

2.0 Background & Introduction

This report has been produced by Newcastle University for South Yorkshire Passenger Transport Executive under a contract with the Department for Transport. Any views expressed in this report are not necessarily those of the Department for Transport.

3.0 Calendar of Events

4.0 Results

Executive Summary

1.1 Additions to this version of the Data Book

This is the second Data Book for the Yorcard project, and includes a summary of the data collected during the Phase 2 surveys (boarding time and bus drivers).
The Data Book also includes an incident report and calendar of events, information on patronage figures for the pilot routes used in this Yorcard project on local trains between Sheffield-Doncaster, and monthly weather reports from April 2008 to December 2008.

1.2 Summary of Data Interpretation

The data collected during Phase 1 was used to establish a baseline scenario against which the results of future phases will be compared, in order to measure and monitor the impact of the introduction of the Yorcard smartcards. Smartcards were introduced to a limited number (69) of school children on 19th February 2008 (approximately halfway through the duration of Phase 1) before going live in Phase 2 on Stagecoach pilot services on 28th April 2008 and on First pilot services through September 2008. Rail services went live shortly after, on November 3rd 2008. Therefore it is not possible to infer any impacts of the introduction of Smartcards on patronage at this early stage.

Comparison of the survey results between Phase 1 and Phase 2 suggests that the new ETMs have had a slightly negative impact on operations. Key statistics from the Boarding Time studies shows an increase in the average Dwell Time and Boarding/Alighting times from Phase 1 to Phase 2. Results from the Drivers Survey indicate that in Phase 2, all the ETM tasks were perceived to be slightly more difficult, and a lot more time consuming compared to Phase 1. As the Drivers Survey commenced towards the end of Phase 2, shortly after all pilot services went live, it is likely that the bedding-in period of the new ETMs and drivers learning how to operate them could have had an effect on the results.

Data collected in future phases will allow for a more meaningful comparison of the operational impacts and benefits of the introduction of Smartcards to be measured and monitored, and a greater discussion of these impacts will be included in future Data Books.

1.3 Effects of the Calendar of Events

As noted, the introduction of smartcards across all the pilot routes was spread across Phase 2. Apart from this, there does not appear to be any significant impact of the events included in the Calendar of Events upon the data collected or on patronage levels throughout Phase 2.
Comparisons will be made between Phases as the Yorcard project progresses to ascertain whether there are any external events which could have had an impact upon operational performance, patronage and thus influence the results of any data collection exercises.

1.4 Content of the Next Data Book

The next Data Book will contain similar reports and analysis derived from the data collected during the respective Phase 3 studies.

The Data Book – Background & Introduction

2.1 Scope of the Data Book

The Yorcard Project was intended to deliver a multi-modal, multi operator public transport smartcard scheme to be trialled in part of the South Yorkshire area during 2008. The scheme offers certain commercial and concessionary ticket products in 'Smart' format and is built to the ITSO standard. Yorcard Limited has procured all the hardware, software and services required to enable the successful implementation of a Pilot scheme. The Pilot is being mounted on the services of three bus operators in the S10 area of Sheffield and on Doncaster to Sheffield rail services. Details of the Yorcard project and the research programme can be found in the research General Reference document.

This Yorcard Data Book is the document that sets out detail results of the outputs of the Pilot for use by Yorcard Project Stakeholders and other public and private sector participants. It is also available for use by any organisation that is considering implementing either a new ITSO compliant public transport smartcard scheme, or those considering the extension or upgrade of an existing smartcard scheme, in accordance with the conditions for circulation set down from time to time.

The Yorcard Data Book sets down the consolidated outputs of a research contract between the South Yorkshire Passenger Transport Executive (SYPTE) and the Department for Transport (DfT) Transport Technology and Standards Division.

The scope of the Data Book is to facilitate:

- Evaluation of the success of Yorcard Pilot by individual stakeholders on both technical and commercial grounds and thus to:

- Inform both public and private sector business cases for the expansion of the system to full roll out in South and West Yorkshire across all modes of transport.

- Informed discussions with potential funding organisations.
- Negotiations with Scheidt and Bachmann (primary supplier) under the terms of the Supply and Service Agreement entered into in 2007 with a view to the full roll out.

The Data Book is prepared in such a manner that:

- It complies with the terms set out in the Yorcard 'Participation Agreements';
- It enables commercially confidential data to be protected; and
- It complies with all current competition legislation at the time of initial preparation and that it can be adapted during the currency of the Pilot period should there be any change to or judicial interpretation of such legislation howsoever arising.

Calendar of Events

3.1 Data Collection Methodologies

The Calendar of Events sets out background reasons for any deviation from the baseline data collected within the live Yorcard Pilot and reference periods

The Calendar of Events started in June 2007 and shows occurrences of any and all of the following so far as information is available. For Phase 2, the Calendar of Events commences with the subsequent event following on from the end of Phase 1 (end of April 2008) and finishes in December 2008.

Primary events listed in the Calendar include the following:

- Major road incidents (roadworks, accidents, exceptional traffic levels and congestion);
- Delays to the Public Transport networks (engineering works, route diversions);
- Alterations to Public Transport services (timetable changes, route revisions, ticketing, ENCTS introduction, marketing, information and associated promotions);
- Special calendar dates (public holidays, school and university holidays, religious days, industrial action);
- Yorcard data collection dates;
- Yorcard project milestones; and
- Exceptional meteorological events (heavy rain, snow)

3.2 Calendar of Events

The following table show key events and any significant meteorological conditions which could have had an impact on services during the data collection for this Phase.

Date(s) and time(s)	Event
27 April 2008	Engineering work between Sheffield and Meadowhall 0001 until 1600. Revised timetable and some rail replacement buses operating
27 April 2008	Sheffield Marathon – some services diverted and delays expected
28 April 2008	**Stagecoach services 52 and 120 go live with ENCTS products**
28 April 2008	Service 52 Stagecoach new timetable in operation, no longer serves Heavygate Avenue in Crookes
28 April 2008	Service 120 Stagecoach no longer serves Sheffield Interchange with minor timetable changes
02 May 2008	Article published in Sheffield Telegraph on Stagecoach launch
05 May 2008	May Day public holiday
18 May 2008	Rail 'Advance' tickets replace all advance purchase tickets
18 May 2008	Rail Summer timetable is introduced
w/c 19 May 2008	Phase 2 data collection for boarding time study
23 May 2008	Final day of Sheffield Hallam University year
24 May 2008	Schools begin late spring holidays
23 – 26 May 2008	Engineering works on rail between Sheffield and Meadowhall with bus replacement service operating at 15 minute frequencies
26 May 2008	Public Holiday
02 June 2008	Schools return from late spring holidays
14 June 2008	Final day of Sheffield University year
04 July 2008	Doncaster TIC closed
05 July 2008	Lord Mayors parade Sheffield city centre
18 July 2008	**Last day of school year**
23 July 2008	Incident near Barnsley Interchange – many rail services cancelled throughout most of the day
23 July 2008	Derailment at Doncaster – many rail services cancelled throughout most of the day
07 August 2008	**Sheffield TICs go live retailing TravelMaster products**
07 August 2008	Transplant Games parade Sheffield city centre
25 August 2008	Public holiday
01 September 2008	**First go live with route 52**
01 September 2008	School year begins
07 September 2008	Great Yorkshire Run – major diversions and delays throughout Sheffield
07 September 2008	Rail 'Off Peak' and 'Anytime' tickets replace all on the spot purchase tickets
08 September 2008	Changes to prices of Stagecoach tickets – 52 day to £2.50 and 52 week to £7. Other bus and tram tickets also revised
13 September 2008	First change Orange Line tickets (40/41/42) to match Stagecoach 52 and Red Line (52) prices. First Week Student ticket also revised
20 September 2008	Congestion in the Broomhill and Eccleshall Road areas – significant delays to most pilot services
22 September 2008	**First go live with remainder of pilot routes**
25 September 2008	Signalling problems in the Mexborough area causing delays, cancellations and diversions to services between Doncaster and Meadowhall (and beyond)
29 September 2008	Sheffield University year starts
18 October 2008	First change Red Line (52, 552) and Orange Line (40, 41, 42, 94, 95) day ticket prices to £3 and weekly £9
26 October 2008	Fright Night Sheffield city centre diversions lunchtime onwards
27 October 2008	Schools start half term holiday
w/c 01 November 2008	Remainder of Phase 2 boarding time study data is collected First driver surveys distributed
03 November 2008	**Rail part of pilot goes live**
03 November 2008	Schools return from half term holiday
09 November 2008	Remembrance Sunday
17 November 2008	Incident on the rail line between Sheffield and Meadowhall. Significant disruption between the hours of 1000 and 1500 including cancellations, diversions and early terminations
20 November 2008	A series of cable thefts and vandalism in the Rotherham area affected rail services in the area for approximately one week
24 November 2008	Stagecoach weekly Megariders on pilot routes increased in price to £9. Day tickets increased from £2.50 to £3.
04 December 2008	Snow caused disruption to bus services from early morning until mid-afternoon
20 December 2008	Sheffield University begin Christmas Holidays
20 December 2008	Schools begin Christmas holidays

Table 1 – Calendar of Events occurring during Phase 2

Notes to accompany Calendar of Events:

1. Data collection dates have w/c and the first Monday to avoid any issues regarding reporting of sensitive data and if data collection was multiple days in a week.
*2. Yorcard project milestone dates in **bold italics.***

3.3 Summary of Monthly Weather Reports

A daily weather report was obtained from Weston Park weather station, the official climatological station in Sheffield. The following tables present a monthly summary of the weather conditions throughout the data collection for this Phase, with more detailed data and discussion occurring in other reports.

April 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	79.2	126.8
Monthly Average	11.4	4.4	7.9	2.6	4.2
Long Term Trend	11.8	4.5	8.2	63	130

May 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	43.5	186.7
Monthly Average	17.5	8.6	13.1	1.4	6.0
Long Term Trend	15.7	7	11.4	56	185

June 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	56.7	198.1
Monthly Average	18.7	10.7	14.7	1.9	6.6
Long Term Trend	18.3	10.0	14.2	67	177

July 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	108.7	202.6
Monthly Average	20.8	13.0	16.9	3.5	6.5
Long Term Trend	20.8	12.4	16.6	51	195

August 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	82.6	141.1
Monthly Average	20.1	13.4	16.7	2.7	4.6
Long Term Trend	20.5	12.1	16.3	63	183

September 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	103.8	111.7
Monthly Average	17.0	10.7	13.8	3.5	3.7
Long Term Trend	17.3	10.1	13.7	64	131

October 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	92.8	129.5
Monthly Average	12.7	7.1	9.9	3.0	4.2
Long Term Trend	13.3	7.1	10.2	74	87

November 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	61.0	53.1
Monthly Average	8.9	4.8	6.9	2.0	1.8
Long Term Trend	9.2	4.2	6.7	78	53

December 2008 Summary	Temperature (Max.)	Temperature (Min.)	Temperature (Max. & Min.)	Rain (mm)	Sunshine (Hours)
Monthly Total	-	-	-	51.4	60.3
Monthly Average	6.1	2.1	4.1	1.7	1.9
Long Term Trend	7.2	2.6	4.9	93	35

Results

4.1 Bus Patronage

This data has been supplied by SYPTE from published SYITA reports.

Year	Quarter	Months Covered	Patronage (Millions)
2008/2009	Q2	April to June	29.92
	Q3	July to September	29.35
	Q4	October to December	30.33

4.2 Rail Patronage

Figures represent the scaled number of tickets sold per month for travel between stations on the pilot route which are fitted with Yorcard equipment (Sheffield, Meadowhall, Rotherham Central, Swinton, Mexborough, Conisborough and Doncaster) only. Figures are based upon a sample of less than 1% of journeys which are then scaled up to estimate the total numbers.

Passengers travelling on this line as part of a through journey (e.g. Leicester to Grimsby via Sheffield) are not included.

Source: SYPTE monitoring origin and destination surveys.

2008

Ticket Type	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
Adult Return	Data from these Months Reported in Phase 1 Databook			35670	36720	33464	39003	25260	39139	37535	28337	34502
Adult Single				15940	20183	14531	15782	10509	19251	20119	12215	12897
Child Concessions				8950	10459	5749	6906	6727	5431	7404	3630	10447
Child Non Concessions				20331	31795	28574	35160	23971	26127	36172	27065	21478
Other				0	0	0	0	0	0	254	0	0
Pre-Paid (Other)				15406	11742	13543	15358	5687	20296	15353	11556	6657
Pre-Paid (PTE)				47228	45727	44629	63667	38921	64672	54458	50383	34057
Unknown				85	1477	896	1193	743	1024	466	1578	0

4.3 Service Performance Outputs

This section will report on the research outputs.

Boarding Time - Phase 2

	Boarding Time Measurement (see below)	Average (Mean) (Sec.)	Standard Deviation (Sec.)	Buses Observed (no.)	Minimum (Sec.)	Q1 (Sec.)	Median (Sec.)	Q3 (Sec.)	Maximum (Sec.)
Data without Other Factors	A	40.77	60.69	1212	2.38	12.58	23.47	42.03	542.69
	B	33.14	51.95	1212	1.97	9.73	18.90	34.46	560.21
	C	9.08	13.33	1212	0.75	3.10	5.55	9.45	124.70
	D	19.81	36.71	303	1.39	7.26	12.14	23.77	242.01
	E	17.71	32.07	158	1.97	7.02	10.23	19.53	123.59
	F	25.88	50.96	474	0.83	4.05	10.22	26.83	590.21
	G	4.90	6.82	274	0.42	1.67	3.22	5.73	75.29
	H	14.04	15.65	191	0.38	2.68	7.00	17.00	221.32
	I	4.62	1.44	92	0.38	2.03	2.67	3.50	9.31
	J	9.00	12.24	504	0.13	3.00	6.24	12.28	154.13
	K	1.38	0.71	268	0.01	0.98	1.25	1.54	6.50

Boarding Time - Phase 1

	Boarding Time Measurement (see below)	Average (Mean) (Sec.)	Standard Deviation (Sec.)	Buses Observed (no.)	Minimum (Sec.)	Q1 (Sec.)	Median (Sec.)	Q3 (Sec.)	Maximum (Sec.)
With Other Factors	A	34.25	72.52	1049	2.66	10.90	18.71	34.07	1884.03
Data without Other Factors	A	28.66	68.06	965	2.66	10.19	17.95	29.34	1884.03
	B	23.78	34.95	965	0.40	8.00	14.67	26.01	596.66
	C	5.76	9.22	965	0.40	2.47	4.16	6.60	241.98
	D	10.47	23.82	254	0.60	3.83	6.07	9.92	268.35
	E	9.51	19.21	128	0.60	3.52	6.00	10.69	212.48
	F	19.79	37.63	448	0.47	3.35	8.01	22.32	568.6
	G	2.91	2.37	254	0.24	1.21	2.25	3.80	15.30
	H	9.34	6.32	34	3.31	4.75	6.55	11.57	24.40
	I	7.57	1.83	16	5.00	6.12	7.01	9.40	10.94
	J	18.95	10.76	161	3.79	11.66	17.56	23.90	62.43
	K	2.44	0.76	94	1.42	1.89	2.27	2.94	5.56

Boarding Time Measurements

A	Dwell Time	G	Boarding Time (2) per boarding passenger (no alighters)
B	Average Bus Stop B/A time	H	Average Alighting Time (1)
C	Bus Stop B/A time per B/A passenger	I	Alighting Time (1) (no boarders)
D	Average Boarding Time (1)	J	Average Alighting Time (2)
E	Boarding Time (1) (no alighters)	K	Alighting Time (2) per alighting passenger (no boarders)
F	Average Boarding Time (2)		

Please refer to the General Reference Document for a detailed definition of each measurement.

Consumer Survey

Section 1 – About You

Base = All Respondents. Phase 1 = 946

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
1a	Age	16 and under	75	8%	No Consumer Survey in Phase 2					
		17-59	617	65%						
		60 and over	252	27%						
		Missing/No Answer	2	0%						
1b	Gender	Male	473	50%						
		Female	471	50%						
		Missing/No Answer	2	0%						
1c	Home Postcode	Not to be reported (Personal Data Confidentiality)								
1d	Which of the statements best describes you at the moment?	Employed in full time work	264	28%	No Consumer Survey in Phase 2					
		Employed in part time work	67	7%						
		Self employed	16	2%						
		Gov't training programme	4	0%						
		Unemployed and available for work	24	3%						
		Permanently sick or disabled	8	1%						
		Wholly retired from work	228	24%						
		Looking after the home	13	1%						
		In full time education	298	32%						
		Refused to tell								
		Missing/No Answer	19	2%						
1e	Which of the following types of transport have you used in the past month?	Bus	514	54%						
		Train	305	32%						
		Tram	385	41%						
		None of the above	209	22%						

Section 2 – Non-Bus Users

(Base = Respondents who didn't use Bus or Train in Q1. Phase 1 = 383)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
2a	What type of transport do you use most frequently?	Tram	161	42%	No Consumer Survey in Phase 2					
		Car	143	37%						
		Taxi	2	1%						
		Motorcycle	2	1%						
		Pedal cycle	2	1%						
		Walking	60	16%						
		Park and tram	1	0%						
		Other	2	1%						
		Missing/No Answer	10	3%						
2b	Why do you prefer to use this mode of transport rather than bus or train?	It is convenient	212	55%						
		It costs less than using other modes	52	14%						
		I can travel alone - it's peaceful/ quieter	16	4%						
		It's quicker than other modes	74	19%						
		I can exercise at the same time	25	7%						
		I don't know how to use public transport	1	0%						
		Other	107	28%						

Section 3 – Public Transport Appeal

(Base = All Respondents. Phase 1 = 946)

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
3a	Please tell me how strongly you agree or disagree with the following statements	I find it easy to buy tickets	4	No Consumer Survey in Phase 2		
			4			
			0.92			
		I find it convenient to buy tickets	3.8			
			4			
			0.97			
		The tickets available are easy to use	4.2			
			4			
			0.86			
		I have a ticket or pass to suit my travel needs	3.9			
			4			
			1.25			
3b	Which of the following would encourage you to use public transport more?	If it were easier to pay for tickets	2.6			
			3			
			1.34			
		The tickets were more secure	2.9			
			3			
			1.41			
		If there was a ticket available to suit needs	3.3			
			3			
			1.35			
3c	Please rank the following statements regarding thoughts to causing delays to public transport journeys	People paying with notes	2.5			
			2			
			0.5			
		Lots of people boarding	2.2			
			2			
			1.06			
		Not having money ready	2			
			2			
			0.98			
		Long conversations with the driver	3.2			
			4			
			1.03			
			2			
			0.98			
		Long conversations with the driver	3.2			
			4			
			1.03			

YORCARD Awareness

(Non-users, Phase 1 = 383)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
-	Yorcard is a public transport smartcard for storing tickets and passes. Have you heard of it?	Yes	25	7%	No Consumer Survey in Phase 2					
		No	347	91%						
		Missing/No Answer	11	3%						

Section 4 – Purchasing Tickets

(Base = Respondents who used Bus or Train in Q1. Phase 1 = 563)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
4a	Which type of public transport do you use most often?	Bus	383	68%	No Consumer Survey in Phase 2					
		Train	171	30%						
		Missing/No Answer	9	2%						
4b	What type of ticket do you usually use?	Single ticket	122	22%						
		Free concess'ry pass	159	28%						
		40p concess'ry pass	41	7%						
		Return or day ticket	142	25%						
		Period ticket (of any length)	90	16%						
		Missing/No Answer	9	2%						
4c	What type of period ticket do you usually use?	Not to be reported (Commercial Sensitivity)								
4d	Where do you usually buy your ticket from?	On the bus	244	43%	No Consumer Survey in Phase 2					
		Railway station	76	13%						
		Online	35	6%						
		TIC	146	26%						
		On train	8	1%						
		Local shop or Paypoint store	2	0%						
		Other	25	4%						
		Missing/No Answer	27	5%						
4e	How do you decide which ticket to buy?	Convenience	131	23%						
		Unsure when returning	39	7%						
		Best value for the travelling I do	229	41%						
		I don't know what other tickets are available	6	1%						
		I use more than one operator	7	1%						
		I use a concessionary pass	198	35%						
		Other	8	1%						
4f	Where do you usually find information about public transport fares and tickets?	Traveline	22	4%						
		On the bus	99	18%						
		Online	187	33%						
		Railway station	51	9%						
		TIC	94	17%						
		On the train	1	0%						
		At the bus stop	32	6%						
		Word of mouth	21	4%						
		Other	11	2%						
		Missing/No Answer	45	8%						
4g	Do you usually find the information accurate?	Yes	485	86%						
		No	44	8%						
		Missing/No Answer	34	6%						
4h	How would you like to get more information about fares and tickets?	At the bus stop	245	44%						
		Posters in public places	143	25%						
		Leaflets through door	117	21%						
		Adverts on bus	146	26%						
		Other	46	8%						

Section 5 – Journeys by Bus

(Base = Those who answered 'Bus' to Q4a. P1 = 383)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
5a	How many bus journeys do you usually make every week?	<1	31	8%	No Consumer Survey in Phase 2					
		1-3	92	24%						
		4-6	81	21%						
		7-10	72	19%						
		11+	101	26%						
		Missing/No Answer	6	2%						
5b	Which is your most frequent purpose for travelling by bus?	To/from Work	95	25%						
		Shopping	90	23%						
		Leisure	46	12%						
		Visiting friends and family	29	8%						
		Education	109	28%						
		To/from Medical appointments	3	1%						
		Other	1	0%						
		Missing/No Answer	10	3%						
5c	Is your most frequent journey a single or return?	Single	141	37%						
		Return	229	60%						
		Missing/No Answer	13	3%						
5d	For your most frequent journey which day/s do you travel in a typical week?	All weekdays	283	74%						
		Monday	36	9%						
		Tuesday	31	8%						
		Wednesday	39	10%						
		Thursday	30	8%						
		Friday	42	11%						
		Saturday	117	31%						
		Sunday	86	22%						
5e	For your most frequent journey, what time do you normally travel?	Single Journey								
		M-F bef. 0900	121	32%	No Consumer Survey in Phase 2					
		M-F 0900-1530	90	23%						
		M-F 1530-1830	11	3%						
		M-F after 1830	5	1%						
		Sat bef. 1830	7	2%						
		Sat after 1830	5	1%						
		Sun bef. 1830	1	0%						
		Sun after 1830	1	0%						
		No fixed time	120	31%						
		Missing/No Answer	22	6%						
		Return Journey								
		M-F bef. 0900	2	1%	No Consumer Survey in Phase 2					
		M-F 0900-1530	44	11%						
		M-F 1530-1830	113	30%						
		M-F after 1830	19	5%						
		Sat bef. 1830	6	2%						
		Sat after 1830	1	0%						
		Sun bef. 1830	5	1%						
		Sun after 1830	0	0%						
		No fixed time	83	22%						
		Missing/No Answer	110	29%						
5f	For your most frequent journey what routes do you normally use?	Not to be reported (Commercial Sensitivity								

YORCARD Awareness (Bus users, Phase 1 = 383, Phase 2 = n/a)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
-	Yorcard is a public transport smartcard for storing tickets and passes. Have you heard of it?	Yes	24	6%	No Consumer Survey in Phase 2					
		No	347	91%						
		Missing/No Answer	12	3%						

Section 6 – Journeys by Train

(Base = Those who answered 'Train' to Q4a. P1 = 171)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
6a	How many train journeys do you usually make every week?	<1	80	47%	No Consumer Survey in Phase 2					
		1-3	51	30%						
		4-6	21	12%						
		7-10	10	6%						
		11+	3	2%						
		Missing/No Answer	6	4%						
6b	Which is your most frequent purpose for travelling by train?	To/from Work	30	18%						
		Shopping	18	11%						
		Leisure	38	22%						
		Visiting friends and family	61	36%						
		Education	11	6%						
		To/from Medical appointments	5	3%						
		Other	2	1%						
		Missing/No Answer	6	4%						
6c	Is your most frequent journey a single or return?	Single	18	11%						
		Return	144	84%						
		Missing/No Answer	9	5%						
6d	For your most frequent journey which day/s do you travel in a typical week?	All weekdays	50	29%						
		Monday	27	16%						
		Tuesday	39	23%						
		Wednesday	36	21%						
		Thursday	29	17%						
		Friday	68	40%						
		Saturday	46	27%						
		Sunday	44	26%						
6e	For your most frequent journey, what time do you normally travel?	Single Journey								
		M-F bef. 0900	22	13%	No Consumer Survey in Phase 2					
		M-F 0900-1530	27	16%						
		M-F 1530-1830	15	9%						
		M-F after 1830	6	4%						
		Sat bef. 1830	10	6%						
		Sat after 1830	0	0%						
		Sun bef. 1830	0	0%						
		Sun after 1830	0	0%						
		No fixed time	74	43%						
		Missing/No Answer	17	10%						
		Return Journey								
		M-F bef. 0900	1	1%	No Consumer Survey in Phase 2					
		M-F 0900-1530	5	3%						
		M-F 1530-1830	26	15%						
		M-F after 1830	13	8%						
		Sat bef. 1830	2	1%						
		Sat after 1830	3	2%						
		Sun bef. 1830	13	8%						
		Sun after 1830	9	5%						
		No fixed time	69	40%						
		Missing/No Answer	30	18%						
6f	Do you travel on local train service between Doncaster and Sheffield? If so which stations do you use?	Sheffield	66	39%						
		Meadowhall	39	23%						
		Rotherham Cen	22	13%						
		Swinton	22	13%						
		Mexborough	21	12%						
		Conisbrough	20	12%						
		Doncaster	52	30%						
		Don't travel on this line	96	56%						

YORCARD Awareness (Train users. Phase 1 = 171, Phase 2 = n/a)

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4			
			n	%	n	%	n	%	n	%		
-	Yorcard is a public transport smartcard for storing tickets and passes. Have you heard of it?	Yes	3	2%	No Consumer Survey in Phase 2							
		No	160	94%								
		Missing/No Answer	8	5%								

Driver Survey

Section 1 – Employment

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
1a	How many years experience do you have?	0<2	18	17%	24	19%				
		2<4	19	18%	20	16%				
		4<6	10	10%	11	9%				
		6<8	12	11%	14	11%				
		8 or more	46	44%	57	45%				
1b	Do you work full or part time?	Not to be reported (Commercial Sensitivity)								

Section 2 – Shift Patterns and Routes

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
2a	Do you usually work a fixed shift?	Not to be reported (Commercial Sensitivity)								
-	What hours do you usually work?	Not to be reported (Commercial Sensitivity)								
-	What shift pattern do you usually work?	Not to be reported (Commercial Sensitivity)								
2b	Which bus routes do you usually work on?	Not to be reported (Commercial Sensitivity)								
2c	How often do you work on these routes?	Not to be reported (Commercial Sensitivity)								

Section 3 – Your New Electronic Machine and Validator

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
3a	Thinking about the new ticket machine and validators you use on the bus, how strongly would you agree or disagree with the following statements?	They have has made my job easier	N/A	2.82		
				3		
				1.15		
		Ticket machine is well placed in the driver's cab		3.88		
				4		
				0.76		
		Validator is well placed for me to help people		3.67		
				4		
				0.98		
		They helps people board more quickly		2.57		
				2		
				1.19		
		They are reliable and always work		2.31		
				2		
				1.21		
		Validator is easy for people to use		3.17		
				4		
				1.08		

Section 3 – Your New Electronic Machine and Validator Continued

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
3b	Thinking of the ETM you use, how difficult or easy do you find each of the following tasks? (1 = 'Very Difficult', through to 10 = 'Very Easy')	Logging on	9.08	8.68		
			10	10		
			2.03	2.24		
		Updating the fare stage	9.22	9.06		
			10	10		
			2.11	2.06		
		Reading the ETM display	8.33	8.24		
			10	10		
			2.50	2.62		
		Pressing the buttons	8.61	8.05		
			10	9		
			2.17	2.63		
		Memorising what the buttons do	7.84	6.80		
			8	8		
			2.46	2.68		
		Issuing paper tickets	8.83	8.01		
			10	9		
			2.31	2.57		
		Issuing paper tickets with wallet	8.19	6.18		
			9	6		
			2.66	2.96		
		Changing ticket rolls	8.09	8.01		
			10	9		
			2.57	2.50		
		Unjamming the ticket roll	7.03	6.86		
			8	8		
			3.22	2.83		
		Scrolling menus or selecting tickets	7.86	6.31		
			8	7		
			2.53	3.21		
		Validating Smartcards	N/A	7.16		
			N/A	8		
			N/A	2.85		
		Processing Smartcard tickets	N/A	6.69		
			N/A	7		
			N/A	2.85		
3c	Are there any other ETM tasks you find difficult or easy to do?	Open question	No answers given	No answers given		

Section 3 – Your New Electronic Machine and Validator Continued

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
3d	Are there any ETM tasks you find time consuming? (1 = 'Very', through to 10 = 'Not at all')	Logging on	7.54	1.76		
			9	2		
			3.17	0.43		
		Updating the fare stage	9.20	1.94		
			10	2		
			1.91	0.23		
		Reading the ETM display	8.72	1.81		
			10	2		
			2.28	0.39		
		Pressing the buttons	8.67	1.73		
			10	2		
			2.20	0.44		
		Memorising what the buttons do	7.66	1.57		
			8	2		
			2.49	0.50		
		Issuing paper tickets	8.23	1.74		
			10	2		
			2.60	0.44		
		Issuing paper tickets with wallet	7.00	1.46		
			8	1		
			3.20	0.50		
		Changing ticket rolls	6.78	1.73		
			8	2		
			3.02	0.45		
		Unjamming the ticket roll	6.14	1.61		
			6	2		
			3.20	0.49		
		Scrolling menus or selecting tickets	7.97	1.39		
			8	1		
			2.53	0.49		
		Validating Smartcards	N/A	1.69		
			N/A	2		
			N/A	0.46		
		Processing Smartcard tickets	N/A	1.74		
			N/A	2		
			N/A	0.44		

Section 4 – Keeping to Time

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
4a	Putting aside traffic delays, do you find it easy to keep to the bus timetable?	Yes	133	80%	73	55%				
		No	34	20%	54	41%				
		No Answer	0	0%	6	5%				

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
4b	Which of the following do you think delays the bus?	Customers not having fare ready	2.31	2.34		
			1	2		
			2.5	1.49		
		Customers paying with notes	3.05	2.67		
			2	2		
			2.48	1.45		
		Lots of people boarding	4.54	2.99		
			4	3		
			2.56	1.39		
		Issuing paper tickets	7.13	3.35		
			8	3		
			2.61	1.51		
		Issuing paper tickets with wallet	4.79	3.17		
			4	3		
			2.97	1.46		
		Being unable to read passes or tickets	3.74	3.37		
			3	4		
			2.74	1.33		
		Finding the correct ticket on ETM	6.88	3.05		
			8	3		
			2.65	1.58		
		Passengers disputing fares or documents	4.9	3.46		
			5	3		
			2.83	1.65		
		Discussions with people about fares etc.	5.1	3.21		
			5	3		
			2.90	1.68		
		Passengers using Smartcards	N/A	3.43		
			N/A	4		
			N/A	1.89		

Section 5 – Safety and Security

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
5a	Please rank the following from 1 to 4, where 1 in your opinion is the greatest security risk	Carrying cash on the bus	1.58	1.71		
			1	1		
			0.91	0.97		
		Carrying cash to the depot	2.21	2.61		
			2	3		
			1.09	1.09		
		Carrying cash on a Monday or Tuesday	2.4	2.41		
			2	2		
			1.17	1.08		
		Passenger confrontation	2.91	3.28		
			3	4		
			1.05	1.05		
5b	Please rank the importance of the following improvements to safety and security, from 1 to 3	Less cash handling	1.31	1.38		
			1	1		
			0.63	0.70		
		Reliable way to validate a ticket or pass	2.11	2.38		
			2	3		
			0.84	0.84		
		Not accepting payment from large notes	1.97	2.01		
			2	2		
			0.80	0.74		

Section 6 – Fraud

Q'n No	Question	Answer	Phase 1		Phase 2		Phase 3	Phase 4
			n	%	n	%	Mean	Mean
6a	How often do you encounter expired or fake tickets and passes?	0-2	57	58%	80	61%		
		3-4	25	25%	38	29%		
		5-6	12	12%	8	6%		
		7+	5	5%	6	5%		
6b	How many times each day does the ticketing equipment show an invalid ticket or pass when a Smartcard is used?	0-2	N/A		79	62%		
		3-4	N/A		31	24%		
		5-6	N/A		6	5%		
		7+	N/A		12	9%		
6c	Excluding Smartcards, what do you think is the most common method of passenger fraud?	Out of date tickets	46	62%	75	49%		
		Copied or fake tickets	3	4%	15	10%		
		Passing tickets back to others	1	1%	10	6%		
		Tickets from other operators	0	0%	3	2%		
		Over-riding	14	19%	40	26%		
		Rushing past the driver or hiding behind other boarders	10	14%	11	7%		
6d	Considering Smartcards only, what do you think is the most common method of passenger fraud?	Printed dates on smartcards have expired	N/A		37	31%		
		Paper counterpart doesn't match	N/A		19	16%		
		Smartcards passed back for others to use	N/A		12	10%		
		Equipment shows invalid Smartcard	N/A		53	44%		

Section 7 – About You

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
7a	Age	18-24	4	4%	6	5%				
		25-34	18	18%	20	16%				
		35-44	31	32%	45	36%				
		45-59	33	34%	44	35%				
		60+	12	12%	11	9%				
7b	Gender	Male	95	97%	123	98%				
		Female	3	3%	3	2%				

Travel Information Centre Survey

Section 1 – Employment

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
1a	How many years experience do you have?	0 - <2	2	33%	No TIC Survey in Phase 2					
		2 - <4	0	0%						
		4 - <6	0	0%						
		6 - <8	0	0%						
		8 or more	4	67%						
1b	Do you work full or part time?	Full Time	4	67%						
		Part Time	2	33%						
1c	Is your role Clerical or Supervisory?	Clerical	4	67%						
		Supervisory	2	33%						

Section 2 – About You

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
2a	Age	18-24	0	0%	No TIC Survey in Phase 2					
		25-34	2	33%						
		35-44	1	17%						
		45-59	2	33%						
		60+	1	17%						
2b	Gender	Male	0	0%						
		Female	6	100						

Section 3 – Selling Tickets

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
3a	Do you understand the ticket range used in Yorcard area?	Yes	4	67%	No TIC Survey in Phase 2					
		Nearly all	0	0%						
		Some	1	17%						
		No	1	17%						

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
3b	How much do you agree with the following statements?	I sell the customer the ticket they ask for	1.00	No TIC Survey in Phase 2		
			1			
			0.00			
		I discuss the tickets available and then recommend a ticket	2.00			
			2			
			0.58			
		I discuss the tickets available and the customer decides	2.00			
			2			
			0.82			

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
3c	How often do you spend time discussing tickets with customers?	Every day	5	83%	No TIC Survey in Phase 2					
		Once a week	1	17%						
		Less than once a week	0	0%						
		Never	0	0%						
3d	Do you find that customers are confused about tickets?	Yes	1	17%						
		No	4	67%						
3e	N/A									
3f	How often do you feel under pressure to serve customers quickly?	Often	0	0%	No TIC Survey in Phase 2					
		Only when there are long queues	6	100%						
		Rarely	0	0%						

Section 4 – Using the Ticket & Pass Issuing Equipment

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
4a	How time consuming do you find logging into the systems?	1	0	0%	No TIC Survey in Phase 2					
		2	3	50%						
		3	1	17%						
		4	2	33%						
		5	0	0%						
4b	Do you think that this process could be simplified?	Yes	0	0%						
		No	6	100%						
4c	N/A									
4d	On a scale of 1 to 5, how time consuming do you find it to enter data?	1	1	17%	No TIC Survey in Phase 2					
		2	2	33%						
		3	0	0%						
		4	3	50%						
		5	0	0%						

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
4e	Thinking about issuing concession passes, please rank the following tasks in order of which you think are the most time consuming to the least	Verifying entitlement	2.00	No TIC Survey in Phase 2		
			2			
			0.45			
		Identifying the customer in eCRM	1.75			
			2			
			0.82			
		Making the pass	2.25			
			2			
			0.72			

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
4f	Do you think any of the above (4e) processes could be simplified?	Yes	0	0%	No TIC Survey in Phase 2					
		No	4	100%						
4g	N/A									
4h	Do you experience any of the following problems when collecting information for issuing concession passes?	Postcode or address not in system	1	17%	No TIC Survey in Phase 2					
		Wrong types of photos	3	50%						
		Applicants not having the right documents	6	100%						
		Applicants are not eligible	3	50%						
4i	Thinking of the problems you encounter in 4(h), do you think that the process for collecting information for a concessionary pass could be simplified?	Yes	0	0%						
		No	4	100%						

Section 5 – Payments

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
5a	On a scale of 1 to 5, how time consuming do you find it to take payments for tickets and passes?	1	1	17%	No TIC Survey in Phase 2					
		2	1	17%						
		3	0	0%						
		4	2	33%						
		5	2	33%						

Q'n No	Question	Answer	Phase 1	Phase 2	Phase 3	Phase 4
			Mean	Mean	Mean	Mean
			Median	Median	Median	Median
			Std. Dev.	Std. Dev.	Std. Dev.	Std. Dev.
5b	Please rank the following in order of the most time consuming to the least.	People paying by chip and pin	1.80	No TIC Survey in Phase 2		
			2			
			0.84			
		Giving change for notes	2.60			
			3			
			0.55			
		Not having enough change	1.60			
			1			
			0.89			

Q'n No.	Question	Answer Categories	Phase 1		Phase 2		Phase 3		Phase 4	
			n	%	n	%	n	%	n	%
5c	Do you think any of the above (5b) processes could be simplified?	Yes	1	20%	No TIC Survey in Phase 2					
		No	4	80%						
5d	N/A									
5e	On a scale of 1 to 5, how time consuming do you find it to offer refunds or exchanges for tickets?	1	1	17%	No TIC Survey in Phase 2					
		2	1	17%						
		3	1	17%						
		4	2	33%						
		5	1	17%						
5f	Do you think any of the above (5e) processes could be simplified?	Yes	1	25%						
		No	3	75%						

Notes