AN ANALYSIS OF THE ROLE OF REAL TIME PASSENGER INFORMATION ON BUS USERS IN A EUROPEAN CITY: THE CASE OF DUBLIN, IRELAND

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This thesis is submitted to University College Dublin in part fulfilment of the requirements for the degree of Master of Regional and Urban Planning

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Table of Contents

List of Figures

Thesis Declaration

Except where otherwise acknowledged this thesis is entirely my own work.

Signed:

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Abstract

RTPI is becoming increasingly essential in a modern metropolis. All major competitive cities around the globe have introduced RTPI and Ireland has recently followed suit. The introduction of RTPI is an attempt to improve customer satisfaction and allow the passenger to make more informed decisions when it comes to public transit. All with the hopes of eventually increasing bus ridership numbers and decreasing the unsustainable reliability on the privately owned motor vehicle. The research directly relating to RTPI is both sparse and comprehensive in parts. This study considers RTPI from the perspective of the user, trying to obtain their views and opinions of this relatively new service. It assesses the socio-economic profile and demography of RTPI users, examines the systems functionality and reliability and explores its potential to attract new riders to Dublin Bus.

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Chapter 1

Introduction

1.0 Introduction

1.1 Context

Real Time Passenger Information (RTPI) has been introduced to increase the attractiveness of public transport in Dublin City. The RTPI system was introduced to Dublin in an attempt to increase customer satisfaction rates and in time increase ridership numbers. According to the National Transport Authority it is available to help passengers 'plan your journey more accurately' (NTA, Accessed Aug 7th 2012). Dublin is not the first city however to introduce RTPI, far from it, RTPI has been available in cities across the world for more than twenty years. The system operates by estimating the time of arrival of the bus ensuring passengers know to the nearest minute when the next bus is going to arrive. The information can be accessed via a multitude of devices, from the electronic display available at selected stops, to the home internet and smart phones via text message and the internet (See Appendix A). Passengers are encouraged to use the information before arriving at the bus stops to reduce the frustration of long waiting times.

The RTPI scheme was initiated on the 26th of September 2011.At present there are approximately 520 signs located in the Greater Dublin Area serving 118 million people per year (Dublin Bus, 2012). Such has been the success of the RTPI in Dublin there have recently been 47 signs erected in Cork and plans to extend further to Waterford, Galway and Limerick. The National Transport Authority was responsible for contracting the RTPI and the signposts were implemented by Dublin City Council. Initially Dublin Bus were to have complete control of the implementation of the RTPI

but were denied this as it would strengthen the stranglehold they already possess on public bus transit in Dublin. The total cost of the system across the 5 cities is estimated to cost €6.5 million and an investment of 4 cent per passenger has been made by the National Transport Authority (Dublinbus.ie, Accessed, 7th August, 2012).

The literature has depth in parts giving very robust reasoning behind certain effects of RTPI; however there is a distinct lack of research on topics such as the socio-economic status and age of RTPI users. Despite this, and, given the success of the system in Dublin, RTPI is generating a lot of interest between local governments around the country to try and attract a larger user base to public transit nationally. For this reason it was felt that conducting a study on RTPI, would help provide a baseline of knowledge that could further established the role of RTPI internationally as well as in Ireland. It is hoped that this study will provide some interesting and useful information for transport authorities and planners alike and will aid further research in the area.

1.2 Research Aims, Objectives and Hypothesis

1.2.1 Hypothesis

The hypothesis for the research project is 'Passengers wait time perceptions are improved by the introduction of Real Time Passenger Information'.

1.2.2 Aim

The study aims to critically examine the reliability of the RTPI, to examine the psychological effects that the system can have on the current user base and to observe whether or not ridership numbers can potentially be increased.

1.2.3 Objectives

In order for these aims to be achieved a number of objectives were set out:

- To explore the evidence on the benefits of RTPI for passengers and bus companies alike;
- To identify, and carry out a questionnaire on the passengers of Dublin Bus;
- To examine the reliability of the RTPI;
- To determine if there is a significant variation in people's use of RTPI at low, medium and high frequency routes;
- To determine, if the RTPI has an effect on the passengers perceptions of the bus service;
- To examine the effects that socio-economic profile and age have on the passengers use of RTPI;
- To establish what is the most popular method of accessing the RTPI;
- To identify whether or not the RTPI has encouraged passengers to use the bus more frequently;
- To establish what are the passengers greatest frustrations associated with taking the bus;

- To determine whether reliability varies between low, medium and high frequency routes;

It was foreseen that these objectives would lead the investigation, allowing the study to achieve the research aim and allowing all the relevant data to be acquired and a comprehensive study to be carried out.

1.3 Thesis Structure

This thesis comprises of five chapters. The first chapter is the introduction; secondly there will be the literature review, which will cover a broad range of related topics regarding RTPI. Chapter 3 describes and rationalises the methodology used in the primary research and collection of data relating to this study. Chapter 4 presents all of the main findings in the results Chapter, and Chapter 5 is the conclusion where some recommendations are put forth.

Chapter 2

Literature Review

2.0 Literature Review

‘At its most fundamental, the process of doing research involves reading and writing’ (Back, 2004:398)

2.1 Introduction

This chapter will discuss all the relevant literature with regard to the benefits of RTPI, the effects of RTPI on the passenger’s perceptions of the service and the effects of RTPI on bus ridership numbers. The literature further gives the author insight into what devices are used to access the RTPI and what passengers find to be the most frustrating aspect of taking the bus?

2.2 Benefits of Real Time Passenger Information

‘The most frequently reported benefits were being informed of the remaining waiting times and knowing whether the expected vehicle had already arrived’ (NCTR, 2005)

2.2.1 Waiting Times

The above statement is a strong inclination of how the public’s view of the RTPI service is portrayed in the literature. Although the RTPI may be implemented to try and increase numbers taking the bus, it is in reality there to remove that sense of anxiety from the passengers mind about an arriving bus Tang et al (2006). The vast majority of respondents (80%) indicated that not knowing the arrival time of their service caused frustration and questions of whether their bus had passed already (Caulfield, 2009). The greatest benefit of the RTPI derives from this, knowing when the bus is going to arrive. RTPI is all about improving the off bus passenger experience (Wofenden, 2006). Over the past couple of decades buses all over the world as well as in Dublin have a terrible

reputation for being delayed, slow or in some cases not turning up. In many ways the introduction of the RTPI has been an attempt to improve the service as a whole. In recent years, RTPI has been introduced as a new feature to increase the attractiveness, punctuality and utility of public transport, especially as the bus is an alternative to the private car (Schweiger, 2003). The literature is largely pointing to the fact that the RTPI is not necessarily being implemented to improve the actual regularity or punctuality of the bus but more to benefit individual passengers and increase customer satisfaction.

The majority of the studies undertaken also seem to have similar results on the benefits to passenger in terms of waiting times. When it comes to people taking the bus there biggest frustration almost always seems to come back to having a long and onerous waiting time at the stop. Wardman (2003) found in a study he undertook in London that there had been reductions in waiting times at all of the stops he studied. This is largely due to people not having to wait without access to any information, they can use their time more productively and turn up at the stop much closer to the time the bus is actually due to arrive. This is very comparable to the results found by Caulfield (2009) in which he found that public transit users tend to overestimate their waiting times. Passengers with RTPI overestimated their wait time by 9-13% and passengers without it overestimated by more than double that 24-30%. These comparable results give a look into the benefits that are being taken by the bus users from the system that has been implemented. These studies can also be linked with the research undertaken by Mishalani et al, (2006) in which it is stated that in the majority of cases the waiting times and the amount of time the passenger actually spends outside the vehicle can be longer and more onerous than the time spent travelling to the destination. In Munich Lehtonen et al (2001) found that there was a highly positive response to RTPI and in Gothenburg and Turin 85% and 75% of people respectively found the system to be a

help when dealing with waiting times. Overall this shows the reader what is firstly the passenger's main problem with the bus and secondly what is the main benefit to the passenger's having RTPI. Both topics appear consistently throughout the literature. It would appear that a reduction in waiting times has been one of the biggest successes of RTPI. Perhaps the most conclusive and significant study into people's perceptions of RTPI was undertaken by Smith et al (1994). It covered topics such as passengers behaviour at the stops, passenger perceptions and valuation of the Countdown system (RTPI) and ridership gains as well as any new revenue generation. Several key findings are that interviews with the passengers found that the system brings a much reduced level of stress, that average wait time of passengers dropped dramatically from 11.9 minutes to 8.6 minutes and that interestingly passengers were willing to pay an extra 31 cents for the countdown service. This is important because it demonstrates the psychological effect that the RTPI has on the passengers. Although many passengers may be waiting at the bus stop for the same length of time as normal the author Zhang et al (2007) has stated that the passenger believes the bus is arriving with a higher rate of punctuality than it used to arrive. Throughout the literature this seems to be one of the strongest benefits of RTPI as Tang et al (2006), Lehtonen et al, (2001), Mishalani et al, (2006), Wardman (2003), Caulfield (2009), Wolfenden, (2006) and Holdsworth, (2007) all continuously reinforce.

2.2.2 Psychological Effects of Real Time Passenger Information

From the literature it would appear that the reduced waiting times of passengers is directly related to the psychological effects of RTPI. It is noted by Zhong (1999) that the most important factor to the passenger when it comes to taking the bus is the bus arriving on time. Zhong notes that in a survey he undertook, several respondents marked 'on time performance' of the bus as 'very important' in their decision to ride the bus. Therefore if the RTPI can improve perceptions of arrival times, it would appear to improve satisfaction rates. Pratt (2000) seems to largely agree with this theory as he states that improvements in the perceptions of travellers were found to be the principle impact of the implementation of a timed transfer system (RTPI). Pratt further notes that of the riders he surveyed, the majority felt that service quality had improved with the implementation of the timed transfer system. 77 % of passengers felt that scheduling had improved, and 71% felt that travel times had decreased. This view is further reinforced by Schweiger (2003) and Tang (2011). Schweiger in particular believes that the perception among customers is that bus services have improved. This gives the passengers a safety reassurance when travelling at night. He feels as a result of this that passengers are now becoming more and more reliant on the RTPI as part of their travel experience. Finally with regard to the changes to passenger's perceptions of the service Tang (2011), Schweiger (2003) and NCTR (2005) all believe that the introduction of RTPI does have a positive effect on the perceptions but more importantly each writer also states that the RTPI may indeed lead to ridership gain.

Overall from the literature it appears evident that the passengers find the reduced waiting times the biggest advantage from the RTPI. It seems to lessen any worries passengers have of the bus already having passed, or the bus not arriving for another

hour and it being a waste of their time. It is further apparent from the literature that the RTPI has quite a large effect on the passenger's perceptions of the service. Passenger's satisfaction rates not only with the buses arrival times but with the overall bus service would appear to be improved. Passengers begin to believe that the bus is arriving sooner than it used to before the introduction of the RTPI service even though this may not strictly be the case. Finally according to the literature the overall improvement in passenger's perceptions of the service should over time firstly maintain the current passengers and eventually increase the numbers of people taking the bus.

2.2.3 Ridership gain

Ridership gain is one of the key reasons for the introduction of RTPI. If Dublin City Council can improve the bus service, then it should lead to a ridership gain. Has this been the case however, from the previous section on waiting times it has become apparent that passenger's perceptions of the service have been improved. This however does not necessarily mean a gain in passengers. Holdsworth (2007) states just how difficult it is to increase patronage declaring a 1 or 2% increase in patronage would be a significant achievement. 5% across the whole network would be unheard of. There are nonetheless studies that do show that there have been increases in bus patronage such as a study undertaken by Infopolis (1998) which asserts that there have been increases of 5 or 6% on the lines equipped in both Liverpool and Brussels.

In the literature both sides of the argument are brought forward. Firstly, it is reasoned that ridership gain is unlikely, for example a study undertaken in the United States of America on two RTPI systems known as Transit Watch in Seattle (2002) and Transit Tracker in Oregon (1999) found that, there were no changes in ridership at the bus stops

as a result of deploying transit tracker. The agency responsible for Transit Watch found that although users felt that the bus service benefitted them, they did not believe that it improved the service as a whole. Therefore it did not lead to an increase in ridership numbers. Similar results to this are also published by Zhang et al (2007) in which it is stated that although transit agencies and scholars should not be too optimistic about achieving immediate ridership increase by providing real time transit information to travellers, they can expect positive responses from transit riders. These results are further backed in journals by Tang et al (2006) and Schweiger (2003) with Schweiger reporting that none of the agencies they contacted with regard to RTPI reported that there had been an increase in ridership due to the introduction of RTPI. Whereas, Tang states that there are as of yet no definitive reports of transit use or mode share increase as a result of real time transit information and that higher satisfaction levels and reduced anxieties are common since the introduction of the service.

It seems evident that the literature is conveying a situation where RTPI is helpful to passengers, but, it is only part of a series of changes that need to occur in order to increase ridership gain. According to this section of the literature the RTPI succeeds at improving the overall service and increase satisfaction rates but just doesn't quite do enough to achieve ridership gains. To sum it up a recent study undertaken by Chorus et al (2006) showed that even in the case where transit information is acquired, and the message is favourable to transit, its impact on mode choices will be limited. In effect the RTPI alone cannot do enough to encourage a shift in modal choice away from the far more dominant privately owned car.

As stated, however, there are contradictory studies to these that display a rise in passengers taking the bus since the implementation of RTPI. It appears when it comes to the implementation of RTPI it is common that agencies feel that there may have been

an increase in bus patronage but have no definitive statistics to say there has been or that it is a direct result of RTPI. 'Most agencies reported that there may have been an increase in ridership, but they were not certain it was a direct result of the system' (Schweiger, 2003: 3). Many of these agencies argue that at the very least there is maintenance of the current ridership numbers.

Studies have however shown increases. Lehtonen (2001) illustrates the effectiveness of the STOPWATCH system in Southampton where 81% of passengers found it useful and an impressive 3.7% said they would use the service more as a result. In Glasgow Infopolis (1998) reports that there is phenomenal support for the system with 98% of people finding the information useful and a staggering 46% of users saying that they would use the system more as a result of the real time system put in place. It is important to note however that both of these writings have not actually displayed any statistical results or facts of an actual increase in ridership numbers. They merely state that the passengers believe that they would increase their use of the service.

In the literature it is a little more difficult to find any conclusive or definitive results that display an increase in ridership numbers, however there are still studies that boast some such as that undertaken by Infopolis (1998) in which they found that in Brussels there were a fixed number of lines equipped with the information service. Of the lines that were not equipped with the electronic displays, patronage stayed the same and on the lines where RTPI was introduced they reported an increase of 6%. Further they found similar results in Liverpool where a 5% increase was noted along the lines with RTPI serving them. Lehtonen (2001) further reports similar facts where in Helsinki an increase of 4% was seen on a bus corridor after the introduction of RTPI. There are a number of studies that further support these views as Kelland in London (2003) and Suen and Geehan in Ottawa, Canada (1986) illustrates that RTPI can increase passenger

demand by up to 10%. Meanwhile it has been reported in London by DFT (2003) that routes increased patronage by 1% following the introduction of RTPI. Interestingly Zhong (1999) points out that in California where there was a decided expansion of their RTPI system, the ridership numbers increased significantly. However Zhong notes that it would be difficult to attribute the ridership increases to the RTPI as it could be a result of the revamping of the whole system. In conclusion therefore there is evidence to suggest that the RTPI has led to an increase in ridership numbers. According to Tang (2012) several authors have found that increase in ridership numbers result in routes where RTPI has been provided (Body, 2007; Cross, 2003; Lehtonen and Kulmala, 2001; Infopolis2, 1998; Rolefson, 2003; Schweiger, 2003).

The literature has somewhat painted a mixed picture here, as Zhang (2007) puts it on the one hand stated-preference and simulation studies generally found positive influences of RTPI on modal shift. On the other hand real-world applications have not provided definitive evidence of an increase in ridership due to real time transit information, although positive psychological responses were usually detected. Overall from the literature the RTPI certainly seems to improve the quality of the service, as well as improving satisfaction rates of the passengers. Whether or not RTPI attracts more passengers is somewhat up in the air. It seems the fairest point of note with regard to RTPI is that it is a stepping stone to a better system. As Harrison et al (1999) feels it is often a combination of measures that increases ridership, making it difficult to ascertain the exact contribution of RTPI.

2.3 Gaps in the Literature

Gaps in the literature are common in all types of research, firstly they can consist of weaknesses, for example some areas may have been previously studied but it simply hasn't gone into enough depth on the subject. Secondly a gap in the literature can consist of an area or topic that simply has not been studied at all, it is an area that when filled it will give a more comprehensive picture of an overall topic.

2.3.1 Devices Used to Access Real Time Passenger Information

Little to no research has been carried out when it came to the public's preference for accessing the RTPI. One of the very few pieces undertaken was documented by Abdel-Aty (2001). It is noted that in a study undertaken in Hong Kong to examine passenger preference for RTPI, it was found that passengers obtained the greatest benefit from information delivered via a mobile phone device, or a personal digital assistant. The author found that as travel time and trip complexity increased so did the likelihood that the passenger would choose to access the information via a mobile device or a personal digital assistant. The information also informs the reader that women with full time bill contracts are more likely to access the RTPI from their phones. All of this information is insightful and gives further information about the use of the service, but it seems to be one of the very few articles touching on the subject. This area could certainly be further researched, finding out what device is the most popular to use, what device each age group has the greatest preference for and why and when do people feel the greatest need to use RTPI.

2.3.2 Socio-Economic Status of Real Time Passenger Information users

Another gap in the literature appears in the socio-economic status of the users of RTPI. There has been no definitive study undertaken on this subject. This is unfortunate as it could give some interesting results. A study on this topic could give inclinations into which groups of people use the service the most, for example do people of a higher socio-economic status have easier access to smart mobile phones therefore have a higher rate of use of the system. Do the lower social classes have a difficult time accessing the information, if so then maybe the agencies in control of these situations need to do more to serve the complete populace of users?

Similarly there have been no studies undertaken on the demography of the users of RTPI. This further leaves a significant gap in the literature as it leaves beneficial questions unanswered. What age group uses the system the most frequently, do young people access the information more regularly than old? Should more be done to give access to the real time information to elderly bus users? All this information could be used to further improve the real time service getting access to a greater variety of people which is what RTPI is all about.

Both the information on socio-economic status and demography of users would further give agencies in control a better idea of where the electronic RTPI displays should be located as to reach the largest number of patrons. All in all it would undoubtedly not only strengthen the RTPI system but the bus system as a whole.

2.3.3 Real Time Passenger Information Reliability

Although studies have been conducted regarding reliability and the RTPI systems, the reliability between different bus frequencies has yet to be researched. Although probably less important than the prior gaps in the literature, it would still add to the knowledge already collected concerning the service. It can give basic information about which routes perform the best punctually and can give the governing agencies in control the chance to improve underperforming routes. If reliability can be improved across the board then it will possibly further improve the passenger's perceptions of the service.

Overall the literature for RTPI is quite broad and has covered a wide variety of topics intensively. However there are still a possible few topics that need to be either researched or more conclusively researched. These gaps however small will still add further knowledge and lead to system improvements.

2.4 Summary

This chapter discussed the benefits obtained from RTPI, whether or not the RTPI leads to ridership gain and any relevant gaps that appear in the current literature.

From the passengers' point of view the greatest advantage of RTPI has been the reduced waiting times. Passengers stated that they were becoming frustrated as they were unaware if a bus had already passed, or if they were going to be waiting an hour for a bus to arrive. In many cases the passengers were waiting longer at the bus stops waiting for the bus to arrive than they were on the actual bus. Once RTPI was introduced, it in many ways improved this situation. According to the literature it was now possible for

passengers to make better estimates of when the bus was going to arrive. This then potentially allows passengers to spend the time they would have wasted waiting doing something more productive and still making the bus with relative ease.

Furthermore the psychological effects of RTPI were a significant benefit to not only the passengers but to the bus companies as well. According to the literature the psychological effects of RTPI has affected the passengers perceptions of the bus service, in some situations helping them believe the bus was arriving with a higher rate of punctuality. According to research undertaken the arrival of the bus on time is regarded as the most important by the bus passengers; the RTPI seems to eradicate many anxieties that the bus patrons have had, improving their perceptions of the service. These psychological effects also have knock on effects with patrons feeling the journey time had improved. Finally the psychological effects can have long term positive results on passenger numbers. A number of researchers believe that with satisfaction rates on the rise more and more passengers will hear of the improved service and greater numbers will be attracted to using public transit.

Ridership gain is the most controversial subject represented in the literature when it comes to RTPI. Both sides of the argument are fought leading to slightly mixed results. On one side of the argument although RTPI does lead to customer satisfaction being increased, it is argued that there is no definitive increase in the number of patrons taking the bus. It seems quite clear that many agencies that have implemented RTPI simply haven't seen any increase in passenger numbers; the system is simply in place to improve satisfaction rates of the customers. However, the other side of the argument is largely contradictory to this, arguing that the RTPI does indeed lead to ridership gain. Numerous articles proclaim that there has indeed been increase in ridership, with bus patrons stating that they would use the system more as a result of the RTPI. Furthermore there have been studies undertaken that show factual increases in ridership numbers. The literature is somewhat muddled here with both arguments being robustly supported.

Finally there are the gaps in the literature. Although the topics missing from the literature are not quite as important as some of the earlier topics discussed, they nonetheless would add depth to the literature. Firstly, little study has been undertaken on which devices are most popular among the passengers and what age group have the

highest rate of use of the service. All this information could help controlling agencies to shape their RTPI systems around the passengers that find it most difficult to gain access to the information. Lastly reliability between low, medium and high frequencies has never been researched; information relating to this could give basic results on the efficiency of different frequency bus routes and lead to an overall improvement in the service.

Chapter 3

Methodology

3.0 Methodology

3.1 Introduction

This chapter describes the research design and provides a justification of the methods chosen, as well as an in depth description of the data collection methods and research tools used. Additionally this chapter aims to outline the approach used for statistically analysing the data gathered.

As stated already in Chapter 1, the study has a number of primary and secondary questions. The primary questions were to examine how reliable is the service of RTPI, is there a significant variation in people's use of RTPI between low, medium and high frequency stops, to analyse if the RTPI has an effect on the passenger's perceptions of the bus service and to examine what effect a person's age/socio economic status has on their use of the RTPI. The secondary questions to be researched were to examine of those who use RTPI, what is the most popular way of accessing this information, has the RTPI encouraged people to increase their use of the bus, to examine the passenger's greatest frustrations with taking the bus and to analyse if the reliability of RTPI varies on low, medium and high frequency routes. Existing literature on people's perceptions of RTPI is sparse (Holdsworth, 2007), never mind in the more specific context of Dublin City. Secondly, the level of use of RTPI between low, medium and high frequency routes is under researched. Thus, one can conduct research sought specifically to fill these gaps.

3.2 Research Design

Research design is a well thought out plan for your research project. It helps ensure that the correct questions are covered, the methods used to collect data are reliable and that data analysed is both reliable and accurate. Research design refers to the plan, structure and implementation of procedures used to gather and analyse data (Leddy, 1997). 'Design is concerned with turning research questions into projects' (Robson, 2002: 79)

In research there are two different approaches, quantitative and qualitative. Quantitative research is about asking people for their opinions of a particular topic in a structured format so hard facts can be produced. Studies are undertaken of a number of small instances in detail, collecting and analysing data in numeric form. Many sociocultural researchers tend to recommend qualitative research, but quantitative research can achieve very definitive results reaching a large sample of people. It emphasises a much larger scale than qualitative data 'Quantitative content seeks to show patterns of regularities in content through reputation, and qualitative content analysis…. emphasises the fluidity of the text and content in the interpretive understanding of culture' (Ericson et al. 1991: 50). It can be easily subjected to tests of significance and other statistical tests. Once the projects objectives were reviewed it became clear that in order obtain the required information a quantitative approach would be undertaken.

In order to successfully undertake this research project a significant amount of primary data would have to be gathered. This required gathering information from Dublin Bus users as well as undertaking a study on the reliability of the electronic RTPI at individual stops. In order to facilitate a broad sample of the bus taking population it was decided that a questionnaire survey would be the appropriate method for gathering the data needed.

3.3 Questionnaire

The aim of the questionnaire is to create a direct comparison between a broad range of people, be it a comparison of age, socio economic status or rate of use of the service. Questionnaires are cheap, easy to administer and standardised making it easy to compile data.

3.3.1 Questionnaire Design

The design of the questionnaire is intimately related to the general plan of the survey (Burton et al, 1970). Bloch (2004) states that the beginning of the survey should briefly outline the purpose of the survey, who is carrying out the research, and what will become of the information gathered. The author has adhered to this (See Appendix B), hence the section preceding the questions stating the anonymity of the survey as well as the fact that the study is being undertaken as part of a UCD research project. The most important of the instructions appear in bold to reinforce certain information such as the anonymity of the survey (See Appendix B). It is also important to state that when administering the survey face-to-face the researcher gave a brief overview of the survey stating the rationale behind the study to each potential respondent.

It was decided that the overall questionnaire design should be attractive and clear to the respondents. Questions were well spaced ensuring that the questionnaire did not appear cluttered. Shading was placed around possible answers to each question to guide respondents to the answers and avoid confusion. The majority of the questions were closed questions ensuring that the author would have fewer problems coding the survey. However, there are three open ended questions; these were included because it was felt that the variability in answer was far too high to restrict answers. Furthermore, the author did not want to leave out an important category so it was decided these questions

would be coded afterwards. Throughout the entire survey it was acknowledged that the wording of the questions needed to be as simple, straightforward and to the point as possible (Rea et al, 1992). Each question used the simplest language possible and tried to avoid any colloquial terms or potentially ambiguous questions. De Vaus (2002) states that many questionnaires can suffer from bias, double barrel questions or have leading questions. This issue was recognised at the outset and avoided. The questions were made as short as possible to avoid confusion (De Vaus, 2002) and the minimum amount of questions needed to gather the required information were used to try and avoid respondent's fatigue.

The sequence of the questions was carefully constructed, ensuring that similar questions appeared together in sets. Each question flowed into the next as to ease the respondents through the questionnaire and avoid any surprising questions that may confuse.

The first five questions of the survey referred to the socio-economic profile of the respondents (See Appendix B), beginning with gender, age, employment status, occupation and income. These questions give a strong insight into the background of the respondents ensuring robust comparisons could be made. Questions six to ten sought to get information on the respondents overall usage of the bus. Question six sought to discover whether the respondents owned a car. Seven and eight sought to discover the purpose of the respondents current journey, as well the primary mode of transport for the current journey respectively. These questions had an important function as they aimed to give insight into when passengers use RTPI and whether regular bus users or irregular bus users use the RTPI more frequently? Question nine was directly linked to

eight trying to examine whether RTPI is related to passengers's change of mode on that particular day.

Question ten sought to determine the amount of times per week the respondent used the bus. This is an important part of the survey as it will give an interesting inclination as to whether people who use the bus daily or weekly use the RTPI service more frequently. Question eleven asks a more specific question on RTPI; it is a straight forward question on whether the respondent uses RTPI. Question twelve and thirteen query where and how people access the RTPI. These questions importantly note, what the most popular method to access RTPI is and could be used to note which age group is using particular devices the most.

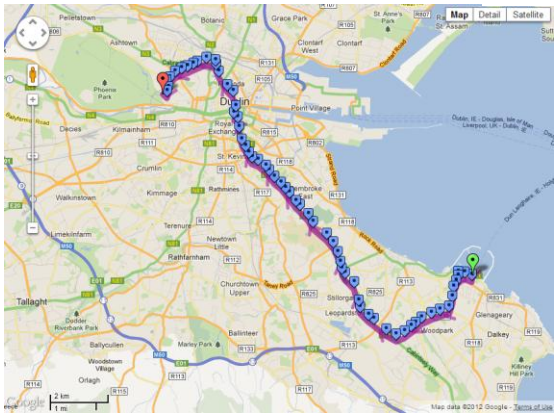
Question fourteen examines when people find the service most useful and is an open question. Fifteen, sixteen and seventeen look to gauge changes in the passenger's use of the bus since the introduction of RTPI as well as their perceptions of bus reliability and if their perceptions of reliability have changed since the information service has been provided. Question 18 investigates what the respondents see as the biggest advantage of RTPI and nineteen is a more general question designed to see if waiting times are the most frustrating aspect of taking the bus as many other studies have shown. Question twenty brings the survey to a close with a question that all passengers will be capable of answering, whether they use RTPI or not. It investigates whether the passenger felt the service had improved due to RTPI?

3.3.2 Sampling Strategy

'Sampling is defined as the selection of part of an aggregate of material to represent the whole aggregate' (Burton et al. 1970: 95) in other words it is designed to select a small proportion of individuals from within a population to accurately estimate the whole population. In this case, the sample population consisted solely of Dublin Bus users and were chosen to get the greatest geographic area of the city covered.

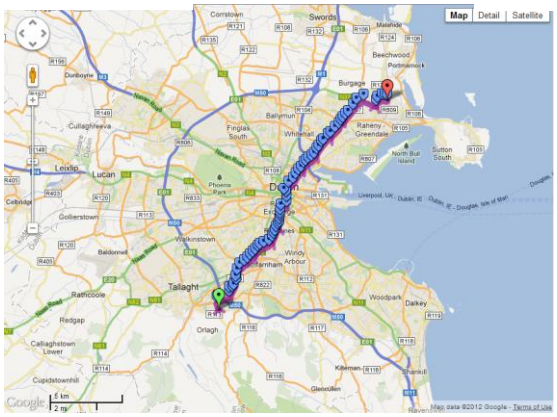
The overall sampling approach had two facets. First bus routes with different levels of frequency were chosen. These were low, medium and high frequency routes. Specifications for low, medium and high frequency routes were based upon the running headway along each route. High frequency routes were deemed to be routes with headway of 6 buses an hour, medium with headway of 11-20 minutes and finally low with headway 21 minutes or greater (Transport for London, Accessed 20th July, 2012). Second the number of routes to be selected was decided. Two routes each from the low, medium and high frequency routes were chosen. A series of criteria was established for selecting the routes. This would be that the buses would traverse the city, and that the north, south east and west of the city would be covered to include the greatest geographic area. There was however an exception to this rule, for the low frequency routes there was one bus that served the north of the city and one bus that served the south of the city. This was due to a lack of low frequency routes traversing the city.

Figure: 3.1 46a



Source: After Author

Figure: 3.2 15



Source: After Author

For the high frequency routes the 46a and 15 were chosen (See Figure 3.1, 3.2). These routes not only traverse the city but they also cover a very wide geographic area. The 46a moves from Dun Laoghaire to the very South East of the city to Phoenix Park at a very westerly point to the north of the city. The 15 bus route also traverses the city, however it moves from Ballycullen Rd to the South West of the city to Clongriffin to the North East of the city. Both of these routes have headway of ten minutes or less and cover a huge geographic spread in Dublin City meaning they were prime routes for the research project. The routes also traverse through areas of completely contrasting socio-economic characteristics the 46a moving from one of the most affluent parts of the city to an area of a lower socio economic status.

Figure: 3.3 11

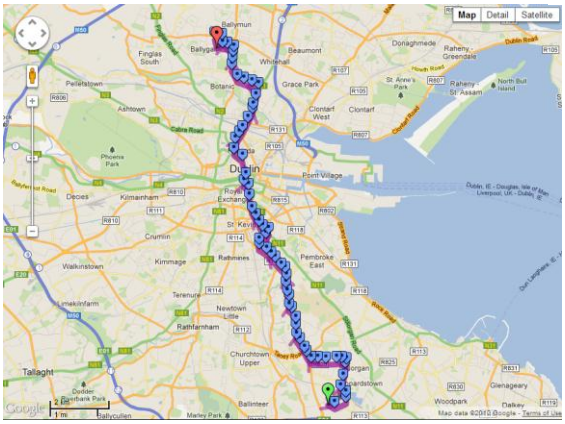


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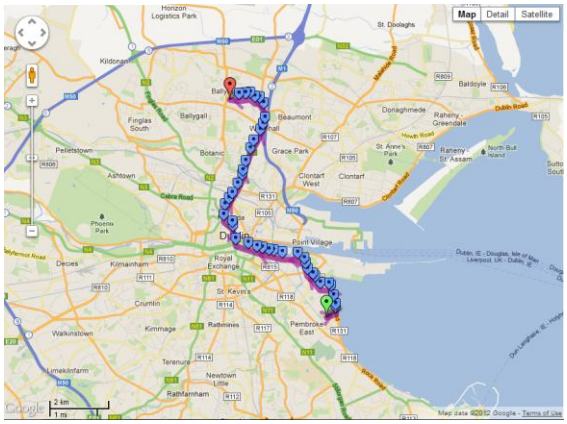
Figure: 3.4 1



Source: After Author

For the medium frequency routes the 11 and the 1 were chosen (See Figure 3.3, 3.4). The 11 begins its journey at Wadelai Park to the North West of the city and finishes to the South East at Sandyford Industrial estate, once again giving a good sample of the population. The 1 begins to the very east of the city in Sandymount moving to a very northerly location in Santry. This bus covers areas that are very affluent on Sandymount to Santry which would have a much lower economic status.

Figure: 3.5 33

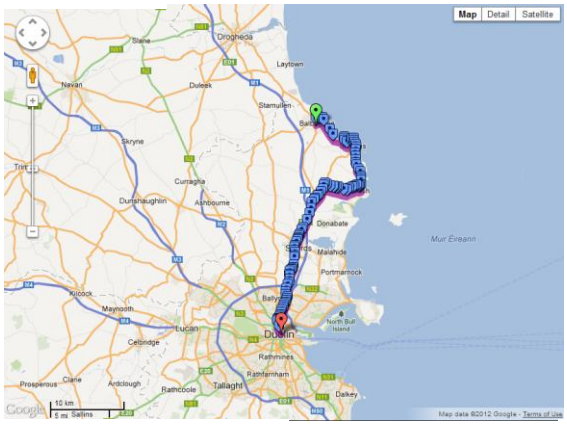


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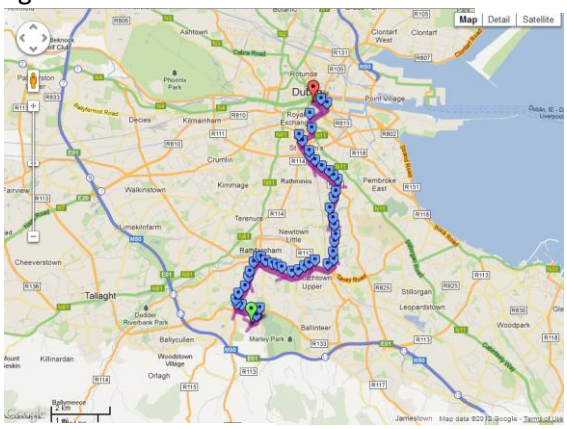
Figure: 3.6 61



Source: After Author

Figure 3.5 and 3.6 illustrates the low frequency routes the 33 and 61 that were chosen. The 33 begins its journey on Lower Abbey St. and runs northwards to Balbriggan. The

61 begins at D'Olier St. and runs towards Whitechurch to the south of the city. Although different to the rest of the routes, the north and south of the city is still covered with these routes.

In order to get an accurate sample of the travelling public, it was necessary to undertake the survey during peak and off peak periods. 60 respondents would be sought from each of the 6 routes, amounting to a total of 360 respondents. This meets the minimum sampling requirement for undertaking statistical tests (Blalock, 1979). From each route 30 surveys are to be taken at peak and 30 at off-peak times. Peak times consist of morning and evening peak; off-peak times consist of daytime and evening off-peak. When Dublin Bus was contacted by the author unfortunately average daily trips was only available for the 46a, nonetheless, this will for example result in 60 (0.3%) people being examined out of the 19,000 (Dublin Bus, 2012) average users of the 46a bus route.

3.3.3 Questionnaire Administration

Due to the fact that the researcher had very little experience in the administration of surveys it was decided that the survey would be self-administered at the Dublin Bus stops. Face-to-face questionnaires also have traditionally had the highest response rates (De Vaus, 1985). Given the time constraints it was decided it was the best form of administration. Using self-administered questionnaires reduces biasing error caused by the characteristics of the interviewer and the variability of interviewer skills (Bloch, 2004). It also ensured that the questions are answered in the order intended so that the integrity of the questionnaire sequence is maintained (Rea et al, 1992). It is further argued that the respondent will answer a self-administered questionnaire more frankly

than they would an interview administered one, since anonymity is not only assured but is seen to be assured (Burton et al, 1970). Self-administration further gives the administrator the chance to choose who does the survey. This ensures that everyone who undertakes the survey is a Dublin Bus patron. When administering the questionnaire in this way it also allowed for a number of people to be given the survey at the same time ensuring that the sufficient numbers could be reached in a limited amount of time. Importantly, it further gives the respondent the ability to ask the administrator any questions or queries they may have about the survey ensuring once again that a high response rate is achieved with the most accurate results possible. While undertaking the surveys the administrator took a number of personal observations in order to supplement the data from the questionnaires.

The surveys were all administered during the allotted times. In order to reach the minimum sample size required a research assistant was utilised. This ensured that within the tight time constraints enough respondents could be reached particularly if any of the routes had a particularly low rate of response. It also ensures that as little interviewer bias as possible occurs as a larger amount of respondents can be approached with a greater number of researchers present.

The survey was administered equally both north and south of the city, in order to get an accurate account of the passenger's perceptions of the RTPI and also see the differences between low, medium and high frequency routes.

3.3.4 Pilot Survey to Final Draft

A pilot study is an exploratory survey, undertaken in experimental forms (Burton et al, 1970). 'The greatest value of pilot work is, however, in helping to devise the actual wording of the questions' (Burton et al, 1970: 56). The pilot was a draft of the questionnaire; it was composed of twenty questions and was conducted at a randomly selected bus route. Ten respondents were approached at random with the aim of ascertaining whether there was bias in the survey, the questions were clear and any other obvious problems had been overlooked in the survey draft. The pilot was also undertaken in order to give the author confidence in conducting surveys and data collection.

The pilot questionnaire was conducted with few issues emerging. However, one change was made and that was to question thirteen. The question read 'If you answered Yes, which device do you use to access Real Time Passenger Information?' This became a problem as respondents were either asking the administrator could they tick more than one box or ticking more than one box anyway. Accordingly a small change was made to the question in order for it to read 'If you answered Yes, which device(s) do you use to access Real Time Passenger Information?

3.4 Real Time Passenger Information Reliability

The RTPI reliability will be examined in order to get an account of the accuracy of the service. Whether the service is a success in the long term may come down to the accuracy of the service, as over time if it is not people will lose faith in the service and it will have become a waste of money 'Poor information provision has been a contributing

factor in the decline of the bus use' (Holdsworth et al, 2007: 184). The figures announced by Dublin Bus on reliability reveal a 93% accuracy rating (Worrall, 2012) so the authors figures can be tested against this.

The reliability research will be undertaken by taking note of the amount of time displayed on the electronic RTPI display. From this point a stopwatch will be activated and the amount of time it takes the bus to arrive will be noted, be it for example plus 1 minute and 30 seconds or minus 2 minutes. This will be undertaken 15 times on each of the 6 bus routes surveyed meaning a total of ninety buses overall will be examined. The surveyed will also be undertaken during morning and evening peak as well as the off peak times during the afternoon enabling the researcher to make comparisons.

3.5 Limitations of Methodology

As with much research, there were limitations of the methodology. These will now be discussed in detail.

Issues arose on the first day of administration during peak times on the bus route 61. It became apparent that there simply were not sufficient numbers at the bus stops to achieve the quota. The author and research partner made a decision to begin boarding the bus in an attempt to get sufficient numbers. This immediately led to an increase in uptake. On the second day of surveying on the other low frequency route (33) bad weather and low passenger numbers again became a problem leading to the author and research partner once again boarding the bus. From this point on it became the normal

criteria to board the bus due to both bad weather and low uptake of the surveys at the bus stops.

Throughout the survey the language barrier was a constant problem while attempting to conduct the survey. Foreign nationals were continuously refusing to undertake the survey due to not understanding the content. It may be a problem with the overall sample that foreign nationals are underrepresented in the overall sample.

An additional limitation was the confidentiality factor. A handful of respondents were reluctant to give their age and the sensitive question of salary led to many stating to the author that they felt this question was an intrusion of their privacy.

Furthermore, question fourteen led to problems, although none of the respondents had a problem answering the question; many seemed to be led by the examples given. The question is enquiring as to when the RTPI is most useful to the respondent with 'bad weather' and 'at night' in brackets as examples. These examples led to a barrage of respondents answering 'bad weather' in particular.

Finally on the two low frequency routes the 61 and 33, the huge numbers of declines led to a smaller number of respondents being surveyed. On the 33 eighty people were approached in order to get forty five respondents. This was similar to the 61 where seventy people were approached in order to get forty five respondents. This may have been due to the fact that both buses were running through areas of lower socio-economic status therefore bus patrons were far more unwilling to undertake the survey.

3.6 Data Analysis

All of the data analysis came from the questionnaires as they were the only form of primary data obtained. Each survey collected was coded and all of the information was inputted into SPSS. This made the data easy to summarise and analyse and could in time be made into effective charts and graphs to summarise the results. The information was further analysed by undertaking cross tabulations in SPSS, the results were then summarised and depicted in graphs.

Chapter 4

Results

4.0 Results

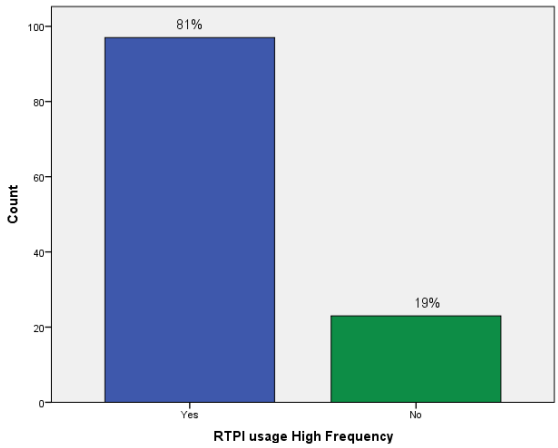
4.1 Introduction

This chapter aims to assess the obtained information and thoroughly showcase the results that have been attained. The results of the questionnaire will be presented in tangent with any other related material to summarise trends as well as any observations made by the researcher.

4.2 Real Time Passenger Usage at High, medium and low frequency routes

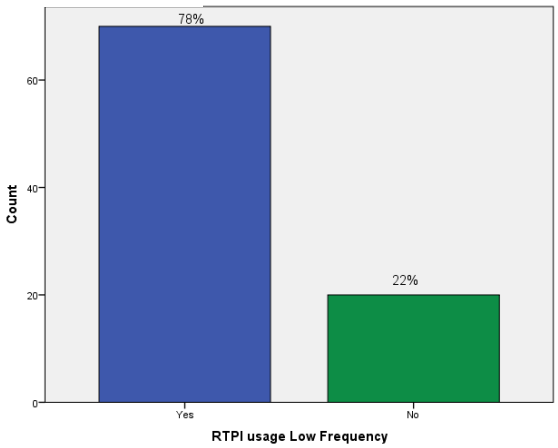
As mentioned at the beginning of the study it was believed that there would be a higher usage of RTPI at the low frequency routes. This the author believed would be largely to do with the fact that buses do not run as regularly at the low frequency routes, therefore patrons are more likely to 'turn up and ride'. It would make sense for patrons to use RTPI more frequently at low frequency routes than at high frequency routes. This however was not the case. The difference in RTPI usage along the different routes was marginal at best. Rather surprisingly, the RTPI usage was lowest at the low frequency routes (22%) (See Figure: 4.2). The medium frequency routes had the highest rate of RTPI usage with 85% of people stating that they access it and 81% of the respondents on the high frequency routes stated that they used the information in some form (Figure: 4.1).

Figure: 4.1



Source: After Author

Figure: 4.2



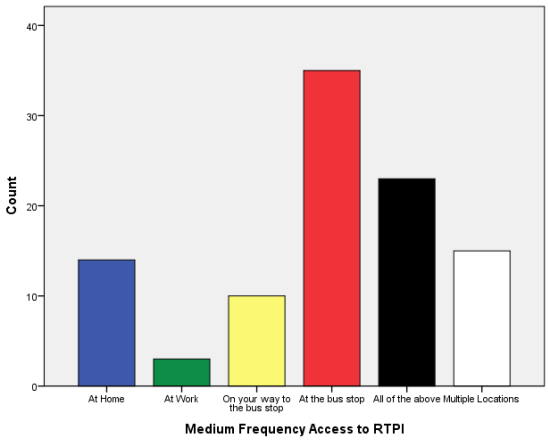
Source: After Author

There are some possible reasons behind the lack of use of the RTPI at the lower frequency routes. Both route 33 and the 61 served areas of a low socioeconomic status. This automatically narrows the amount of people capable of accessing the RTPI as many bus patrons on these routes simply cannot afford the so called 'Smart phones' (Thomas, 2008) or may not have access to the internet at home or at work. If this is the case it reduces the amount of people who have access to RTPI and brings up the question of whether or not Dublin Bus and Dublin City Council are doing enough to make the RTPI easily available to people from less privileged socioeconomic backgrounds. Furthermore on the low frequency routes there were a much smaller percentage of electronic real time information display signs. When the author queried Dublin Bus on this they replied stating firstly, that signs are deployed subject to ESB consideration. Signs are then located where they will provide information to the greatest number of passengers. There are four criteria taken into account when choosing an electronic displays location, firstly the number of bus services and number of existing and potential passenger using the stops each day, secondly locations near key services like shopping districts or key public buildings, thirdly proximity to Quality Bus Corridors and finally proximity to major transport interchanges. This lack of signs at

low frequency stops led to some elderly people not even being aware of the service, again not making it easy for people to obtain access to the RTPI and begs the question of whether Dublin Bus and the Dublin City Council are doing enough to cater for the less frequent routes and the socially disadvantaged bus users. On the high and medium frequency routes there is a higher usage of the RTPI as stated earlier with 81% and 85% of people using the service on each route respectively. The buses chosen to study on these routes the 46a and 15 (high frequency) and 11 and 1 (medium frequency) both traverse the city and access some areas with very high socioeconomic status, but these routes have a much higher percentage of electronic RTPI displays at the stops. Thus RTPI is more accessible along these routes.

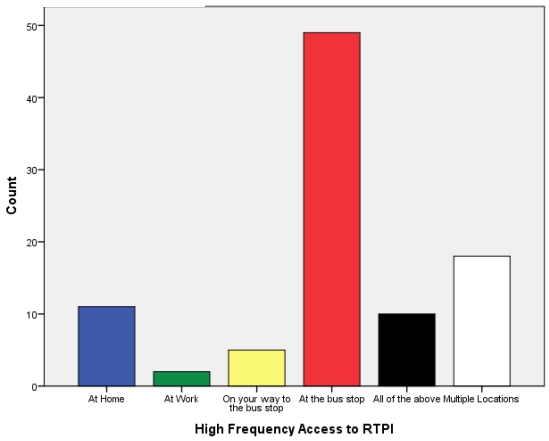
It was expected on the higher frequency routes that the bus patrons would just 'turn up and ride' but in many cases respondents seem to be still using the RTPI on almost all journeys. Additionally, 38% of people on high frequency routes were using either the mobile phone application or the internet on the mobile phone to access the RTPI. This is in contrast to the low frequency routes where there was a 27% usage of either the mobile phone application or the internet using the mobile phone. This further supports the argument put forward earlier that respondents using the lower frequency routes find it increasingly difficult to gain access to RTPI. On the medium frequency routes 42% of patrons were accessing RTPI either on the mobile application or the internet via the mobile. This is quite a high rate of usage of mobile phones to access information and could be due to the fact that route 11 runs by both University College Dublin and Dublin City University. Thus a large amount of students are likely to take this bus. Students had the highest overall usage of RTPI via mobile phones with 47%; therefore this route was probably heavily influenced by students.

Figure: 4.3



Source: After Author

Figure: 4.4



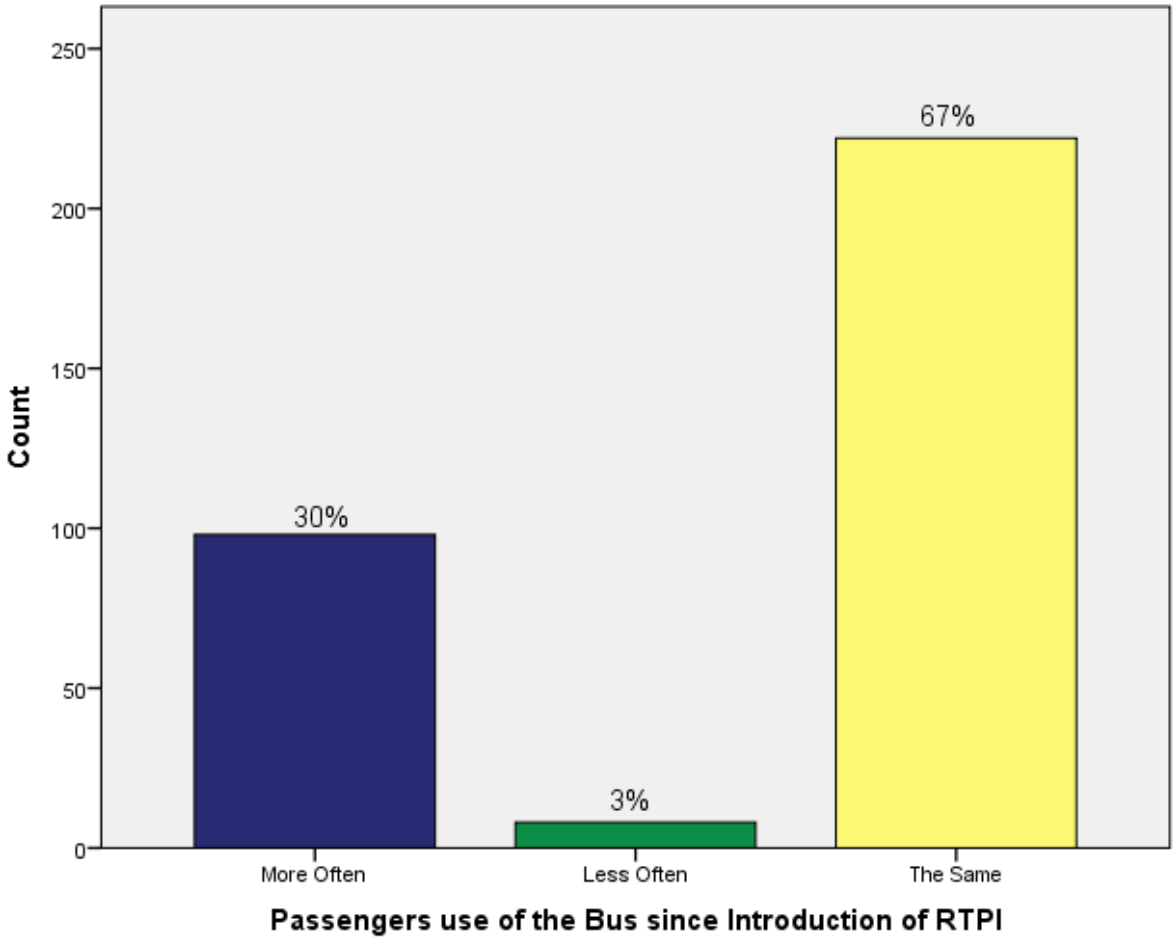
Source: After Author

As can be seen from figure 4.4, on the high frequency routes when it came to the access of the RTPI 78 of the 120 people (65%) stated that they accessed the information at the bus stop. Of these 78, 49 (63%) of them only accessed the information at the bus stop, showing therefore that they still used the us service as a turn up and ride service and that the RTPI was merely a bonus for them. This is similar to the respondents of both the medium (See Figure: 4.3) and low frequency routes, on the medium frequency 73 of the 120 people (61%) stated they accessed the information at the bus stop, and of these 73 people 35 (48%) of them only accessed the information at the bus stop. On the low frequency routes where 51 of the 90 respondents (57%) stated they accessed the information at the bus stop, of these 51 people 30 (59%) only accessed the information at the stop. Overall therefore passengers on the high frequency routes had the highest 'turn up and ride' use of the RTPI. This is possibly due to the fact that the high frequency buses run the most regularly therefore there is less of a need for passengers to check the information before they arrive at the bus stop. Or that people simply are not utilising the service to its fullest potential, which again links back to are Dublin Bus and Dublin City Council making passengers aware that the electronic display at the stops is not the only way to access the RTPI service?

4.3 Real Time Passenger Information and Increased Ridership

One of the most important questions raised about the RTPI is whether or not it manages to encourage current bus users to use the bus more often and whether it attracts new users to the bus? In Southampton only 3.7% of people said that they would use the bus more as a result of the implementation of RTPI (Lehtonen et al, 2001) Additionally in Helsinki where a similar system was implemented there was an increase in patronage of 4% on the tram and a large increase of 10% on the bus (Caulfield, 2003). However Tang (2012) states that most additional trips come from infrequent transit commuters. Commuters who do not regularly use transit are less likely to increase transit use even with the RTPI available.

Figure: 4.5



Source: After Author

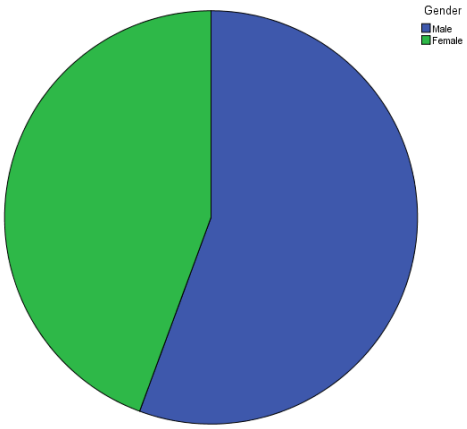
In Dublin there was an overwhelmingly positive response from the respondents when asked would they use the bus more often, less often or the same since the introduction of RTPI? Figure: 4.5 illustrates that the majority of people (67%) use the bus the same amount since the introduction of RTPI. This goes along the same lines as Caulfield and Tang earlier stated. However, there was still a large (30%) proportion of respondents who felt that they would use the bus more often due to the introduction of RTPI (Figure: 4.5). These figures are interesting. These results indicate the future potential for a modal shift. If passengers begin to use the bus more regularly it will reduce the use of the privately owned car and through word of mouth could encourage further people to begin using the bus. Even the smallest change in modal choice would be considered a huge triumph. As Holdsworth et al (2007) states a one or two percentage increase in

patronage would be a significant achievement. An increase in sustainable transport usage would lead to an increase in the quality of life in cities around the world. Any potential increase in bus ridership numbers could further encourage Dublin Bus and Dublin City Council to increase investment in public transit. In other words that RTPI would just be the first in a series of improvements to public transit.

4.4 Demographics and Socio-Economic Profile

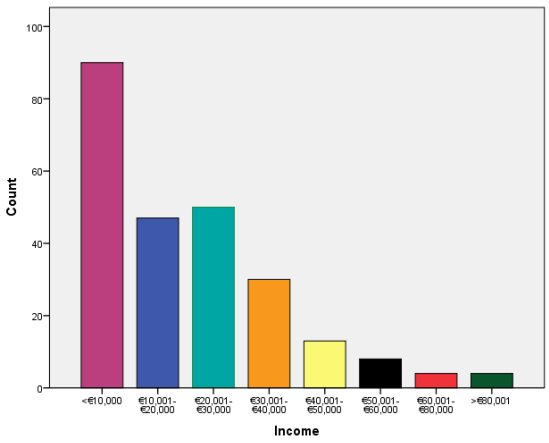
According to Cervero (2002) differing regions and cultures can have an effect on people's modal choice; the greatest influence comes from a person's gender, income and age. Therefore the use of RTPI by those factors was examined.

Figure: 4.6



Source: After Author

Figure: 4.7



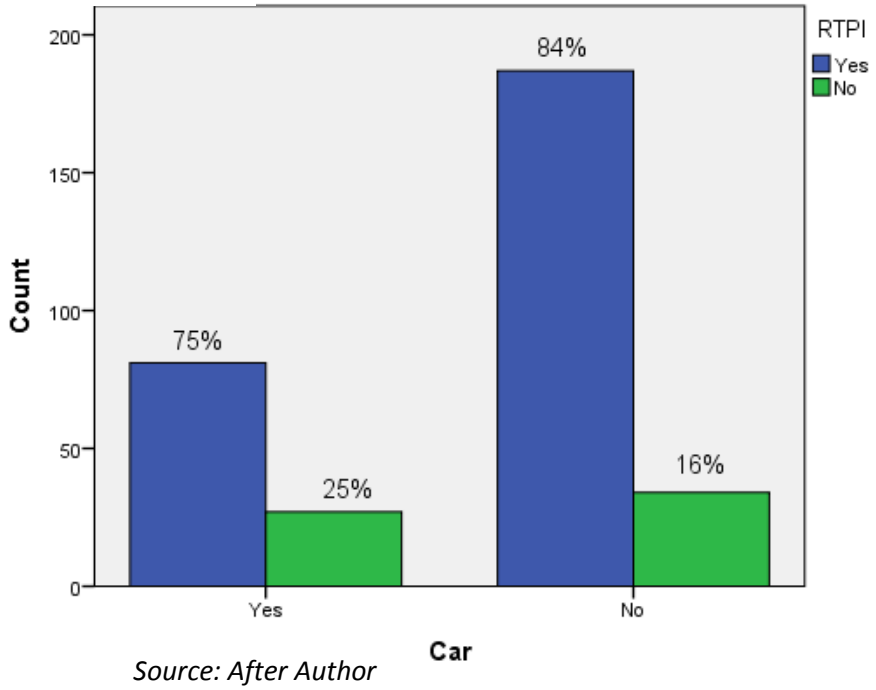
Source: After Author

The math showed that 55% and 45% of respondents were male and female respectively (Figure: 4.6). The average age of respondents was 33. Of those surveyed 47% of respondents were employed and the average income was €29,100 which is just below the average of €33,000 (World Bank, Accessed 5th Aug 2012) for the whole country. Furthermore, many studies perceive car ownership levels to be higher among the wealthier socioeconomic groups (Moudon et al, 2005). It is important to note therefore

that 33% of respondents stated that they owned a car, this is also just below the average of 42% for the country as a whole (Howley et al, 2009)

Figure 4.8 demonstrates the differing usage of RTPI between those who do and do not own cars. Interestingly, there is a higher percentage of RTPI users among the respondents that do not own a car. Furthermore, it is important to note that when asked 'What primary mode of transport would you normally use for your current journey?' of the respondents that stated car, when asked why they changed to bus today 1% replied with RTPI. This may seem like a small amount but even a 1% shift in modal choice would be considered a huge success by Dublin Bus.

Figure: 4.8 Car Ownership and RTPI Usage

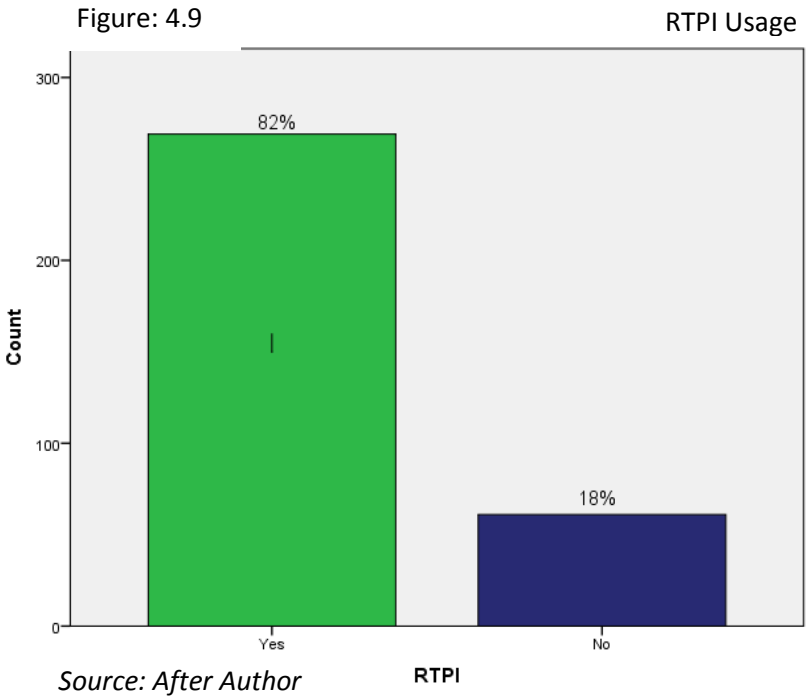


Source: After Author

There is a high overall usage among bus users of the RTPI. Figure 4.9 represents the 330 respondents, 82% of them used the RTPI in some form; either at the stop on the electronic displays, on a mobile phone or via computer based internet. Of those who stated that they use RTPI the average age is 31 and the average age of those who stated

that they did not use RTPI was 39. These figures indicate that currently a slightly younger demography is more likely to use the RTPI.

Figure: 4.9

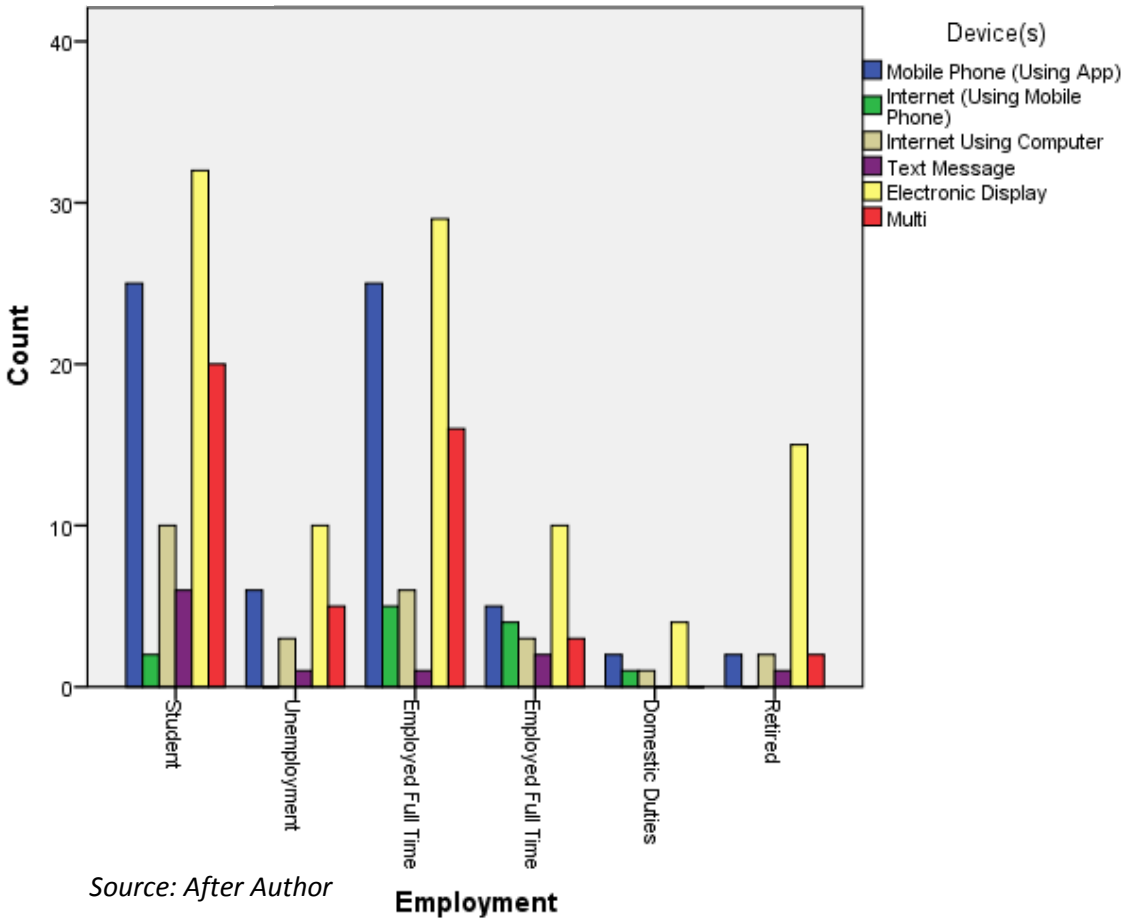


Source: After Author

Interestingly, as portrayed in figure 4.10 of the respondents who stated they were retired the vast majority of them (87%) only used the RTPI at the bus stop. This shows that the older generation are using the RTPI differently; they still turn up at the stop and use the electronic display rather than base their whole journey on the information by accessing it at home. This may be due to a lack of awareness of the availability of RTPI on computers or smartphones or possibly they do not have access to internet or smart phones. This is in stark contrast to the one hundred and twelve students that undertook the survey as 67 of them (60%) used the electronic signs at the stops as well as one other device to access the RTPI (See Figure: 4.10). Of these 67 the most popular form of access of the RTPI aside from the electronic display was the mobile phone application, showing that it may be possible that age is a bigger factor in the usage of

the RTPI than socioeconomic status may be. From the authors experience interacting with respondents while undertaking the survey it became apparent that many elderly passengers were unaware that the RTPI could be accessed via a mobile phone or the internet. Therefore maybe more work should be done advertising the system and attempting to make bus patrons aware.

Figure: 4.10 Employment and Devices Used to Access RTPI

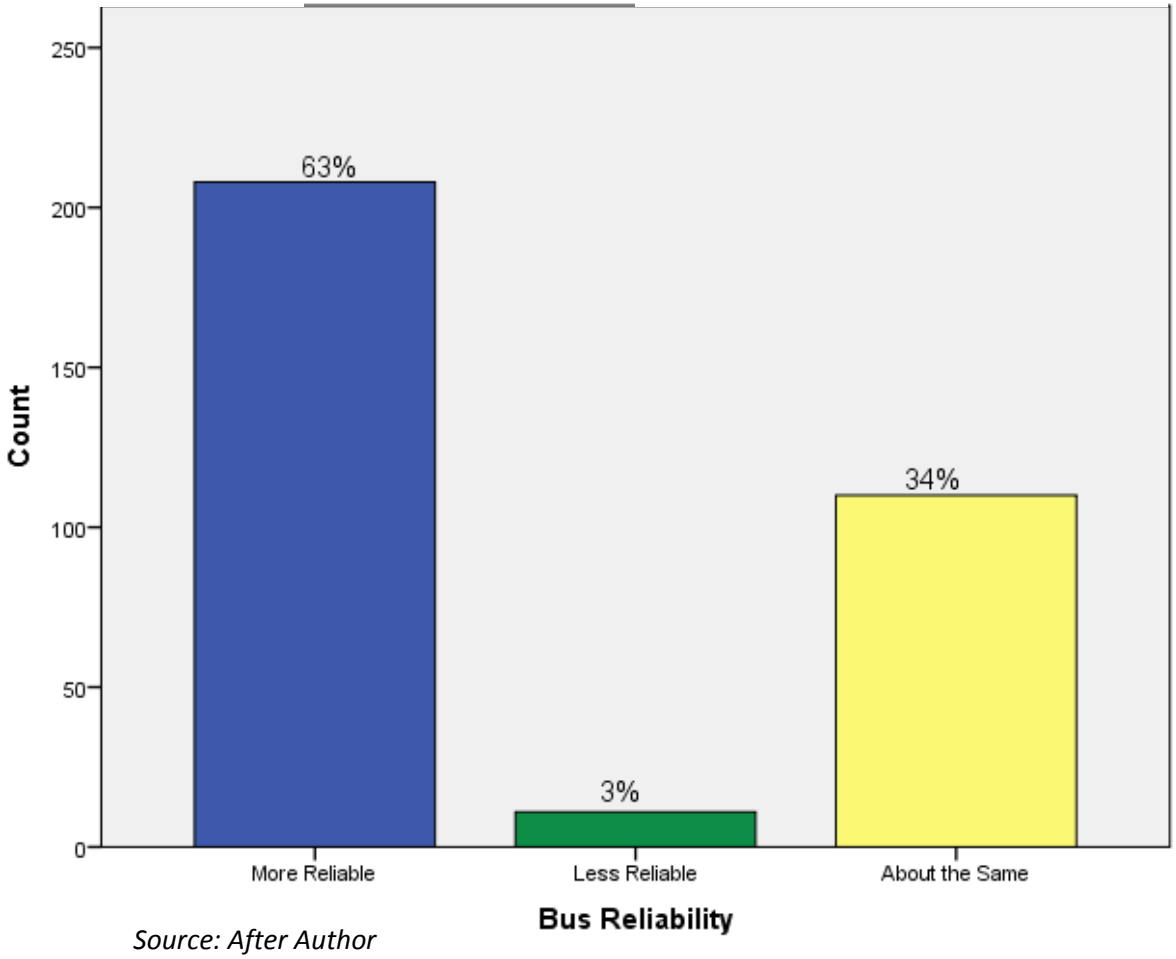


Source: After Author

4.5 Effects of Real Time Passenger Information on Passengers Perceptions

RTPI has the potential to increase customer satisfaction by enhancing the waiting experience, which in turn, contributes to the entire experience (Basford et al., 2003). The results obtained by the author largely seemed to mirror this statement.

Figure: 4.11 Passenger's Perceptions of Bus Reliability

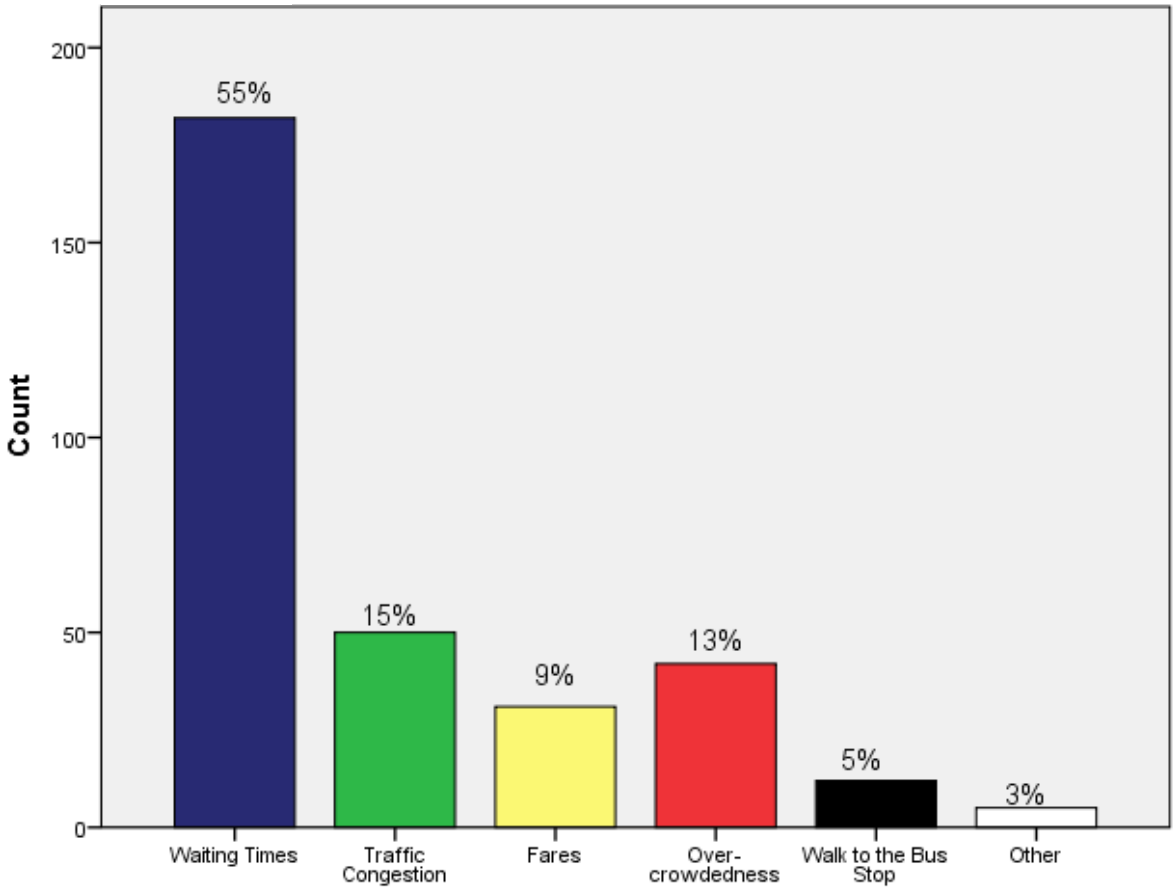


Source: After Author

Although the RTPI does not improve reliability of the bus, the majority of respondents (63%) believed that the bus itself had become more reliable since the introduction of

RTPI (See Figure: 4.11). This shows a relationship with the vast amount of research already undertaken in this area (Duffy, 2002; Evans 2006; Thomas, 2008; Tang, 2012). A possible explanation of this is explained by Pratt (2000) in which it is stated that the RTPI can have the effect of reducing perceived wait times as well as lowering the passengers anxiety. Passengers can now spend the time that would have been waiting at the bus stop undertaking something more productive because they know when the bus is going to arrive. Moreover these results are similar to research undertaken by Evans (2006) in which he found that 64% of British people thought that reliability had improved even though it had, in reality worsened. Although no research has been undertaken on any potential improvements in reliability of Dublin Buses service since the introduction of RTPI, it is highly unlikely the service has improved their punctuality. Therefore, it is possible that RTPI does have a strong effect on the passenger's perceptions of the service. Research has shown that passenger's want as much information as possible when undertaking a bus trip (Evans, 1996). In many cases poor information provision has been identified as a contributing factor in the decline of bus use (Holdsworth et al, 2007). The RTPI ensures passengers can plan their journey better, make more informed decisions with regard trips which will save time for the passenger and ultimately reduce frustration and increase satisfaction (Miterek Systems, 2001).

Figure: 4.12

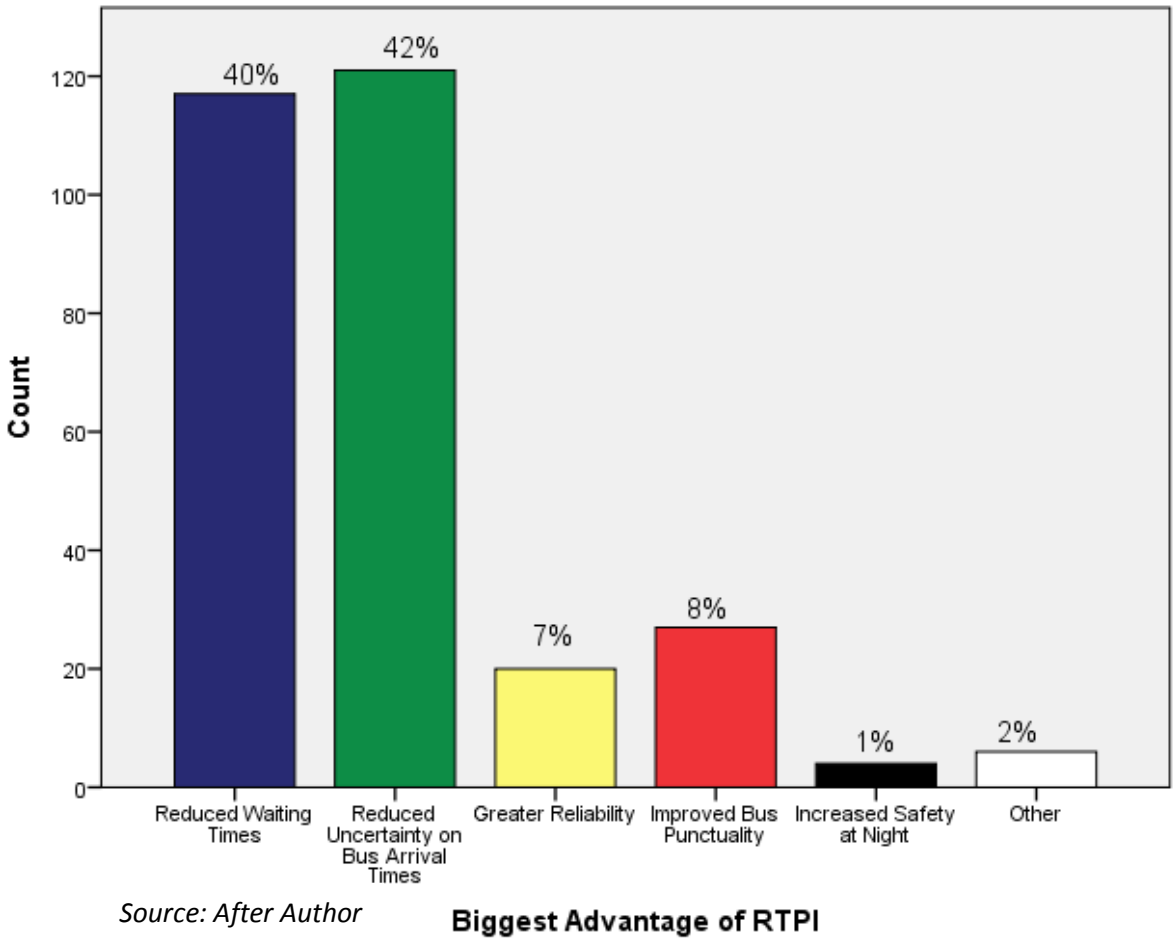


Source: After Author

Figure: 4.12 is in relation to the passengers' perceptions of reliability. When asked what they consider the most frustrating aspect of taking the bus a majority (55%) said waiting times. This is similar to other studies that have been undertaken: 'Empirical evidence shows that the time travellers spend outside the transportation vehicle of choice (e.g., waiting at a stop) is more onerous than the time they spend inside the vehicle in motion to their destination' (Mishalani et al, 2006: 81). Waiting times were easily the greatest frustration passengers felts when taking the bus with 'Traffic Congestion' being the second most frequent frustration (15%) and thirdly the 'Over-crowdedness' of the bus (13%). It is no shock therefore that respondents believe that the bus is more punctual now that they have information to base their decisions on. Wolfenden (Accessed 20th July, 2012) states similarly that travelling by bus is made up of two parts, the waiting

and the journey itself. The long waiting times for the patrons forms the greatest point of resistance. This can be seen in the respondents' answers and has in the long term led to a greater uptake in the privately owned car. The RTPI is just the first of many steps that must be taken to increase usage of public transport systems.

Figure: 4.13

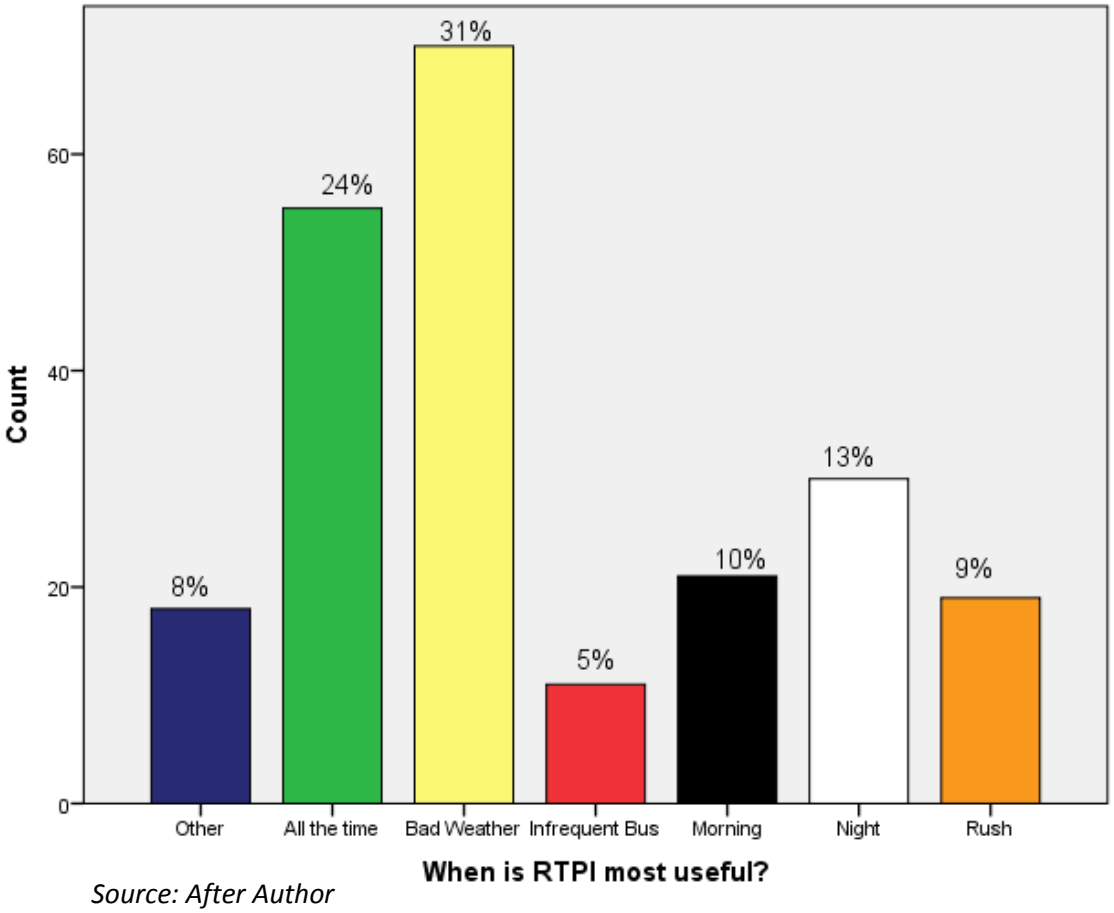


Source: After Author

These facts on the passengers' perceptions of the bus service and the RTPI are further backed up by the fact that, when people were asked what they felt was the biggest advantage of RTPI, as demonstrated in figure: 4.13 40% of people felt that reduced waiting times was the greatest advantage and a further 42% felt that reduced uncertainty on bus arrival times was the biggest advantage. Overall, 82% of people felt that the

reduction in waiting times and uncertainty of bus arrival was the biggest advantage of RTPI. It is fair to say therefore that RTPI has been a success in the reduction of uncertainty for passengers and is part of the reason why 86% of passengers felt that RTPI improved their overall experience with the bus. According to Caulfield (2009) bus users have a higher information requirement than users of other public transit modes; this makes sense due to buses historically being unreliable and their ability to become delayed by traffic regularly as they do not operate on a right of way like a train. According to Hughes (1994) the failure of the printed timetable has led to an increased interest in RTPI. This is largely due to a move forward in technology and the need to improve the image of bus services. This failure appears to be at least partly addressed as the RTPI has been successful at reducing the uncertainty of bus arrival times and a reduction in waiting times.

Figure: 4.14



Source: After Author

Respondents were additionally asked when they found the RTPI most useful. Caulfield (2009) states that 79% of bus users said they would use the RTPI when the weather is bad. Although a much smaller percentage but still the largest grouping, 31% of people found that the RTPI was most useful in the bad weather. This was followed closely by people (24%) who had no particular preference for when they use the RTPI and simply stated that they used the information 'all the time'. As can be seen from (Figure: 4.14) 'Night Time' and 'Morning' were also popular answer with 13% and 10% respectively. The results were also similar to that of Caulfield (2009) in that he also finds that running late is a popular answer with 43% of people declaring that they would access the information when running late. It is likely Caulfield's results are more concise as it

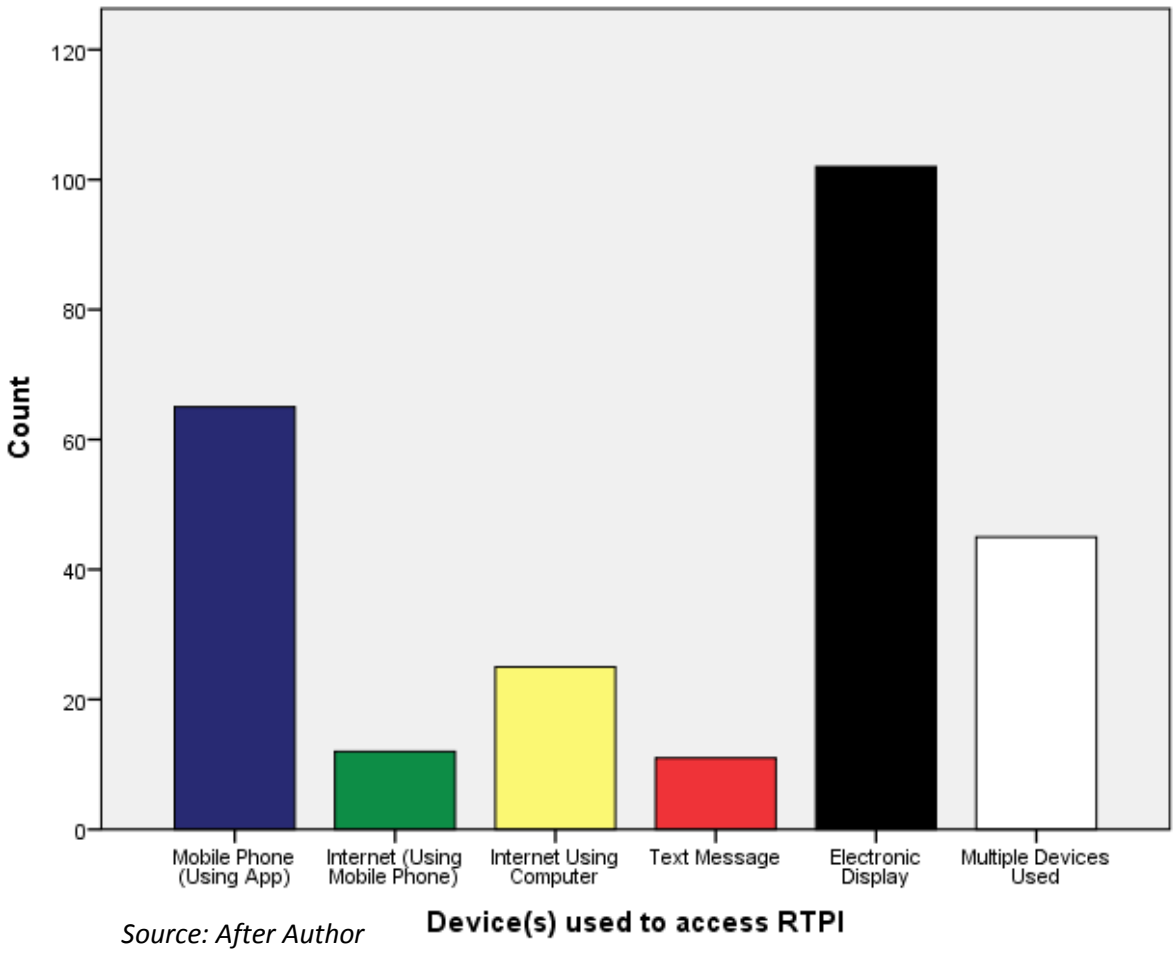
is likely he used a closed questioning format for this question, whereas this was one of the very few open questions that the author asked.

Overall, a reduction of perceived wait times and associated uncertainties could be one of the primary factors linking RTPI systems with increased bus use (Tang, 2012). Therefore this reduction in perceived wait times could in the future give the added benefit of increased ridership numbers to bus companies with RTPI. According to respondents of the questionnaire it is clear that waiting times are the biggest concern of bus patrons, they are effectively the biggest hindrance to the growth of bus services. But however, it is evident from the information provided that RTPI has improved wait time perceptions of the passengers which could possibly lead to increased satisfaction rates. It reduces the disutility of waiting times and enables them (the passengers) to make more informed travel decisions or conduct time filling diversionary activities without the fear of missing the bus (Horbury, 1999, Mishalani et al, 2006)).

4.6 Methods of accessing Real Time Passenger Information

As to be expected the most popular method of accessing the RTPI was with the electronic RTPI bus stop display. The electronic display is hassle free and passengers just have to turn up at many bus stops and they have access to the information. Figure: 4.15 below illustrates that 78% of patrons that said they used RTPI stated they used the electronic displays to access the information. The more interesting results come from what other devices the respondents use to access the information.

Figure: 4.15

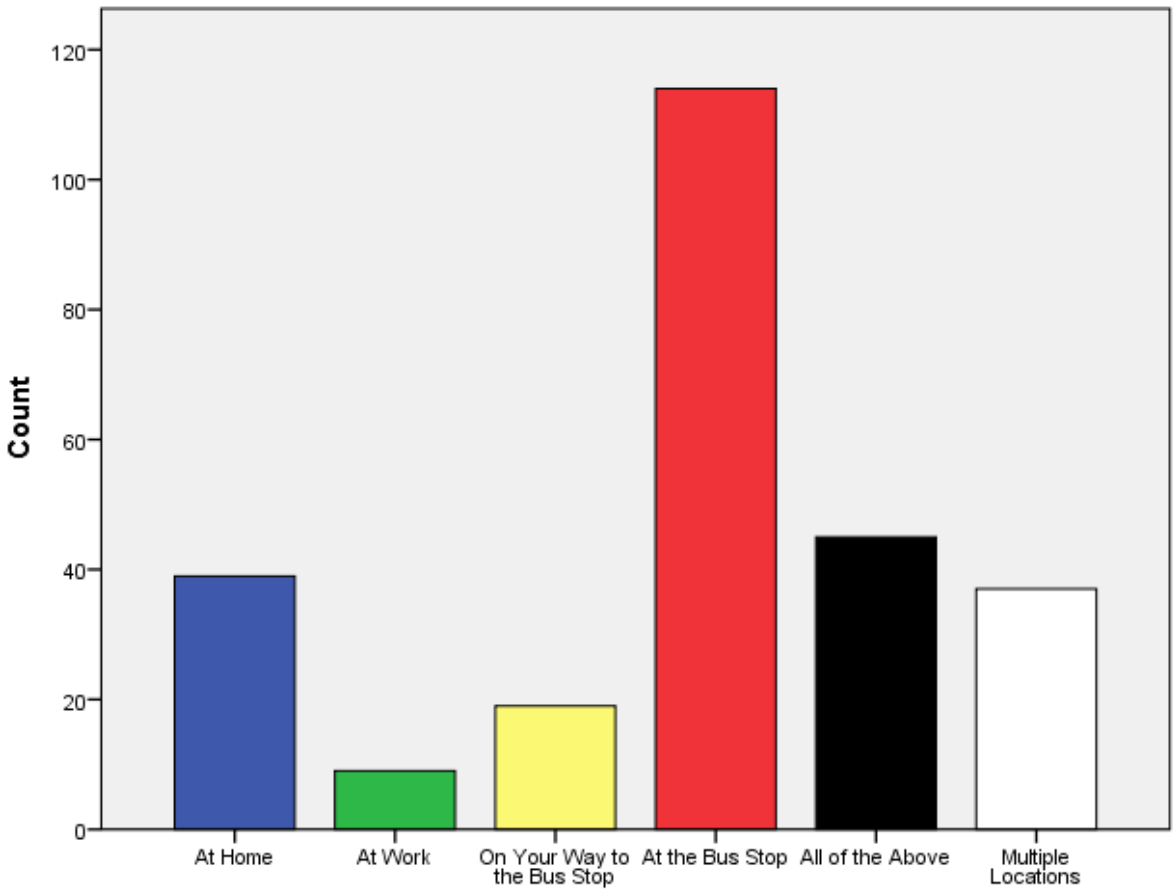


Source: After Author

The most common method of accessing RTPI aside from the electronic display was via a mobile phone application. Of the 330 people surveyed 96 of them used the mobile phone application; this is a large percentage of people amounting to 29% of the respondents. It is also a much higher amount than its closest rival which is the use of the internet via a computer; 55 of the 330 respondents stated that they use the internet via a computer to access the information. There are a number of potential reasons for the mobile application being more popular than the computer. In a situation where you could miss the bus by seconds a computer would take just that little bit longer. Furthermore the mobile phone application is much more accessible being portable. People can access the information when they are at home or in the city on their way home meaning it serves a much broader range of areas. Finally the least popular method

used to access the RTPI was the text message with a modest 21 of the 330 respondents (6%) stating that they use the text service. As asserted by Caulfield (2009) 'People are very price sensitive when it comes to paying for RTPI'. This would further reinforce why the RTPI electronic displays at the bus stop are the most popular method of accessing the information. It would seem with the electronic sign being the most popular, the smartphone application next and finally the text message, respondents use the device which gives the greatest ease of access.

Figure: 4.16



Source: After Author

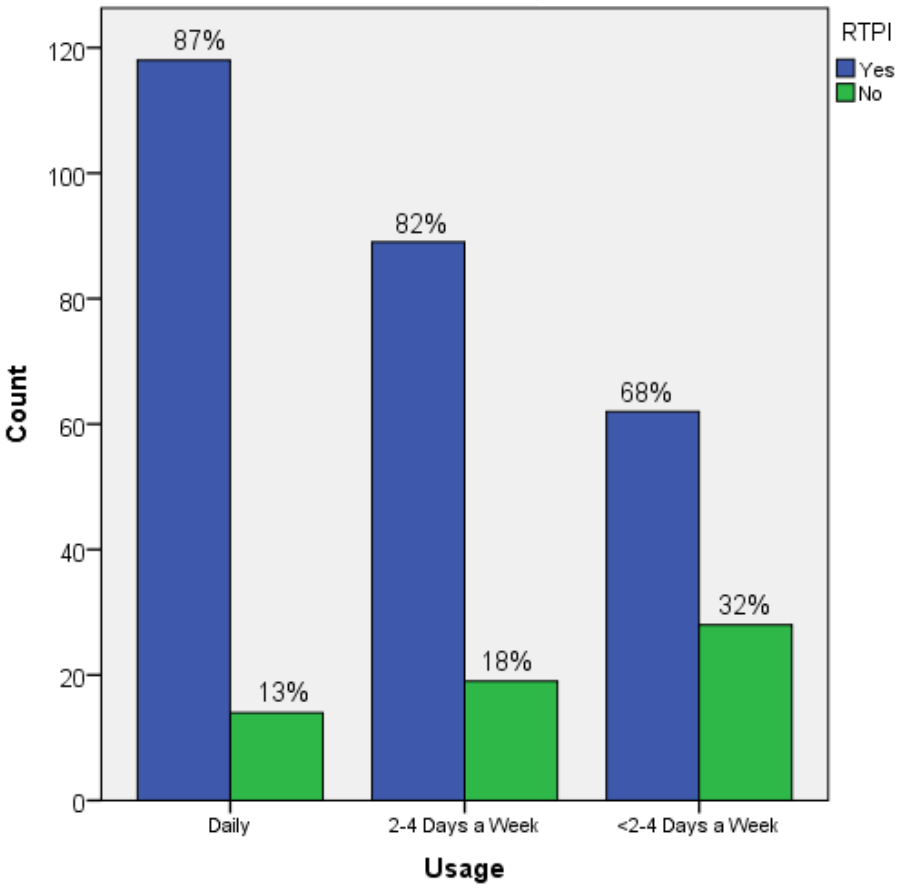
Figure: 4.16 demonstrates when is the most popular time to access RTPI. At home was quite a popular method of accessing the information. Of the 330 respondents 39 of them

stated that they only accessed ‘At Home’. 19 of the 330 respondents only access the information on their way to the stop and again access to the information at the stop was most popular with 114 of the 330 respondents only accessing the information at the bus stop.

4.7 Bus and Real Time Passenger Information Usage

Cross tabulations were undertaken in an attempt to examine the relationship between the amount of times a week the passengers use the bus and their use of RTPI. It is evident from the results displayed in figure 4.17 that the passengers who use the bus on a daily basis tend to use the RTPI more frequently. Only 13% of the passengers who use the bus on a daily basis don’t use the RTPI. As one progresses onto 2-4 days a week there is immediately an increase in the number of people not using the RTPI with 18% of these passengers not using the RTPI. Finally there are the people who use the less than 2-4 days a week. This trend continues with 32% of the passengers who use the bus less than 2-4 days a week do not use the RTPI. This information suggests that there is indeed a relationship between the regularities with which passengers use the bus and their use of RTPI. Respondents who use the bus less frequently seem to be less likely to use the RTPI service.

Figure 4.17 Bus and RTPI Usage



4.8 Reliability of Real Time Passenger Information

In order for a passenger to experience an excellent service, reliability has to be the main focus (Initag, 2012). The author therefore felt that a reliability study must be undertaken. Hickman et al (1995) found that on average the buses run at -1 minute and +2 minutes compared to the information displayed on electronic RTPI displays. Further according to (Worrall, 2012) quarterly surveys undertaken by Dublin Bus reveal a 93% accuracy rating of the RTPI. Both sets of results indicate a very accurate service that would satisfy most customers.

In Dublin in the majority of cases the RTPI was accurate. When all routes were taken into consideration the buses arrived on time 57% of the time. Although still accurate the

majority of the time a long way off the 93% that Dublin Bus are reporting. The buses that were arriving early or on time were on average a minute early, this is similar to the results of Hickman et al (1995). This does not however paint the overall picture. Although there was a high percentage of buses arriving early or on time (57%), the buses that arrived late were sometimes very late. It was not uncommon of a bus (13% of the time) to be between seven and ten minutes late. Of the buses that arrived late they were an average of four minutes late. A number of buses (3%) surveyed arrived twelve minutes late which is a far cry from the 57% of buses arriving on time. For the system as a whole the buses were on average one minute and thirty seconds late.

When the routes are broken down into low, medium and high frequency the results are similar but some interesting trends emerge nonetheless. The high frequency routes were the most accurate being an average of one minute and twenty seconds late. Next buses on the medium frequency routes arrived an average of one minute and forty seconds late; finally buses on the low frequency routes were an average of one minute and forty five seconds late. There are a few possibilities as to why the high frequency buses are on average the most reliable. They have the highest headway and are less likely to be held up by large crowds of patrons waiting to get on the bus at each stop. The high headway will clear the stops frequently and keep a smooth flow to the service. Lower frequency routes will likely have bigger crowds waiting at the stops and will cause slight delays.

Overall the reliability of the RTPI was very good. The arrival of the buses on average only varied from one minute early to one and a half minutes late. These times illustrate an effective and robust system that no doubt improves the overall bus experience for passengers.

4.9 Summary

This study examined, compared and related the primary data collected as set out in the research objectives at the beginning of the project. The key findings of the study can be summarised as follows:

The average age of the respondents was 33 with a pretty even split of 55% male 45% female. 47% of respondents were employed, with an average overall wage being €29,100 annually. Respondents were generally low to middle income earners. 82% of respondents used the RTPI in some way. As imagined the information seems to have been utilised by the younger generation with the elderly making least use of the system. Many elderly people seemed to be unaware that the service is also available on the internet or via a mobile phone. Furthermore 63% of passengers believed that the RTPI had improved the reliability of the bus and 54% of respondents felt that the RTPI itself was reliable. These figures all pointed strongly towards a successful service that was improving the overall bus experience of the user. Interestingly waiting times were the biggest frustration for people taking the bus for 55% of bus users. Possibly giving insight as to why so many people believed the reliability of the bus had indeed improved as many respondents felt that their waiting times had been reduced. Surprisingly it was the low frequency routes that had the lowest use of RTPI; this could largely be due to the lack of real time electronic displays at the bus stops in comparison to some of the higher frequency routes. Passengers in general on these routes seem to have found it more difficult to access the information. The low frequency routes also traversed through areas of low socio-economic status. This lessens the likelihood that a large amount of passengers would have access to ‘smartphones’ again reducing their chance of being able to access the information. 78% of users stated that they used the

electronic display at the stops. This method of access was the highest and as to be expected the mobile application was next most popular with 29% of people stating they used it. When it came to increasing the passengers bus use the data obtained was quite surprising. An overwhelming 30% of respondents said they now use the bus ‘more often’ since the introduction of RTPI. These are phenomenal figures and could in time help lead to a change in modal choice in cities internationally. Finally there is the reliability of the service; overall there service fared very well with predicted times being correct at least 57% of the time. There were however times when a rogue bus may be very late, nevertheless a very solid performance.

Chapter 5

Conclusion

5.0 Conclusion

5.1 Overview

This study achieved its overall aim; examining the effects RTPI has on the passenger's perceptions of the service, investigating the reliability of the RTPI and researching its potential role in generating further custom for Dublin Bus through the objectives set out at the beginning of this paper. A critical review of the relevant academic literature was conducted, covering a broad range of topics related to the initial study aim. Users of the bus and the RTPI were identified and primary data was collected through the employment of quantitative methods. The changes in passenger's perceptions were examined, as the hypothesis was that passengers wait time perceptions are improved by RTPI. The socio-economic profile and demography of passengers and users of the RTPI was studied. The difference in passenger's use of the RTPI between low, medium and high frequency routes was examined. Furthermore, what is the most popular method of access of the RTPI was studied along with what the passengers see as the most frustrating aspect of taking the bus. Finally whether or not the RTPI has encouraged passengers to take the bus more frequently was examined. The methodology of this project was described in great detail to explain how the quantitative data was collected, and the results comprehensively presented in a robust manner.

5.2 Conclusions and Recommendations

The ensuing conclusions were drawn from the results obtained throughout the study. The study on RTPI was indeed undertaken in Dublin, but the results obtained are presented to be viewed on an international level for improving RTPI and understanding passenger's perceptions of the bus services as a result of RTPI.

5.2.1 Real Time Passenger Information and Ridership Increase

General Conclusion

The literature on this subject was somewhat muddled, much saying that RTPI does indeed increase ridership numbers. The other argument being that concrete results that definitively shows an increase in ridership simply has not taken place. From the authors findings it became clear that if the passengers used RTPI it was highly likely that they would be more willing to use the bus more frequently.

Recommendation

Dublin Bus and the City Council should now use this as a stepping stone to increase ridership numbers for public transit. The RTPI should be the first in a long line of improvements that are added to the bus service. Possibly the next step that could be taken would be a bus priority system that would further increase the attractiveness of public transit. Bus priority involves giving the bus the priority over other vehicles at intersections and traffic lights. For example if a bus was approaching the traffic lights the light would become green in the direction of the bus to allow them to pass through

efficiently and on time. This would undoubtedly improve bus punctuality and with time possibly increase passenger numbers.

5.2.2 Socio-Economic Profile of Real Time Passenger Information Users

General Conclusion

It was found that the majority of Dublin Bus users were of a medium to more predominantly low socio-economic status. It was initially foreseen that people of a lower social class would find it more difficult to gain access to RTPI. This did in effect seem to be the case as the bus routes that traversed through the areas of the lowest social standing had the lowest rate of usage of RTPI.

Recommendation

In order to maximise the potential of RTPI it must be made equally accessible to all users of Dublin Bus. This would be aided by placing more RTPI signs along the lower frequency routes. This gives people a greater chance to benefit from the RTPI. Furthermore on the routes that traverse areas of lower social ranks more electronic displays will give a much broader group of bus users the chance to benefit from the real time service.

5.2.3 Demography of Real Time Passenger Information Users

General Conclusion

It became apparent quite quickly while the author was undertaking the survey that the younger bus users use a much broader range of devices to access RTPI than the older demo graph. 60% of students surveyed used RTPI on the electronic displays as well as at least one other device, whereas 87% of the older demo graph only used RTPI at the bus stop.

Recommendation

In order for the RTPI to attract new riders to the bus and to reach its full potential, the current imbalance of usage between the youth and the elderly needs to be addressed. It is recommended that older people are made more aware of the different devices that can be used to access the information. This may be achieved through an advertisement campaign to promote RTPI and reach the older generation.

5.2.4 Passenger's Perceptions and Real Time Passenger Information

General Conclusion

From the data collected it became clear that the original hypothesis was proven that passenger's wait time perceptions at bus stops are improved by RTPI. A great majority of passenger's believe that the amount of time they spent waiting at bus stops had significantly been reduced. The RTPI has the ability to improve passenger perceptions and thus improve customer satisfaction for Dublin Bus.

Recommendation

This huge benefit of the RTPI has to be maximised by Dublin Bus. They must use this improvement in passengers wait time perceptions as a spring board to increase ridership numbers. Through advertisement they must try and gain a modal shift from car to bus by getting the positive feedback of the current bus patrons to people who use privately owned vehicles. Even if a small modal shift occurred it would still be worth it and would give Dublin Bus something to build on for the future.

5.2.5 Methods of accessing Real Time Passenger Information

General Conclusion

As expected the electronic display at the bus stops was the most popular method of accessing the RTPI. Its ease of access meant that a very large percentage of passengers had access to it. However, more importantly of the other methods of accessing the information the mobile phone application was the most popular with 33% of respondents stating that they used it to check the RTPI. It would appear that device popularity has a lot to do with how efficiently the information can be accessed and the ease of access. The electronic display is the easiest way to access RTPI. The mobile phone is more efficient than other methods as one can access the information on the move, whereas for example with the computer one can realistically only access the information from a set location like at home or work.

Recommendation

Firstly everybody must be made aware of the availability of the RTPI on mobile devices and the internet. A number of elderly people had no idea that such a service was available. Again people of lower socio-economic standings and elderly people need to be shown and encouraged to use all methods of accessing the information so as to improve their overall bus experience.

5.2.6 Real Time Passenger Information and Reliability

General Conclusion

It was found that the reliability of the RTPI was quite high. The real time displays were generally very accurate with buses arriving between 1 minute early and 2 minutes late. However it was not uncommon to have a stray or rogue bus that would appear between 7 and 10 minutes late. These buses however were reasonably rare.

Recommendation

Dublin Bus along with the City Council must continue to provide an accurate service. Improvements can still be made however. These agencies should further attempt to curb the amount of stray buses that arrive very late. If this can be remedied there would be an extremely robust and accomplished service provided by both agencies.

5.3 Summary

This paper has found that RTPI can play a significant role in the promotion of public transit use in Dublin. The service has a strong future ahead of it and could possibly be the start of a revamping of the whole bus system. The RTPI system has already been introduced to Cork City and with Waterford, Limerick and Galway lined up to receive the service, it is clear that passengers are soon going to become dependent on the service to plan all of their journeys be it short or long.

The system allows bus patrons to make well informed decision with regard travel and can potentially play an important role in connectivity between different types of public transit. Considering the benefits that this service can give to not only bus companies but to urban life as well, it is clear that planners internationally are putting more and more thought into RTPI.

Overall this study has helped contribute to the literature of transport planning, not only in Ireland but internationally as well. It has provided interesting information and knowledge about the benefits of RTPI that can be applied to cities around the world.

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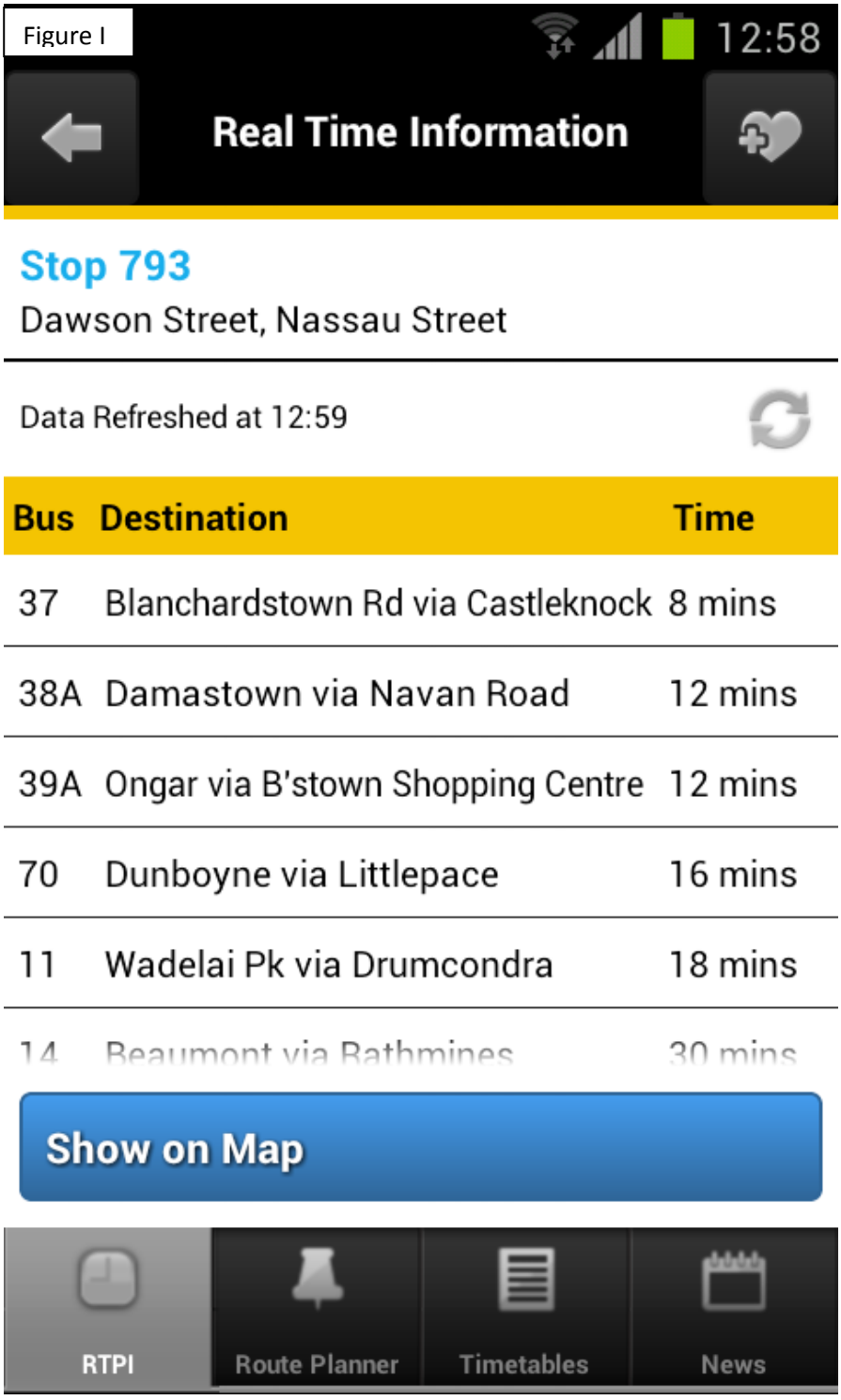
Appendices

Appendices

Appendix A

The following are images of the mobile phone application for RTPI and the Dublin Bus website that gives access to RTPI.

Figure I



Source: After Author

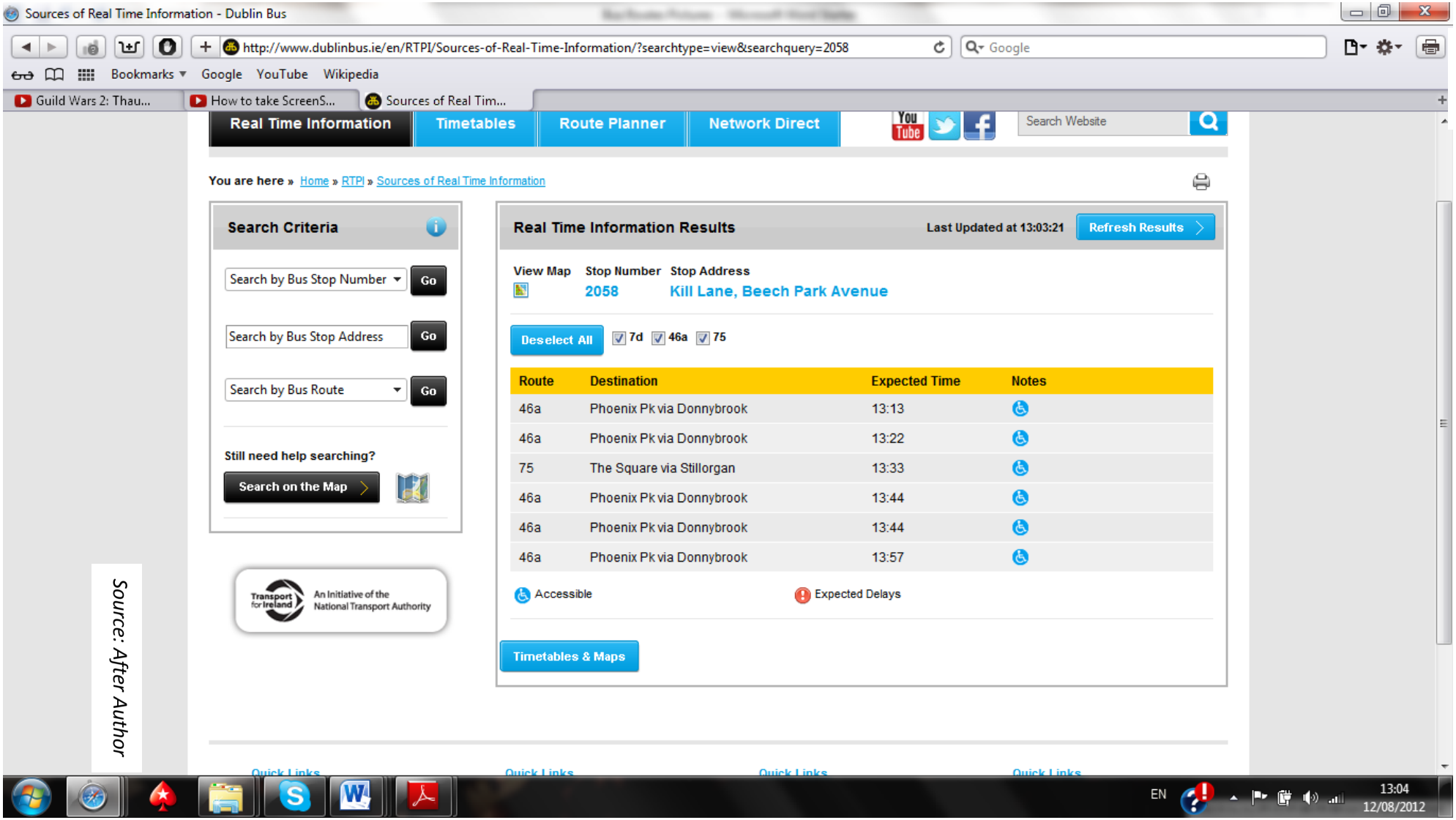


Figure II

Source: After Author

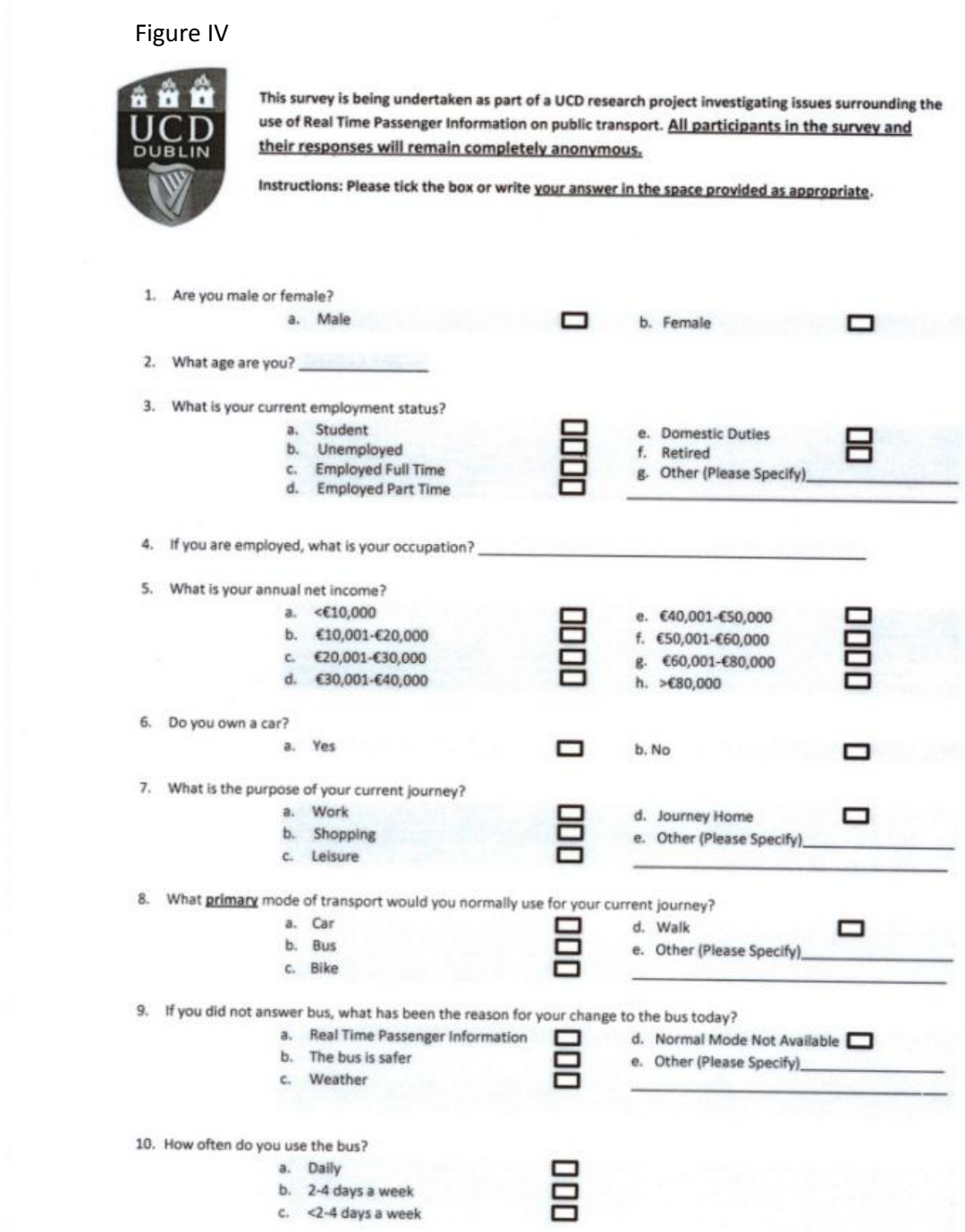
Figure III

Source: Dowling, T.

Appendix B

Figures IV and V are scanned images of the completed questionnaire before administration.

Figure IV



UCD DUBLIN

This survey is being undertaken as part of a UCD research project investigating issues surrounding the use of Real Time Passenger Information on public transport. All participants in the survey and their responses will remain completely anonymous.

Instructions: Please tick the box or write your answer in the space provided as appropriate.

1. Are you male or female?
   a. Male ☐ b. Female ☐
2. What age are you? _____
3. What is your current employment status?
   a. Student ☐ e. Domestic Duties ☐
   b. Unemployed ☐ f. Retired ☐
   c. Employed Full Time ☐ g. Other (Please Specify)_____
   d. Employed Part Time ☐ _____
4. If you are employed, what is your occupation? _____
5. What is your annual net income?
   a. <€10,000 ☐ e. €40,001-€50,000 ☐
   b. €10,001-€20,000 ☐ f. €50,001-€60,000 ☐
   c. €20,001-€30,000 ☐ g. €60,001-€80,000 ☐
   d. €30,001-€40,000 ☐ h. >€80,000 ☐
6. Do you own a car?
   a. Yes ☐ b. No ☐
7. What is the purpose of your current journey?
   a. Work ☐ d. Journey Home ☐
   b. Shopping ☐ e. Other (Please Specify)_____
   c. Leisure ☐ _____
8. What **primary** mode of transport would you normally use for your current journey?
   a. Car ☐ d. Walk ☐
   b. Bus ☐ e. Other (Please Specify)_____
   c. Bike ☐ _____
9. If you did not answer bus, what has been the reason for your change to the bus today?
   a. Real Time Passenger Information ☐ d. Normal Mode Not Available ☐
   b. The bus is safer ☐ e. Other (Please Specify)_____
   c. Weather ☐ _____
10. How often do you use the bus?
    a. Daily ☐
    b. 2-4 days a week ☐
    c. <2-4 days a week ☐

Figure V

11. Do you use Real Time Passenger Information?
    a. Yes ☐ b. No ☐

12. If you answered Yes, do you access Real Time Passenger Information?
    a. At Home ☐ d. At the bus stop ☐
    b. At work ☐ e. All of the above ☐
    c. On your way to bus stop (e.g. Walking, In shop) ☐

13. If you answered Yes, which device(s) do you use to access Real Time Passenger Information on?
    a. Mobile Phone (Using App) ☐ d. Text Message ☐
    b. Internet (Using mobile phone) ☐ e. Electronic RTPI Bus Stop Display ☐
    c. Internet Using Computer ☐

14. When is Real Time Passenger Information most useful to you? (e.g. Bad Weather, At night)

    _____

15. Which of these statements best describes your use of the Real Time Passenger Information?

    a. I use the bus **more often** since the introduction of Real Time Passenger Information. ☐
    b. I use the bus **less often** since the introduction of Real Time Passenger Information. ☐
    c. I use the bus **the same** amount since the introduction of Real Time Passenger Information. ☐

16. Do you consider the bus to be more or less reliable since the introduction of Real Time Passenger Information?
    a. More Reliable ☐
    b. Less Reliable ☐
    c. About the Same ☐

17. In your experience with the service to date, please state how reliable you think the Real Time Passenger Information is at stops?
    a. Very Reliable ☐ d. Unreliable ☐
    b. Reliable ☐ e. Very Unreliable ☐
    c. Neither Reliable nor Unreliable ☐ f. Don't Know/No Opinion ☐

18. What would you consider to be the biggest advantage of Real Time Passenger Information?
    a. Reduced waiting times ☐ d. Improved bus punctuality ☐
    b. Reduced uncertainty on bus arrival times ☐ e. Increased safety at night ☐
    c. Greater Reliability ☐ f. Other (Please Specify)_____

    _____

19. From your experience, what would you consider to be the most frustrating aspect of taking the bus?
    a. Waiting times ☐ d. Over-crowdedness ☐
    b. Traffic congestion ☐ e. Walk to the bus stop ☐
    c. Fares ☐ f. Other (Please Specify) _____

    _____

20. Do you think Real Time Passenger Information has improved your overall experience of the bus?
    a. Yes ☐ b. No ☐