Assessment of Service Quality and Satisfaction from Passengers Perspective to Inform Bus Operator Decision Making

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ACRONYMS

ATCO	Association of Transport Coordinating Officers
CA	Cluster Analysis
CAT	Child All-day Ticket.
CfIT	Commission for Integrated Transport
DETR	Department for the Environment Transport and the Regions
DfT	Department for Transport
DoE	Department of the Environment
DoT	Department of Transport
DTLR	Department for Transport, Local Government and the Regions
ENTCS	English National Concessionary Travel Scheme .
EOQC	European Organisation for Quality Control
FA	Factor Analysis
ITA	Integrated Passenger Authority
ITS	Intelligent Transport System
KMO	Kaiser Meyer Olkin measure of sampling adequacy
KS	Kolmogorov Smirnov test of statistical difference
KW	Kruskall Wallis test, a one way analysis of variance
LTP	Local Transport PlanKS
LTS	Local Transport Strategy
LTT	Local Transport Today
NBC	National Bus Company
NSR	Non Superoute
OECD	Organisations for Economic Cooperation and Development
OLR	Ordered Logit Regression
ONS	Office for National Statistics
PTA	Passenger Transport Authority
PTC	Public Transport Consortium
PTE	Passenger Transport Executive
PTEG	Passenger Transport Executive Group
QBC	Quality Bus Corridor
QBP	Quality Bus Partnership

QC	Quality Contract
QPS	Quality Partnership Scheme
RPI	Retail Price Index
SPSS	Statistical Package for Social Sciences
SR	Superoute
TfL	Transport for London
TPP	Transport Policies and Programmes
TRB	Transportation Research Board
TRL	Transport Research Laboratory
TSGB	Transport Statistics Great Britain
VIF	Variation Inflation Factor

ABSTRACT

This research considers important aspects of bus service improvement through a detailed investigation of bus operations and service *quality* initiatives introduced in the context of an informal Quality Bus Partnership (QBP). Passengers' views of the quality of bus service improvement were studied by comparing routes which have experienced significant improvements in quality (Superoute services, SR) with those that have not (Non Superoute services, NSR) using Tyne and Wear, UK as a case study. How seventeen service quality attributes influence passenger *satisfaction* in the context of their perceived importance, is investigated. Five different statistical analysis approaches, namely Descriptive, Importance and Satisfaction Analysis (ISA), Factor Analysis (FA), Cluster Analysis(CA) and Ordered Logit Regression (OLR) were adopted to endorse underlying patterns in the data and thus to add credibility to the final results. Three groups of quality attributes resulted from the Factor Analysis the first, with ten attributes, related to Service infrastructure (including cleanliness of buses and bus stops, personal security, duration of journey and cost of tickets), the second, with five attributes, was Bus Operation (including frequency of services at weekends and on a Sunday and reliability of bus arrival) and finally with two attributes, Ticket Purchase (whether purchased on the bus or at Travel Centre). Four clusters of passengers emerged from the cohort and these were used as a basis to improve understanding of the relative *importance*, and their associated levels, of *satisfaction* of the quality attributes according to the characteristics of particular passenger groups.

Finding information about bus routes, security on the bus and at bus stops, conditions of shelters and friendliness of drivers emerged as improvements resulting from investment in SR. A much different picture emerged for the four cluster groups. The only groups that exhibited a higher proportion of SR users, mainly female senior citizen shoppers were satisfied with all 17 attributes, whilst the similar cohort of mainly NSR, were dissatisfied with all 17 attributes and all attributes were considered to be important. Younger adults mainly NSR users considered reliability as the only important attribute with which they were dissatisfied. Dis*satisfaction* for the 'cost of tickets' was prevalent throughout all passengers irrespective of whether NSR or SR however, SR users appeared to always be more satisfied with lower importance indicating investment has led to the perception of improvements in value for money. The results showed consistently that SR Likert scores for *satisfaction* were higher than other services whilst the *importance* scores were in the main statistically similar. The OLR showed that the quality attributes that influence the overall rating and overall quality of the service were found to be different. The results of this research provided evidence that SR services introduced, as a voluntary QBP, have influenced passenger satisfaction and lead to evidence with potential to influence the decisions of bus operators regarding investment.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The policy to deregulate the bus industry introduced in 1985 empowered bus operators to control the operation of services and fares of local buses in the UK (except London). The open market allowed direct competition which is based on price, service and quality (Hibbs, 1997a; Hibbs, 1997b). White and Farringdon (1998) found that 13 years after deregulation, whilst passenger journeys in 1985 had increased by twenty five percent in London, and they had fallen in the rest of the UK by thirty five percent and Docherty and Shaw (2003) presented evidence to show that fares had increased in real terms. By 2009 passenger journeys had increased by 88 percent over 1985/86, in London and had reduced to 50% in English Metropolitan areas (DfT, 2009c).

The general opinion suggests the current demise of the bus industry, outside London, is due to the failure of deregulation (White and Farrington, 1998; Docherty and Shaw, 2003) Consequently, the government, under the Transport Act 2000, has introduced the idea of voluntary Quality Bus Partnerships (QBP) to encourage local authorities and bus operators to work together to deliver schemes with more emphasis on the *importance* of quality in bus service provision. QBPs have enabled local authorities to be proactive in reducing, or limiting, traffic congestion, improving reliability of bus journey times as a consequence. In January 2010 with the introduction of Quality Contracts (DfT, 2009a) giving new powers to local authorities throughout England to determine routes, timetables, fares and other aspects of bus services, one might argue is a step back towards bus regulation. The new powers will allow local authorities to decide which bus services are required in local communities and to be proactive in entering into contracts with operators to run those services.

The Transport Act (2000) requires each authority to produce a “bus strategy” and has made provision of powers for statutory Quality Partnerships Schemes and Quality Contracts to allow a local transport authority to determine the bus services to operate within the area. QBP have been seen as a tool to deliver the Government's pledge, in the context of the *Ten Year Plan* (2000), to increase bus patronage by 10%. Voluntary Quality Bus Partnerships (VQBP) focus mainly on delivering *quality* in infrastructure, both on and off vehicles, as well as in the service itself.

1.2 Research Motivation

Despite the *importance* of QBP initiative established almost 10 years ago, there has been limited independent research examining their impacts in depth. TAS Consultants have undertaken a three-year study of QBP prepared for the Department for Environment Transport and the Regions (DETR) (TAS Partnership, 2001). The research was based on data from local authorities and bus operating companies, as well as bus users. The results revealed a growth in patronage following the implementation of fourteen case studies (TAS Partnership, 2002). The increase in patronage was attributed to the QBP, and in another study by LEK Consulting, it was claimed that QBP represents good value in achieving modal shift (CfIT, 2004). (Mackie, 2001) cited one of the reasons that patronage in London had increased was because of the upgrading of *service quality* such as integrated ticketing, good information and travel concessions for elderly and disabled people. (Davison, 2006a) emphasised that more evidence is needed to evaluate whether or not QBP have achieved their objectives of attracting new users as well as to increase the patronage and suggested that, in order to create a good public transport system, there is a need to understand the unique characteristics of passengers and their perceptions of the *quality* of the service. Davison and Knowles hypothesised that all passengers have their own perceptions of the bus system and an improved understanding of these would better inform investment decisions.

Previous research (Parasuraman *et al.*, 1988; Carman, 1990; Cronin and Taylor, 1992; Teas, 1993; Brady and Cronin, 2001) confirmed that, when passenger expectations are met, *satisfaction* will be achieved and hence loyalty increases. In addition, service *quality* is important because by making buses more attractive than cars, modal shift is promoted with consequential reduction in traffic congestion. Understanding which service *quality* factors are the most *important* to passengers (or passenger groups) is crucial in influencing their *satisfaction* and provides evidence to inform wise investments by service operators. Indeed passengers' views of a bus service are very important (Stradling *et al.*, 2007a) and in their research of bus services, they used *'disgruntled'* as a measure of '*satisfaction'* to explore the relationship with *quality*. Surveys were carried out at interchanges and along Princes Street in Edinburgh which is the main shopping route in the city. The analyses used cross tabulation of *importance* and '*disgruntlement'* against 16 elements of *quality* by journey purpose, able-bodied and elderly impaired adults. The results showed that the average level of '*disgruntlement'* for enough crossings, safe crossings, pavement condition, security for people and trees and flowers, were higher for the older compared to younger adult pedestrians.

In this context therefore, the overall aim of this research is to obtain qualitative data on passengers' views of current bus services and to evaluate the effect of public transport improvement on *satisfaction* in relation to a range of *quality* factors such as reliability, punctuality, information provision, cleanliness, etc. as promoted under the QBP. Figure 1.1 explains the linkage of the emergence of research gaps for this research. The research model was developed to understand the relationship between bus service *quality* (A), *importance* (B*)* and *satisfaction* (C), which is expected to have a significant impact on behavioural intentions (D). In relation to this research, perceived *quality* and passenger *satisfaction* are proposed as key drivers of investment in bus service performance. Passengers value the service *quality*, and that influences *satisfaction* which in turn drives the intentions to use buses more. Bus service provision from the operators' perspective is governed by Policy and Regulation, which, to a greater or lesser extent, influences the **Economic** (fares and distance travelled), **Physical** (vehicles, routes, infrastructure, bus stops, shelters) and **Operational** (frequency, reliability, punctuality). The purpose of this research is to evaluate specific service *quality* attributes individually and of the service overall in the context of perceived quality in terms of what is deemed to be important and the resulting level of *satisfaction*. In this way those quality attributes in which the operator should invest are identified for groups of passengers with different demographics with view to influencing behavioural intentions.

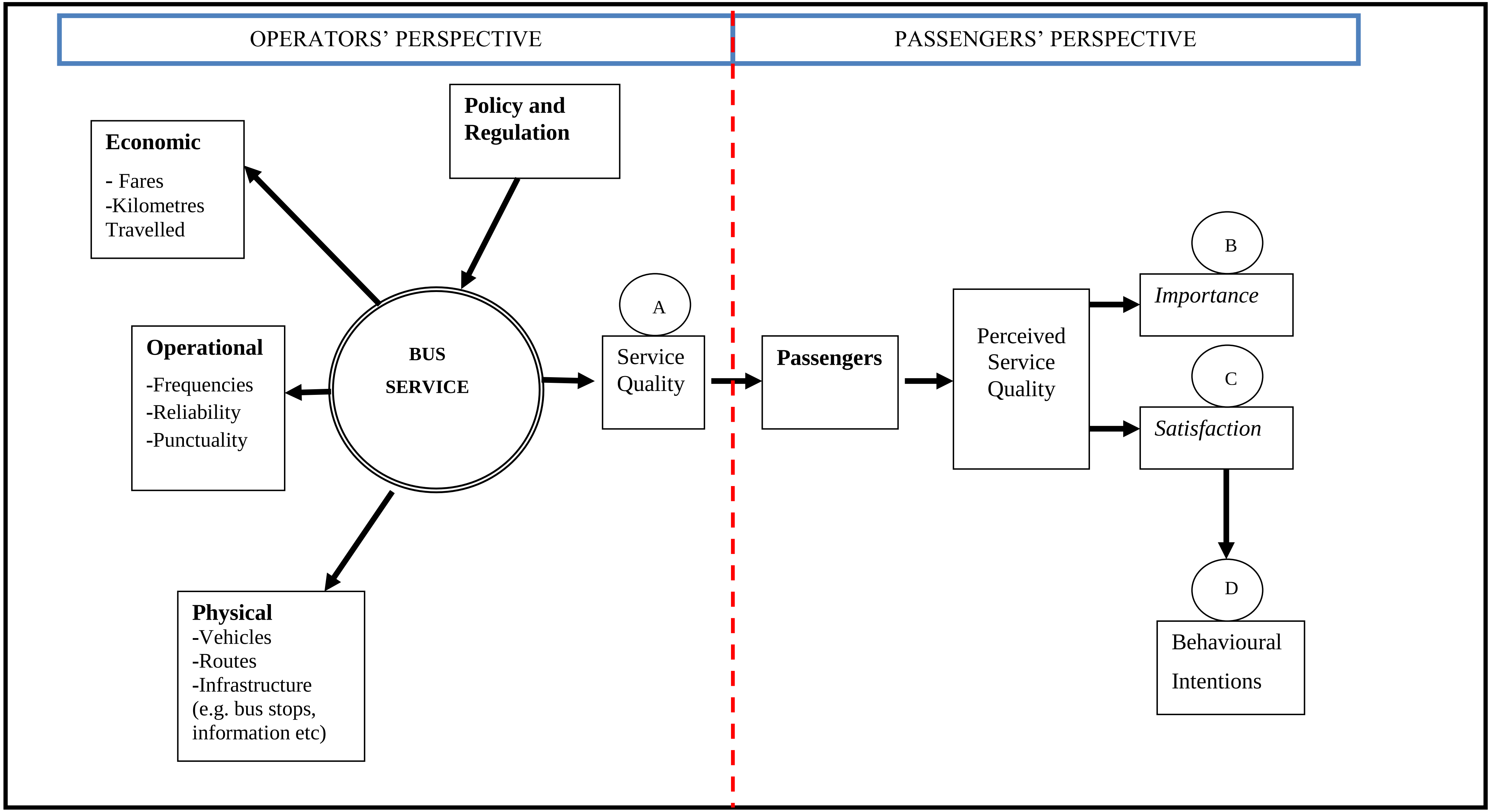

Figure 1-1 : Bus Service Measurement from Passengers' Perspectives

1.3 Aim and Objectives

1.3.1 Aim

The aim of this research is to provide evidence that bus service improvement has influenced passenger *satisfaction*. This will be achieved through an investigation of the association between bus *quality* attributes which are *important* and lead to passenger *satisfaction,* and for different passenger groups and thus to collate evidence to influence the decisions of bus operators regarding investment.

1.3.2 Objectives

The specific objectives are:

1. To carry out an in depth state of art review to define the policy context, the research methodology and analytical approach.
2. To develop data collection methodology and analysis procedures appropriate for a study of passenger perceptions of *quality* of bus services.
3. To understand the characteristics of the sample population of bus passengers engaged in this research.
4. To identify which factors are *important* and contribute to passenger *satisfaction* with particular reference to *quality* measures implemented by a Quality Bus Partnership.
5. To explore how *quality* can influence passengers perception by comparing their perception on two different types of bus routes; a route with and without bus service improvement.
6. To establish any differences in the perceptions of which quality attributes are *important* and result in *satisfaction* as a function of socio-demographic characteristics such as age, gender, employment status and purpose of journey.

7. To explore perception of safety and the effectiveness of the branding of the services in raising the awareness of passengers for the improvements in service quality through QBP initiatives.
8. To identify which *quality* factors have a predictive effect on the overall rating of bus service and quality.
9. To collate the findings of the different analytical approaches adopted, to inform future investment strategies for bus operators.

1.4 Case Study

This research took advantage of a QBP scheme known as Superoute introduced within the County of Tyne and Wear, North East of England. The research concentrated on services which have no bus improvements and services that have bus improvement through the *Quality* Bus Partnerships (QBP) scheme.

1.5 Framework of Thesis

The reporting of this research was organised into five chapters. ***Chapter 2*** presents an overview of transport policy and trends and describes the current state of art of research into *quality* and *satisfaction* including all relevant cross disciplinary perspectives from tourism, health, business and marketing. Also, this chapter appraises related bus policies which involves collection of information from existing government policies and previous studies. ***Chapter 3*** describes the methodological approach to the research and covers sampling, data collection, and data analysis. Chapter three describes the case study, the questionnaire design and articulates the statistical methods that form the basis of this study. ***Chapter 4*** presents the framework of the analysis used in the research and elaborates the details of the descriptive and gap results. ***Chapter 5*** develops the importnance and satisfaction analysis (ISA) highlighting the limitations of the analysis technique and details the results of the factor analysis of passenger perceptions. ***Chapter 6*** presents the results of the Cluster Analysis and the ISA on the four groups of data that emerge. ***Chapter 7*** presents the analysis of Ordered Logit Regression Analysis and interpretation of results. ***Chapter 8*** integrates the results over the five statistical analysis adopted in this research and presents a critique of the findings that emerged from this study and outlines the limitations of the work. Finally, ***Chapter 9*** concludes the thesis and presents the original contribution of this research, recommendations to the bus operators and other stakeholders and makes suggestions for further work.

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction

This chapter reviews the history of measures to improve bus services in the United Kingdom since deregulation was introduced in 1985. In particular, this review focuses on improvements in relation to *quality* and passenger *satisfaction*. In the following section 2.2, an overview of road based public transport policy in the United Kingdom (UK) since 1985 is given detailing the development of the industry's regulatory structure. Section 2.3 outlines the background of Quality Bus Partnerships (QBP). Section 2.4 elaborates the challenges of quality contracts followed, in 2.5, by a description of measurement of bus service quality. The relationships between patronage, quality and passenger *satisfaction* are presented in section 2.6 providing the basics for articulating in Section 2.7 the Importance and *Satisfaction* analysis used in this study. Section 2.8 details the statistical analysis methods used in this thesis, the chapter is summarised in Section 2.9. This chapter addresses the first objective namely to carry out an in-depth state of art review to define the policy context, the research methodology and analytical approach.

2.2 Overview of UK Bus Policy

In 1984 the White Paper reported that passenger kilometres made by bus gradually declined from 42% in 1953 to 24% in 1963, 13% in 1973 and 8% in 1983 (DoT, 1984). In addition, revenue support from local authorities increased from £10 million in 1972 to £490 million in 1982, along with a 30% increase in the cost of service provision which was double the Retail Price Index (ONS, 2006). The higher cost of service provision led to a year on year increase in total subsidy provided by the government.

There were also other factors contributing to the decline in patronage such as a 30% increase of fares from 1972 to 1982, an increase above the rate of inflation in England (DfT, 2006). The White Paper suggested the abolition of Road Service Licensing outside London to deregulate the public transport sector in an attempt to make it more competitive.

2.2.1 UK Transport Policy from Mid 1980s up to the late 1990s

Deregulation was introduced in Britain's bus industry in 1985 under the Conservative Government. Deregulation is relatively free from rules and regulation and can be defined as a mechanism to encourage the evolution of natural monopoly (where the bus operators have full control over the market) in order to encourage the efficiency of operation of bus systems (Glaister *et al.*, 2006). Deregulation allows free entry and competition for bus service operators and is 'laissez-faire' where the government does not intervene but instead allows the market to decide what is needed. Whilst (Hibbs, 1985a; Hibbs, 1985b; Hibbs, 2003; Hibbs, 2005) strongly supports deregulation in the bus industry drawing attention to the fact that overregulation of business is thought to spoil innovation by creating delays through increased bureaucracy and the obvious alternative is deregulation Hibbs (1985a).

The 1985 Transport Act was initiated by the White Paper *Buses* (DoT, 1984). Deregulation day was implemented on 26th October 1986 across the United Kingdom, except in Northern Ireland and Greater London where the buses remained in public ownership. The Transport Act 1985 allowed for any operator to run any service or introduce changes, such as the new service, timetables and also service withdrawals, subject to 56 days advance notice. In the case where routes were not commercially viable, but are important to the public (i.e. have social need), the Passenger Transport Executive (PTE) took over responsibility.

The Act therefore introduced two types of service; 'commercial' and 'tendered'. Commercial services are operated without receiving any bus subsidy from the government and bus operators have full control over the fares. The tendered services not commercially profitable generally run in early mornings, late evenings, Sundays or in rural areas. The PTE have the powers to place a tender on the respective routes so long as the cost is not considered expensive by Local Government (DoT, 1984).

Since bus deregulation, per capita car ownership in Britain has risen from 34% in 1985 to 55% in 2000 (TAS Partnership, 2002). A report by the (DfT, 2009f) highlighted that private car ownership has increased from 16.4m in 1985 to 27m in 2008. This has occurred at the same time as a decline in numbers of bus passengers. As shown in Figure 2.1 where the number of passenger journeys in millions, since deregulation was introduced in the United Kingdom in 1985, is presented. TAS reported that lower investment in the bus industry, poor perceived *quality*, and higher fares are among the factors that contributed to the increase in car ownership. Figure 2.1 shows the number of passenger journeys in millions since deregulation was introduced in the United Kingdom in 1985.

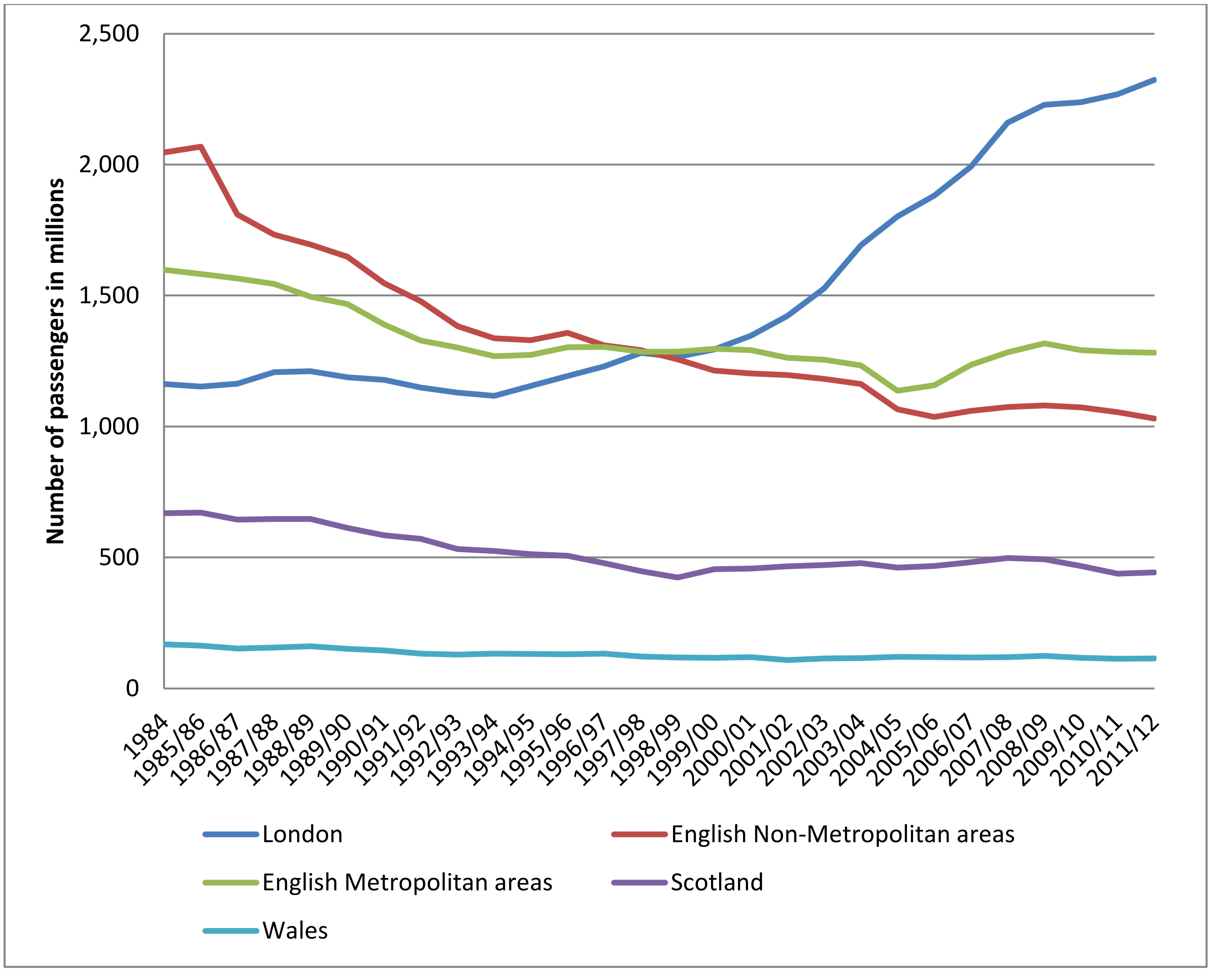

Figure 2.1: Passenger Journeys on Local Bus Services by Area

Source: (DfT, 2011),(DfT, 2012)

In total in the year 2011/12, there were an estimated 5.2 billion bus passenger journeys amounting to about two-thirds of all public transport journeys. In Scotland, bus passenger journeys have dropped from 687 million in 1985/86 to 515 million in 2008/09. Bus passenger journeys have fallen by 18% in English non metropolitan areas (from 1,636 million in 1985/86 to 1,335 million in 2008/09). Whilst in metropolitan areas, witnessed a 96% fall from 2,184 million in 1985/96 to 1,111 million in 2008/09. Similar decline has occurred in Wales where 166 million passenger in 1985/86, and only 124 million in 2008/09 (DfT, 2009e). However, in London, bus patronage has increased from 1,141 million bus passenger journeys to 2,149 in 2008/09, an increase of 88%. Therefore by 2006, in general there had been a steady decline in patronage in other areas except London. However, an increase of 0.6% in bus passenger journeys in England for the period of 2010/11 and 2011/12 was reported.

Fairhurst and Edwards (1996) in a study examining the bus trends in the UK, pointed out that improved service *quality* is one of the factors that has contributed to the increase in passengers in London accompanied with other measures, for example, the restrictions on parking and the introduction of travel cards. Another contributing factor to the success of the bus service in London is due to population size and income levels.

Bus deregulation in the UK has shown that it is possible to have competition in the local bus industry and accommodate procedures to enable subsidies for unprofitable services. LAs take responsibility for establishing and collating evidence for the social needs of non-profitable services and justifying the use of public money to subsidise them. The LAs set out the requirements and through competitive bidding, contracts an operator to deliver a subsidised service securing a commercially unviable service at the lowest possible cost (Glaister, 1993). The PTE control the fares, routes and journey times of the bus services. Proponents of deregulation argue that government intervention impedes the natural laws of supply and demand and ultimately increases costs to consumers.

The benefits of deregulation are derived from the competition among bus companies. Increased competitiveness among operators leads to better *quality* and higher efficiency of services. In addition, fares are lower which give people the freedom to choose the services that are best for them (Mackie and Preston, 1996). The cost of the bus service will come from the operators from profit gained from the services without burden to tax payers.

However, there are also disadvantages. Deregulation can lead to the over concentration of services in high demand corridors, contributing to congestion, as was the case in the 'Manchester Bus War'. There were problems in Nottingham in 1986 onwards as well. In real terms, deregulation has led to an increase in fares. In an unregulated market, there is a tendency for larger existing operators or bigger organisations to control both entry into and prices within the market.

2.2.2 UK Transport Policy Late 1990s up to 2000

Over a decade later, the change from a Conservative to Labour Government in 1997 initiated a series of policy documents, namely The Transport White Paper, A New Deal for Transport: Better for Everyone (DETR, 1998); its daughter document From Workhorse to Thoroughbred: a Better Role for Bus Travel (DETR, 1998); the 10 Year Plan (DETR, 1998); the Transport Act 2000 (DfT, 2000) and the Future of Transport White Paper (DfT, 2004a). Whilst Docherty and Shaw (2003) argued that informal partnerships are not sufficient to achieve an increase in patronage, A New Deal for Transport (1998) stressed the need for integration within and between all modes of transport, in order to improve accessibility for people and in a bid to increase patronage set out by the *Quality* Bus Partnerships (QBP). The '*Quality* Partnership' concept was introduced from the mid-1990s to cover the developments and initiatives by LAs and operators designed to improve the *quality* of bus services, and at the same time maximise the benefits to passengers. It also highlighted the *importance* of the role of a voluntary QBP to improve the *quality* of local public transport services and reduce or limit traffic congestion, noise or air pollution.

QBPs are a joint and voluntary initiative between LAs and bus operators set up to improve bus services by allowing LAs to set required standards on a route which operators would be required to meet prior to being allowed to operate and also to promote bus travel as a viable alternative to the car (House of Commons, 1999). QBPs do not allow the local authorities to set the fares and routes, which gives some limitations to what the authority can achieve. QBPs recognise the need for bus operators to drive the delivery of better service of buses and have encouraged industry led innovation and in some places, have led to increased responsiveness to passenger needs (Davison and Knowles, 2006). In Leicestershire, a new Quality Bus Corridor improvement between Leicester, Loughborough and Sheffield attracted 26% more passengers in its first year than what was forecast (LTT, Issue 337; Docherty and Shaw (2003). In Brighton and Hove, partnership between the LA and Brighton and Hove Buses has seen a wide range of measures introduced to improve services resulting in bus use in the city growing by 50% over the last 10 years (DfT, 2004b). Other successful QBP schemes are in Southend on Sea where a partnership exists between the Borough Council, Arriva Southend, First Essex Buses and Stephensons of Essex. Others include Brighton, Cheltenham, Edinburgh, Leeds, Kent, Havant, Leicestershire, East Gateshead, Wokingham, Hastings and North East Lincolnshire (Docherty and Shaw 2003).

2.2.3 UK Transport Policy in Early 2000s

The Transport Act 2000 (Great Britain, 2000) gave powers to the LAs so that they could take the lead in providing information (but not in defining fares and service levels) and guarantee a minimum of half fare concessionary for the elderly and disabled. Also, stated in the Act, to set in law, measures to improve the *quality* of bus travel, including the concept of *Quality* Partnership Schemes (QPS). A QPS exists between local authorities and operators and there is a statutory procedure for establishing, maintaining and enforcing them. LAs are required to prepare a local transport plan (LTP) outlining in detail a bus strategy, addressing the specific needs of their area.

The Integrated Transport White Paper, A New Deal for Transport (DETR, 1998) argued that informal partnerships are not sufficient to achieve increases in patronage (Docherty and Shaw, 2003). In addition to the proposals for statutory QPS, the idea of a *Quality* Contract (QC) was introduced. QC schemes were subsequently defined under Section 124 of the Transport Act (2000) as follows:

> *"A local transport authority, or two or more such authorities acting jointly, may make a quality contracts scheme covering the whole or any part of their area, or combined area, if they are satisfied that—*
> *(a) making a quality contracts scheme is the only practicable way of implementing the policies set out in their bus strategy or strategies in the area to which the proposed scheme relates, and*
> *(b) the proposed scheme will implement those policies in a way which is economic, efficient and effective."*

Transport Act 2000 (DfT, 2000), pp. 97)

The emphasis is on the role of partnership between local transport authorities and bus operators and allows the LA to define the bus services which operate within the area covered by the scheme. These must be approved by the Secretary of State for Transport before implementation. Table 2.1 reproduced from DfT (2009c), seeks to further clarify the Quality Partnership terminology. Bus service improvements have become increasingly important in the UK and it is clear that partnerships between the key players in the bus industry, namely local authorities and bus operators, are integral to its success. Among the most successful bus partnerships are those in York, Cambridge, Edinburgh, Ipswich, Leeds and East Midlands, although many other towns and cities have developed partnerships (Donald and Garner, 2001).

The successes have resulted from the introduction of initiatives such as enhanced service frequencies, bus priority measures – bus lanes, signal improvements etc., park and ride facilities, infrastructure improvements such as new bus shelters, raised kerbs, improved bus station facilities, provision of low floor buses, to improve accessibility, public transport service level improvements and public transport information – including timetable information, maps, websites, roadside information and interactive information terminals.

Table 2.1 : Quality Partnership Terminology

Initiative	**Terms**
Quality Bus Partnership (QBPs)	Voluntary Partnership • The LA usually concentrates upon providing infrastructure to enhance the attractiveness of the bus product • The Bus Operating Companies usually concentrate on providing an improved service with a high standard of vehicle, customer service and frequency • Can be on a formal or informal basis
Quality Partnership Scheme (QPSs)	Statutory partnership • The LA is legally responsible for providing and maintaining facilities to enhance the attractiveness of the bus product. • The Bus Operating Companies using the facilities are legally responsible for providing vehicles of the standard specified by the LA • The LA cannot impose service/frequency requirements on the Bus Companies
Quality Contract Scheme (QC)	Statutory Contract • The LA determines what bus services should be provided in their area and to what standard. They provide the facilities to enhance the attractiveness of the bus product • Contracts are let to suitable Bus Operating Companies for a maximum of 5 years, offering exclusive rights to the route and the facilities provided • As of 2004 *Quality* Contracts are restricted to areas served by LA also introducing levies on car users and diverting money from the local rail network
Voluntary Agreement	• non-statutory term *quality* bus partnership agreement • agreement entered into voluntarily by one or more LA and one or more bus operators, and possibly other relevant parties • involve a single route or even part of a route, or to a wider network of routes within the authority's area. • authority agrees to provide facilities or operational benefits and the operators agree to meet certain standards in return

Source: (Davison and Knowles, 2006);(DfT, 2009b)

2.3 QBP initiatives

Although QBP have been successful, they are only suitable for a limited number of routes. The Public Transport Consortium (PTC), representing LAs outside Metropolitan areas, believes that only 10 to 20% of routes in their areas are suitable for *Quality* Partnerships (CfIT, 2004). Of the remaining routes, the PTC believes that there is not enough potential for revenue growth to justify the purchase of new buses for example. This is because not every route has the potential to achieve the levels of growth being generated through the more successful partnerships. The evidence from PTC clearly shows that the approach will create a two-tier level of bus service: main routes in cities and major towns and some inter-urban routes will achieve growth in bus use, whilst the rest of the network becomes increasingly marginalised, receiving older buses and less marketing attention. In addition, QBPs do not allow agreements on service frequencies, timetables and fares, falling some way short of meeting all of the requirements of an integrated system. Existing *quality* partnerships may already be concentrating resources on a few routes to the detriment of others. As a result, QBPs, which are voluntary, do not guarantee an operator's commitment to frequencies or long-term service provision in an area.

In the context of QPS, however, LAs have the power to enforce *quality* standards such as improved ticketing for bus and rail services and better service information for passengers. There is currently insufficient information on how these measures influence bus usage. Under the Transport Act 2000 (DfT, 2000), LAs have a duty to determine what local bus information should be made available to the public and the way in which this information should be made available. LAs also have a duty to make arrangements with bus operators to ensure the information is provided. If operators fail to ensure the provision of the required information, the LA must arrange for it to be made available and may recover from the operator the reasonable cost of doing this.

The New Deal for Transport (DETR, 1998) and its daughter directives, namely the 10 Year Plan (DETR, 2000) aimed to encourage modal shift from cars to public transport. The 10

Year Plan gave the commitment from government to deliver a good transport system. However, letters from 28 Professors to the Secretary of State for Transport (TPS, 2002) expressed their concern over the direction of Governments' transport policy. In addition, Goodwin stated that the White Paper 1998 had the wrong approach and which represents one of the least successful areas of government achievement. The 10 Year Plan aimed to focus on traffic reduction and to reduce the negative effects of traffic growth. However, it would be a political backlash for the government if it were to be labelled 'anti-car.'

It is still questionable as to what the 10 Year Plan has delivered. In May 2002, a report published by the House of Commons Transport Committee presented evidence that the 10 Year Plan had failed to tackle the rising cost of public transport. The report did not focus on congestion enough, there was too much attention given to capital infrastructure, not enough attention on operations, management, education, finance and that the plan had no serious detailed time scale. The plan did not mention any action to monitor and assess the extent to which the objectives of the plan were achieved. Statistics presented by White (2008) suggested little progress had been made; bus passenger trips between 1996/97 to 2006/07 had dropped from 1,358 million to 1,109 million for English PTEs and from 1,303 to 1,269 million for the rest of England. The report Putting Passengers First (DfT 2006), published on 12th December 2006 identified concerns that services provided by operators did not meet passengers' expectations. It stressed the balance between the role of LAs and bus operators to ensure partnership and emphasised the need to create QCs.

In summary, the plan has not shown success in delivering the main objectives and brought no clear definition on future direction. Besides, the 10 Year Plan aimed to reduce car dependency whilst the 2004 White Paper, The Future of Transport, promoted a different type of choice; aiming to increase traffic by 17% and at the same time to reduce congestion levels by 6% (Docherty and Shaw, 2003).

2.4 The Challenges of Quality Contracts (QCs)

It can be argued that The Transport Act 2000 introduced a degree of re-regulation with QCs which again have been amended in The Local Transport Act 2008 (Great Britain, 2008). The new act stated that the QC must be the only solution to achieve the LAs objectives and replaced the approval procedure by the Secretary of State with an independent QCs Board (DfT, 2009d). The board comprises a traffic commissioner as the chairperson and two additional members appointed by the Secretary of State.

In a simpler terminology, QCs can be considered as the legal context of QBPs. QC is aimed to be fair and straightforward and able to control fares with specification of *quality* and the frequency of service. In addition a QC is believed to benefit passengers with improved bus facilities, for example integrated ticketing, integration with other transport modes and improved journey times due to the introduction of bus priority measures and also bus stops refurbishment and provision.

QCs are expected to improve network stability for the bus services and at the same time allowing the LAs to be able to control fares and service *quality*. Bus routes can be retained if they bring profit to the bus operators and can be secured as providing the services to the people. With this re-regulation, bus operators on the other hand are given more security and can invest in new fleets.

Mackie (2001) agrees with the provision of a QC in the Act with due consideration that such measures need powerful leadership at the local level which involves a robust monitoring scheme to ensure that the project is deliverable. Most local authorities prefer QC and it is considered as the best method to ensure the agreement between the LAs and bus operators. In December 2009, over 30 Members of Parliament (MPs), supported QCs in West Yorkshire and stated their reason based on the success of a similar arrangement in London where a high growth of passengers, as compared to any other areas outside

London[1] had been experienced. Preston (2003) in “The Bus Industry Under Labour” stated that QC is a case similar to that in London or the performance based contract that has been practiced in Australia and New Zealand. The bus operators protested the idea of QCs and emphasised that the decline in bus use originated from the regulated scheme. They stressed that the rest of the UK could not follow the London system because it is different and they are confident with the current bus partnerships. In addition to their arguments, figures quoted by the Passenger Transport Executive Group (PTEG) for passenger decline in the metropolitan areas, did not take into account changes in population. NERA (2006) further claimed that the increase of bus usage in London was not mainly because of the exemption from the deregulated bus policy, but was due to improved service *quality*, for example, improved reliability and condition of the buses. The patronage was affected by the higher number of tourists that rely mostly on buses, the population shift to London and congestion charging all believed to be the contributory factor to the patronage increase. Nevertheless, London is receiving bus subsidies.

The inability to agree a set of service frequencies is believed to be the main concern of QC. Among PTEs that have established a Statutory *Quality* Partnerships (SQP) (previously called, *Quality* Partnership Scheme) under the Transport Act 2000 are West Yorkshire and North Sheffield (491), 2008; Forster, 2008). The only difference between voluntary QBP and SQP is QBP is a voluntary agreement, while SQP is set out by the authority through a binding agreement. The DfT supports the way forward towards a statutory QBP where it places emphasis on the fact that it would be good practice for LAs to establish a formal governance structure. However, SQP allows the LAs to specify maximum fares, frequencies and timetables in a scheme, and at the same time improving the service *quality*. In supporting that, the bus operators need to agree with LAs in terms of frequencies and timings of the services. In a situation where a bus operator fails to deliver the agreed requirements under the QPS, the service can be withdrawn from the scheme and face the instigation of legal proceedings (DfT, 2000).

[1] (http://www.wymetro.com/news/releases/archive/2010news/091202)

In this context, Preston (2003) has commented on the lack of expertise in LAs to prepare a binding contract and argues that QBP may result in spending more on *quality* measures compared to the returns in terms of profit. CfIT (as cited in Preston 2003), the free travel for elderly, generally bring negative profit. Preston (2003) further commented that QC has more opportunity to achieve a balance of *quality* and price and also can prevent any misuse of subsidy to shareholders. He further suggested that QC should be implemented in one PTEs area as an experiment. The measures could include change in fares and the implementation of Intelligent Transport System (ITS).

Huntley (2001) stated that the implementation of QCs will ensure that the subsidised services can be managed in a more cost effective way, hence increase accountability of public support funding for the bus industry. However, (Hibbs, 1997a; Hibbs, 1999; Hibbs, 2005; Hibbs, 2007) disagrees with the applicability of the policy in a deregulated world. Further adding that the reregulation is using tax payers' money and its management will be complicated whilst DETR (1999) points out that the bus operators will lose their power of decision making.

Prior to the introduction of the QC scheme, PTEs had very little influence on the service *quality* in their administration areas. Given that fourteen percent of the bus funding is from the tax payers' money, it does not give equal return for what the public has spent and yet it was beyond the LAs' power to control the fares and timetabling.

In certain cases, the QC is suitable for application in small towns like Corby, Wellingborough and High Wycombe (ref). The QC gives the LAs powers to control bus scheduling, to facilitate integration with other public transport modes as well as fixing fares. This in turn encourages the competition among the bus operators to secure the tenders at the bidding stage. Another issue that has been highlighted is that the major bus companies have strong financial footing providing the ability to participate in the bidding, whereas the small bus operators are not be able to compete due to the lack of funding. When submitting tenders, bus operators have to wait a further 21 months in England and 6 months in Scotland prior to approval (DfT, 2009a). This will affect the current services for the bus operators and create instability in the service itself (Preston, 2003).

In addition, ATCO commented that the system will have a significant increase in procuring the services (DETR, 1999). The QC aims to control the monopoly of big companies, such as First and Stagecoach. However, despite this the system still allows the big companies to win the tender mainly because of their strong financial background. Therefore, it is believed that QC do not actually offer any significant changes to the current system (TAS Partnership, 2001). Subsequently any development on QC was placed on hold until the Competition Commission completed its review.

All initiatives whether QBP or QC have stressed the main principles of bus service provision is of course *quality*. The next section will discuss in more detail the background of *quality* explaining how the concept of 'quality' has evolved along with its relationship with satisfaction.

2.5 An Introduction to Quality

Early research by Parasuraman *et al.,* (1985) acknowledged that finding a definition of *quality* is complicated and suggested an approach which begins with the challenge of understanding what *quality* really means. The meaning of '*quality*' can be described as an evaluation from the customers' point of view (Parasuraman *et al.,* 1985). This is supported by Crosby (1979) who suggested that *quality* is a *means of conformance to the requirements* and it is about customers' perception of the value of the suppliers' work output and stressed that it is intangible and cannot be measured. This interpretation is supported by the European Organisation of Quality Control (EOQC) that defined *quality* control as *the degree to which a product meets the requirements of the customer*. In philosophical terms, Oakland (2003) defined *quality* as an approach of *right from the start* rather than *detect and correct*.

2.5.1 *Service Quality* as the 'intangible' characteristic of overall Quality

A *service* has been defined as a *deed, act or performance* (Berry, 1980; cited in Lovelock (1983). *Service quality* is defined by Parasuraman *et al.*, (1985) as *a form of attitude*. On the other hand (Parasuraman *et al.*, 1985; Zeithaml *et al.*, 1996) and (Crosby, 1979) have defined *service quality* as *how well the service meets or exceeds the customers' expectation*. The increase in the number of operators and the range of services offered has created competition and therefore marketing has become increasingly important. In this case, *service quality* is recognised as the prime driver and held high in any ranking of service attributes by most companies. In order to compete with other companies, the need for a very high *quality of service* has been recognised to be crucial to maintain a healthy business (Lovelock, 1983). In this way, companies will try to be different from their competitors (Lovelock, 1983). By offering good services, the companies can obtain profit for example from an increased market share and sales. Zeithaml *et al.*, (1996) suggested that every company should conduct a survey on *service quality* to identify problems in order to achieve a better level of service and secure current customers.

2.5.2 The underlying dimensions of Service Quality

In evaluating any service quality, the process of service delivery should be assessed (Parasuraman *et al.*, 1985). However, the three characteristics of service quality itself i.e. intangibility, heterogeneity, and inseparability make it difficult to measure service quality (Parasuraman *et al.*, 1985). Therefore, Parasuraman *et al.*, (1985, 1988) suggested that the most suitable method of determining service quality was to measure customers' perceptions. Parasuraman *et al.*, (1988, p.17) introduced a definition of perceived quality as the degree and direction of discrepancy between consumers' perceptions and expectations. Carman (1990) highlighted that perceptions and expectations play an important role in measuring overall quality.

Ekinci (2002) suggested that in defining what *service quality* is, there are two ideologies. The first is the North American ideology mostly dominated by the research conducted by Parasuraman *et al.*, (1985), whereas, Gronroos (1984) is one of the pioneers of the second, the Nordic European ideology (Ekinci, 2002). According to Gronroos (1988), the two dimensions of perceived *service quality* are technical and functional. The technical dimension is defined as *quality of the service delivered*. The functional dimension is described as how customers are influenced by *how they receive the service* and *how they experience the simultaneous production and consumption process.* Gronroos (1988) advocated that the technical dimension can be measured objectively, whereas, the functional dimension is usually evaluated subjectively. The operational image also has a large effect on the way customers perceive *service quality*. Furthermore, Gronroos (1984) highlighted that the technical and functional qualities of a service have a direct effect on an operation's image. Gronroos (1988) put forward six criteria of perceived *quality*; these include, a) professionalism and skills; b) attitudes and behaviour; c) accessibility and flexibility; d) reliability and trustworthiness; e) recovery, f) reputation and credibility.

Lehtinen and Lehtinen (1991), described a similar approach to measuring *service quality*. These researchers have both a three and a two dimensional approach. The three dimensional approach comprises of three components of *service quality* including physical, interactive, and corporate. The two-dimensional approach has two elements of *service quality* namely process and outcome. Both approaches developed by Lehtinen and Lehtinen (1991) are similar to the technical, functional, and image service qualities suggested by Gronroos (1988).

Figure 2.2 presents a conceptual model of service quality as proposed by Valerie *et al.*, (1990). The quality of service is presented from two perspectives, that of the customer and the service provider.

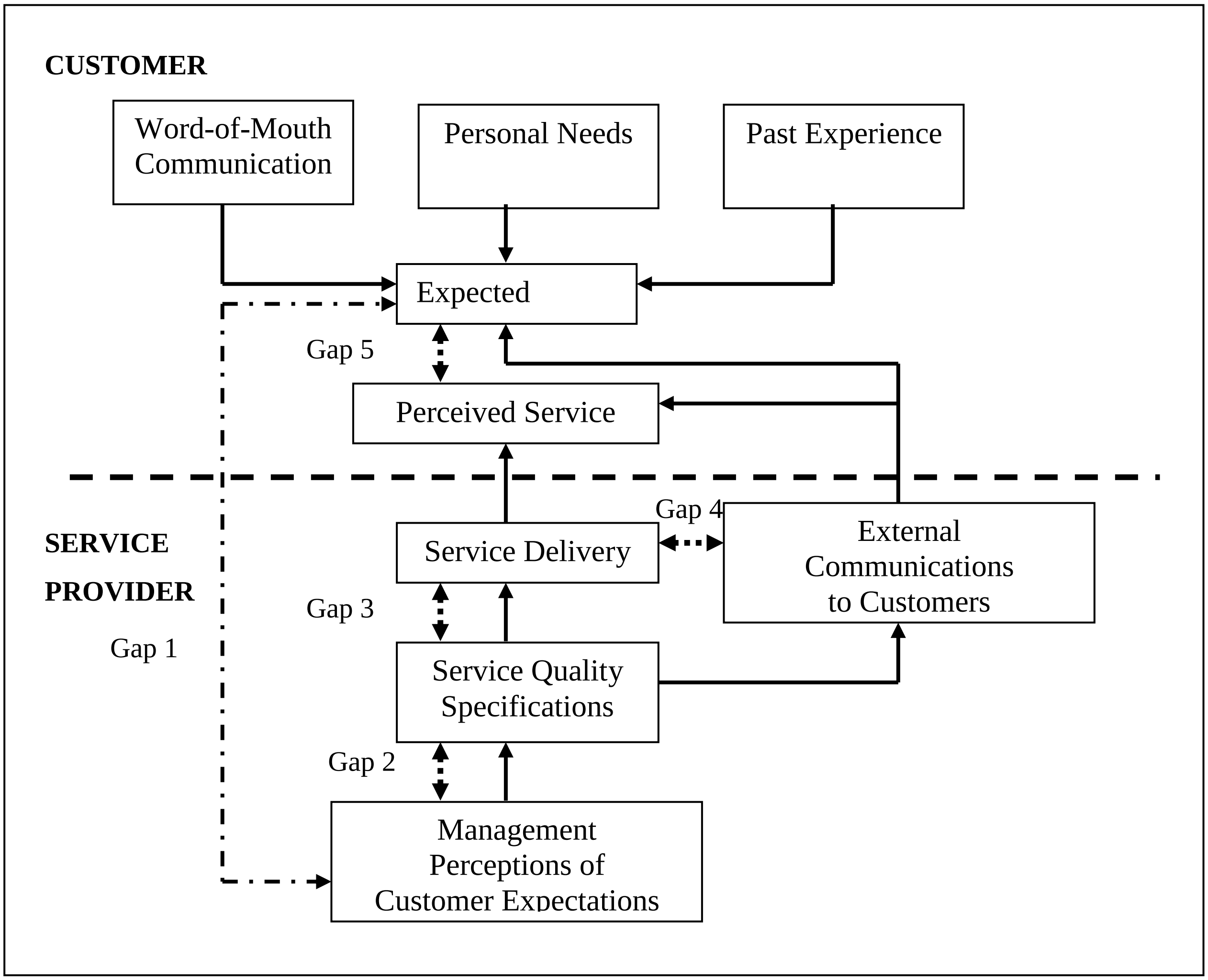

Figure 2.2: Conceptual Model of Service Quality

Source: Valerie *et al.*, (1990)

With reference to Figure 2.3, personal need to take a trip by bus is made possible by word of mouth communication and the passenger forms an opinion and reaches a level of expectation based on past experience. This expectation however can be influenced in either a positive or negative way by external communication with the service provider. Expectation is one thing, what may be more important is the perception of the service (which often is long lasting) and the extent to which this matches expectation. From the service provider perspective, the quality of the external communications and the service itself, are governed directly by the extent to which service quality is managing the expectations to ensure the passenger perception at least meets, but desirably exceeds, expectations.

Parasuraman *et al.*, (1985) established an idea to measure *service quality* through a 'gap model' in which they identified five gaps in service *quality*. (Gap 1) aligns management perceptions with customer service expectation. (Gap 2) informs the management perception the *service quality* based on *service* specifications. (Gap 3) provides evidence between management *service quality* specifications and the reality of the service delivery. (Gap 4) is mapping service delivery with the appropriate and timely external communications to customers and appertains to how companies inform the customers about their services. (Gap 5) potentially the most important, is the difference between the customers' expectation and their perception of the service which then can assist organisations in determining what the customer really wants (Parasuraman *et al.*, 1988).

2.6 Bus Service Quality Measurement

New Research into *quality* bus schemes, particularly those in North America and continental Europe, TRB (2004), suggests that the most successful schemes have been those with features which have, as closely as possible, replicated those of light rail schemes. Design features which have been found particularly important include:

- a system which largely operates on exclusive rights-of-way, typically with long distances typically between stations to ensure high vehicle speeds;
- attractive stations which offer a "waiting" environment suited to all weather conditions;
- high *quality* timetabling, including the provision of real-time passenger information;
- clearly and distinctively branded buses;
- off-vehicle fare collection which helps to reduce bus dwell times;
- quiet, easily accessible modern multi-door vehicles;
- a frequent, all-day "turn-up-and-go" service;

- the implementation of accompanying measures to improve traffic management, including bus lane camera enforcement;
- the provision of passing spaces in stations to prevent services being delayed by other vehicles loading and at bus stops; and
- fitting vehicles with tracking equipment to enable timely response to any incidents, which will affect journey times.

Bus operators have increased efforts to improve the *quality* of service whilst at the same time reducing costs, however, in the deregulated environment operators have to bear the cost of service improvements. As a consequence, operators have placed a high priority on identifying an effective method of measuring the performance of services to ensure the maximum return on investment. TRB (1999) in Transit Capacity and *Quality* of Service Manual have defined public transport performance measures to fall into one of three categories namely, operators, vehicle and passenger. Figure 2.3 illustrates the factors that measure public transport performance. From the operators' perspectives, quality can be measured through patronage and economic factors of the service, whilst vehicle based measures include capacity, speed and traffic signal delay and finally from the passengers' point of view reflecting their evaluation of how they perceive the *quality* of the service, for example comfort and convenience and availability of the service.

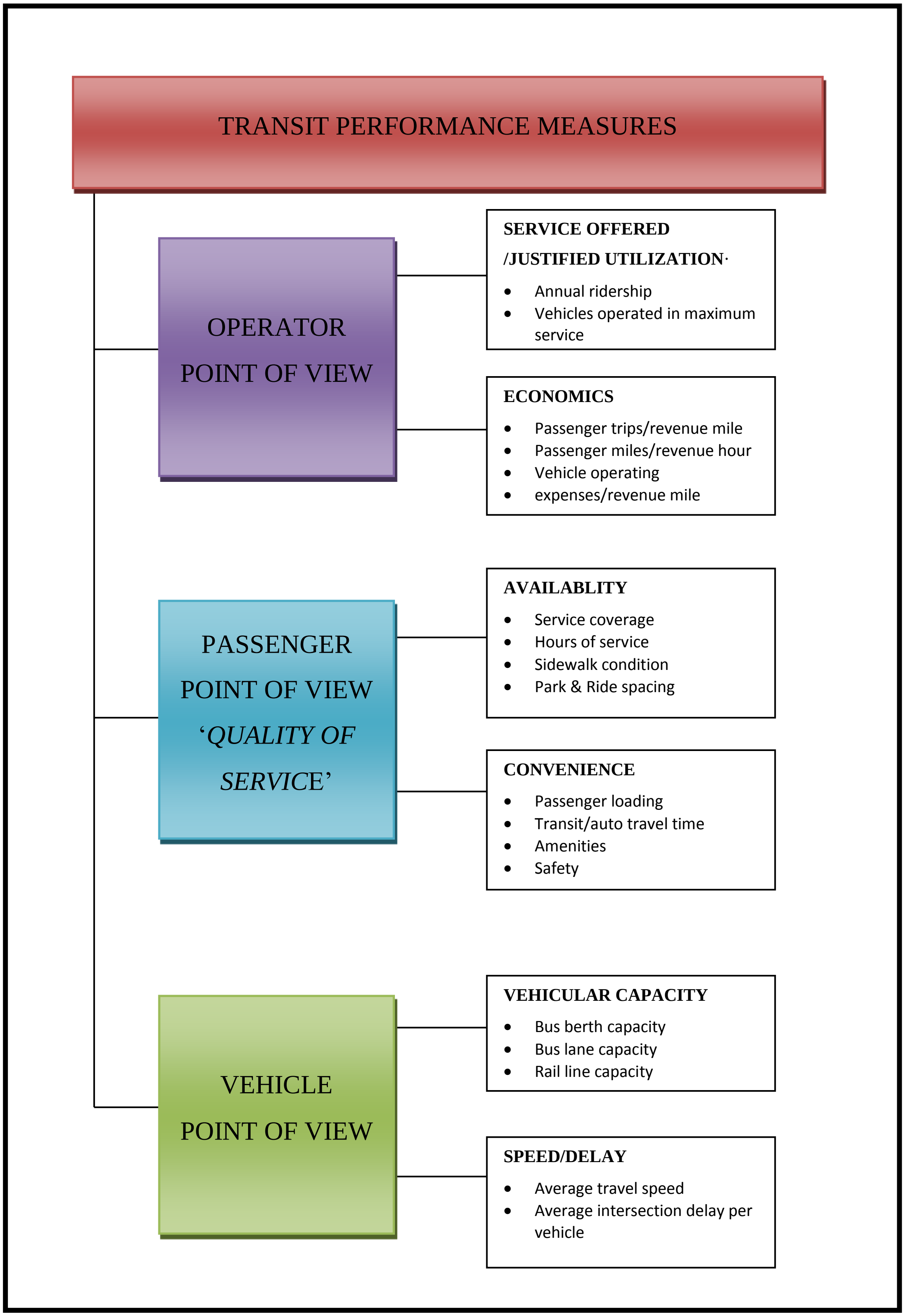

Figure 2.3: Transit Performance Measure Categories and Examples
Source : adapted from TRB (2004)

TCRP Report 100 (TRB, 2004) identified that a bus service can be measured through its passengers, vehicles and operations. Hensher and Prioni (2002) examined the Service *Quality* Index for contract performance based on passengers' perception. Hensher used the stated preference method to best analyse how individuals evaluate the total bus service packages. Hensher and Prioni (2002) developed a Service *Quality* Index which is useful for operators to benchmark service effectiveness and avoids evaluation based on costs.

On the other hand, Davison and Knowles (2006) examined both user and non-user perspectives of the *Quality* Bus Partnership and explored how users perceived the changes introduced by the QBP and what parameters influenced their perspectives. However, the findings did not investigate, in any depth, the impact of the QBP itself. Instead the attributes addressed in the questionnaire were related more to the infrastructure such as the presence of bus lanes, easy access of low floor buses, raised kerbs, selective vehicle detection, waiting facilities, availability and usefulness of information, cycle lanes, puffin crossings, changes to the geometric design and the introduction of parking bays on targeted streets. The research did not include a *before* and *after* study to examine the impact of the intervention by the QBP.

Instead the study defined measures to evaluate bus service at a specific point in time through cost efficiency, labour, vehicle utilisation, patronage, service *quality* and accessibility. The authors suggested that the evaluation should place individual components into several categories such as economic, social, operations, physical and demographics. Many studies have examined the economic efficiencies of bus service rather than social factors but others such as Crosby (1979) stated, '*quality*' is intangible and therefore not measureable. This raises the question of how to quantify *quality* – what is the metric and what is the process of evaluation? Crosby (1979) states that in discussing *quality* in the context of this type of research 'we are dealing with a people situation'.

The most important factor is to evaluate the bus service from the passengers' perspective for the reason that bus service is controlled by the market. For example, given a situation where, despite the bus operators providing well maintained vehicles, with new tracking technology to promote real-time bus stop information, passengers overall *satisfaction* is not raised. From this perspective the return on investment should be scrutinised. On the other hand, if such investment has substantially impacted the proportion of socially excluded customers if evaluated against the different metric ‘social inclusion’, then the economic assessment looks very favourable.

2.6.1 Gap Measurement of Service Quality

Parasuraman *et al.,* (1988) developed the SERVQUAL instrument which originated from Gap 5. It is an exploratory method to measure SERVice QUALity from the customers’ point of view. SERVQUAL distinguished 10 dimensions of *service quality* which are reliability, responsiveness, assurance, tangibles, empathy, access, communication, competence, courtesy and credibility. All of these are potential components of the gap or shortfall between expectations and perceptions. However, further research led to modification of SERVQUAL model in 1988, to evaluate five dimensions of service *quality* as follows:

1. Tangibles: physical facilities, equipment, and appearance of personnel
2. Reliability: ability to perform the promised service dependably and accurately
3. Responsiveness: willingness to help customers and provide prompt service
4. Assurance: knowledge and courtesy of employees and their ability to inspire trust and confidence
5. Empathy: Caring, individualised attention the firm provides its customers

adapted from (Parasuraman *et al.*, 1988).

SERVQUAL provides a framework for the business industry to examine the effectiveness of service *quality*. High quality of service will benefit the companies in terms of referral and repeat customers thus will give impact to higher returns. Despite being an established technique to measure service *quality*, SERVQUAL has received criticisms by many researchers (Carman, 1990; Bolton and Drew, 1991; Cronin and Taylor, 1992; Teas, 1993). Carman (1990) questioned the relevance of the gap between expectations (‘E’) and perceptions ('P') stated in the survey in order to quantify measures of service quality that needs improvement. The difference between Perception and Expectations is called as 'gap analysis' by applying the difference in scores. A later work by Cronin and Taylor (1992) criticised the measurement of perception ('P') minus expectations ('E'). Expectations ('E') were measured in the first half of the survey and Perceptions ('P') were measured in the second half of the survey. They argued that the expectations vary across time and could not be evaluated at the same time as perception. Furthermore, in another study by Teas (1993), he further argued that the value of 'E' was based on respondents' interpretations from the questions and not based on their attitudes. Teas (1993) recommended two alternative models to SERVQUAL called Evaluated Performance (EP) and a Normed Quality (NQ) Model; Evaluated Performance (EP) addressing the classic ideal point, while Normed Quality (NQ) Model revised the expectations concepts. Teas (1993) tested the revised two models against SERVQUAL using 120 samples in Midwestern city on three stores; K-Mart, Target and Wal Mart. The results from the two revised models gave a high level of validity from the responses. Despite many criticisms of SERVQUAL (Parasuraman *et al.*, 1985; 1988), it should be acknowledged as the first attempt to measure service quality and, despite the limitations, it is the only instrument proven to be valid and reliable in terms of measuring service quality.

2.6.2 *Satisfaction* as the Measurement of Service Quality

According to Hutton and Richardson (1995), *quality* and *satisfaction* become more *important* as competition increases. In order to compete with other service providers it is necessary to develop successful marketing strategies. Young and Brewer (2001) state clearly that an organisation must recognise what is *important* to customers' perceptions of *quality*. Other research has acknowledged a strong positive correlation between service *quality* and *satisfaction* (Bitner and Hubert, 1994; Ekinchi, 2004) however, there is debate on the extent to which one affects the other. Some researchers argue that *satisfaction* precedes service *quality* (e.g. Bitner and Hubbert, 1994), while most researchers have indicated that service *quality* provides a positive influence on customer *satisfaction* (Oliver, 1980; Bitner M. J., 1990; Bolton and Drew, 1991; Cronin *et al.*, 2000). It has been suggested that the key target for competitive business is customer *satisfaction* which is the key aim in marketing.

The work by Fornell *et al.*, (1996) based on *satisfaction*, developed the American *Customer Satisfaction Index* model, which comprehensively identifies causal relationships among customer *satisfaction* and the consequences resulting from the customer *satisfaction*. Caro and Garcia (2007) suggested that there is no suitable method to measure service *quality*. Perception of service *quality* based on Parasuraman *et al.*, (1985) is 'disconfirmation paradigm' founded upon the difference between *expectation* and *perception*. The second alternative is based only on performance. *Satisfaction* has become an important perspective in the measurement of services provided. In health industries, surveys of patients about specific services provided by the hospitals, has become a common approach.

2.6.3 Understanding Behaviour Change Due to Quality Initiatives

Investment in quality improvements aim to enhance the attractiveness of a service in order to change the public's behaviour. In the context of the QBP initiatives, it is to maintain existing bus patronage and to encourage a modal shift from cars. A well-established approach applied in exploring human behaviour is the Theory Planned Behaviour (TPB) mostly applied in social psychological studies to understand behaviour. The theory suggests that human action is guided by three kinds of considerations; beliefs about the likely consequences of the behaviour (behavioural beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may further or hinder performance of the behaviour (control beliefs) (Ajzen, 1991; Bamberg *et al.*, 2003). The TPB explains that 'belief' is a basis for behaviour mostly applied when predicting human behaviour and assumes that humans are usually rational beings who make systematic use of the information available to them, and consider the implications of their action before deciding whether to act. In the event of no measurement of a behaviour being available, the best predictor of behaviour is intention. The resultant independent variables are summed to provide a measure of intention (Ajzen, 1991, 2006).

As a general rule, the more positive attitude and subjective norm, the greater is the perceived control that will influence the individual's intention to perform that behaviour. Attitude predicts beliefs about the expected outcome of behaviour (behavioural beliefs), and the individual evaluates the outcome by a set of normative beliefs about whether individuals think that other people would prefer them to perform the behaviour and their motivation to comply with these perceived wishes (motivation to comply). Behavioural beliefs produce a favourable or unfavourable attitude toward the behaviour; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioural control, the perceived ease or difficulty of performing the behaviour. In combination, attitude toward the behaviour, subjective norm, and perception of behavioural control lead to the formation of a behavioural intention. As a general rule, the more favourable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behaviour in question (Bamberg, Ajzen & Schmidt, 2003). In summary, intention is the predictor of future behaviour when an individual perceives control. Psychological theories can help to better understand the function of beliefs in service quality.

2.7 Service *Quality* and Passenger *Satisfaction* in Transport

Having studied in detail the concepts of service *quality* and their interdependencies applied to the manufacturing industries and business, the rest of this chapter develops these concepts in the transport environment. In relation to bus policy in the UK, the meaning of '*quality*', extracted from the QBP terms can be interpreted in several ways. *Quality*, in the context of QBP, could be interpreted either as the *quality* of the bus service itself or the *quality* of partnership between LAs and bus operators. *Quality* attributes that have been emphasised in QBP are reliability, punctuality, cleanliness, safety and friendliness of drivers. TAS (2002) identified *quality* as part of the cycle that contributes to the increase in patronage in the bus industry. On the other hand poor perceived *quality* can be linked to the decline of a bus industry as illustrated in Figure 2.4.

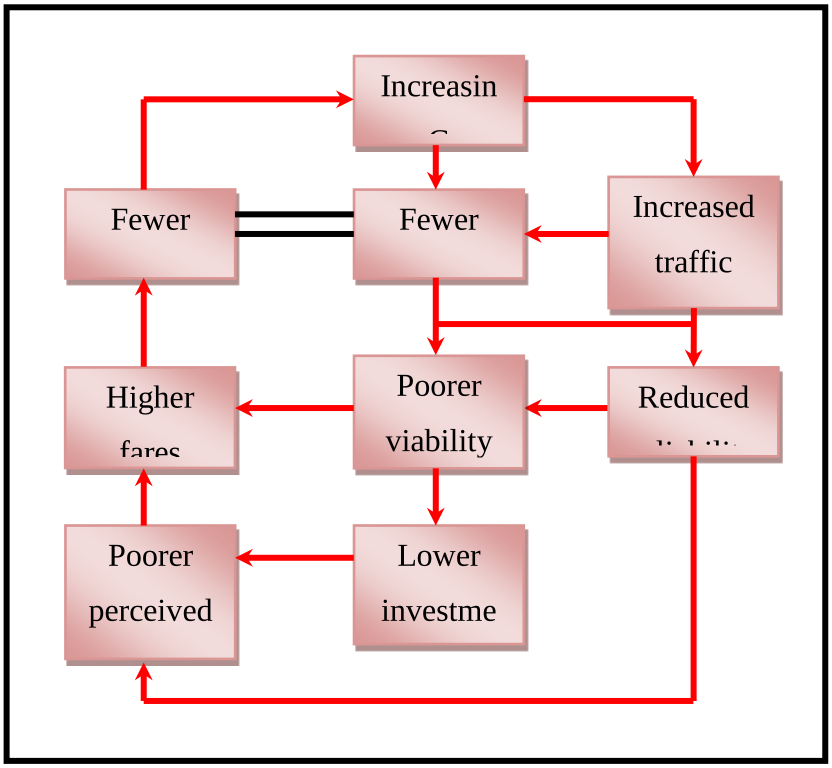

Figure 2.4: The Bus Industry's Cycle of Decline
Based on: TAS (2002:p.19)

Increase in car ownership has significantly influenced traffic congestion. The effect of congested roads has led to more delay to buses and deterioration in the quality of the bus service. At the same time, lower bus patronage has led to services becoming less profitable with poor visibility in the market place. When the industry has less revenue there is lower investment, the perceived *quality* deteriorates. In order to maintain profitability, bus operators have to increase fares to cover higher operational costs. As a result, the car becomes financially attractive and people buy cars instead of using public transport resulting in fewer passengers.

There are few studies that determine passengers' *satisfaction* in the context of public transport. Research on *satisfaction* developed by Chen (2008) found that perceived value of *quality* and overall *satisfaction* directly influences passengers' future intentions. However, questions remained. The first was the extent to which *quality* of service had to be improved to satisfy more passengers and thus increase patronage and secondly, exactly how '*quality*' of bus service would be able to attract non-users to choose to use the bus as their preferred mode of transport. Chen (2008) argued that once the *quality* is improved, passengers will be satisfied, thus increasing the chances of retention. However, Chen (2008) deemed it important to understand the effect of specific improvements to service *quality* on *satisfaction* of specific passengers or groups so that through passenger feedback to bus operators, specific aspects of service can be improved.

Glaister (1993) suggested that a bus operator's reputation is built on the range of *quality* of service measures they provide, including factors such as irregularity, network change, poor information and marketing, all might influence *quality* to a lesser or greater extent and can be responsible for patronage decline. There are many factors that can affect people's choice to travel by public transport. The *quality* of the service is of considerable *importance;* on the other hand, an individual perception of '*quality*' varies depending on circumstance. Situation and people can place great emphasis on availability of service, walking distance to the nearest station, ticket fares, punctuality, reliability and comfort etc. In reality, what is important to the customer may be totally different from the suppliers' view.

There have been extensive reviews on service *quality* in travel and tourism, marketing, banking and finance and health industries. However, only limited literature was available on service *quality* in relation to passenger transport. Research by Eboli and Mazulla (2007) examined service *quality* attributes to measure customer *satisfaction* in public transport and a structural equation model was used as a method to evaluate those relationships. The study found that perceived quality attributes namely bus stops availability, frequency, reliability, cost, safety and security, bus stop furniture, comfort, cleanliness, information, accessibility, complaints and bus stop maintenance have an impact on customer *satisfaction*.

Litman (2008) published a report about service *quality* (Build for Comfort, Not Just Speed: Valuing Service Quality Impact in Transport Planning), which covered improvement for walking and cycling, as well as public transport service itself. Improvement of service *quality* for public transit included more comfortable vehicles, reduced crowding, pleasant environments at stations, better user information, elevated security, marketing and promotion. The author stressed that by improving public transport service and more specifically convenience and comfort, may attract non-public transport users at a lower cost rather than increase travel speed achieved by expensive grade separation.

The relationships between service *quality* and *satisfaction* have also been explored in airline industries (Ostrowski *et al.*, 1993; Sultan and Simpson, 2000; Park *et al.*, 2004; Ching-Fu Chen, 2008). As *satisfaction* is the major driver for future intentions, the best approach is to improve the *quality* of service thus increase their *satisfaction*. Therefore, a greater understanding of quality is needed in order to influence the loyalty of the passengers. Given that service *quality* has been identified as the antecedent of customer *satisfaction*, how quality can influence the *satisfaction* from passengers' perspectives will now be discussed.

Passengers as 'customers' are the most important assets of the bus industry. Therefore, operators must nurture and grow those assets in order to continue their profit. Furthermore, there is a common belief that satisfied customers have a higher likelihood of repeat patronage. According to research on how people talk about bus and car travel, Guiver (2007) found that the performance of the service has an influence on the future choice of travel mode.

A study by Khanker (2009) on the attitudes towards *service quality* investigates the reason for using transit in the Canadian City, Calgary. The study used a transit customer *satisfaction* survey conducted in 2007 and applied a latent choice model for the analysis. Two small latent variables were used in the model, these were 'ride comfort and reliability' and 'convenience'. The study found that there were ten reasons why respondents chose public transport, these were:

- No particular reason
- Less expensive/save gas/high gasoline prices
- No car available
- Avoid traffic
- Avoid parking
- Don’t drive
- Convenient service
- Faster travel time
- Comfortable/relaxing
- Environmental reason

This study found that ‘reliability’ and ‘convenience’ were the most important factors for choosing to use public transport. In addition to the findings, women, users travelling for social/recreational trips, lower income people and the younger population aged 15 years and below were not satisfied with the service. However, older people (age over 60) perceived the service more positively towards ‘reliability and convenience’ and ‘ride comfort’ and males were found to have a more positive perception than females in terms of ‘reliability and convenience’ and ‘ride comfort’.

dell'Olio *et al.*, (2010) studied user perception of public transport by comparing ‘before’ and ‘after’ responses captured in the survey of a respondent evaluation of *service quality*. The study involved focus groups and a survey onboard the bus and at bus stops. A Probit Analysis using overall service *quality* as the dependent variable showed that service reliability is a very important variable for all users. The questionnaire asked about the *importance* of the following *quality* attributes: waiting time, journey time, access time walking to the initial bus stop, safety within the vehicle, comfort during starting and stopping, comfort during the journey, deviation from the optimal route, cleanliness of the vehicle, price of the bus ticket, *quality* of the vehicle, reliability of the vehicle and the kindness of the bus driver. The case study was carried out in a medium sized town, Santander, which has a population of around 180,000. In this study, vehicle cleanliness was established as relevant for sporadic and high income users. The study also revealed that overall *service quality* was influenced by reliability, waiting time and driver kindness.

Beirão and Cabral (2007) carried out a study exploring the attitudes of public transport users and non-users in Porto, Portugal. The analysis applied was based on 'grounded theory' which is founded upon the perceived advantages and disadvantages of modes used. The results indicated that the characteristics of individuals and the type of journey can influence the choice of transport. This information was identified as a very important factor in the decision to use public transport. In addition, infrequent users and non-users perceived the *importance* of information as a barrier to using public transport.

Cain and Sibley-Perone (2005) carried out qualitative research on perception which concentrated on teenage attitudes and perceptions of public transport. Focus groups were carried out with parents and teenagers in Miami and Tampa to determine the teenagers' perceptions of safety, cost, accessibility, reliability and the image of the service. The comments made were recorded and then transcribed into text. Recommendations included a partnership between the school and local organisation, and improved marketing strategies to attract teenagers to use the bus more often.

Shiftan *et al.,* (2008) carried out research on user behaviour towards public transport usage. The research used Factor Analysis and structural equation modelling to group the users and aimed to explore direct factors that influence people's choice of transit. In another study, Beale and Bonsall (2007) explored the public perceptions of buses and carried out the study in two phases before and after the marketing scheme was launched. The objective of the research was to correct the misperception of buses by looking at the psychological perspectives. The survey was carried out in Leeds with a sample of 408 individuals. Respondents were asked to rate 15 aspects of bus service (i.e. duration of journey, fare level, driver customer care, type and condition of vehicles, etc) on a five point Likert scale ranging from 1 'dreadful' and 5 'excellent'. The study found that the marketing had a positive effect on the behaviour of bus users and a negative effect on the non-users.

Nathanail (2008) measured the quality of rail transport on the Hellenic Railways. The study involved the estimation of 22 indicators using multivariate evaluation developed using an overall performance index for quality provided by the operators. The study found that the Hellenic Railways operate moderately, providing high performance in safety, reliability of services and low performance in cleanliness and information provision to passengers. The survey questionnaire was to passengers and mystery shoppers and involved a rating scale of 1 to 10.

A study by Joewono and Kubota (2007) explored user perceptions of *quality* of service of paratransit which are availability, accessibility, information, customer service and frequency of negative incidents and found that *satisfaction* on transit service and loyalty are linked. Another study by Fujii and Tan Van (2009) explored motorcyclist perception and judgment on the bus service including moral concern, negative impression, quality perception and social status in Ho Chi Minh City. Based on the ordered logit analysis, it was found that moral concern and perception on quality can influence their future behaviour to use the bus.

Table 2.2 and Table 2.3 provide an overview of the attributes respectively used as direct and indirect measures of service quality of bus services that have been used in previous studies reviewed in this thesis. The quality attributes highlighted in bold are those used in this study and will be further discussed in Section 3.4. While all of these attributes have been considered as the important attributes when it comes to measure service quality, they actually can be categorised into two, the first relating to the operation of the service itself, and the second, characteristics of the vehicle and service provision. Therefore, it is appropriate to reword the service measurement as direct and indirect measures and it is clear that whilst studies have employed both direct and indirect measures, studies tend to have concentrated mainly on one or other. This research seeks to take a more balanced approach and considers attributes which are operational and those relating more to infrastructure.

Table 2.2 : Evaluation on service quality: Attributes Used as Direct Measures – The attributes in bold and numbered are those investigated in this research and identified in consultation with the stakeholders, see section 3.4

Direct Measures	
Eboli and Mazulla (2007)	16 quality attributes Bus stop availability Route characteristics **1 2 3. Frequency** **4. Reliability** Bus Stop Furniture Overcrowding **8 9. Cleanliness** **17. Cost** **12 13. Information** Promotion Safety on Board **14 15. Personal Security** Personnel Complaints Environmental protection **9 16. Bus Stop Maintenance**
TAS (2002)	**4. Reliability** **5. Punctuality** **8 9. Cleanliness** Safety **11. Friendliness of Drivers**
TRB (1999)	3 categories of public transport performance measures : Operators, Vehicle, Passengers
TRB (2004)	Availability Service Coverage Scheduling Capacity **12 13. Information** Comfort and Convenience Factors Passenger Loads **4. Reliability** **10.Travel Time** **14 15. Safety and Security** **17. Cost** Appearance and Comfort
Davison and Knowles (2006)	Presence Of Bus Lanes Low Floor Buses Raised Kerbs Selective Vehicle Detection Waiting

	Waiting Facilities Availability **12 13. Information** Cycle Lanes Puffin Crossings Changes To Geometric Design Introduction Of Parking Bays
dell'Olio *et al.,* (2010)	Waiting Time **10. Journey Time** Access Time Walking To The Initial Bus Stop Safety Within The Vehicle Comfort During Starting And Stopping Comfort During The Journey Deviation From The Optimal Route **8.Cleanliness Of The Vehicle** **17.Price Of The Bus Ticket** *Quality* Of The Vehicle **4.Reliability Of The Vehicle** **11.Kindness Of The Bus Driver**
Cain and Sibley-Perone (2005)	Safety **17. Cost** Accessibility **4. Reliability** Image of the service
Beale and Bonsall (2007)	Marketing
DfT (2006)	**4. Service reliability** **12. Information (display of destination and duty boards)** Failing to pick up or drop passengers at authorised stops **8. Vehicle condition (cleanliness, Leaking Roof, Missing Or Broken Seats, Broken Or Missing Windows)** **Route Deviations** The Lack Of Operational Electronic Equipment For Ticketing
Mokonyama and Venter (2012)	**4. Reliability** Staff Respect **14 15. Security** **1 2 3. Frequency of Service** Climate Control Information quality **17. Payment Convenience** Hostess Service Newspaper **17. Fare**

Diana (2012)	**1 2 3. Service Frequency** **5. Punctuality** Possibility of finding sitting places Speed of the service **8. Cleanliness of the vehicles** Comfort while waiting at bus stops Connectivity with other municipalities **13. Convenience of the schedules** **17. Cost of the ticket**

Table 2.3 : Evaluation on service quality: Attributes Used as Indirect Measures

Indirect Measures	
Glaister (1993)	Irregularity Network Change **12 13. Poor Information** Marketing
Litman (2008)	**12 13. Better use of information** Marketing and promotion Comfortable vehicles Reduce crowding Pleasant Environment **14 15. Security**
Khandker *et al.* (2009)	Ride comfort **4. Reliability** **17. Inexpensive** No car available Avoid traffic and parking Don’t drive Convenience service Fast travel time Environment externalities
Fujii and Tan Van (2009)	Negative impression Quality perception Social status
Joewono and Kubota (2007	Availability Accessability **12. Information** Customer Service Frequency of negative incidents

2.7.1 Methods to measure quality from passenger perspective

There are several methods and approaches available to measure quality from the passenger perspective. Martilla and James (1977), applied the simple and easy method known as Importance *Satisfaction* Analysis (ISA). The method was mostly applied in market surveys which are concerned with customer *satisfaction*. The evaluation of *satisfaction* combines measures of performance of a service delivery by assessing the perceived *quality* attributes along with their *importance*. In this way those quality attributes, that are of *importance* and yet provide least *satisfaction* (the sources of the largest service quality gaps), can be identified. ISA forms a basis of final decision making regarding on which *quality* attributes to concentrate most to deliver cost effective improvement. Abalo *et al.*, (2007) suggested that measuring the *importance* of the different components of a service is a little more challenging than measuring *satisfaction* because different people have widely different perceptions of *importance* and *satisfaction* both in terms of absolute level as well as range. The ISA method, however, has remained a popular method, particularly in the tourism industries, for nearly 30 years since this method was first introduced.

ISA analysis uses the Likert scale to enable users to express their degree of *satisfaction* (1 very dissatisfied to 5 very satisfied) against their level of *importance* (1 very unimportant and 5 very important). By presenting the *importance* and *satisfaction* data graphically as shown in Figure 2.5, those attributes that fall in each of the four quadrants can be identified. Quadrant I (High *Importance*, High *Satisfaction*) referred to as keep up the good work, Quadrant II (High *Importance*, Low *Satisfaction*) Concentrate Here, Quadrant III (Low *Importance*, Low *Satisfaction*) Low Priority and Quadrant IV (Low *Importance*, High *Satisfaction*) Possible Overkill are illustrated. The attributes fall into each quadrant depending on the scores which are based on the Likert scores (assigned by the user of the service). The ISA has evolved from the Importance Performance Analysis (IPA) by replacing *performance* with *satisfaction*, but with the same resulting four quadrants (Tonge and Moore, 2006). Martilla and James (1977) emphasised that the ISA method of analysis was very useful and easy to apply and found gaps between what customers think is important and how satisfied they were with the services consistent with that of Hansen and

Bush (1999); later, Kano (1984) states that the customer *satisfaction* can be applied on the basic assumptions of IPA.

High **Attributes Performance** ***(Satisfaction)***	**Quadrant IV** Low *Importance*/High *Satisfaction* **“Possible Overkill”**	**Quadrant I** High *Importance*/High *Satisfaction* **“Keep Up the Good Work”**
Low	**Quadrant III** Low *Importance*/Low *Satisfaction* **“Low Priority”**	**Quadrant II** High *Importance*/Low *Satisfaction* **“Concentrate Here”**
	Low ← **Attributes *Importance*** → High	

Figure 2.5 : *Importance Satisfaction* Analysis

Source: adapted from Matzler *et al.*, (2004) with modifications from Martilla and James (1977)

This method of analysis has been applied previously in fields other than transport, for example in tourism (Zhang and Chow, 2004; Tonge and Moore, 2006); bank services (Matzler, Sauerwein, and Heischmidt, 2003), automobile industry (Matzler, Bailom, Hinterhuber, Renzl and Pichler, 2004a); education (Alberty and Mihalik, 1989); and healthcare services (Dolinsky and Caputo, 1991). Dolinsky and Caputo (1991) and Matzler (2003) applied IPA to modern management and an orientation study of the tools.

However, there are very few studies applying IPA (or ISA) in public transport. Stradling (2007b) applied the method to three case studies; user *satisfaction* with bus interchange, user *satisfaction* with trips by different travel modes and pedestrian *satisfaction*. He used *disgruntlement* instead of *satisfaction* and cross tabulated with *importance*. Beirao and Cabral (2009), applied the ISA by plotting *dissatisfaction* against *importance* in a study of public transport services from the perspectives of public transport and car users. The questionnaire used the Likert Scale from 0 to 10 from 'not important' to 'very important' and 'totally disagree' to 'totally agree'.

2.7.2 Defining Cross Hair

A first step in the ISA is to justify positioning of the cross hair which refers to the line dividing the quadrants. The most common approach is to use the 'grand mean score' (e.g. Zhang and Chow, 2004) whilst other studies (Chen and Lee (2006); Go and Zhang (1997); Tarrant and Smith (2002) have used the middle score of the Likert Scale (e.g. three for a five point scale). The location of the 'cross hair' will affect the interpretation of the results and thus influence the subsequent action taken by the decision maker. Oh (1999) was of the opinion that ISA failed to give clarity for decision making and TRB (1999) demonstrated that if used without care and caution, that it may lead to incorrect interpretation. Matzler and Sauerwein (2002) on the other hand suggested the use of regression techniques to find correlation between specific individual attribute performance and the overall *satisfaction* as a method to inform decision making. In the research presented in this thesis, it is suggested that the interpretation of the analysis should not simply consider in which quadrant the result lies but the magnitude of the score and the statistical confidence of its distance away from the cross hair in the x and y direction and these issues will be dealt with in more detail in Chapter 3.

2.7.3 Application of ISA to the bus industry

Turning now to the application of ISA, specifically to the bus industry, given that passengers are considered to be their most valuable ‘asset’, bus companies should take steps to present to passengers a positive impression towards their services. This can be achieved through the provision of *quality* in those attributes that are deemed important by the customer. Furthermore in the marketing world, research has confirmed that customer retention is a major key to the ability of a service provider to generate profits (Zeithaml *et al.*, 1996). Clearly, while bus operators are aiming to provide a high quality of service, they must also consider what passengers expect from the service. By understanding the connection between these two (*importance* and *satisfaction*), bus operators can set up strategies to increase patronage. The differences between the *importance* and *satisfaction* define the ‘gap’ and identify areas in need of improvement.

Therefore, ISA can be used as an informative tool, allowing bus companies to better understand the characteristics of passenger groups and to establish how they perceive the service *quality* which, in turn can influence the decision making within a bus company regarding investment in service provision. In a climate of budget constraint, this research seeks important knowledge to target investment for maximum return.

2.8 Statistical Techniques

One unique element in this research is in adapting a multifaceted approach to the analysis of the survey data. This will be detailed in Chapter 3. However, this section elaborates on the statistical analysis procedures for completeness.

2.8.1 Factor Analysis

A method of analysis often applied is Factor Analysis (FA) which was first introduced by Thurstone (1931) FA is used to simplify large sets of data in order to reduce the number of variables and to explore in further detail, structure in relationships between the data variables establishing those that are and those that are not independent. FA was used to firstly reduce the number of quality attributes to accommodate commonality and to minimise multicollinearity (Field, 2005) and secondly by comparing SR services with NSR services to test for significant differences between services both in terms of how passengers perceived *importance* and *satisfaction* of the reported bus service.

The seven steps involved in FA as suggested by (Hair *et al.*, 2006, p. 162) are:

1. Clarification of the objectives
2. Selection of variables and sample
3. Assumptions of factor analysis such as departures from normality, homoscedasticity and linearity among the variables.
4. Extraction of factors and decide number of factors
5. Rotation of factors and interpretation.
6. Validation of factor analysis solutions
7. Further analysis such as creating summated scales, or computing factor scores.

Factor Analysis is presented by Everitte and Dunn (1991) as follows:

$$x_1 = \lambda_{11} f_1 + \lambda_{12} f_2 + \dots + \lambda_{1k} f_k + u_1 \qquad (1)$$

$x_2 = \lambda_{21} f_1 + \lambda_{22} f_2 + \ldots + \lambda_{2k} f_k + u_2$

.

.

.

$x_p = \lambda_{p1} f_1 + \lambda_{p2} f_2 + \ldots + \lambda_{pk} f_k + u_p$

and can be summarised as below:

$$\mathbf{X} = \mathbf{\Lambda f} + \mu \qquad (2)$$

$$\mathbf{\Lambda} = \begin{pmatrix} \lambda_{11} & \cdots & \lambda_{1k} \\ \vdots & & \vdots \\ \lambda_{p1} & \cdots & \lambda_{pk} \end{pmatrix}$$

$$\mathbf{f} = \begin{pmatrix} f_1 \\ \vdots \\ f_k \end{pmatrix}$$

$$\mu = \begin{pmatrix} u_1 \\ \vdots \\ u_p \end{pmatrix}$$

Where:

x = observed response variable, p

λ= constant, loadings

$\mathbf{\Lambda}$ = p x k matrix of constants, called the matrix of factors loadings.

$\mathbf{f}$ = factor score of the observed response variable, k

$\boldsymbol{\mu}$ = unique term (i.e. residual) for the observed response variable

FA was conducted using the correlation coefficient between the variables and factors referred to as factor loading. The squared factor loading represents the percentage of variance explained by a factor. *Communality* is the sum of the squared factor loading for all factors which represent the variance shared with the other variables through the common factors. The diagonal of the factor covariance matrix can be summarised as below:

$$\mathbf{\Sigma} = \mathbf{\Lambda\Lambda'} + \mathbf{\Psi} \tag{3}$$

Where:

$\mathbf{\Sigma}$ = population covariance matrix

$\mathbf{\Psi}$ = diagonal matrix contains the variances of the residual variate, μ

$\mathbf{\Lambda'} +$ is the transpose of $\mathbf{\Lambda}$

FA was conducted using principal components as the method of extraction with orthogonal rotation. The orthogonal rotation allows the factors not to be correlated between each other after the rotation. The most common orthogonal method is varimax rotation (Field, 2009). Varimax rotation maximizes the sum of the variances of the factor loading and is able to avoid multicollinearity between the scores (Hair *et al*., 2006). The aim of the rotations is to achieve correlation to be close to 1 to show the significant variables which indicate significant contribution to the reduced factors. Table 2.4 explains the guideline for identifying the factor loading based on sample size.

Table 2.4 : Guideline for Identifying Significant Factor Loadings based on Sample Size

Factor Loading	Sample size needed for significance[a]
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

[a] Significance is based on a 0.05 significance level (α), a power level of 80 percent, and standard errors assumed to be twice those of conventional correlation coefficients.
Source : Hair *et al.,* (2006)

There are measures to identify the intercorrelation among the variables. The Kaiser Meyer Olkin (KMO) measure is used to assess the degree of correlation among the variables (Field, 2009). Hair *et al.*, (2006, p. 114) recommended for this measure to deliver a specific level of confidence of the prediction a value ranging from 0.9 – 1.00 to be perfectly predicted down to a value 0.00 – 0.49 for unacceptable result as shown in Table 2.5.

Table 2.5 : Interpretation of the KMO

KMO Value	Degree of Common Variance
0.90 – 1.00	Perfectly predicted
0.80 – 0.89	Meritorious
0.70 – 0.79	Middling
0.60 – 0.69	Mediocre
0.50 – 0.59	Miserable
0.00 – 0.49	Unacceptable

Source: Hair *et al.*, (2006), p. 114

The suitability of the correlation matrix is tested using the Bartlett test of Spericity and reliability analysis (Field, 2009). The Bartlett of Spericity test is used to find the significance of all the correlations within the correlation matrix as an indicator of the strength of the relationship among variables. The indicator used for the reliability analysis was Cronbach Alpha coefficient (Field, 2009). The normal recommended value for the Cronbach Alpha co-efficient for exploratory research is 0.6 (Hair *et al.*, 2006). Nunnally (1978) mentioned that when the value of validity is higher than 0.7, this indicates a guaranteed level for reliability and validity of the analysis carried out. This is consistent with the results of Cuieford (1965) who stated that a Cronbach's Alpha value that is higher than 0.7 indicates the high validity, the value between 0.7 and 0.35 indicates acceptable validity, and the value which is lower than 0.35 means rejected validity.

FA uses two criterion to choose which factors are statistically significant; these are eigenvalues and the scree plot. The eigenvalue reflects the variance in the variables which is accounted for within the reduced factors (Hair *et al*., 2006). The values of eigenvalue are derived from the sum of squared factor loadings for all the variables. Those factors with eigenvalue of 1 are selected, whilst low eigenvalue means no explanation of the variances in the variables. The scree plot of eigenvalues is shown in Figure 2.6.

Figure 2.6 : Example of a Scree Plot presented in Hair *et al.*, (2006)

Further analysis of FA is to have a summated scale of the reduced factors. As recommended by Hair *et al.*, (2006), the raw data of the summated scale of the reduced factors are combined to obtain the average score of the variables. This is to reduce the measurement error and also as an alternative to factor scores.

In this research, **X** is the vector of the variables namely quality attributes, x_1, x_2, x_3, …x_p. **X** is a matrix of the rating scale assigned by each respondent of the quality attributes. In Stage 1, each of the 17 quality attributes for both *importance* and *satisfaction* based on the Likert scale ranging from 1- 5 were then collated to produce a matrix of two sets of 17 scores giving 34 variables in total therefore p = 34. The FA enables the association between the level of *importance* and perceived *satisfaction* of the variables to be investigated and thus to identify the extent to which each variable is associated with any others, to create a set of common factors that can describe largely independent sets. In this way the analysis reduces the total set of quality measures into fewer categories of attributes that are governing and influencing the bus service performance.

Despite its ability to reduce the variables, FA has limitations in the use of rotations, as it assumes that all rotations are equally valid outcomes of standard FA optimisation. All rotations represent different underlying processes. Thus, it is impossible to choose the proper rotation using FA alone. Besides, in the research presented in this thesis the interpretation of the FA alone cannot identify causality between perception and the overall rating of service quality which is why more than one analytical approach was adopted.

2.8.2 Cluster Analysis

Cluster Analysis (CA) is widely used in marketing research to identify and characterise target groups and help managers to maximise the return on investment for example in advertising (Everitt, 1993). Everitt (1993) and Hair *et al.,* (2006) demonstrated that CA helps to identify consumer market segments based on subjective parameters such as attitude, motivation, aspiration, etc. and is based on tangible characteristics such as gender, age, and social class. The objectives of the CA are to create and identify groups that are homogenous within the data. By identifying the groups, it becomes simpler to analyse and reveal any relationships among the sample within groups and between groups. This in turn enables marketing strategies to be targeted at specific categories of consumers resulting in higher cost benefit ratios.

As suggested by Hair *et al.*, (2006), there are six steps in Cluster Analysis which are as follows:

1. Clarification of the research problems and objectives
2. Formulation of research design
3. Assumption in Cluster Analysis such as sample representativeness and multicollinearity
4. Selection of clustering technique (hierarchical, non hierarchical or combination)
5. Interpretation of the cluster solution
6. Validation and profiling the clusters

The CA methodology adopted in this research is based on a statistical process that uses the parameters of distance and similarity, where 'distance' is a measure of how far apart two objects are, whilst 'similarity' considers how similar the two objects are. This technique has been discussed extensively in statistics text books such as Tryon and Bailey (1970). The ability of CA to take complex inputs, and reveal the relationships and structures in data has been demonstrated by Tryon and Bailey (1970) and Backer (1995) respectively. CA is based on a data matrix of the variables. The CA is used to identify whether heterogeneity exists in the sample with particular characteristics.

This is summarized as follows:

$$\begin{array}{c|cccccc|} & X_1 & X_2 & \ldots & X_j & \ldots & X_p \\ u_1 & x_{11} & x_{11} & \ldots & x_{1j} & \ldots & x_{1p} \\ u_2 & x_{21} & x_{22} & \ldots & x_{2j} & \ldots & x_{2p} \\ : & : & : & \ldots & : & \ldots & : \\ u_i & x_{i1} & x_{i2} & \ldots & x_{ij} & \ldots & x_{ip} \\ : & : & : & \ldots & : & \ldots & : \\ u_n & xn_1 & x_{n2} & \ldots & x_{nj} & \ldots & x_{np} \end{array} \tag{4}$$

Where,

Xij = *i*th observation for the *j*th variable ($i = 1, 2, \ldots n$; $j = 1,2 \ldots p$)

Units are combined into groups on the basis of *p*-dimensional observations (rows of data matrix) and variables are combined into a group on the basis of *n*- dimensional observations (columns of data matrix). Then, the next step involves the identification of the distance matrix for the nearest pair of clusters. The steps are repeated until the algorithm terminates to obtain the optimum number of clusters. Hair *et al.,* (2006) listed six types of distance measures; Euclidean, squared Euclidean, City Block (Manhattan), Chebychev and Mahalanobis. Euclidean Distance uses the distance between the points by calculating the length of the hypotenuse of a right angled triangle. Squared Euclidean Distance is the sum of the squared differences without taking the square root. City Block uses the sum of the absolute differences of the variables; Chebychev distance uses the greatest distance across all of the clustering variables; finally Mahalanobis distance uses the generalised distance obtained from the correlation among variables, which involved standardisation of the variables. Figure 2.7 illustrates the Euclidean distance between two objects measured on two variables, X and Y followed by the equation to calculate the Euclidean distance.

The statistic used to assess performance in this research was the log likelihood as a measure of the distance between two clusters; a cluster was created based on the decrease in the log likelihood and the Bayesian Information Criterion (BIC) was compared to determine the optimal number of clusters. SPSS software version 15 was used for this analysis and the cluster with the smallest number for BIC was chosen as the optimal solution for the number of clusters, assuming the distribution of the sample is not normal but multinomial next time. The formula for BIC is as follows:

$$\mathrm{BIC_K} = \mathrm{D(M_k)} - \mathrm{d}f_k \ln N \tag{5}$$

Where,

D(M) = deviance for Model Mk

Df = degree of freedom associated with the deviance

N = Number of clusters

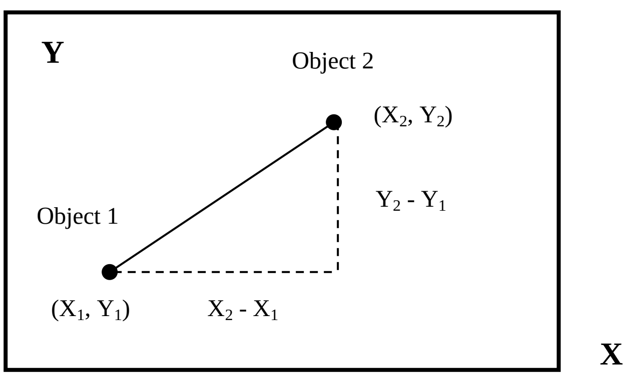

Figure 2.7 : Illustration of Euclidean Distance between two Objects Measured on Two Variables, X and Y

Source: Hair *et al.*, (2006) pp. 575

$$\text{Distance} = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2} \tag{6}$$

2.8.3 Ordered Logit Regression (OLR)

Ordered Logit Regression (OLR) is probably the most used regression method to identify the relationship between independent and dependent variables in the case where the dependent variables are in an ordered scale. The latent variables are widely used to qualify the relationship in the regression modelling process which is easy to implement, interpretable and produces results valid for case-control studies (Borooah, 2002); (Field, 2009). OLR is commonly used in a diverse number of fields for example in econometrics (Ayuso and Santolino, 2007); (Hsieh *et al.*, 2009); (Mora and Moro-Egido, 2008); engineering (Jung, 1993); business marketing (Kaul and Rao, 1995); Intelligent Transport System (ITS) (Mannering *et al.*, 1995); road safety (O'Donnell and Connor, 1996); transport (e.g. attitudes and travel behavior) (Golob, 2001; Ben-Elia and Ettema, 2009); and public transport (Tyrinopoulos and Antoniou, 2008); psychology and social sciences (Amilon, 2009; Howley, 2009); traffic engineering research (Pai *et al.*, 2009), and also on customer *satisfaction* with public transport (Van Exel and Rietveld, 2009).

OLR was considered to be the preferred method when response choices are rank-ordered (for example, the scale of ‘very poor’ to ‘very good’) compared to other types of regression for example Multinomial Logit (MNL) or Multinomial Probit (MNP) (Akiva and Lerman, 1985; Louviere, 1991; Agresti, 1996; Tyrinopoulos and Antoniou, 2008; Hensher *et al.*, 2009). OLR is based on the proportional assumption introduced by McCullagh (1980) where it assumes equal distance between one category to another category of dependent variables (Greene, 2000).

OLR has been used to test and explore the significance of hypothesised relationships and also to identify the probability of events (Greene, 2000; Borooah, 2002). Greene (2003) claimed that in ordering the response categories, one of the advantages of OLR is that it includes fewer parameters to estimate. In addition, OLR allows for the use of error terms to be included in the analysis, as opposed to the linear model in which observations are assumed to be free from error (Borooah, 2002).

Multicollinearity implies the existence of strong correlation among the explanatory variables that will affect the explanatory power of parameters, which can have a significant impact on the model. Multicollinearity can be detected using a correlation matrix, which is a technique that estimates the extent to which (using R^2 as a regression estimate) the variation in one explanatory variables is related to another (Hair *et al.*, 2010). Even though the overall test of the explanatory power of the model itself suggests a good fit, the coefficients of the individual explanatory variables can be statistically insignificant. A common approach to overcome the multicollinearity problem is to exclude all the explanatory variables are correlated with each other. For example, in the case where two variables are highly correlated to each other, it is appropriate to choose only one of the variables to be a proxy for both independent variables. Multicollinearity can be detected through linear regression analysis. The Variation Inflation Factor (VIF) is the indicator of the existence of multicollinearity in the model. Any value exceeding 20 indicates the presence of multicollinearity (Hair *et al*., 2010). Ordered Logit Models have the parallel regression assumption where the slope for each is parallel (similar), but the intercept may be different. The Brant test is used to test the parallel assumption for each variable.

In this thesis, the OLR analysis was performed using STATA 10 software and the algorithms employed are now elaborated upon. The model used the rating of service quality, *y*, as the dependent variable. In this case, *y* is treated as choices made by the respondents, ranging from 'very poor' to 'very good'. The results will indicate how passengers perceived the *importance* and how satisfied they are against a specific service *quality* attribute, or combination of more than one and which can implicate overall perception on the *quality* of bus services.

The overall rating of service *quality*, *y*, y was assumed as the probability function of passengers' assessment of overall service *quality* of the bus. Figure 2.8 illustrates the categories for the dependent variable. The threshold for the categories (μ μ) were estimated based from the ranking of the perception from 'very poor' to 'very good'. The independent variables in the model are assumed to have a causal effect on the dependent variable implying the direction of the effect either a positive (+ve) or negative (-ve) depending on the direction of the slope.

The OL algorithm estimates the parameter for threshold, μ based on the measurement of the latent variables that divides y into J ordinal categories. The threshold values μ, are unknown parameters. The estimated value of μ's explain the value between y = 1 and 2 (μ_0) ; y = 2 and 3 (μ_1); y = 3 and 4 (μ_2) and continues until j.

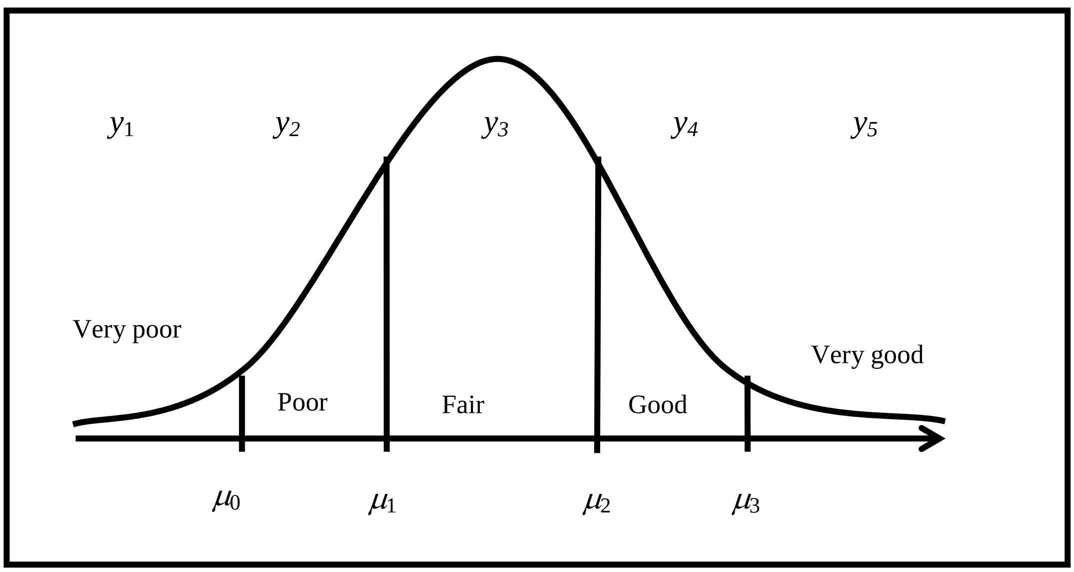

Figure 2.8: Illustration of distribution of perception on service *qualit*y (dependent variable)

OLR can be summarised as the relationship between a dependent variable as the OLR can be summarised as the relationship between a dependent variable as the observed response categories y, and an independent variable, x. Where the slope of the regression line, β_j, shows the change and direction (negative and positive) in the dependent variable y, as a result of a one unit change in the independent variable, x. The $\beta'$and ε represent the vector of coefficients and the error term, respectively. The equation as stated in Green (2000) and Long and Freese (2006) can be written as follows:

$$\boldsymbol{y} = \boldsymbol{\beta}' \, \boldsymbol{x} + \boldsymbol{\varepsilon} \tag{7}$$

The model expands the outcome categories by dividing *y* into j* ordinal categories:

Where:

$y = 0$ (poor) ; if $y^* \leq 0$

$y_1 = 1$ (fair); if $0 < y^* \leq \mu_1$

$y_2 = 2$ (good); if $\mu_1 < y^* \leq \mu_2$

$y_3 = 3$ (very good); $\mu_2 < y^* \leq \mu_3$ (8)

Each category is assigned a value 0, 1, 2 or 3 which are referred to as ratings. The μ, represents the cut off points estimated by the model. The probability of choice of the rating for service *quality* at a given point in time y^* equals a specific category μ of five levels of overall rating for service *quality*. Therefore, the probability that y^* falls into j*th* category is given by:

Prob ($y = 0) = \Phi(-\beta' x)$

Prob ($y = 1) = \Phi(\mu_1 - \beta' x) - \Phi(-\beta' x)$

Prob ($y = 2) = \Phi(\mu_2 - \beta' x) - \Phi(\mu_1 - \beta' x)$

Prob ($y = 3) = \Phi(\mu_3 - \beta' x) - \Phi(\mu_2 - \beta' x)$

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Prob ($y = j) = 1 - \Phi(\mu_{j-1} - \beta' x)$ (9)

In terms of model output, goodness of fit is important to evaluate the model fitness as a predictor. A commonly used value to indicate the fitness of the model is the value of the regression coefficient R^2. However, Greene (2008) suggested using a Likelihood Ratio Index (LRI) that is equivalent to the R^2 in the linear regression model, as follows:

$LR = -2(\ln L(\mathrm{L_R} - \mathrm{L_U})$ (4)

Where,

LR = the value of the maximum likelihood function

L_R = log-likelihood for the base model

L_U = sum of the log-likelihood of the sub-models that were estimated

In this research the threshold parameter μ provides the metrics against which perception of quality between different passenger cohorts can be benchmarked, the BIC enables the optimal number of clusters to be defined and the LRI provides a measure of the goodness of fit.

2.9 Summary

A series of government policies confirms commitment to achieving high *quality* services in public transport. Whilst it is acknowledged that bus deregulation has stimulated investment in service provision, a two tiered service has emerged. There is much competition for the high patronage high revenue routes, and systematic decline of other services with little service integration. QBP were seen to provide a mechanism for bus operators to co-operate with local authorities and concentrate on the provision of high standards of vehicle, customer service and frequency, on the understanding that the infrastructure such as integrated information across service providers, and provision of bus shelters, would enhance the attractiveness of the bus service product. QBP were set up on a voluntary basis whilst further government initiatives the Quality Partnership Schemes and more recently, Quality Contract Schemes have made quality agreements between LA and bus companies more formal.

The key findings of a number of studies of public transport schemes indicate that in order to increase public transport use, the service should be designed in a way that accommodates the level of service required by passengers as well as attracting non-users to use public transport. In many cases where QBPs have been implemented, an increase in patronage has been demonstrated. This chapter also reviewed previous research methods used to evaluate customer *satisfaction* and *service quality* in relation to public transport. The application of different methods of evaluation of *quality* from the perspective of customer *satisfaction* that have been practiced in business industries, have been presented and shown that their adoption in the transport research field is less developed. Examples of evaluation methods include the SERVQUAL instruments (Parasuraman *et al.,* 1988) which assessed service quality as the gap between expectations and perceptions from the management and customer points of view. Other research has concentrated on assessing passenger *satisfaction* as a measure of service quality.

However, a particularly interesting method proposed by Martilla and James (1977) known as Importance Satisfaction Analysis (ISA), popularly applied in the tourism industry, is considered appropriate for this research. However, it is necessary to develop a basic understanding of the issues highlighted in previous research. These include the statistical parameterisation of the cross hair and dealing with the lack of normality in the distribution of the Likert Scale scores, with magnitudes that may be quite different depending on the demographic qualities of passengers, as well as across the services which experience different levels of investment. These issues will be addressed further in Chapter 4.

This chapter has provided evidence from literature that the mechanism to evaluate *quality* and *satisfaction* often applied in industry has shown promise in its application to transport but without substantial statistical evidence of its success in real-world application. This forms the basis of the research developed in this thesis. The next chapter builds on the knowledge gained in this literature review and describes the bespoke methodology applied to this research.

This chapter was concluded by describing the five statistical analysis approaches adopted to gain a fundamental understanding of current bus services. These approaches included; descriptive analysis (DA), *Importance Satisfaction* Analysis (ISA), Factor Analysis (FA), Cluster Analysis (CA) and Ordered Logit Regression (OLR). The results of DA, ISA and FA are presented in Chapter 4 and 5, CA in Chapter 6 and OLR in Chapter 7. The integration and critical review of the analysis will be presented in Chapter 8 and conclusions appear along with recommendation to bus companies and future research in Chapter 9.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The previous chapter has presented an overview of the current bus policy in the UK and a literature review. The mechanism of QBP was introduced in 2000 to enable bus operators to work in partnership with LA to introduce *quality* initiatives in bus services in a competitive market. Whilst previous research has found evidence of how QBP initiatives can influence bus passenger *importance* and *satisfaction,* there is little evidence of causal links between the two. This chapter explains in detail the methodology adopted in this research to explore which quality attributes introduced by a bus operator have most influence on passenger perception of *importance* and *satisfaction*. A key challenge is to identify, in a consistent way, a 'quantitative measurement' which can be used to evaluate qualitative measures associated with bus *quality*. More specifically to establish a method that can provide an assessment of individual *quality* attributes that can be associated directly with both their *importance* to and *satisfaction* of a passenger and which also influence the overall *perceptions* of the same service. The study was carried out on bus services operating across Tyne and Wear. In this chapter section 3.2 elaborates on design methods; 3.3 provides a description of the case study; 3.4 proposes the evaluation framework; 3.5 details the design of the questionnaire; 3.6 describes the surveys; 3.7 the data screening carried out before analysis could begin; 3.8 provides an overview of the data analysis methods (detailed in Chapter 2) applied in this study and 3.9 presents a critical review of the analysis. Finally an overview of this chapter is presented in Section 3.10, summary. This chapter addresses the second objective: to develop data collection, methodology and analysis procedures appropriate for a study of passenger perception.

3.2 Design Methods used in Research

Research design methods are divided into three categories namely; qualitative, quantitative and mixed. Quantitative methods involve designs that describe, test and explain, whereas qualitative designs, explores and comprehends (Creswell, 2009). The former are useful for identifying research problems, which require description of trends or to prove (or disprove) a theory and involves numerical data collection followed by statistical analysis. Qualitative design is unstructured and flexible which aims to explore what people think and how they behave and this usually involves knowledge gathering and observation (Kumar, 2005). Quantitative research procedures are formal, structured and predetermined and often aim to quantify the extent and strength of a relationship (Kumar, 2005; Neuman, 2007) by identifying a cause-and-effect relationship (Field, 2005).

Mixed methods combine the two and have both a quantitative and qualitative component. Greene (2007) concluded that mixed methods involve philosophical paradigms and theoretical assumptions, and can be diverse in data gathering exercises to produce better outcomes. (Neuman, 2007) stated that the most important aim is to ensure that the selected methodology is able to answer the research questions. It can be concluded that all the three methods differ in terms of the type of data collection, analysis and the output of results, which have their own unique advantages and are well practised in research (Kumar, 2005; Punch, 2005).

In terms of data measurement for all three methods, a numerical scale is normally applied. Rensis Likert developed the Likert scale to improve assessment in social research by defining levels of measurement (Punch, 2005). This method is useful for gathering data that are not physically quantifiable, for example, respondents' opinion, attitudes, perception, preferences etc. The Likert scale has been previously applied in various studies (Bei and Shang, 2006; Eboli and Mazzulla, 2007; Stradling *et al.*, 2007a; Eboli and Mazzulla, 2009). By presenting a rating scale which has a clearly defined qualitative lower and upper value, for example, 'very poor' to 'very good', 'not important' to 'very important' with an associated numerical range such as 1 to 7, a range of responses consisting of numerical scores can be developed by the responders. In general, this technique is easy to administer and often a scale range from 1 to 9 (Babbie, 2004; Punch, 2005) is adopted. By using a scale divided into an odd number, ensures that responders are able to choose the control segment which reflects a neutral response to the question.

In this research, the Likert Scale was adopted to allow exploration of passengers' perception towards bus service by way of a quantitative measure. This was achieved through an interview survey using a questionnaire with latent variables such as satisfied, not satisfied, good, etc and to measure passengers' opinions regarding service quality. Latent variables are referred to as variables that are not directly observed and are variables that involve categories such as social economic status, parenting skills, quality of life, etc. The qualitative variables when converted to numerical values can be applied in mathematical models (Punch, 2005). The variables in the questionnaire will be the "indicator" to measure perception of individuals with respect to their preferences in the *service quality* measured for a range of attributes.

Dawes (2008) studied the effect of using Likert scaling with score ranges of 5, 7 and 10, on the mean scores, measures of dispersion and shape. The study applied the three scales to eight questions using three groups sampled randomly from the population. The total sample for each group was respectively 300, 250 and 185. All data collected on the 5 and 7 point scale were rescaled to 10 using a simple rescaling method.

The study considered data characteristics, in terms of the mean, standard deviation, skewness and kurtosis. The study found that at the 95% level of confidence, the scale of 5 and 7 produced similar results in terms of score after rescaling. Whilst, a scale of 10 produced mean of 0.3 lower than the scale of 5 and 7, this was not found to be statistically significant at 95% level. On the basis of these findings it was decided to base a Likert scale of 5 in this research.

The research by Kuzon *et al.*, (1996) highlights common errors in the use of statistical analysis that are regularly observed in research involving customer *satisfaction*. The seven errors were:

1. Use of parametric analysis of ordinal data;
2. Inappropriate use of parametric analysis in general;
3. Failure to consider the possibility of committing type II statistical error, the use of unmodified t-tests for multiple comparisons;
4. Failure to employ analysis of covariance, multivariate regression, nonlinear regression, and logistical regression when indicated;
5. Habit of reporting standard error instead of standard deviation;
6. Underuse or overuse of statistical consultation.;
7. Confidence and common sense are advocated as a means to balance statistical significance with clinical importance.

In this study, care was taken at all stages of the analysis to avoid these types of errors. This was achieved by testing for normality of all distributions of gap, each quality attribute and using non parametric testing and appropriate use of statistical parameters such as standard deviation and standard error.

3.3 Case Study

This research investigated passengers' views of the quality of bus service improvement, by comparing data collected on services operating on routes which have experienced significant improvements in quality with those that have not, using Tyne and Wear, UK as a case study. 'Superoutes' (SR) is the branding of a successful non-statutory QBP, which has been introduced across Tyne and Wear in phases since its launch in 2002 and provided the focus for this research. Figures 3.1 and 3.2 show the Superoute Network for Tyneside and Wearside areas. The research concentrated on Stagecoach (local) buses that operate on primary routes in the Tyne and Wear region. This region had at the time of the study, a population of 1,075,938 (Department for Statistic, 2009). Tyne and Wear is a metropolitan county and consists of five boroughs namely South Tyneside, North Tyneside, Newcastle upon Tyne, Gateshead and Sunderland. Tyne and Wear shares borders with Northumberland to the north and west and County Durham to the south. The major bus operators, Go North East, Stagecoach and Arriva have been working in partnership with Nexus (the Tyne and Wear Passenger Transport Executive that administers funds on behalf of the Tyne and Wear Passenger Transport Authority and local authorities in the area, to operate the SR bus services. SR is designed to offer passengers high *quality* services and operates across a number of the major corridors, to encourage greater use of public transport and thus to address the passenger decline. The service *quality* measures introduced included replacement of old stock with new modern buses with easy low level access for wheel chairs and pushchairs; provision of shelters; information at bus stops; increase in service frequency typically from 30 minutes to 15 minutes and bus priority measures resulting in improvements in reliability. As of 2009, a total of 40 SR services were in operation across Tyne and Wear following the initial launch in 2002 several criteria were considered in the selection of routes namely:

a) Catchment characteristics which affects demographics
b) Number of passengers during peak/off peak which influences sampling
c) Type of service (either Superoute or Non Superoute)

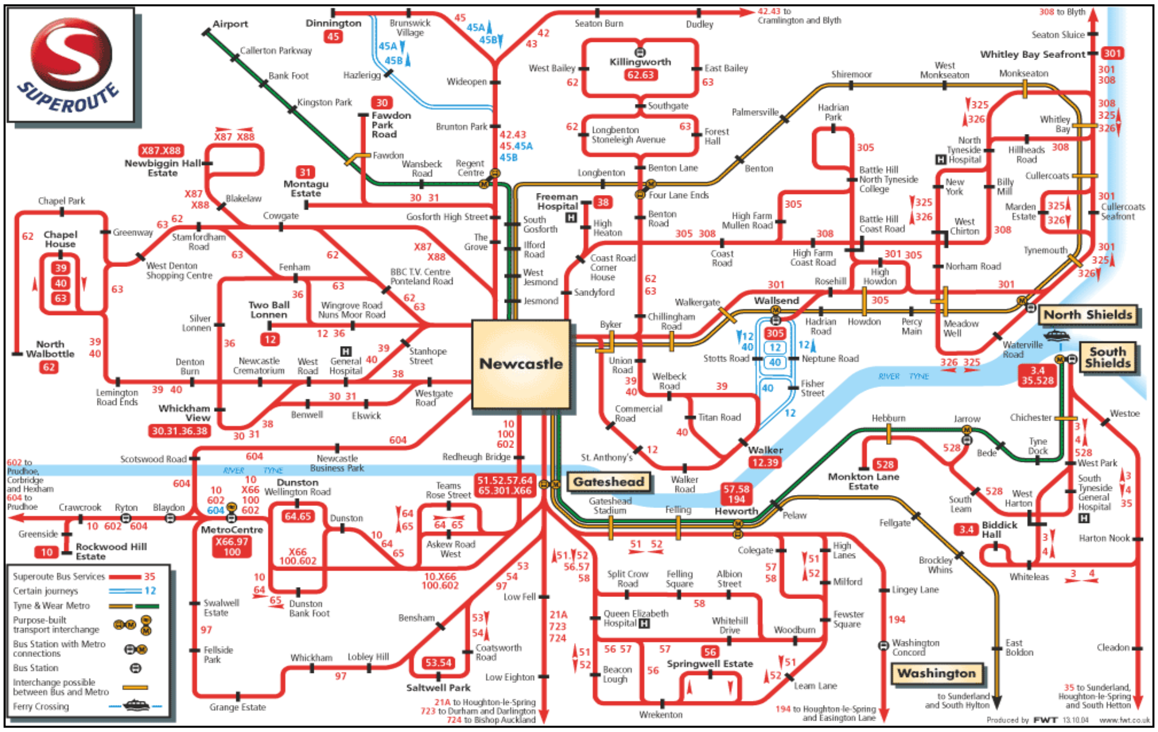

Figure 3.1 : Superoute Network in Tyneside
Source: Harrison (2006)

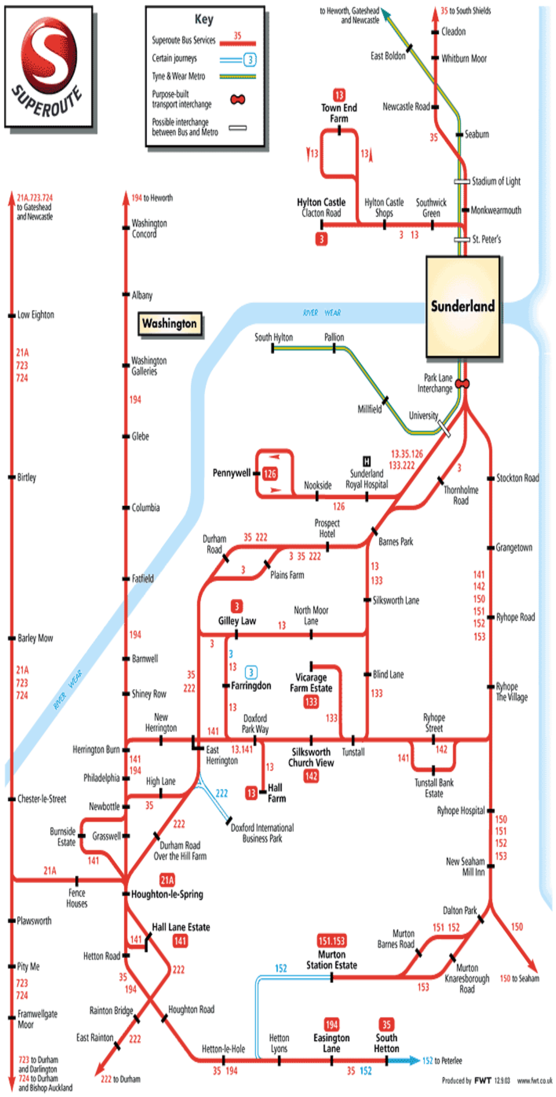

Figure 3.2 : Superoute Network in Wearside
Source: Harrison (2006)

At an early stage of data collection a comparison between routes for all criteria was carried out. This was based on the representativeness of the type of services which are Superoute or Non Superoute and the number of passengers on each route. For Superoute services, a two-tier analysis was carried out. First, comparison was made between all Superoute bus services based on the number of passengers. The service with the highest number of passengers from the three companies was selected. For example, Bus Service No. 39/40 was selected because they have the highest passengers compared to other services run by Stagecoach (see Figure 3.4) whilst, bus No. 308 run by Arriva and Go North East has the highest patronage numbers compared to other services, 40/41/42/43, 45, 308 and 602/603 (see figure 3.5) . Route 308 has the highest ridership of all Superoute services.

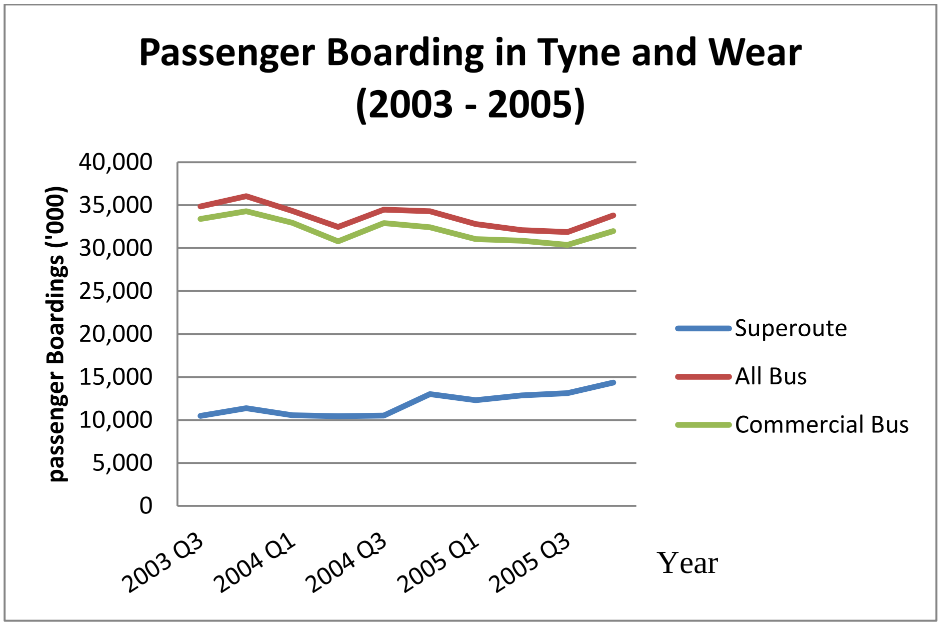

Figure 3.3 : Passenger Boarding in Tyne and Wear (2003 – 2005)

Source : Nexus (2006)

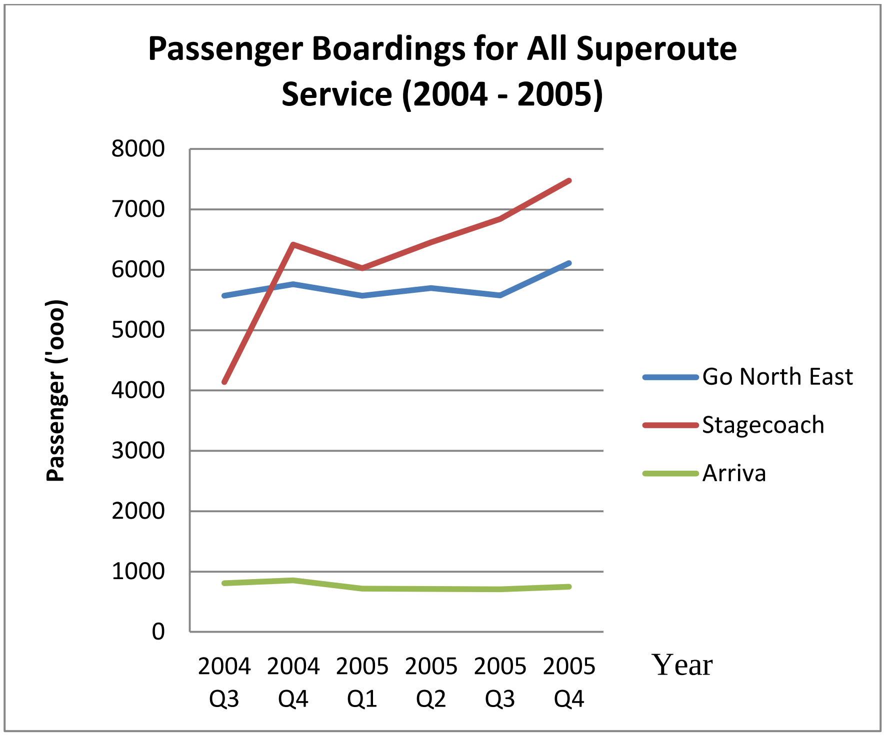

Figure 3.4 : Total Passenger Boarding in Tyne and Wear dissagregated by Bus Services provider Go North East, Stage Coach and Arriva

Source : Nexus (2006)

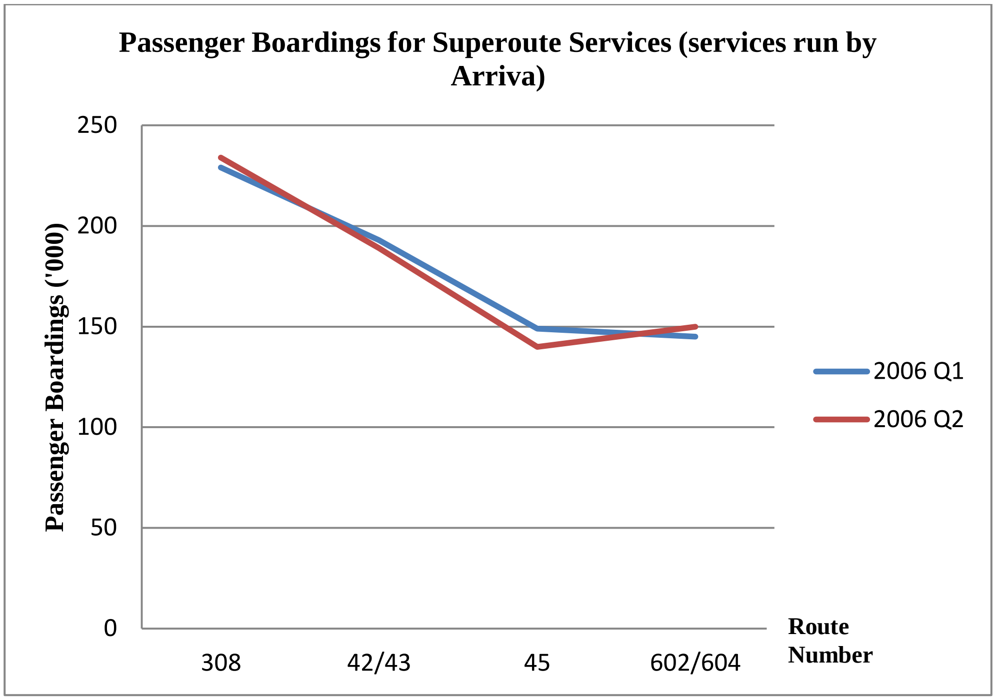

Figure 3.5: Total Passenger Boarding in Tyne and Wear and disaggregated by superoute and commercial Bus Services by Stage Coach and Arriva. Graph sourced by Nexus (2008)

The second criteria in choosing the bus routes was based on the population 1,160,000 in the area served by the bus which in 2001 for each local council district:

Population Density			
District	**Population**	**Area**	**Density (per km2)**
Newcastle	273,500	113	2,420
North Tyneside	197,300	82	2,394
South Tyneside	151,400	64	2,351
Sunderland	280,100	138	2,037
Gateshead	190,700	142	1,339
Tyne and Wear	1,093,000	540	2,025

Source : Nexus (2010)

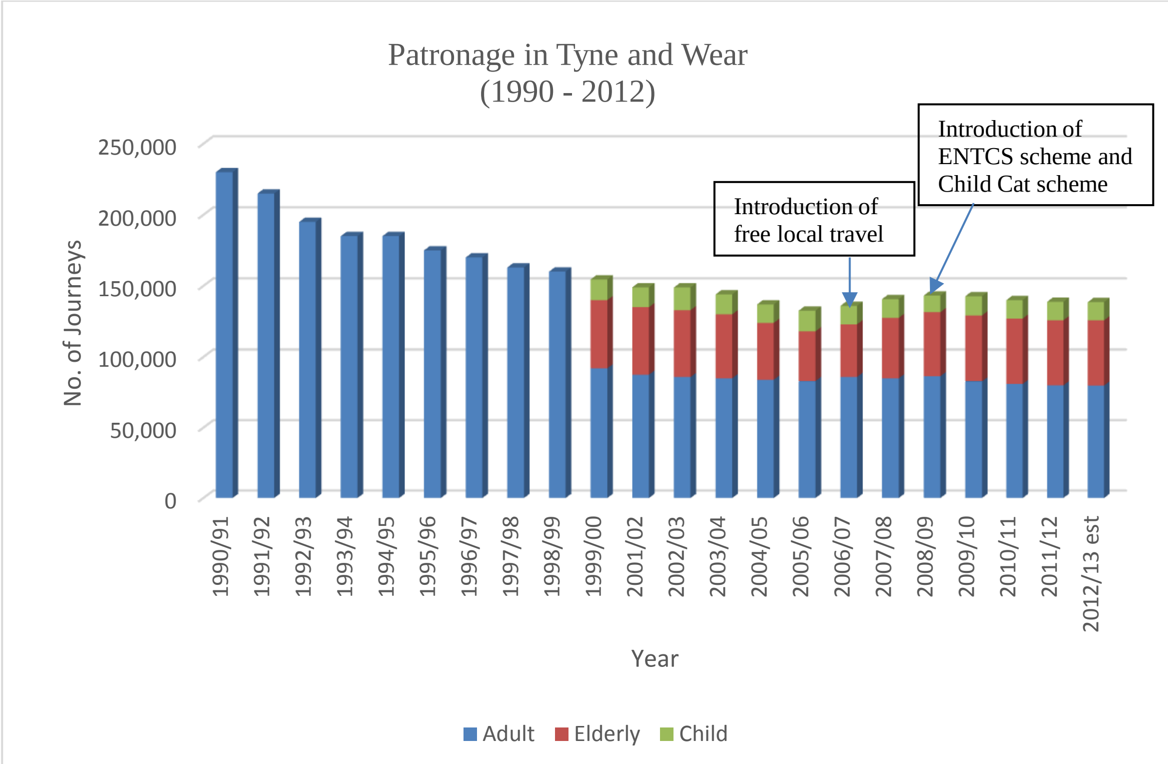

Figure 3.6 : Patronage in Tyne and Wear

Source : Nexus (2010)

Figure 3.6 shows the patronage data in Tyne and Wear from 1990/91 to 2012/2013 disaggregated into three categories; full fare adults, elderly and disabled and children. Data after 1999 was disaggregated according to demographics, elderly, children and total. The introduction of concessionary fares in 2006 contributed to the increase in patronage in Tyne and Wear stemming the earlier decline in patronage observed in this cohort. Also, the rise in the number of children, using bus services resulting from the introduction of ENCTS but with a decline in fare paying adults over a period of 14 years.

Therefore, in summary this research focused on three bus services (namely Bus No. 308 and 39/40) branded as Superoute (SR). Five services (namely Bus No. E1, 639, 20 and 10/11), that experienced no improvement and referred to as Non Superoute (NSR), were also studied, to create a set of control data for comparison. Details of the specific routes, including operator of the service, are given in Table 3.1 and the actual geographical location of the routes studied in this research are presented in Figure 3.7. Routes were chosen to reflect shorter line hauls within the city centre as well as more distant suburban catchment areas.

Table 3.1 : Details of Routes Surveyed

Category	Routes No	Operators	Routes	Frequencies	Length
Non-Superoute	E1	Stagecoach	South Shields – Whitburn- Sunderland Via Marsden, Coast Road And Roker	Peak – 20 mins Off Peak – 30 mins	9.8 miles
	[2]639	GoNortheast	Crawcook - Queen Elizabeth Hospital	Peak – 1 hr Off Peak – 1 hr 10 mins	25 miles
	20	Stagecoach	Pennywell - Sunderland	Peak – 10 mins Off Peak – 30 mins	4 miles
	10/11	Stagecoach	North Kenton - Newcastle- West Denton Park	Peak – 20 mins Off Peak – 1 hr	10 miles
Superoute	308	Arriva 70% & GoNortheast 30%	Newcastle - Whitley Bay - Blyth	Peak – 15 mins Off peak – 30 mins	20 miles
	39/40	Stagecoach	Dumpling Hall - Newcastle - Walker	Peak – 10 mins Off peak – 20 mins	6 miles

Source : Nexus (2006)

[2] The 639 has been renumbered to the 69 and the 69A. The basic route is unchanged though extended at the eastern end. West of Blaydon the route bifurcates and only the 69 goes through to Winlaton as did the former 639.

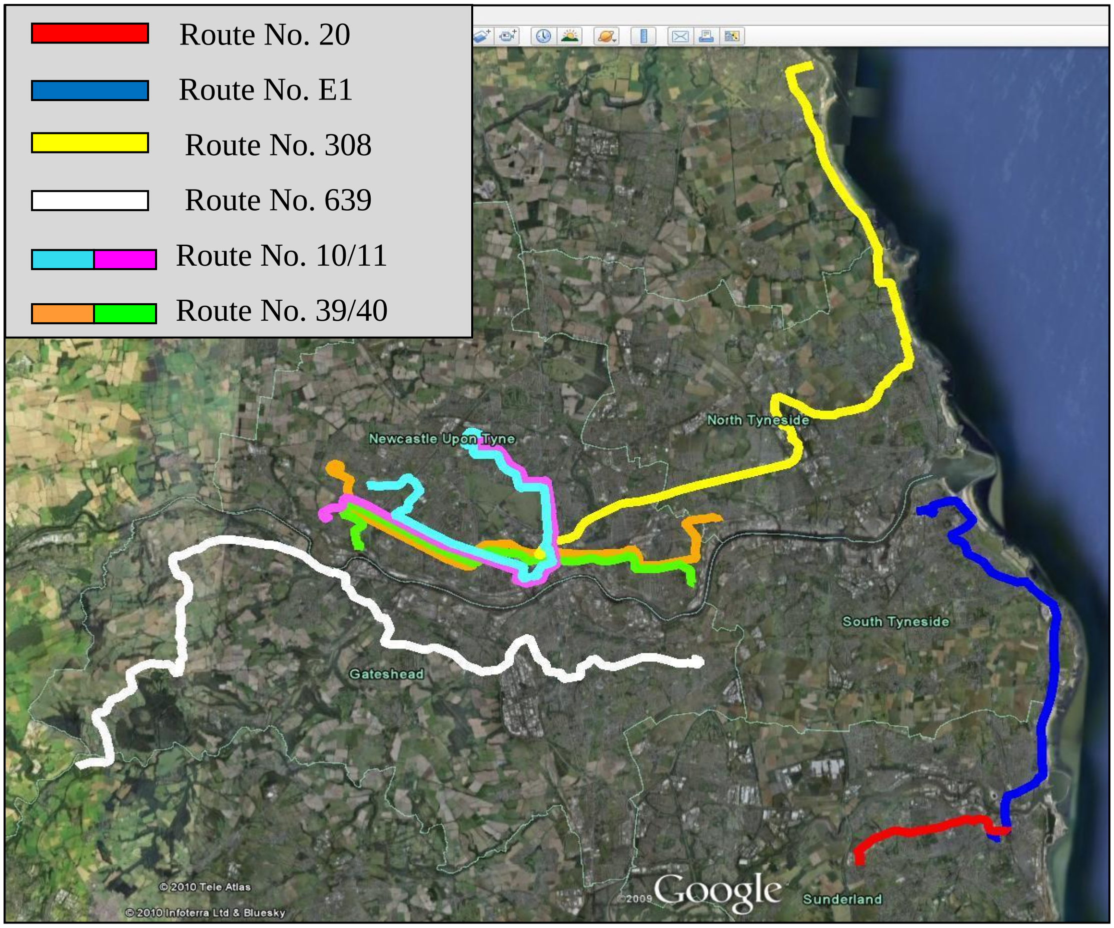

Figure 3.7 : Surveyed bus routes in Tyne and Wear

Source : Google Maps (2006)

3.4 Identification of Evaluation Framework

Consistent with the research by Pullen (1991), one-to-one meetings with Nexus took place to explore, discuss and agree the list of quality attributes that were to be used in the passenger interviews, to assess the impact of the bus service improvements in terms of *satisfaction* which in turn has been demonstrated to encourage loyalty in regular passengers to further increase bus use in the future. In this respect, the *satisfaction* rating can be considered as a proxy or the benchmark for use by the bus operators, to inform the potential to increase the passenger numbers, which was the main objective of QBP.

A fundamental assumption for this research is that *quality* is positively associated with passengers' *satisfaction* measured by the overall rating of bus service. Also, it is suggested that the more passengers are satisfied against the *quality* attributes, the higher the overall rating will be for the buses, resulting in higher passenger numbers and retention. The service quality attributes finally adopted in this research were influenced by the literature survey but also drawn from the Handbook for Measuring Customer *Satisfaction* and Service Quality (TRB, 1999) with some modifications to reflect the objectives of Superoute introduced by Nexus.

The *quality* attributes investigated in this research were:

1. How often the bus runs in the evening;
2. How often the bus runs during the day;
3. How often the bus runs on Sundays;
4. How reliable the bus is in turning up;
5. How punctual the service is;
6. Ease of buying a ticket on the bus;
7. Ease of buying a ticket at the Travel Centre;
8. Cleanliness of the bus;
9. Cleanliness at the bus stops;
10. How long the journey takes;
11. Friendliness / helpfulness of drivers;
12. Information at bus stops;
13. Finding information about bus routes;
14. Your personal security on bus;
15. Your personal security at bus stops;
16. Condition of shelters at bus stops;
17. Cost of tickets.

These attributes were used in the questionnaire to capture the key data needed to address the research questions posed in this research which were targeting the attributes in which investment was being made by the QBP initiative. Therefore, these were biased to service operation and provision. However, it is important not to lose sight of those attributes considered *important* from the passengers' perspective. Therefore, it was for this reason that the attributes chosen for this research in consultation with stakeholders have been mapped onto those studied in previous research shown in Table 2.2 (see Chapter 2) using the same numbers consistent with those given in the list of 17 attributes used in this research (See list above).

Clearly previous studies have identified attributes most relevant to the evaluation of their own specific research questions and therefore some are not relevant to this research. However, it is important to note that the specific attributes chosen here to provide an evaluation of QBP are consistent with those used in previous studies which dealt mainly with the user perspective of services. For this reason, there is some degree of confidence in the choice of measures resulting from the discussion with NEXUS and reflect attributes considered appropriate to directly measure perceptions from a user perspective.

Also, the measures (with reference to the list above) were chosen to relate directly to operational characteristics (1, 2, 3, 4, 5, 6, 8, 11, 14, 17) and infrastructure (7, 9, 10, 12, 13, 15, 16) because the differences between SR and NSR are expected to be higher for operational than for infrastructure measures. With 17 attributes specifically chosen to map onto those QBP investment criteria means that the assessment is targeted at those attributes where differences are expected to occur. This is because attributes associated with bus stops, travel centres and delays caused by congestion affect both SR and NSR services. By creating a statistical analysis framework using 4 different approaches enabled the features expected in the data to be explored from different perspectives; the descriptive statistics providing an overview of the different services and individuals in the sample.

The ISA provides a two dimensional matrix of how satisfied the users of the NSR and SR against what is considered important and allows inferences as to whether improved quality affects importance as well as *satisfaction*. Factor analysis is expected to establish whether differences anticipated in operational and infrastructural quality attributes enhanced our understanding. Cluster analysis delves deeper into the characteristics of groups of passengers explaining features and patterns that emerge from other statistical analysis. OLR of course provides a higher level of understanding which should confirm key messages that emerge from earlier analytical approaches. Of course it remains that there is no guarantee that the evidence that the changes measured have resulted directly from the investment in the QBP but due to something else totally unrelated. However, if a set of attributes behave in a consistent way within different analytical approaches and features in the data can be systematically explained with statistical significance then it is assumed some level of credence can be attached to the fact that the changes are resulting from QBP investment and not due to coincidence.

3.5 Questionnaire Design

Table 3.2 serves as a useful overview of the questionnaire used in this research. It consists of three sections as follows: Section 1: respondent's current journey, Section 2: their perceptions of the quality of the current bus as users of the service and Section 3: respondents' socio-demographic details. The questions in Section 2 are designed to provide a 5-point Likert scale measurement and the same questions were asked to firstly capture the responders' assessment of the degree of *Importance* (ranging from 1 = 'Very Unimportant' to 5 = 'Very Important') of each quality attribute and secondly an independent assessment of quality attributes in the context of *Satisfaction* (ranging from 1 = 'Very Dissatisfied' to 5 = 'Very Satisfied'). The full version of the questionnaire designed for use at the pilot stage of this research is given in Appendix A and a brief description of each question in each section, see Table 3.2, is given below.

Table 3.2 : Key Questions of the Survey

Sections		Questions
Section 1	Current Journey	Journey Purpose
		Access to a Car
		Frequency of Use
		Comments by ‘rarely’ or ‘first time’ user
		Type of ticket used
Section 2	Perception of Service *Quality*	Safety while waiting at bus stops and travelling on
		Measures that would encourage increase of bus use
		Importance of 17 *Quality* Attributes of Bus service
		Satisfaction of 17 *Quality* Attributes
		Rating of Current Bus Service
		Awareness of Superoute
		Suggestions to improve bus service
Section 3	Demographic Characteristics	Age
		Gender
		Origin and Destination
		Income
		Occupation

3.5.1 Section 1: Current Journey

The first section of the questionnaire consisted of six questions asking respondents to provide details of their purpose of journey (work, school/college, shopping, visiting friends/relatives, leisure/recreation, a night out and other); frequency of bus usage (daily, 5 times a week, 3-4 times a week, 2 times a week, rarely and first time), access to a car for the current journey (yes or no), their knowledge before they left the house of the timetable of the services on their bus routes (yes or no), type of ticket normally used for the journey and for non-frequent respondents, the reasons for rarely choosing to use the bus (i.e. not enough information, just don’t like using public transport, journey too uncomfortable, fare too expensive, service too unreliable, etc). The data in Section 1 provided information that enables categorisation of passengers into groups that may influence their perception on how *important* and consequently how *satisfied* they are against a particular quality attribute.

3.5.2 Section 2: Perception of Service *Quality* and Bus Service Improvement

In this study, it was important to develop a survey methodology which identified the areas where the *quality* indicators have a significant influence on passenger perception and to attempt to identify which attributes are *important* and how they contribute to user *satisfaction*. Whilst Brady and Cronin (2001) stated that respondents were more interested in listing all factors that influenced their perceptions consistent with their experiences, according to (Vaske *et al.*, 1986) single-item measures were considered to be superior when examining differences among individuals. As this study focused on individuals' responses to quality attributes for different services, rankings were based on assigning a qualitative measure (Likert Scale 1-5) to a specific attribute one by one in a pre-defined list. Therefore, the questionnaire was designed with questions that listed 17 *quality* attributes (each relating to a specific SR *quality* improvement measure as outlined in Section 3.3). These are detailed in Table 3.3.

Table 3.3 : Quality Attributes applied for both *Importance* and *Satisfaction* separately

1	How often the bus runs in the evening	5	4	3	2	1
2	How often the bus runs during the day	5	4	3	2	1
3	How often the bus runs on Sundays	5	4	3	2	1
4	How reliable the bus is in turning up	5	4	3	2	1
5	How punctual the service is	5	4	3	2	1
6	Ease of buying a ticket on the bus	5	4	3	2	1
7	Ease of buying a ticket at the Travel Centre	5	4	3	2	1
8	Cleanliness of the bus	5	4	3	2	1
9	Cleanliness at the bus stops	5	4	3	2	1
10	How long the journey takes	5	4	3	2	1
11	Friendliness / helpfulness of drivers	5	4	3	2	1
12	Information at bus stops	5	4	3	2	1
13	Finding information about bus routes	5	4	3	2	1
14	Your personal security on bus	5	4	3	2	1
15	Your personal security at bus stops	5	4	3	2	1
16	Condition of shelters at bus stops	5	4	3	2	1
17	Cost of tickets	5	4	3	2	1

The important objective in this section of the questionnaire was to ask respondents four fundamental questions in order to reveal their perception; First, 'How they rate the *importance* of the individual quality attributes'; Second, 'How they rate their *satisfaction* of the individual quality attributes' and Third, 'How they rate the overall service quality' and finally, 'How they rate the overall rating for the bus service'. A quantitative value on a 5 point Likert scale ranging from the lowest 1 = 'very poor' to the highest value 5 = 'very good' was used for all cases.

In the ISA analysis, the value (on the Likert scale) assigned to each of the *quality* attributes was averaged over all 17 quality attributes to produce a mean score for *importance* and the corresponding value was calculated for *satisfaction* for each respondent.

The concluding questions asked in this section related to the level of awareness of the branding of 'Superoute' and respondents opinion of safety issues whilst 'waiting at bus stops' and 'travelling on buses'. For the latter, a 5-point Likert scale was used with 1 'very unsafe' to 5 'very safe' An open question was asked to gather suggestions on what could bus companies do to improve the local bus service. Respondents were asked to comment on their experiences with the bus services in Tyne and Wear. Respondents were also asked to rate the bus service measures that will encourage them to use the bus more frequently on a scale of 5 ranging from 1 'very unlikely' to 5 'very likely'.

3.5.3 Section 3: Demographic Characteristics

In this section, respondents were asked about their demographic characteristics such as gender, age, income and employment status. Research in the United States proved that socio-demographic characteristics are related to travel behaviour (Rosenbloom, 1998). Rosenbloom found that workers with low incomes and no household cars tend to use public transport more. Also, according to Rosenbloom, immigrants who had been in the United States less than 10 years used public transport frequently; passengers tend to be young adults (aged from seventeen to twenty-nine) and women tend to use public transport more often than men. These studies suggest that a typical non-user would be a white, middle-aged man with a household income above USD 15,000 (Rosenbloom, 1998).

3.6 Description of surveys

In this research, given that a direct face to face interview method was adopted as the most suitable, it was important to consider research ethics defined as "moral principles guiding research, from its inception through to completion and publication of results and beyond" (Economic and Social Research Council, 2005). As identified by Neuman (2007) and Babbie (2004), the interviewer has to abide by strict procedures when conducting surveys, to ensure that public participation is voluntary and steps need to be taken to protect the confidentiality of research subjects and never cause injury to the participants. In addition, due consideration was given to the several criteria of participation for example, minors (under the age of 19 years), mentally incapacitated participants, victims, individuals with neurological impairments, pregnant women, prisoners and in certain cases individuals with AIDS as highlighted by Sarantakos (2005). Therefore, only adults were approached and consistent with the recommendation of Sieber (1998), at the beginning of the survey, the interviewer gave a brief introduction about the purpose of the research; made a statement of guarantee of confidentiality to the participant and the permission to terminate the interview at any point during the interview.

3.6.1 Preliminary testing of questionnaire

As Fowler (1995) stated "design of the questionnaire has great influence on the survey results in which it should be able to reflect the actual differences in a respondent's attitudes and perceptions". As Brace (2008) added, poor design of a questionnaire will lead to erroneous conclusions.

A preliminary study was performed to test the suitability of the questionnaire. This allowed improvements to the questions and as suggested by Dillman *et al.*, (2009), the survey questionnaire must test for reliability to produce the same result for all occasions. The preliminary survey involved 20 participants; Female (N = 11) and Males (N = 8).

Respondents were asked two predefined questions once they had completed all the questions in the questionnaire. The predefined questions were:-

1. Did you understand the questions?
2. Did you find it easy to answer all the questions?

The time was recorded from the start of the survey until the session ended. It was found that the time taken was typically 20 minutes.

Out of 20 samples, it was found that 90% understood the questions and 90% found it easy to answer all the questions. Based on the findings, changes were made to the details of the questionnaire. These involved modification in the wording, changes in the order of the questions and a few questions were removed. In particular, at an early stage of this research it was found that most of the respondents were reluctant to state their income in the questionnaire because the question was regarded as sensitive. This was consistent with the earlier research by Fowler (1995) who found that income was perceived as personal and might cause a respondent discomfort. Also it was often found that respondents deliberately recorded salary incorrectly. This was thought not to be to too detrimental because the question addressing employment education retired status dealt with the first order effect and actual income effect was secondary. By reducing the number of questions, the survey was reduced to a total length of 10 minutes. It was also suggested that the detail of the characteristics of the participants, are placed at the end of the questionnaire.

3.6.2 Pilot Survey

As with all scientific study, a pilot study has a very important role, particularly in finalising the details of the questionnaires (Kumar, 2005) and testing the survey methodology. It was essential to carry out a pilot survey not only to test the comprehension of the question, but also to address the adequacy of the data collected to deliver answers to the research questions. Of particular importance in this research was to establish the duration of the interview and if necessary to adjust the chosen method of data collection. The pilot survey was carried out during April 2006 on bus service No. 10 and 11. The duration for the interview was recorded to identify/ensure the right balance was achieved between collecting sufficient data to support good quality research and maintaining the respondents' interest. Feedback from the respondents was taken into account during the pilot survey and later, improvements were made especially in terms of the coding of questions which affected the later stage of data processing. The questions that were misunderstood included 'how do you rate your local bus service in general? Respondents were asked to rate the local bus service overall according to six categories which were overall image, quality of service, levels of service, level of fares, service information and station/vehicle accessibility. The same questions were asked previously in the questionnaire in the *Importance* and *Satisfaction* section for individual quality attributes and this created confusion for the respondents when completing the questionnaire. Five questions were replaced with one which referred only to the overall service. In order to avoid bias in the given answers to the question for example ‘How often do you use buses in Tyne and Wear?’ The response option of ‘first time’ was added in order to capture the respondents who are first time users of the service. After refinement of the questions, the final version of the questionnaire was ready for the survey. A copy of the final questionnaire is presented in the Appendix B.

3.6.3 Main Survey

The main survey was carried out during August 2006 and was conducted as face to face interviews with passengers using the selected routes 10/11, 39/40, 308, 639, E1 and 20 (see Figures 3.4) during the morning, evening and inter peak periods. Permission to carry out the surveys was obtained from the operators who provided travel cards allowing free travel on the services studied. In order to ensure minimum imposition on commuter travel when buses were heavily loaded often with passengers standing in the aisles, it was agreed with NEXUS to carry out the surveys during August this was at a time when school children were on holiday and some households are away on vacation. This may have an effect on passenger perceptions. Other issues that may affect surveys constrained to the month of August would be associated with the weather for example rain, snow, fog, wind or extreme temperatures may influence people’s behaviour in choosing modes of transport. Stover *et al.,* (2012) stated weather as one of the factors that affects ridership. This research was carried out in Pierce County, Washington and looked at the effect of weather on the ridership using Ordinary Least Square Regression (OLS). The study found that four weather variables have a significant effect on ridership where ridership during winter was found to be lower than during summer. Changnon (1996) showed that rainy days in summer affected ridership, the amount of riders was significantly lower compared to non-rainy days. A study in Dublin by Hoffman and O'Mahony (2005) found bus travel times to be longer on rainy days whilst Kalstein *et al*., (2009) demonstrated that ridership on rail systems in Chicago, the San Francisco Bay area and northern New Jersey, were significantly higher on dry and "comfortable" days. However, neither the presence of school children on the bus nor the weather were considered. This was deemed not to cause any bias in the results in this research because the aim of the research was to measure perceptions of services across all users irrespective of trip purpose. Also, given the constraints imposed by the ethical panel on restricting participation on the survey to adults (over 18 years) school children were outside the scope of the study. All interview responses were coded and entered into a qualitative and analytical software package, SPSS, version 15.

Face to face interviews were the preferred method for this research as it ensured high quality and consistency of data capture and surveys were able to be conducted within a short period, however, it requires much commitment and is labour intensive. Interview bias was minimised by comprehensive training of all surveyors used in the survey campaign. Stokes and Bergin (2006) criticised face to face interviews as it is difficult to obtain in-depth feedback on the surveys. Mindful of the need in this research was to ensure data quality, in-depth feedback questionnaires were executed by face to face interviews. However, in the event, due to the length of the route of the bus services chosen, in particular routes 10/11 and 39/40, the time needed to interview passengers restricted the number of interviews completed in one trip. This was exacerbated by the fact that many passengers used the service for short journeys which resulted in incomplete questionnaires. Therefore, to achieve the highest rate of return for time invested a compromise was reached. If interviews had to be curtailed respondents were handed the questionnaire with prepaid envelopes so that they could complete the remaining questions at their convenience. On some occasions passengers agreed to self-complete the entire questionnaire. According to McDonagh and Rosenblum (1965) by applying both methods (face to face interview and self-completion survey) allows for the advantage of reducing the survey time whilst also reducing the poor response rate of self-complete surveys

(Greenbaum, 1998). Furthermore, face to face interviews gave the researcher opportunity to understand better the respondent's perceptions as they expressed their feelings on the performance against the *quality* of current bus service measures. Also, it became evident that the interviewers' presence on the bus encouraged participation in the survey and increased the sample rate of the survey. However it could be argued that the surveyor may influence the answers and differently, given three individuals were involved with the interviewing creating potential for bias to occur. However, this was kept to a minimum through comprehensive training of survey staff and strict protocol was developed to strive for consistency of data collected.

The sample size was a compromise between a) resources available to actually conduct the surveys, b) the importance of maintaining consistency of responses potentially jeopardised by using a number of interviewers, c) the permissions granted by the bus company to actually conduct the surveys and d) the representativeness and statistical confidence with which results could be delivered. The checking of sample characteristics against those found in previous research and as a result of the pilot study analysis, mindful of the need for a minimum of five observations in any cell to justify statistical significance of the χ^2 test, a sample of between 100 and 200 was considered acceptable. In the event due to actual accessibility to services to carry out the surveys being different for NSR and SR the resulting sample of 110 and 200 was achieved.

3.7 Data Screening

Prior to starting the analysis, careful screening of the data was necessary to identify errors and inconsistencies in the complete records. Cross tabulation of data variables was used and the results were examined to identify any outliers which were corrected as appropriate (Tabachnick and Fidell, 2007). The data records were incomplete for several reasons including when journeys proved to be too short giving insufficient time to complete the interview. However, despite a good return rate some passengers failed to complete some of the questions as they proved to be too long and complicated for self-completion. For example, it was found that one of the questions included in Section 2; 'What improvement would encourage you to increase bus use' was often not answered by the respondent. On reflection, this open question probably made some of the respondents reluctant to participate because it requires more time to think of ideas and suggestions especially since many responders were making short journeys. This particular issue was not exposed in the pilot survey.

3.8 Data Analysis Methods

Before beginning the analysis a comprehensive data cleaning process was carried out. This included inspection of individual responses. In cases where there were partly completed questionnaires, the responses were discarded. Typing and coding errors on data entry was also checked during the data processing and manipulation. However, some missing values were still retained by setting up default values for each data record. The analysis of the data aimed to address the research questions were identified in Chapter 1. This research adopted five complementary statistical analysis methods namely Descriptive, *Importance* and *Satisfaction*, Factor, Cluster Analysis and Ordered Logit Regression. As shown in Figure 3.9 for clarity the key objective to be delivered by each statistical analysis procedure is given and Figure 3.10 elaborates on each step of the analysis and the purpose. Given there was no opportunity to carry out a before and after survey following the introduction of SR services the final stage of the analysis was to consider the outputs from each analysis to establish consistency of results across different statistical techniques. The purpose of the descriptive analysis is to understand the overall characteristics of the population and to give a high level simple glimpse at differences and similarities emerging from the data. ISA provides a two dimensional picture of any difference in relationships between importance and satisfaction for NSR and SR according to trip purpose. FA investigates relationships between attributes so that 17 attributes can be reduced to a fewer number. CA will identify any subgroups of the population which may have rather different perspectives of bus service quality. Finally, Ordered Logit Regression (OLR) identifies which attributes influence overall quality of a service and whether they are different from the overall rating. Each statistical method is detailed in Chapter 2 and the remainder of this chapter is devoted to how the techniques were applied to the data collected in this research.

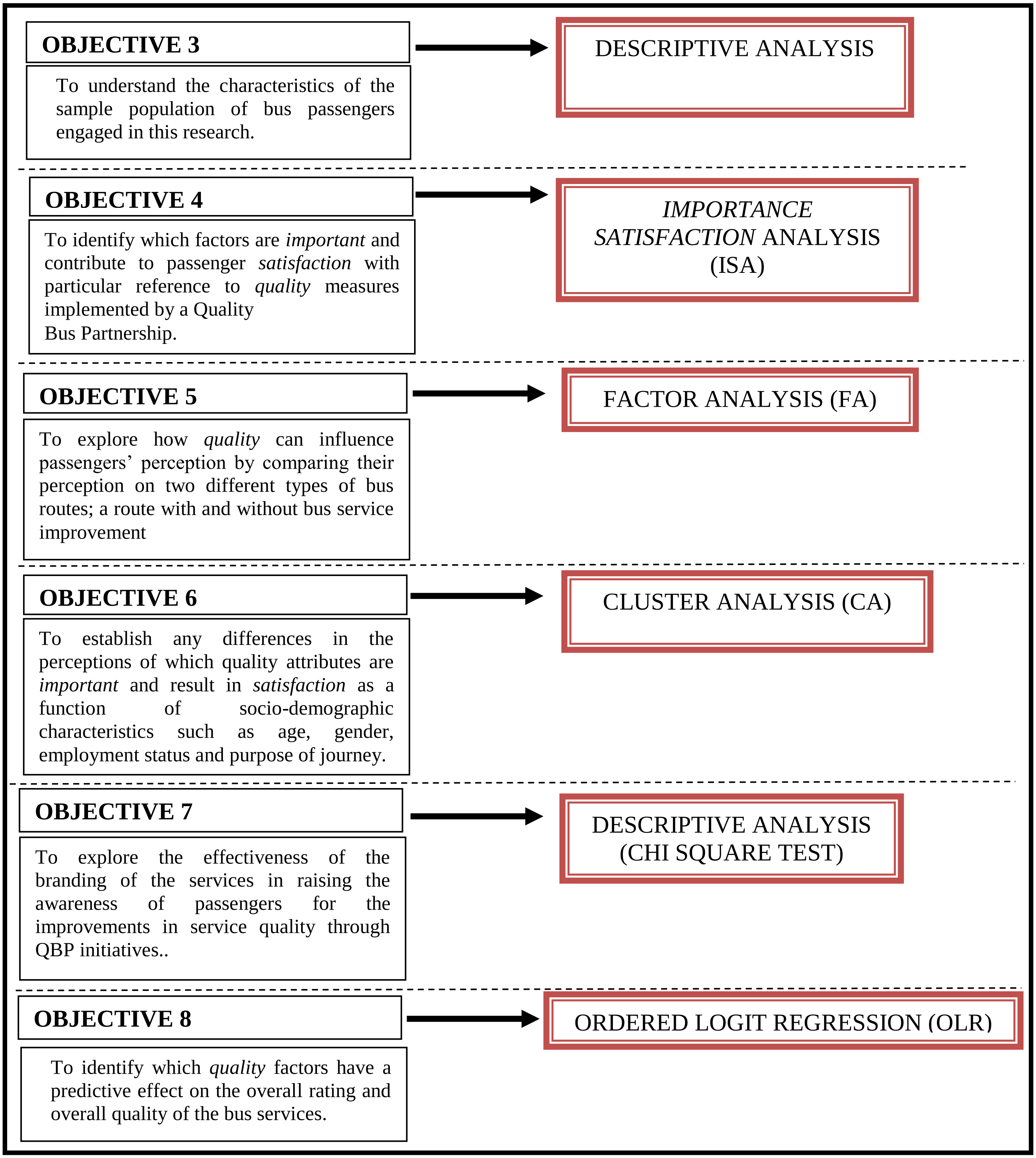

Figure 3.8 : Statistical analysis methods adopted in this research to deliver objectives

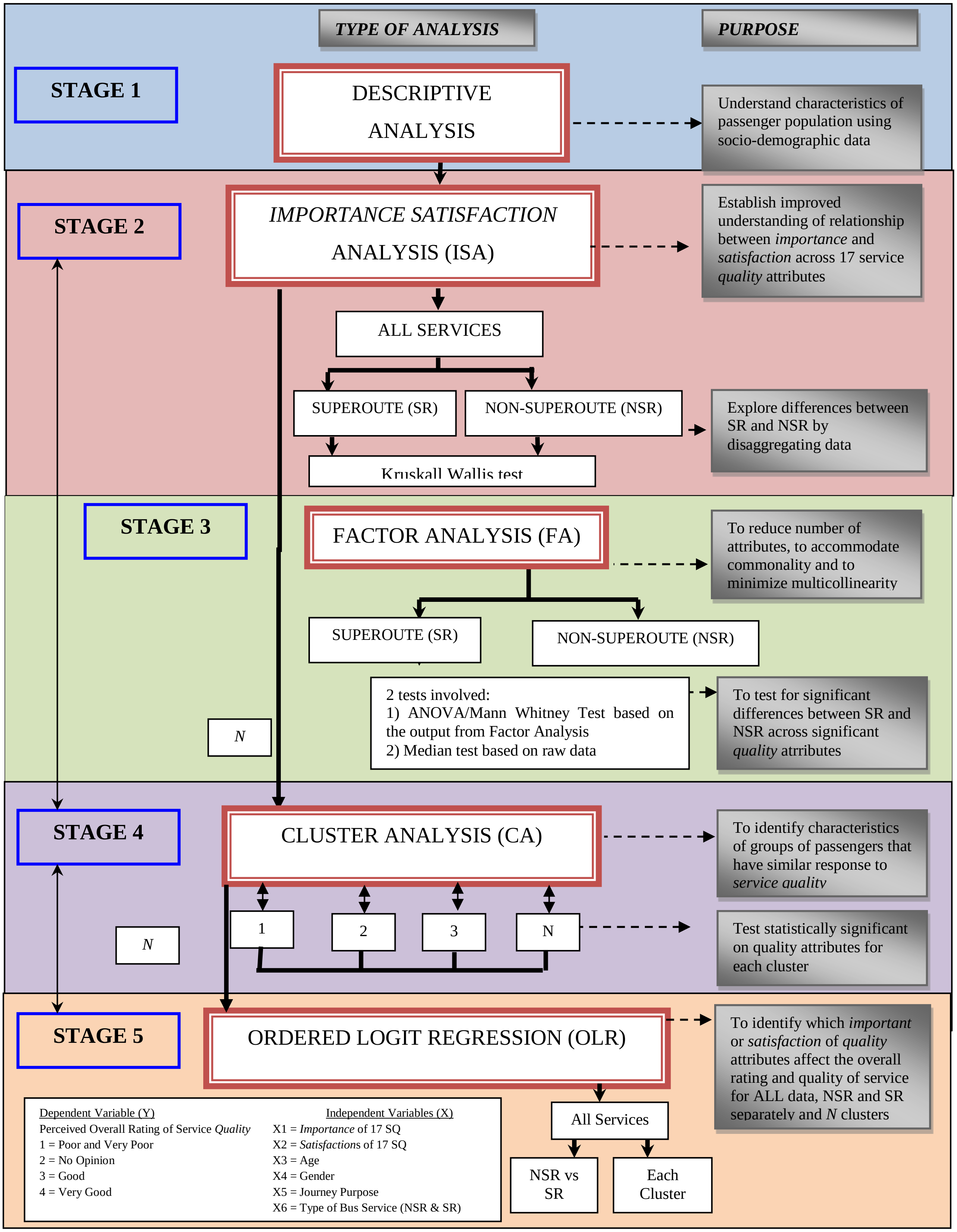

Figure 3.9 : Flow Diagram of Five Analysis Method of Analysis

3.8.1 Stage 1: Descriptive Analysis

As a first step, the data was analysed using descriptive analysis. The initial descriptive analysis explored the data using conventional statistics to provide information that describes the characteristics of the sample taken from the total passenger population. A section of the questionnaire was designed specifically to collect details of socio-demographic characteristics such as age, gender, salary band and employment status. In this research, SPSS version 15 was used to analyse the data collected, to provide a basis for the more detailed analysis that follows. Descriptive statistics are not suitable for research with hypothesis, but are an integral part of the knowledge gathering from the sample, about the population. The statistical information of the sample to be reported include: the mode, mean, median, standard deviation and variance of the sample. The results of the descriptive analysis are normally shown as tables, graphs or charts that include the summary and description of the derived statistics.

A simple overview of features in quality attributes was carried out for the entire data set. The next step was to separate the data into two parts, NSR and SR and test whether there were any statistically significant differences across those quality attributes. Two tests were used, the first analysis of variance ANOVA or Mann Whitney test depending on the output from the factor analysis. The second was the median test based on the raw data. Care needs to be taken to ensure the appropriate test was carried out depending on normality of the distribution.

3.8.2 Stage 2: *Importance* and *Satisfaction* Analysis (ISA)

Importance Satisfaction Analysis (ISA) was used to investigate the differences between passenger expectation (*importance*) and actual experiences (*satisfaction*) in relation to the 17 bus service *quality* attributes. Passengers were asked to express their experiences on a scale of 1 to 5 (very important to unimportant and very satisfied to very unsatisfied) of the bus service on which they were travelling at the time of the interview. In this way, whilst the respondents were experiencing the service quality, an evaluation of what passengers expected and the extent of their *satisfaction* was made possible. The ISA provides useful information to support the decision making of operators keen to maximize overall user *satisfaction* by investing in any improvements in those service quality attributes where the level of *satisfaction* is relatively low and yet the perceived *importance* of that attribute of service *quality* is relatively high. The choice of statistic, whether mean or median and whether parametric or non-parametric tests were used, depended on whether the distribution of Likert scale scores were normally distributed. Therefore, the first step in the ISA analysis was to test distributions for normality, notwithstanding the appropriate choice of parametric or non-parametric testing to establish statistical confidence

A statistical assessment of the mean Likert Score for each of the attributes against the cross hair, seeks to reveal relative differences between the *importance* of the quality attributes of the bus service as perceived by passengers and the corresponding *satisfaction*. Repeating the analysis for the different services and groups of passengers with different characteristics, ISA can be used as an informative tool, allowing bus companies to better understand the characteristics of passenger groups and establishing how they perceive the service *quality* which in turn can influence the decision making regarding investment in service provision. In a climate of budget constraint, this research seeks important knowledge to target investment for maximum return. However, exactly how the cross hair is defined influences the results and (TRB, 1999) warned the need for caution when interpreting the data. Given that the state of art review revealed different opinions regarding the choice of the appropriate statistic for the hairlines, this research investigated the proposed alternatives (mean, median, middle point of Likert Scale) to explore which was most suitable for application to this research. This will be dealt with in detail in Chapter 5.

3.8.3 Stage 3: Factor Analysis (FA)

Stage 3 of the analysis involves the technique of Factor Analysis (FA), which is used to simplify large sets of data to reduce the number of variables and to explore in further detail, structure in the relationships between the data variables establishing those that are and those that are not independent.

3.8.4 Stage 4: Cluster Analysis (CA)

Having explored, those quality attributes found to be independent and significantly different and any differences between NSR and SR, the data was subjected to a comprehensive cluster Analysis (CA). The CA was chosen for this research as an exploratory statistical tool to identify whether in the heterogeneous sample of passengers studied, similar response patterns exist for passenger groups with particular characteristics. A two-step cluster was chosen because it can handle a large data string with either categorical or continuous data (Tabachnick and Fidell, 2007). As discussed earlier in section 3.8.2, the Likert Scale can be considered as both categorical and interval between 1 and 5. The latter assumes a continuous distribution for the total (infinite) population. The population characteristics data on the other hand, is categorical data such as NSR and SR. The first step pre-clusters the cases into many small clusters and the second step associates the sub-clusters resulting from the pre-cluster step, forming an optimal number of clusters. The two-step cluster analysis for this research assumed normal distribution for continuous variables, and multinomial distribution for categorical data. Euclidean (straight line) distance is the distance measure used for continuous variables. If there are one or more categorical variables, then the likelihood distance (also called log-likelihood or maximum likelihood distance) is used. Likelihood distance reflects the drop in the log likelihood statistic, when clusters are combined and conforms to a normal distribution for continuous variables and a multinomial distribution for categorical variables. In the analysis presented in this thesis, variables x, y, z etc. are considered to be categorical variables.

Figure 3.11 illustrates the decision tree to interpret the characteristics of clusters. It starts from the disaggregation of the sample for each cluster based on the specified categories. In relation to this research, categories were based on the socio-demographic characteristics such as age, gender and journey purpose of respondents. Groups that have the highest number accumulating from each branch will be used to characterise that particular cluster. The clusters once identified will then be subjected to a complete ISA (step 2) to establish whether or not there is any statistical evidence that specific population groups identify different quality attributes to be of *importance* and the associated levels of *satisfaction* are found to be different.

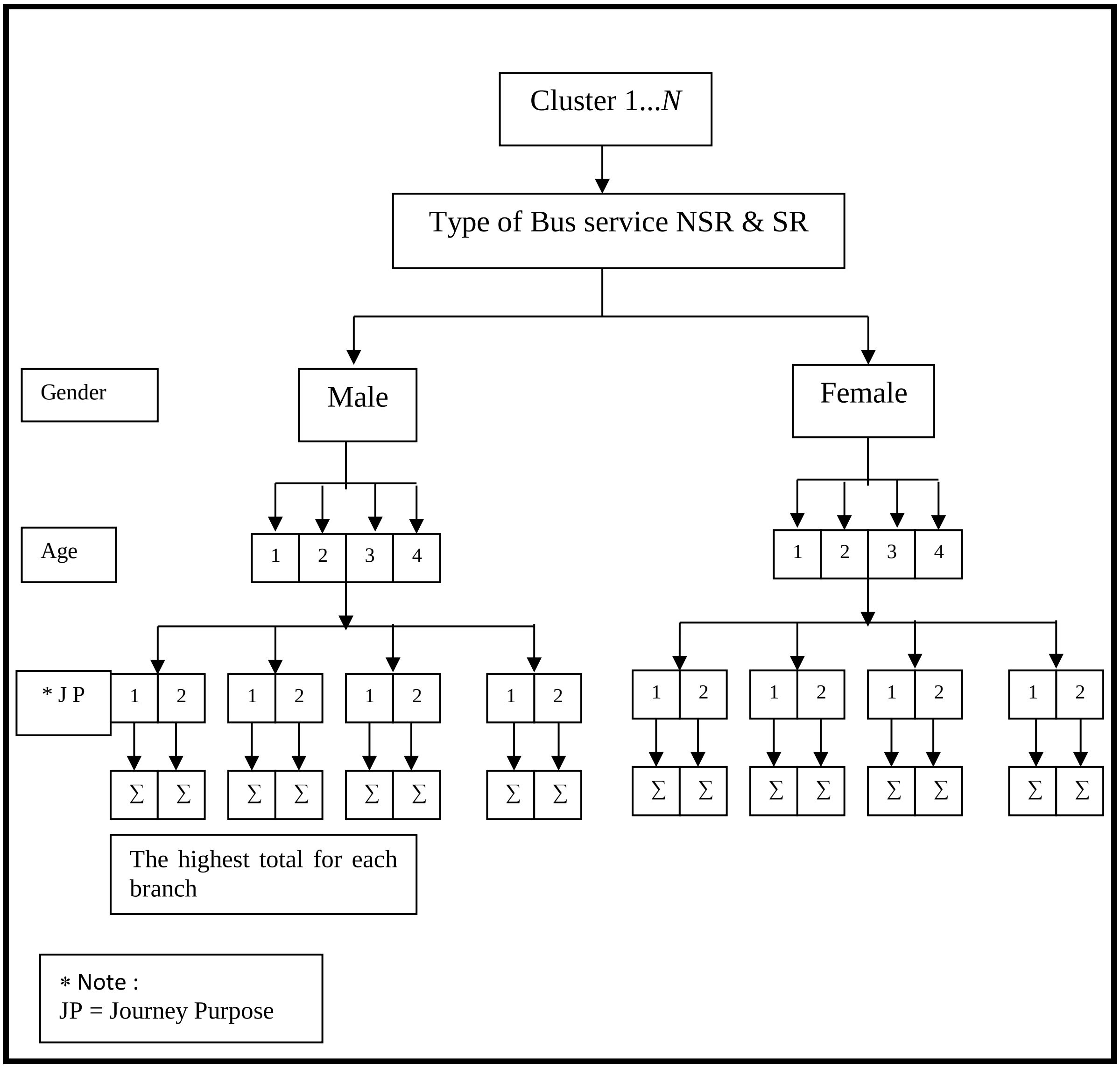

Figure 3.10 : Decision Tree in Interpreting Cluster Analysis

3.8.5 tage 5: Ordered Logit Regression (OLR)

The fifth and final statistical analysis method adopted was Ordered Logit Regression (OLR).

In previously described stages of this research (i.e. Stages 2, 3 and 4); the analysis that was carried out did not necessarily identify the specific attribute influencing or creating the feature but simply exposed their existence. In this research respondents were asked to rate *importance* and *satisfaction* against the seventeen service *quality* attributes separately, but also in the context of (a) an overall rating for bus services and (b) an overall rating for service *quality*. The results of (a) have been presented previously (Hensher *et al.*, 2009) which proved that passengers travelling on SR were more satisfied than NSR, and that improved 'service frequency' and 'personal security on buses' provide positive experiences to the passengers.

The further aim of this research is to identify the relationships between the *importance* and *satisfaction* on 17 service *quality* attributes and the *overall rating of bus service quality* as perceived by each passenger. OLR was used to investigate this research question and then establish any relationship between the categorical outcome variable - the passenger *overall rating of bus service quality* in relation to bus service improvements (reflected by the 17 quality attributes separately) implemented in Tyne and Wear. The OLR analysis was performed using STATA 10 software for which the algorithms were summarised in section 2.8

The categories for the dependent variable and independent variables used in setting up the STATA10 software for the model analysis are presented in Table 3.4 and Table 3.5 respectively. OLR models were developed which include; all respondents according to type of bus service (i.e. NSR and SR) and for each of the four clusters. The different models were distinguished by overall passenger perception of service quality and their socio-demographic characteristics. The 17 independent variables are categorical for both '*importance'* and '*satisfaction*' and were modelled as continuous values. In addition to the 17 quality attributes for both *importance* and *satisfaction*, respondents were asked for their perception of safety on the bus and at the bus stops. The responses to these questions were also included as categorical independent variables in the OLR. The socio-demographic characteristics of respondents included in the model, were age, gender and journey purpose. However, income was not used because many responders chose not to answer this question and there were concerns of bias if included.

Given their potential to influence perceptions, demographic characteristics were taken into account using dummy variables to replace the continuous values (Hair *et al.*, 2010). In the model development, the dummy variable was set to '1' and '0' for 'male' and 'female' respectively. Other variables included journey purpose, type of bus service as shown in Table 3.5 and Table 3.6 shows the interaction terms used in the regression. The OLR model was set up for several different scenarios, the first to explore characteristics of all responses irrespective of service including and excluding variables to gain an understanding of the sensitivity of the model to different components. In each case the statistical parameters, VIF, Brant test and the Likelihood Ratio Index were used to test the statistical significance.

Table 3.4 : Dependent Variable applied in OLR

Dependent Variable	**Likert Scale**
How do you rate service *quality* in Tyne and Wear as a whole?	1 =very poor 2 = poor 3 = fair 4 = good 5 = very good

Table 3.5 : List of independent variables used in OLR

Independent Variable	
Your personal security at bus stops Condition of shelters at bus stops Your personal security on bus Finding information about bus routes Information at bus stops Friendliness / helpfulness of drivers Cleanliness at the bus stops Cleanliness of the bus Cost of tickets How long the journey takes	<u>Likert Scale</u> *Importance* 1 = very unimportant 2 = unimportant 3= fair 4 = important 5 = very important *Satisfaction* 1 = very dissatisfied 2 = dissatisfied 3 = fair 4 = satisfied 5 = very satisfied
How often the bus runs in the evening How reliable the bus is in turning up How punctual the service is How often the bus runs on Sundays How often the bus runs during the day	
Ease of buying a ticket on the bus Ease of buying a ticket at the Travel Centre	
Safety while waiting at bus stops	1 = very unsafe 2 = unsafe 3 = fair 4 = fairly safe 5 = very safe
Safety whilst on the bus	
Age	Modelled as dummy variables. See Table 3.6.
Gender	
Journey Purpose	
Travelling on NSR or SR services	

Table 3.6 : List of Interaction Terms used in OLR

Description of Dummy Variables		Input Data
1. AGE	AGE = AGE 1 (12-16)	AGE 1 = 1 if AGE 1 0 if otherwise
	AGE 2 (16-24)	AGE 2 = 1 if AGE 2 0 if otherwise
	AGE 3 (25-59)	AGE 3 = 1 if AGE 3 0 if otherwise
	AGE 4 (60 years and above)	AGE 4 = 1 if AGE 4 0 if otherwise
2. GENDER	Gender = GENDER 1 (MALE)	GENDER 1 = 1 if MALE 0 if FEMALE
3. JOURNEY PURPOSE	Journey Purpose = JOURNEY PURPOSE 1 (WORK/SCHOOL/COLLEGE)	JOURNEY PURPOSE 1 = 1 if WORK/SCHOOL/COLLEGE 0 if otherwise
4. **TYPE OF BUSES**	Type of Buses = BUSES 1 (SUPEROUTE)	BUSES 1 = 1 if SUPEROUTE 0 if NON SUPEROUTE

Once the model was set up it was run for (a) the complete date set then for disaggregated data sets (b) NSR and SR and (c) for each of the four clusters in turn. The statistics used to evaluate the statistical significance were tested at the 95% level of confidence. The goodness of fit was estimated using the Likelihood Ratio Index.

3.9 Critical review of analysis approach

The final step of the analysis was the collation of the results of all five approaches namely, descriptive, ISA, FA and CA and OLR to identify the consistencies and inconsistencies in the final results and thus to formulate key messages of value to the decision making of bus operators. In the context of this research, and consistent with Greene (2000), the extent of the individuals perceptions of each score 1, 2, 3, 4 and 5 are assumed to be the same. In addition, because individuals are choosing a score relative to a fixed scale, namely very poor to very good, it is reasonable to assume that across the consistency of responses is achieved. Nevertheless there remains one shortcoming, in that the degree or magnitude of *very poor* and *very good* may differ. The bigger challenges that emerge from the literature are (a) with respect to the ISA analysis, it is in establishing of the normality of the data which will drive the choice of whether parametric or non-parametric testing is carried out, (b) in FA it is whether the KMO measure is able to identify inter-correlation among the variables and (c) whether CA is sensitive to the order in which the variables are considered in the analysis process and this needs particular attention. However, as the analysis adopts a mixed approach the research has tried to play to the strengths of each analytical method whilst respecting their limitations. The uniqueness of this integrated analysis approach is believed to be its ability to reveal, with more statistical confidence and less ambiguity, the quality attributes that the passengers really want and therefore need from their bus service provider in order to be satisfied and become regular users. Each stage of the analysis will explore in-depth characteristics and relationships in the data and the comparison of findings across different approaches compounds the evidence. The limitations identified in this research will be dealt with in more detail in the following chapters.

3.10 Summary

This chapter has provided an overview of the survey design and analysis methods used in this research. Following the description and justification of the case study areas of Tyne and Wear chosen for this research, the four steps in the data collection were outlined. Interviewing staff of NEXUS enabled final selection of questions and the permissions and logistics of gaining access to the bus passengers were decided. The design and test of the questionnaire and survey approach through a series of pilots resulted in substantial changes and final refinements in both the questionnaire and survey method. The main survey and logistics were described before presenting the data screening and processing that was needed due to the difficulties presented by the short duration of many of the passenger journeys. On reflection the open questions should not have been included or marked optional as these may have deterred the passengers from completing the questionnaire and returning in the prepaid envelope.

CHAPTER 4 : CHARACTERISING USERS AND PERCEPTIONS

4.1 Introduction

Chapter 3 outlined the data collection methodology based on interview surveys carried out on selected bus services in Tyne and Wear. The survey questions were designed to address 17 factors of service *quality* incorporated within the objectives of 'Superoute'. Respondents were asked to rate the overall *quality* of the bus services on which they were travelling as well as the individual quality attributes for both *importance* and *satisfaction*. *Quality* attributes were measured based on a five point Likert Scale.

The data analysis methods were explained. Five complementary analysis techniques, namely Descriptive, *Importance* and *Satisfaction*, Factor, Cluster Analysis and Ordered Logit Modelling, were used in an attempt to reveal causal links between quality attributes and perceptions. The analysis are divided into four main chapters which together present the results of the five stages of analysis summarised in Figure 3.10 against the objectives as outlined in Figure 3.9. The Descriptive Analysis is dealt with in this chapter, Chapter 5 presents the results of the Importance and Satisfaction Analysis (ISA) and Factor Analysis (FA), Chapter 6 deals with Cluster Analysis (CA) and ISA on the groups that emerge from the anlysis and Ordered Logit Regression (OLR) results are presented in Chapter 7.

Following an analysis of the whole data set, further exploration of passengers' views on bus *quality* was made by comparing the two data groups; NSR and SR. Analysis was carried out based on the assumption that data are interval and categorical. Depending on the Normality Tests, a range of statistical tests were applied including the Kruskall Wallis (equivalent to t test). The Mann Whitney, Tukey, ANOVA and/or the χ^2 test. Statistical significance tests were carried out at a level of 95% statistical confidence and throughout unless stated otherwise.

In this chapter, the descriptive analyses of the two groups (NSR and SR) are discussed in Section 4.2, which reveal the general characteristics of the respondents, their journeys and frequencies of use of services and finally Section 4.3 summarises the chapter.

4.2 General Characteristics of Respondents

The first step was to carry out a comprehensive statistical analysis of the data collected to provide a basic understanding of the characteristics of the overall sample of passengers and to test for its representativeness of the population in Tyne and Wear. The Statistical Package for Social Sciences (SPSS Inc, 1998) was used.

4.2.1 Characteristics of Overall Sample Compared to Tyne and Wear Population

Much effort has been made to gain data sets on the bus user population for Tyne and Wear. Unfortunately, due to the confidential information involved, this has not been possible. Therefore, the only representativeness comparison that could be made was with that of The Tyne and Wear Population. Table 4.1 details the characteristics of survey respondents and those of the Tyne and Wear population. Demographic characteristics available in both datasets included age, gender and employment status. From the analysis, it is found that 58 percent were female (and 42 percent male) in the overall sample.

Further analysis using $\chi 2$ contingency table test[3] based on actual population levels (i.e. not percentages) was carried out to check whether the sample was representative of the total population in Tyne and Wear based on the Census 2001. In terms of gender, the results indicate that there are more female than male bus users, an observation consistent with previous public transport studies which also showed a higher proportion of females using public transport (Pickett and Gray, 1996; Wall and McDonald, 2007). With 95% statistical confidence, it is found that the sample is representative of the population in Tyne and Wear

[3] NB χ^2 test are carried out throughout using numbers and at a 95% confidence level.

for distribution of age. The highest population cohort was aged 60 and over (27%) (22%: see Census 2001), and the second highest was aged between 35 to 49 (21%; see Census 2001) and the lowest 12 – 15 years at 4% (5% see Census 2001). In the study information regarding 12 – 15 years old was volunteered with the permission of accompanying parents4. The age group equal to and below 11 years was not included in this study.

Table 4.1 : Characteristics of Sample

	Total	**Percent**	**Profile of Tyne and Wear Population [a]**		***p* value**
	N	%	N	(%)	
Gender					
Male	129	42	520,286	48	**0.018**❖
Female	181	58	555,652	52	
Total	310	100	1,075,938	100	
Age (years)					
0 – 11	-	-	153,327	14	0.157
12-15	12	4	56,264	5	
16-24	44	14	127,414	12	
25-34	59	19	145,133	13	
35-49	64	21	230,835	22	
50-59	47	15	128,622	12	
60^+	84	27	234,343	22	
Employment Status					
Employed	140	28	419,931	53	**0.001**❖
Unemployed	22	7	50,571	6	
Retired	89	29	115,920	14	
Student	55	18	62,975	8	
Other	4	1	149,424	19	
			798,821		

[a] Census 2001

❖ Statistically significantly different at 95% confidence level at $p < 0.05$

The higher proportion, although not statistically significant, of the 60^+ year olds using buses can be explained by the fact that a concessionary scheme was introduced by the UK government in April 2006 for senior citizens. Despite travel incentives for senior citizens and the survey bias of excluding children under the age of 18, the statistical analysis suggests that the on bus sample for this study was representative of Tyne and Wear. In

[4] NB Interviewing this age group 12 - 15 years old was a bonus and consequential to carrying out the survey during August

terms of the employment status of the respondents, for the same reason the results showed that the largest group of respondents was retired (with a percentage of 29%), followed by respondents in full-time work (with a percentage of 28%). Compared to the population grouping of Tyne and Wear, in this research, senior citizens are overrepresented (concessionary ticketing although not statistically significant) and under-represented in the employed population (probably due to car ownership and found to be statistically significant).

4.2.2 Characteristics of Sample by Type of Bus Service: SR and NSR

Before analysing the variations in passenger perceptions of service *quality* by disaggregating the respondents by service type, a comparison was made of the demographic characteristics between NSR and SR users to test for their similarity. The results are presented in Table 4.2.

The Chi Square test was used to establish any statistically significant differences between the two groups (NSR and SR) in terms of demographic characteristics. The results demonstrated that there was no statistically significant difference at the 95% level of confidence for gender and age, however statistically significantly more passengers were in employment for SR (54%) compared to NSR (35%) sample and more unemployed (10%) and retired (30%) for NSR compared to SR with 2% and 26% respectively.

Table 4.2 : Characteristics of Sample by Type of Bus Service (NSR and SR)

N=310	**Type of Bus Service**				**Total**		**Sig.**
	NSR		**SR**				**p value**
	N	Percent	N	Percent		Percent	
Gender							
Male	86	43	43	39	129	42	0.548
Female	114	57	67	61	181	58	
Total	200	100	110	100	310	100	
Age (years)							
12-15	10	5	2	2	12	4	0.269
16-24	34	17	10	9	44	14	
25-34	38	19	21	19	59	19	
35-49	39	20	25	23	64	21	
50-59	28	14	19	17	47	15	
60^+	51	25	33	30	84	27	
Total	200	100	110	100	310	100	
Employment Status							
Employed full time	51	25	37	34	88	28	**0.007** *
Employed part time	20	10	22	20	42	14	
Self employed	9	5	1	1	10	3	
Unemployed	20	10	2	2	22	7	
Retired	60	30	29	26	89	29	
Student	38	19	17	15	55	18	
Other	2	1	2	2	4	1	
Total	200	100	110	100	310	100	

* Statistically significantly different at 95% confidence level at $p < 0.05$ (***p* value** = 0.007)

NB Interviewing this age group 12 - 15 was a bonus and consequential to carrying out the survey during August

4.2.3 Respondents' Journey Details

This section covers the details of the respondents' answers to questions relating to the specific journey being made at the time of the interview, which are; the purpose of journey, access to a car for their current journey, knowledge about bus timetables before they left the house, regularity of bus use and type of ticket used for their journey. These will be considered in turn. Sampling bias was of concern because of the change of passenger characteristics during the day and that commuters, pressed for time, were disinclined to participate in surveys during rush hours. However, notes taken during the survey showed that there was no measureable difference in refusal to take part at different times of the day. Also, the time needed for completion of the interview was similar for all respondents and the periods of the day during which passengers are travelling to work are shorter, bias may occur even though there was a higher number of commuters, relative to other trip purposes, during peak hours. Therefore, there remains a risk that the cohort may have sampling bias.

a) **Purpose of journey**

Table 4.3 shows the purpose of journey for all respondents, for both NSR and SR services. Shopping has the highest percentage for respondents' journey purpose, with respectively 35% for NSR users and 39% for SR users and overall percentage of 37%.

Table 4.3 : Purpose of Journey by Route Categories

<table>
<tr><th>Purpose</th><th colspan="2">NSR</th><th>Percent</th><th colspan="2">SR</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td>Work</td><td colspan="2">52</td><td>26</td><td colspan="2">24</td><td>22</td><td colspan="2">76</td><td>25</td></tr>
<tr><td>School/college</td><td colspan="2">13</td><td>7</td><td colspan="2">9</td><td>8</td><td colspan="2">22</td><td>7</td></tr>
<tr><td>Shopping</td><td colspan="2">70</td><td>35</td><td colspan="2">43</td><td>39</td><td colspan="2">113</td><td>37</td></tr>
<tr><td>Visiting friends/relatives</td><td colspan="2">18</td><td>9</td><td colspan="2">18</td><td>16</td><td colspan="2">36</td><td>12</td></tr>
<tr><td>Leisure/recreation</td><td>38</td><td rowspan="3">47</td><td>19</td><td>15</td><td rowspan="3">16</td><td>14</td><td>53</td><td rowspan="3">63</td><td>17</td></tr>
<tr><td>A Night Out</td><td>4</td><td>2</td><td>0</td><td>0</td><td>4</td><td>1</td></tr>
<tr><td>Other</td><td>5</td><td>3</td><td>1</td><td>1</td><td>6</td><td>2</td></tr>
<tr><td>Total</td><td colspan="2">200</td><td>100</td><td colspan="2">110</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df = 4, chi square 7.229, $p > 0.05$, ***p* value** = 0.124

The second highest percentage of journey purpose was for work, with 26% of respondents on NSR and 22% on SR. The lowest percentage of journey purpose was for a night out, with only 2% for NSR users and none for SR users. With a high percentage of respondents using buses mainly for shopping, it can be assumed that the bus offers convenience particularly for senior citizens but it is less attractive for work purposes.

By carrying out more surveys during the peak hours relative to other times of the day attempts were made to remove this bias. The Chi Square contingency table test was carried out collating together leisure/recreation/night out and other to avoid observation frequency of less than 5 in the cell sample. The results showed that there was no statistically significant difference between the two categories of bus service; (NSR and SR) with $\chi^2 = 7.229$, df = 4, p value > 0.05 **(p value = 0.124)** for trip purpose.

b) **Access to a car**

This question was asked to identify whether passengers had access to a car prior to taking their journey by bus, given that the availability of a car can affect the respondents' preferences and choices of transport mode Kuby *et al.,* (2004). Table 4.4 illustrates respondents' access to a car for their current journey (being performed during the survey time).

Table 4.4 : Access to a Car by Route Categories

	NSR	**Percent**	**SR**	**Percent**	**Total**	**Percent**
Yes	75	38	30	27	105	34
No	125	62	80	73	205	66
Total	200	100	110	100	210	100

Chi Square Test, df = 1, chi square 3.314, $p > 0.05$, ***p* value=** 0.069

Overall, 66% of respondents did not have access to a car for their journey. It is likely that this was their reason for choosing to use the bus. However, 34% of respondents chose to use buses even though they had access to a car suggesting that the bus is their preferred mode of transport for that particular journey regardless of the availability of other modes of transport. This result to some extent, qualifies the research of Kuby *et al.*, (2004), who stated that car ownership has a direct effect on a person's alternative mode of transport choices in the sense that it is not just car ownership that is important, but also the characteristics of the bus service offering a genuine alternative as seemed to be the case in 34% of respondents in this study. The results of this work are also consistent with Mc Donnel *et al.*, (2006), who found that 62% of respondents had stated lack of car availability as the main reason for choosing the bus service and a study by Guiver (2007) found that 70% of the sample had no access to a car. This is supported by Roth (2003) who stated that car accessibility can be the reason to use other modes of transport. The Chi Square test was carried out to identify any statistically significant differences between passengers on SR and NSR, and it was found that there was no statistically significant difference between the two groups in this regard.

c) Knowledge about bus timetable before leaving house

Knowledge of timetables is very important and passengers are more confident in using bus services that are reliable, and upon which they can rely without knowing the bus schedule prior to their journey (Dobbie *et al.*, 2010). Table 4.5 illustrates the extent of passengers' knowledge of timetables before they left the house.

Table 4.5 : Knowledge About Bus Timetable Before Leaving the House by Route Categories

	NSR	Percent	SR	Percent	Total	Percent
Yes	119	60	51	46	170	55
No	81	40	59	54	140	45
Total	200	100	110	100	310	100

Chi Square Test, df = 1, chi square 4.945, $p < 0.05$, ***p* value** 0.026

The results indicate that 55% of overall respondents knew the time of the bus before they left the house (60% on NSR and 46% on SR). A Chi Square test was carried out to examine the null hypothesis that there was no statistically significant difference between the bus services (NSR and SR), in terms of knowledge about bus timetable prior to the journey.

The results accept the null hypothesis and therefore there was a statistically significant difference between NSR and SR in terms of prior knowledge of timetables.

Interestingly, 54% of passengers on the SR did not know the bus timetable before they left their house. This can be associated with the SR service (with a 10 minutes frequency, improved reliability and punctuality) conditioning passengers to the timetable, making them more confident with the service. On the other hand, poor service reliability and short bus headways often means users turn up at the bus stop and wait, in which case the bus timetables are considered redundant. It should be noted that both NSR and SR services were intra-city routes connecting suburban areas with the city centre and other areas within the Tyne and Wear region. A section of the bus route (referred to here as the line haul section) is common with other services. Therefore, the need for knowledge of timetables for passengers boarding in the line haul section is less important to respondents due to the increased choice of alternative services. This χ^2 test merely exposes the difference between the services with no indication which service is better and to what context. Further analysis will help to reveal the characteristics of passengers and service and will be reported later in this chapter.

d) **Regularity of bus usage by type of bus service**

Table 4.6 represents the number of respondents according to their frequency of bus use and illustrates the regularity of bus usage by bus service. Again, a Chi Square test was performed and at the 95% level, there was no statistically significant difference found between the bus services in respect of regularity of use. It is interesting to see that there were a high percentage of passengers using the NSR and SR services regularly (5 times a week or more), constituting 51% and 50% of all respondents respectively. In addition, the popularity and *importance* of these routes are further endorsed by examining the percentage of medium frequency of bus usage, categorised as 2 times and 3-4 times a week, with 39% and 41% of all respondents respectively for NSR and SR services. This suggests that most respondents are frequent users of both types of bus service (NSR and SR), given that relatively few respondents (7% and 9% respectively for NSR and SR) rarely used the bus and 3% of respondents were using the bus service for the first time on NSR service. Further analysis was carried out by cross tabulating between details of passengers who knew the timetable before they left with their frequency of bus use. It is found that 44% who knew the timetable constitute mostly those who are frequent users. Hence this suggests that because they are familiar with the bus service, they do not need to consult a bus timetable before they leave the house.

Table 4.6 : Regularity of bus usage by Type of Bus Service

<table>
<tr><th></th><th colspan="2">NSR</th><th colspan="2">Percent</th><th colspan="2">SR</th><th colspan="2">Percent</th><th colspan="2">Total</th><th colspan="2">Percent</th></tr>
<tr><td>Daily</td><td colspan="2">71</td><td colspan="2">35</td><td colspan="2">38</td><td colspan="2">34</td><td colspan="2">109</td><td colspan="2">35</td></tr>
<tr><td>5 times a week</td><td colspan="2">32</td><td colspan="2">16</td><td colspan="2">17</td><td colspan="2">16</td><td colspan="2">49</td><td colspan="2">16</td></tr>
<tr><td>3-4 times a week</td><td colspan="2">42</td><td colspan="2">21</td><td colspan="2">24</td><td colspan="2">22</td><td colspan="2">66</td><td colspan="2">21</td></tr>
<tr><td>2 times a week</td><td colspan="2">36</td><td colspan="2">18</td><td colspan="2">21</td><td colspan="2">19</td><td colspan="2">57</td><td colspan="2">18</td></tr>
<tr><td>Rarely</td><td>13</td><td rowspan="2">19</td><td>7</td><td rowspan="2">10</td><td>10</td><td rowspan="2">10</td><td>9</td><td rowspan="2">9</td><td>23</td><td rowspan="2">29</td><td>8</td><td rowspan="2">10</td></tr>
<tr><td>First time</td><td>6</td><td>3</td><td>0</td><td>0</td><td>6</td><td>2</td></tr>
<tr><td>Total</td><td colspan="2">200</td><td colspan="2">100</td><td colspan="2">110</td><td colspan="2">100</td><td colspan="2">310</td><td colspan="2">100</td></tr>
</table>

Chi Square Test, df = 4, chi square 0.113, $p > 0.05$, ***p* value** = 0.998

4.2.4 Type of ticket used

At the time the survey was carried out there were 14 types of ticket offered by the bus service providers in the county of Tyne and Wear. They ranged from single to group tickets and concessionary passes. Each bus operator has their own promotional tickets, for example, Arriva has the Arriva student ticket and Stagecoach has the Stagecoach UniRider. This has created problems for the passengers who need to complete their journey using services operated by more than one operator. This factor could be a barrier for those people who would otherwise benefit from the flexibility offered by the bus service provision to meet their travel needs over the region. Table 4.7 shows the type of ticket that respondents used for their current journey. The results indicated that 65 out of 310 respondents (21%) used concessionary tickets for their journey. Concessionary tickets are only for people aged

60 years and over and are restricted to off peak journeys (after 09.30hrs). Most respondents used a single ticket for their journey (30% of passengers on NSR and 34% of passengers on SR). A Chi Square test was performed to test the null hypothesis that there were no statistically significant differences in type of ticket used between both types of services. Due to the small samples bespoke promotional tickets by operators, weekly and monthly ticket types have been aggregated. The result showed that indeed there was no statistically significant difference between NSR and SR (χ^2= 4.504, df=5, p>0.05 ***p* value** = 0.479) for the type of tickets used.

Table 4.7 : Ticket Normally Used on Routes Studied

<table>
<tr><th></th><th colspan="2">NSR</th><th>Percent</th><th colspan="2">SR</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td>Single ticket</td><td colspan="2">59</td><td>30</td><td colspan="2">37</td><td>34</td><td colspan="2">96</td><td>31</td></tr>
<tr><td>Return ticket</td><td colspan="2">21</td><td>11</td><td colspan="2">9</td><td>8</td><td colspan="2">30</td><td>10</td></tr>
<tr><td>DayRider (all day ticket)</td><td colspan="2">27</td><td>14</td><td colspan="2">14</td><td>13</td><td colspan="2">41</td><td>13</td></tr>
<tr><td>Concessionary</td><td colspan="2">37</td><td>19</td><td colspan="2">28</td><td>26</td><td colspan="2">65</td><td>21</td></tr>
<tr><td>Network Travel Ticket</td><td colspan="2">24</td><td>12</td><td colspan="2">8</td><td>7</td><td colspan="2">32</td><td>10</td></tr>
<tr><td>Day Rover</td><td>5</td><td rowspan="9">32</td><td>2</td><td>5</td><td rowspan="9">14</td><td>5</td><td>10</td><td rowspan="9">46</td><td>3</td></tr>
<tr><td>Stagecoach UniRider</td><td>9</td><td>5</td><td>3</td><td>3</td><td>12</td><td>4</td></tr>
<tr><td>Stagecoach Megarider</td><td>2</td><td>1</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Teentravel</td><td>6</td><td>3</td><td>0</td><td>0</td><td>6</td><td>2</td></tr>
<tr><td>Transfares</td><td>2</td><td>1</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Arriva Student Ticket</td><td>1</td><td>1</td><td>1</td><td>1</td><td>2</td><td>1</td></tr>
<tr><td>Bus pass Under 16</td><td>2</td><td>1</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Monthly ticket</td><td>2</td><td>1</td><td>2</td><td>2</td><td>4</td><td>1</td></tr>
<tr><td>Weekly ticket</td><td>3</td><td>1</td><td>3</td><td>3</td><td>6</td><td>2</td></tr>
<tr><td>Total</td><td colspan="2">200</td><td>100</td><td colspan="2">110</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df =5, chi square 4.504, p > 0.05, ***p* value** 0.479

4.2.5 Summary of Characteristics of Users of Bus Service

From the descriptive analysis, it can be summarised that from the sample of 310 passengers, nearly 60% are female, 27% aged 60 years and over and 66%, were found to have no access to a car for their journey and 55% of respondents knew the bus timetable before they left the house. The majority of respondents used bus services regularly. The highest proportion of the respondents were travelling for shopping 37%, with 25% as commuters. There were no statistically significant differences found between NSR and SR for all quality attributes except for employment status, with more employed passengers and fewer senior citizens travelling on SR compared to NSR. Before embarking on an in-depth analysis of the 17 quality attributes some basic principles of the application of statistical tests will be reproduced here for completeness.

4.2.6 Characterictics of the Sample

In the context of the Likert Scale there are two schools of thought; Knapp (1990) considers Likert scores as categorical and others for example (Duncan and Stenbeck 1987) suggest that they can be considered as interval. Whether one considers the scores assigned by respondents as categorical or interval influences the statistical tests used in the analysis. In the case of categorical data, comparisons between data sets should consider the shape of the whole distribution using tests such as χ^2 whilst interval data can be considered 'continuous', therefore it is appropriate to use means as an indicator of central tendency and standard deviation as a measure of spread. However, parametric tests are appropriate only in cases where the data is normally distributed. Normality tests therefore, need to be carried out on the data before engaging in any statistical analysis. The Kolmogorov Smirnoff (KS) one sample test is used to test whether the data conforms to a normal distribution, and if so, parametric tests such as 't' and 'z' are employed. However, for non-normally distributed data non parametric tests need to be employed. In particular the Mann Whitney (MW) test can be used as a non-parametric test as an alternative to the independent sample t test used for normally distributed data. The MW test is based on rank with the variables that are ordinal, interval or ratio.

The non-parametric test used to establish whether samples originate from the same distribution was the Kruskall Wallis (KW) test. More than two samples that are independent or not related can be compared. The parametric equivalent of the (KW) test is the one-way analysis of variance (ANOVA). It follows that at least one of the samples is different from the other samples when the (KW) test leads to a statistically significant result. The test does not identify where the differences occur or how many differences occur. Also, the test assumes the shapes are the same but with different medians.

4.2.7 Descriptive Analysis of the 17 quality attributes

This section sets out to gain an insight into passengers' views on bus quality by analysing the quantitative measures of 17 quality attributes based on Likert Scale with scores from 1 (very unimportant) to 5 (very important) for *Importance* and 1 (very dissatisfied) to 5 (very satisfied) for *Satisfaction*. The distribution of scores from the Likert Scale across all respondents was examined for each quality attribute. Appendix C shows the distribution over all respondents for each attribute for *importance* and *satisfaction.* Using the Kolmogorov Smirnoff statistic to test for normality it was found that in these and all other cases the distributions were not normally distributed at 95% statistical confidence. Therefore, non-parametric tests were used throughout the analysis in this thesis. The median and mean Likert score over all respondents for *importance* and *satisfaction* for the 17 quality attributes, that were designed to reflect the quality measures offered by the bus operators, are given in Table 4.8. The standard deviations are not presented in the table because the distributions are not normal and therefore are not used in any formal statistical tests carried out. The mean for each attribute, presented for completeness, assumes that the Likert Scale scores are interval data (Knapp, 1990). The reason for providing the mean as well as the median is to elaborate the discussion regarding the relative differences between the quality attributes because the mean better reflects the four tails of the distribution. Also as can be seen from Table 4.8 the medians are mostly the same showing little granularity. Without the granularity offered by the mean, the median is unhelpful simply because the majority of the attributes have the same median score.

Table 4.8 : Descriptive Analysis for *Importance* and *Satisfaction* for all Respondents

	Quality Attributes	*Importance*		*Satisfaction*	
		Median	Mean	Median	Mean
1	Frequency- evening	5.00	4.09	3.00	3.14
2	Frequency - day	5.00	4.48	4.00	3.55
3	Frequency - Sundays	5.00	4.06	3.00	2.97
4	Reliability	5.00	4.63	3.00	3.28
5	Punctuality	5.00	4.57	3.00	3.27
6	Buy ticket - on bus	4.00	4.00	4.00	3.71
7	Buy ticket - at Travel Centre	4.00	3.71	3.00	3.44
8	Cleanliness - on bus	5.00	4.19	3.00	3.28
9	Cleanliness – at bus stops	5.00	4.18	3.00	2.98
10	Journey Time	5.00	4.23	3.00	3.18
11	Friendliness of drivers	5.00	4.36	3.00	3.22
12	Information at bus stops	5.00	4.43	3.00	3.18
13	Finding information	5.00	4.50	3.00	3.09
14	Security - on bus	5.00	4.55	3.00	3.39
15	Security - at bus stops	5.00	4.44	3.00	3.27
16	Condition of shelters	5.00	4.33	3.00	3.02
17	Cost of tickets	5.00	4.30	3.00	2.64

Note: Measurement on *quality* attributes were rated using a 5-point scale; 1 being very unimportant and 5 being very important for '*importance*' and 1 being very dissatisfied and 5 very satisfied for '*satisfaction*'.

All distributions of Likert scores were found to be statistically significantly different from a Normal distribution using a Kolmogorov Smirnoff test at 95% level of confidence. Interestingly over the entire sample the Likert scores for quality attributes for *importance* are systematically higher than those for *satisfaction.* The highest mean score was average 4.63 (median 5) for the quality factor 'reliability' in the context of *importance*. This indicates that passengers perceive reliability in bus services as the most important factor. However, when it comes to their *satisfaction*, the mean score for reliability is 3.28 (3) suggesting room for improvement.

On the other hand, for *satisfaction*, passengers have the highest score on 'ease of buying ticket on bus' Likert Score 3.71 (3) with an associated *importance* score of 4.00 (4) suggesting a failure to reach expectations. The lowest score for *satisfaction* was cost of ticket and for *importance* was purchase of ticket at the Travel Centre which sends important messages to operators who need to pay more attention to the service provision at the Travel Centre, especially since the cost of ticket purchase is unsatisfactorily high. Given the lack of variability in the median scores for the purpose of revealing trends or pattern in the data it has been demonstrated that there is a need to consider the mean scores. It is clear from table 4.8 that all *satisfaction* scores fall below the *importance* scores and there is poor correlation between the two; in the sense that the differences between the *importance* and *satisfaction* scores can be large or small, but always positive. In anticipation that the mixed messages indicated by this result are, to some extent, due to the data reflecting the differences within and between the perceptions of both NSR and SR passengers, the next step in the analysis was to disaggregate the data to explore this further.

4.2.8 Analysis to Compare the Two Types of Bus Services (NSR and SR)

This section explores the perception of passengers in more detail to further understand the relative *importance* of the quality attributes for NSR compared with SR. It is well established that behavioural intention is the antecedent of *satisfaction* which thus influences their future intention to use the bus more (or less). Therefore, it is interesting to explore how the *importance* of passengers on both types of bus service affect their assessment of the *satisfaction* of quality attributes of a bus service. Identification of the effects of and how people respond to bus service improvements, coupled with a deeper understanding of what passengers really want and what is important to them, may assist the decision maker in wise investment. The analysis above was repeated on the disaggregated data NSR and SR separately. Firstly, using the non-parametric Kruskall Wallis test to identify differences in perception within the NSR group and secondly, to identify the differences in perception within the SR group. Finally using the χ^2 any differences between NSR and SR users were identified.

4.2.9 Two types of Approach for analysis

The interpretation of this data is made simpler by adopting two approaches; the first assumes the data is interval and the second, as categorical. These two approaches are carried out comparing the responses of passengers who are travelling on SR with those travelling on NSR services.

Approach 1: Assumption data is interval and normally distributed

Mindful that this analysis is enabling a statistical representation of the data collected on the services at the time of the survey, it provides a method to develop an improved understanding of those quality attributes considered of *importance* by passengers and their *satisfaction* independently for NSR and SR. In turn, this provides some indication of whether the QBP, which led to the creation of the SR concept, has made any statistically significant difference in terms of passengers' perceptions.

The mean scores for each of the quality attributes were calculated to provide an indication of the '*Importance*' and '*Satisfaction*' for the passengers in the sample of NSR and compared with SR. The first step was to establish whether or not the distribution of Likert scores is normally distributed for each of the 17 attributes for each service. The Kolmogorov Smirnoff one sample test was used and the results showed that for all attributes for all services irrespective of whether NSR or SR at the 95% level of confidence, the distribution of Likert Scale scores were statistically significantly different from normal. Hence for the analysis presented in this section, non-parametric tests have been used throughout to analyse how passengers rated the *importance* of the bus service quality attributes and how satisfied they were with the service and thus to identify the differences between the two groups; NSR and SR.

The first step was to explore, using Kruskall Wallis (KW) and Median Test as a non parametric test and the variation of Likert score within the NSR sample (across four services; 1, 639, 20 and 10/11) and within the SR sample (across two services namely 308 and 39/40). Both tests establishe the homogeneity of the responses to the questions across services (4 x NSR and 2 x SR). Kruskall Wallis uses the sum of difference between mean rank, whilst Median test uses the larger and smaller number than the median and not the rank. Therefore, based on the distribution of Likert scores for overall *satisfaction*, Median Test was applied. The results are presented in Table 4.9 and Table 4.10 for each attribute for each service, for NSR and SR respectively.

Table 4.9 : Result of Kruskall Wallis Test on Non Superoute

		Importance		***Satisfaction***	
		Mean	***Median***	**Mean**	***Median***
1	Frequency- evening	**4.19**	5.00	3.06	3.00
2	Frequency - day	4.53	5.00	3.42	4.00
3	Frequency - Sundays	**4.20**	5.00	2.93	3.00
4	Reliability	4.65	5.00	**3.09**	3.00
5	Punctuality	4.57	5.00	3.10	3.00
6	Buy ticket - on bus	**4.12**	4.50	**3.59**	3.50
7	Buy ticket - at Travel Centre	**3.85**	4.00	**3.42**	3.00
8	Cleanliness - on bus	**4.20**	5.00	3.22	3.00
9	Cleanliness – at bus stops	**4.26**	5.00	2.95	3.00
10	Journey Time	**4.28**	5.00	3.20	3.00
11	Friendliness of drivers	**4.39**	5.00	3.10	3.00
12	Information at bus stops	4.51	5.00	**3.01**	3.00
13	Finding information – bus routes	4.54	5.00	**2.95**	3.00
14	Security - on bus	4.62	5.00	**3.25**	3.00
15	Security - at bus stops	**4.47**	5.00	**3.13**	3.00
16	Condition of shelters	**4.30**	5.00	**2.92**	3.00
17	Cost of tickets	**4.31**	5.00	**2.58**	2.00

Statistically significant at 0.05

Non Superoute

With reference to Table 4.9 for NSR services the results show that, for *Importance*, responses to frequencies during the day, reliability, punctuality, information at bus stops, finding information on bus routes and personal security on buses were found to be statistically significantly similar at the 95% level of confidence across all NSR services. This suggests that there are no differences in perceptions across NSR service types.

On the other hand, for attributes frequencies during evening and on Sundays, ease of buying a ticket on the bus or at the Travel Centre, cleanliness on the bus or bus stop, journey time, friendliness of drivers, security at bus stops, condition of shelters and cost of tickets were found to be statistically significantly different across the four NSR services studied.

For *satisfaction*, reliability, ease of buying a ticket on the bus and at the travel centre, information at bus stops, finding information about bus routes and condition of shelters, security on buses and at bus stops and cost of tickets were found to be statistically significantly different. This suggests variation from service to service across the four NSR routes.

Frequencies during the evening and during the day and on Sundays, punctuality, cleanliness on the bus and at the bus stops, journey time and friendliness of drivers, were found to be not significantly different.. This means that passengers travelling on NSR irrespective of bus service have similar perceptions with regard to on these quality attributes. Consistent with *importance* it is clear that for *satisfaction*, there are large variations in the perceptions of individuals to different NSR services. However, the quality attributes that are statistically significant for *satisfaction* compared to *importance* are not always found to be the same. Frequency in the evenings and on a Sunday; cleanliness on the bus and at bus stops, journey time and driver friendliness are not statistically significantly different for *satisfaction* but are for importance whilst reliability, finding information concerning bus routes at bus stops and security on buses are statistically significantly different for *satisfaction* but are not for *importance*. Quality attributes not statistically significantly different for both within *importance* and within *satisfaction* include frequency of services during the day and punctuality. Whilst attributes statistically significantly different for both within *importance* and within *satisfaction* include buying a ticket on the bus and at the travel centre, security at the bus stops, condition of shelters and cost of tickets. It is interesting that those attributes relating to price of fares and ticket purchase (on bus or at Travel Centre) and facilities at bus stops (security and condition of shelters) that are not directly part of the operational elements of public transport provision, are consistent and statistically significant across all NSR services studied.

Table 4.10 : Result of Kruskall Wallis Test on Superoute

		Importance		*Satisfaction*	
	SUPEROUTE	**Mean**	***Median***	**Mean**	***Median***
1	Frequency- evening	3.92	4.00	3.28	3.00
2	Frequency - day	4.38	5.00	3.80	4.00
3	Frequency - Sundays	3.82	4.00	3.04	3.00
4	Reliability	4.60	5.00	3.63	4.00
5	Punctuality	4.59	5.00	3.59	4.00
6	Buy ticket - on bus	3.78	4.00	3.95	4.00
7	Buy ticket - at Travel Centre	3.46	4.00	3.49	3.50
8	Cleanliness - on bus	4.19	5.00	3.38	4.00
9	**Cleanliness – at bus stops**	**4.03**	**4.00**	3.05	3.00
10	Journey Time	4.14	4.50	3.15	3.00
11	Friendliness of drivers	4.32	5.00	3.44	4.00
12	Information at bus stops	4.29	5.00	3.49	4.00
13	Finding information	4.43	5.00	3.35	4.00
14	Security - on bus	4.43	5.00	3.65	4.00
15	Security - at bus stops	4.38	5.00	3.55	4.00
16	Condition of shelters	4.39	5.00	3.20	3.00
17	Cost of tickets	4.28	5.00	2.76	3.00

Statistically significant at 0.05

Superoute

Repeating the entire analysis procedure for the SR services, rather different results emerge. With reference to Table 4.10 it can be seen that one quality attribute, cleanliness at the bus stops, demonstrates statistically significant differences within the SR cohort for *importance*. For all other quality attributes for *importance* and all quality attributes for *satisfaction* there are no statistically significant differences within SR services.

These results suggest that for SR services, there appears to be a common view of passengers across services on the characteristics of *quality* attributes in terms of *satisfaction*, which suggests that the objectives of upgrading to Superoute have generated a much more consistently rated service. However, for *Importance* all attributes except for cleanliness at the bus stops were statistically significantly similar. One could argue that bus stop cleanliness is not a direct responsibility of the bus operator, nevertheless this preliminary statistical analysis suggests that third party responsibilities needs to be tightened on those routes that are creating the within cohort variability. This analysis clearly shows that passengers travelling on SR services have homogeneous perception of all of the quality attributes for *satisfaction* and for *importance* except for cleanliness at the bus stops.

***Post Hoc* Test**

Given that significant differences across NSR services were exposed by the KruskallWallis test, the *post hoc* test was used to establish between which specific services (if any) the responses obtained from passengers on the four NSR services were statistically significantly different or not. With reference to Table 4.11, the statistical difference and similarity are indicated by x and ✓ respectively. Consistent with Table 4.9 results as expected for *importance* for frequencies during the day, reliability, punctuality, information at bus stops, finding information and security on the bus responses are statistically significantly similar based on the K-W test. For all other attributes the responses were statistically significantly different for at least one of the majority of attributes, for all services.

The *post hoc* comparisons using the Tukey test indicated that the median score for quality attributes-frequencies in the evening, was statistically significantly different between the four bus routes of NSR, however two pairs namely (1 and 10/11) and (20 and 639) emerge as being statistically significantly similar to each other. Specifically, this result confirms that there are differences in perception of passengers travelling on the NSR services and this is reflected in the variations in individual scores when compared for the different NSR services. The services group (1 and 10/11) are routes in the city centre running parallel with other services along the radial section into the city. This means that for those passengers alighting and boarding along the main trunk section of the bus route may perceive a better service with more choice, potentially having alternative services available to them. These are in contrast to the other service group (20 and 639) which are out-of-city routes with substantial stretches of the journey with lower frequency services, the former along the coast and the other into the more rural areas of Durham. This result reflects the different catchment characteristics of the NSR.

Table 4.11 : Tukey *Post Hoc* Test for Non Superoute

NON SUPEROUTE		**Importance**					***Satisfaction***				
		Median	**Bus No**				**Median**	**Bus No**			
			1	**10/11**	**20**	**639**		**1**	**10/11**	**20**	**639**
			N=45	**N=56**	**N=52**	**N=47**		**N=45**	**N=56**	**N=52**	**N=47**
1	Frequency-evening	**5.00**	✓	✓	x	x	3.00	✓	✓	✓	✓
2	Frequency - day	5.00	✓	✓	✓	✓	**4.00**	x	x	X	✓
3	Frequency - Sundays	**5.00**	x	x	x	✓	3.00	✓	✓	✓	✓
4	Reliability	5.00	✓	✓	✓	✓	**3.00**	✓	✓	✓	✓
5	Punctuality	5.00	✓	✓	✓	✓	3.00	✓	✓	✓	✓
6	Buy ticket - on bus	**4.50**	x	✓	x	x	**3.50**	✓	✓	✓	✓
7	Buy ticket - at Travel Centre	**4.00**	x	x	x	x	**3.00**	✓	✓	✓	✓
8	Cleanliness - on bus	**5.00**	✓	x	✓	x	3.00	✓	✓	✓	✓
9	Cleanliness – at bus stops	**5.00**	x	x	x	x	3.00	✓	✓	✓	✓
10	Journey Time	**5.00**	x	x	x	x	3.00	✓	✓	✓	✓
11	Friendlines s of drivers	**5.00**	x	x	x	x	3.00	✓	✓	✓	✓
12	Information at bus stops	5.00	✓	✓	✓	✓	**3.00**	x	✓	✓	✓
13	Finding information	5.00	✓	✓	✓	✓	3.00	✓	✓	✓	✓
14	Security - on bus	5.00	✓	✓	✓	✓	**3.00**	✓	✓	✓	✓
15	Security - at bus stops	**5.00**	✓	x	x	✓	**3.00**	✓	✓	x	x

16	Condition of shelters	**5.00**	**x**	**x**	**x**	✓	3.00	✓	✓	✓	✓
17	Cost of tickets	**5.00**	**x**	**x**	**x**	**x**	**2.00**	**x**	**x**	**x**	✓

Note:

Tested at 0.05 statistical significance

✓ homogeneity within groups

x no homogeneity within group

Careful scrutiny of the other between service differences clearly confirms the variations in the service provision of the NSR services. The *post hoc* was not necessary for the SR services because the Kruskall-Wallis test revealed homogeneity in the responses across services.

Mann-Whitney Test

Based on the earlier result, attributes that were found to be statistically similar or homogeneous within their groups only can be considered for comparison in order to identify whether or not both groups are independent of each other. The Mann Whitney test was carried out to test the differences between both groups (NSR and SR) for both *Importance* and *Satisfaction* for each attribute and the results are presented in Table 4.12. Quality attributes for *importance* that were not statistically significantly different (and are homogeneous within NSR and within SR) include:

2. Frequencies during the day
4. Reliability
5. Punctuality
12. Information at the bus stops
13. Finding information about bus routes
14. Security on bus

Table 4.12 : Results of Mann Whitney Test between NSR and SR for *Importance*

		Importance				
		NSR[b] (mean)	NSR[b] (median)	SR[b] (Mean)	SR[b] (Median)	**NSR vs. SR [c]**
2	Frequency - day	4.53	5.00	4.38	5.00	ns
4	Reliability	4.65	5.00	4.60	5.00	ns
5	Punctuality	4.57	5.00	4.59	5.00	ns
12	Information at bus stops	4.51	5.00	4.29	5.00	++
13	Finding information	4.54	5.00	4.43	5.00	ns
14	Security - on bus	4.62	5.00	4.43	5.00	++

[b] Median test, [c] Mann-Whitney test
++ significant at 0.05 between group (NSR and SR)
ns = not significant between group (NSR and SR)

For *importance*, no statistically significant difference was found between NSR and SR users for frequency of service during the day, reliability, punctuality and finding information about routes. However, for *importance*, statistically significant differences were found between NSR and SR services for information at bus stops and security on buses, with Likert scores consistently lower for SR compared to NSR. Results may indicate that the investment made by the bus companies has indeed influenced these perceptions in the sense that improved provision of information at the bus stop and security on the bus has created a degree of complacency and therefore emerges as less important.

Next, the Mann Whitney test was carried out to test that both groups are independent of each other for *Satisfaction* and the results are presented in Table 4.13. The only attributes that were homogeneous within each group are compared. Quality attributes for *satisfaction* not found to be statistically significant (and are homogeneous within NSR and within SR) include:

1. Frequencies in the evening
3. Frequencies on Sunday
4. Reliability
5. Punctuality
6. Buying ticket on the bus
7. Buying ticket at Travel Centre
8. Cleanliness on the bus

9. Cleanliness at the bus stop
10. Journey Time
11. Friendliness of Driver
13. Information on routes
14. Security on bus
16. Condition of shelters

In respect of *satisfaction* (compared to *importance*) for NSR and SR inconsistencies in those attributes that emerge as being statistically significantly different and those that are similar, occur. For *satisfaction*, statistically significant differences are measured between NSR and SR for frequency in the evening and the day, punctuality and friendliness of the drivers with consistently higher average Likert scores observed for SR. However, for *satisfaction*, no statistically significant difference is found between NSR and SR for frequency on Sundays, cleanliness on the bus and at bus stops and for journey time. The only attribute with homogeneity across services within NSR and within SR and significantly statistically different, are between NSR and SR for both *importance* and *satisfaction*, is security on the bus suggesting that SR quality investment has made a measurable improvement whilst at the same time reducing *importance*. Interestingly a clear message that emerges is that whilst generally there are no statistically significant differences in *importance* for SR and NSR, there is for *satisfaction* towards these attributes, with NSR Likert scale scores consistently lower than SR establishing potential evidence of positive benefits resulting from the investment.

For all services irrespective of NSR and SR, those quality attributes without homogeneity (rendering statistical testing inappropriate) include frequencies of services in the day, information at the bus stops, security at bus stops and cost of tickets. Interestingly there is a lack of consistency in the attributes which are statistically similar and different between NSR and SR for *satisfaction* and for *importance.* Also it is pertinent to note that those aspects of quality with no differences between NSR and SR are those relating to financing or what can be considered as third party responsibilities. This is endorsed by the fact that despite investment in services the non-statistical significance of the difference between

NSR and SR for cleanliness on bus and bus stops, journey times due to delays by traffic, illustrates the need for co-operation between LA and bus companies with their different responsibilities to deliver customer needs. This, to some extent is what QBP seeks to achieve.

Table 4.13 : Results of Mann Whitney Test between NSR and SR for *Satisfaction*

		Satisfaction				
		NSR[b] (mean)	NSR[b] (median)	SR[b] (Mean)	SR[b] (Median)	**NSR vs. SR [c]**
1	Frequency- evening	3.06	3.00	3.28	3.00	++
2	Frequency - day	3.42	4.00	3.80	4.00	++
3	Frequency - Sundays	2.93	3.00	3.04	3.00	ns
4	Punctuality	3.10	3.00	3.59	4.00	++
8	Cleanliness - on bus	3.22	3.00	3.38	4.00	ns
9	Cleanliness – at bus stops	2.95	3.00	3.05	3.00	ns
10	Journey Time	3.20	3.00	3.15	3.00	ns
11	Friendliness of drivers	3.10	3.00	3.44	4.00	++

[b] Median test, [c] Mann-Whitney test
++ significant at 0.05 between group (NSR and SR)
ns = not significant between group (NSR and SR)

4.2.9 Approach 2: Assume data is categorical

Although distributions have been demonstrated not to be normally distributed and all statistical tests carried out used non parametric testing, the discussion of the results in the previous section were based on the mean. This was because as shown in the tables 4.9, 4.10, 4.12 and 4.13, the medians are essentially the same with little granularity in the data at all. In this section, therefore, the Likert scores are considered as categorical data, for which Agresti (2007) stated chi square test is desirable. Table 4.14 and Table 4.15 show the results respectively for the cross tabulation between both bus service groups which are NSR and SR for *importance* and *satisfaction*. The results show that there was no statistically significant difference between NSR and SR except for frequency on Sundays and reliability for *importance*, indicating consistency in what passengers perceive as important. Interestingly, over all attributes compared to NSR, SR service passengers attach equal or lower scores to quality attributes and for frequency on Sundays and reliability the are statistically significant. This may be due to the quality improvements lessening their perceptions of *importance* particularly in respect of these two attributes.

Table 4.14 : Chi Square Significance Test between two groups (NSR and SR) for *Importance*

		Importance				
		NSR (mean)	NSR (median)	SR (Mean)	SR (Median)	**NSR vs. SR**
1	Frequency- evening	4.19	5.00	3.92	4.00	ns
2	Frequency - day	4.53	5.00	4.38	5.00	ns
3	Frequency - Sundays	4.20	5.00	3.82	4.00	++
4	Reliability	4.65	5.00	4.60	5.00	++
5	Punctuality	4.57	5.00	4.59	5.00	ns
6	Buy ticket - on bus	4.12	4.50	3.78	4.00	ns
7	Buy ticket - at Travel Centre	3.85	4.00	3.46	4.00	ns
8	Cleanliness - on bus	4.20	5.00	4.19	5.00	ns
9	Cleanliness – at bus stops	4.26	5.00	4.03	4.00	ns
10	Journey Time	4.28	5.00	4.14	4.50	ns
11	Friendliness of drivers	4.39	5.00	4.32	5.00	ns
12	Information at bus stops	4.51	5.00	4.29	5.00	ns
13	Finding information	4.54	5.00	4.43	5.00	ns
14	Security - on bus	4.62	5.00	4.43	5.00	ns
15	Security - at bus stops	4.47	5.00	4.38	5.00	ns
16	Condition of shelters	4.30	5.00	4.39	5.00	ns
17	Cost of tickets	4.31	5.00	4.28	5.00	ns

++ significant at 0.05 between group (NSR and SR)
ns = not significant between group (NSR and SR)

On the other hand for *satisfaction* 10 out of 17 attributes are statistically significantly different reflecting measurable differences in quality of services. Attributes not statistically significantly different were buying tickets at the Travel Centre, cleanliness at bus stops, journey time, friendliness of driver and cost of ticket. This again indicates that, except for friendliness of the driver and the cost of ticket, these attributes are to some extent outside the normal control of the bus operators, being the responsibility of a third party and the local authority managing congestion, providing bus priority, maintenance of shelters, etc. The cost of tickets is likely to always be an issue irrespective of bus quality investment and it is comforting that the friendliness of drivers across services is the same.

Table 4.15 : Chi Square Significance Test between two groups (NSR and SR) for *Satisfaction*

		Satisfaction				
		NSR(mean)	NSR (median)	SR (Mean)	SR (Median)	**NSR vs. SR**
1	Frequency- evening	3.06	3.00	3.28	3.00	++
2	Frequency - day	3.42	4.00	3.80	4.00	++
3	Frequency - Sundays	2.93	3.00	3.04	3.00	++
4	Reliability	3.09	3.00	3.63	4.00	++
5	Punctuality	3.10	3.00	3.59	4.00	++
6	Buy ticket - on bus	3.59	3.50	3.95	4.00	++
7	Buy ticket - at Travel Centre	3.42	3.00	3.49	3.50	ns
8	Cleanliness - on bus	3.22	3.00	3.38	4.00	++
9	Cleanliness – at bus stops	2.95	3.00	3.05	3.00	ns
10	Journey Time	3.20	3.00	3.15	3.00	ns
11	Friendliness of drivers	3.10	3.00	3.44	4.00	ns
12	Information at bus stops	3.01	3.00	3.49	4.00	++
13	Finding information	2.95	3.00	3.35	4.00	++
14	Security - on bus	3.25	3.00	3.65	4.00	++
15	Security - at bus stops	3.13	3.00	3.55	4.00	++
16	Condition of shelters	2.92	3.00	3.20	3.00	++
17	Cost of tickets	2.58	2.00	2.76	3.00	ns

++ significant at 0.05 between group (NSR and SR)
ns = not significant between group (NSR and SR)

4.2.10 Gap Analysis

In the context of this research, the assumption is that what is *important* can vary according to individual preferences, and thus opinions and thoughts expressed by passengers can indicate what they really want from the current bus service. On the other hand an individual’s *satisfaction* score indicates the extent to which the service meets their expectation. It is suggested that an operator delivering high levels of *satisfaction* with those attributes considered to have high importance by passengers, is delivering a quality service, in other words, the *gap* is small.

The way in which the shortfall in service delivery can be quantified is by considering the gap (Parasuraman *et al.*, 1985) defined as the difference in the Likert Scale for *Importance* and *Satisfaction*. This is calculated assuming the data is both ordinal and interval to provide some granularity in the data. The bigger gap demonstrates that passengers have lower *satisfaction* on the particular quality attribute.

a) Gap Value for NSR services

Table 4.16 shows the gap for NSR services for *importance* and *satisfaction* based on the difference between the mean and the median Likert scale value, for each attribute there are large variations between the responses and it is found that the cost of tickets has the highest gap median 2, mean (1.73) followed by finding information about routes median 2, mean (1.59), reliability median 2, mean (1.56) and buying ticket on the bus has the lowest gap median 1, mean (0.53).

Table 4.16 : Gap Value (Difference between Importance and *Satisfaction*) for NSR

		Importance		***Satisfaction***		**Gap between Importance and *Satisfaction***	
	Non Superoute (NSR)	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
1	Frequency-evening	4.19	5.00	3.06	3.00	1.13	2
2	Frequency - day	4.53	5.00	3.42	4.00	1.11	1
3	Frequency - Sundays	4.20	5.00	2.93	3.00	1.27	2
4	Reliability	4.65	5.00	3.09	3.00	1.56	2
5	Punctuality	4.57	5.00	3.10	3.00	1.47	2
6	Buy ticket - on bus	4.12	4.50	3.59	3.50	0.53	1
7	Buy ticket - at Travel Centre	3.85	4.00	3.42	3.00	0.43	1
8	Cleanliness - on bus	4.20	5.00	3.22	3.00	0.98	2
9	Cleanliness – at bus stops	4.26	5.00	2.95	3.00	1.31	2
10	Journey Time	4.28	5.00	3.20	3.00	1.08	2

11	Friendliness of drivers	4.39	5.00	3.10	3.00	1.29	2
12	Information at bus stops	4.51	5.00	3.01	3.00	1.5	2
13	Finding information	4.54	5.00	2.95	3.00	1.59	2
14	Security - on bus	4.62	5.00	3.25	3.00	1.37	2
15	Security - at bus stops	4.47	5.00	3.13	3.00	1.34	2
16	Condition of shelters	4.30	5.00	2.92	3.00	1.38	2
17	Cost of tickets	4.31	5.00	2.58	2.00	1.73	2

b) Gap Value for SR

Table 4.17 presents the gaps for the SR services between *Importance* and *Satisfaction* using a similar approach. The results show clearly that the gap value for SR as compared to passengers travelling on NSR was much lower. Consistent with NSR the biggest gap was for cost and tickets median 2, mean (1.52) followed by condition of shelters median 2, mean (1.19) and finding information about routes median 1, mean (1.08). The lowest of the attributes, again consistent with NSR, was buying a ticket on the bus with a value of 0, do not separate from -0.17 meaning that the passengers are more *satisfied* than they believe is *important*. However, as this value is small it is suggested that this gives some indication of error of measurement (or judgment) in the assignment of Likert scaling score.

Table 4.17 : Gap Value (Difference between Importance and *Satisfaction*) for Superoute (SR)

		Importance		***Satisfaction***		***Gap between Importance and Satisfaction***	
	Superoute (SR)	***Median***	**Mean**	***Mean***	***Median***	***Mean***	***Median***
1	Frequency-evening	4.00	3.92	3.28	3.00	0.64	1
2	Frequency - day	5.00	4.38	3.80	4.00	0.58	1
3	Frequency - Sundays	4.00	3.82	3.04	3.00	0.78	1
4	Reliability	5.00	4.60	3.63	4.00	0.97	1
5	Punctuality	5.00	4.59	3.59	4.00	1	1
6	Buy ticket - on bus	4.00	3.78	3.95	4.00	-0.17	0
7	Buy ticket - at Travel Centre	4.00	3.46	3.49	3.50	-0.03	0.5
8	Cleanliness - on bus	5.00	4.19	3.38	4.00	0.81	1
9	Cleanliness – at bus stops	4.00	4.03	3.05	3.00	0.98	1
10	Journey Time	4.50	4.14	3.15	3.00	0.99	1.5
11	Friendliness of drivers	5.00	4.32	3.44	4.00	0.88	1
12	Information at bus stops	5.00	4.29	3.49	4.00	0.8	1
13	Finding information	5.00	4.43	3.35	4.00	1.08	1
14	Security - on bus	5.00	4.43	3.65	4.00	0.78	1
15	Security - at bus stops	5.00	4.38	3.55	4.00	0.83	1
16	Condition of shelters	5.00	4.39	3.20	3.00	1.19	2
17	Cost of tickets	5.00	4.28	2.76	3.00	1.52	2

c) Comparison of scores between two groups (NSR and SR)

In order to achieve a general understanding of and to compare the differences between NSR and SR for *importance* and *satisfaction*, graphs were plotted in Figure 4.1a) and b) respectively, indicating statistical significance by an asterisk. In order to observe granularity, the data is considered to be interval therefore the means (instead of the medians) are plotted.

It is clear that NSR and SR users have more consistent views about the *importance* of service quality across all attributes whilst consistently for *satisfaction* SR is considered by passengers to have higher quality (higher Likert score) compared to NSR. Generally for NSR compared to SR for *importance* NSR are higher than SR (although only statistically significantly for frequency in the day and on Sundays) suggesting that the improvement in quality may influence the perception of *importance* also. The scores for *importance* are generally higher than for *satisfaction* showing that there is room for improvement of all services. The gap for each quality attribute for SR and NSR is plotted in Figure 4.2 and clearly shows, respectively, how the differences between *importance* and *satisfaction* vary across attributes. Within error of measurement, NSR is consistent across all attributes with a larger gap compared to SR. It is argued that the consistency of change across all attributes adds credence to this not to have occurred by chance but attributable to QBP. Comparing the changes in gaps using the median for NSR compared to SR, the significant results emerging suggest that the QBP has closed the gap for all attributes by at least one unit of Likert scale, except for frequency in the day, conditions of shelters and cost of tickets which remain the same.

The next sections will use *satisfaction* tests to delve more deeply into the differences and similarities in the services.

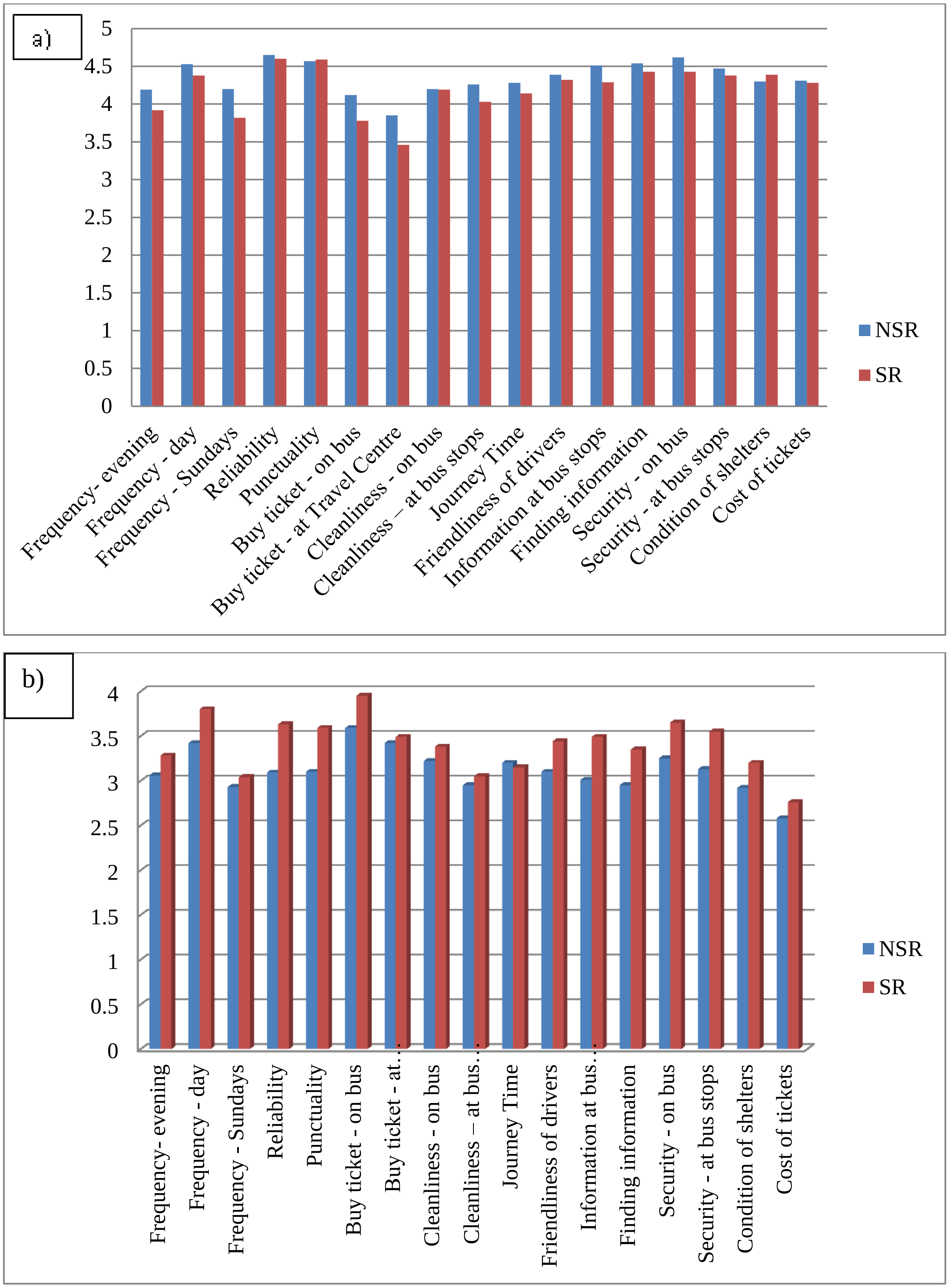

Figure 4.1 : Comparison of mean scores for a) Importance and b) *Satisfaction* for NSR and SR

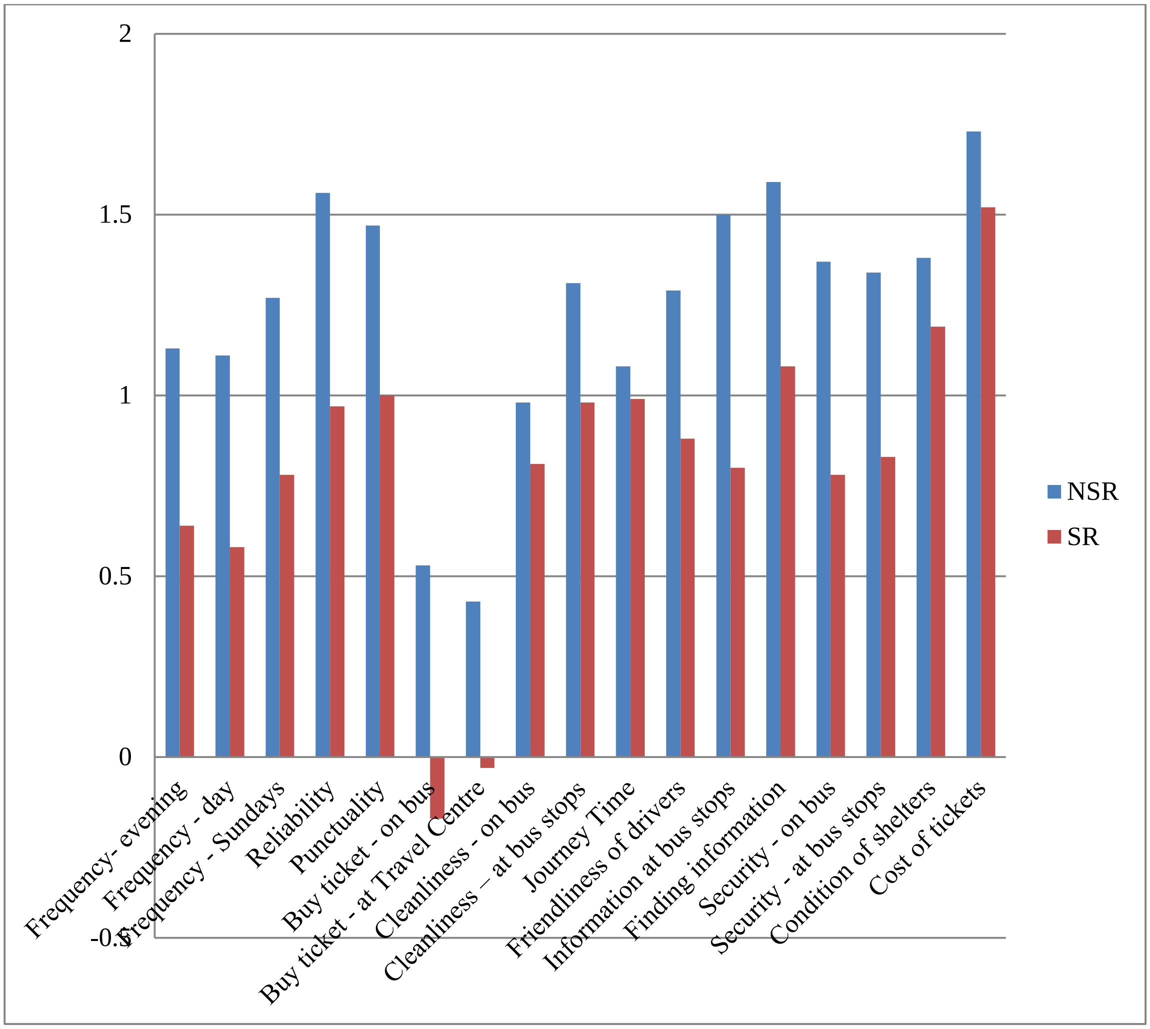

Figure 4.2 : Gap Value for NSR compared to SR

4.3 Summary

This chapter has presented the results of the descriptive analysis to give a general overview of the characteristics of the sample of passenger population.

The results of the descriptive analysis showed that, consistent with other studies, more women than men use the bus, the higher percentage of senior citizens results from concessionary fares and probably due to car ownership, the employed population are under-represented but due to the demographics of the catchment of the services studied rather than sample bias. Although much effort was made to establish the demographics of bus passengers in Tyne and Wear, this data could not be made available by the authorities. This was due to the confidential nature of the data protected by bus companies who operate in competition with each other. There was no statistically significant difference found between gender and age between NSR and SR. However, there was statistically significant difference for employment status where more passengers in employment were found on SR compared with NSR and more unemployed and retired for NSR compared to SR. For other characteristics, tickets, journey purpose, access to a car, there was no statistically significant differences between the services which were mostly used by frequent travellers. However, there was statistical significant difference of knowledge of bus timetable before leaving the house for NSR and SR with NSR users more aware of bus departure times. This was believed due to lower frequency of service at each end of the routes where there were no alternative services.

The scores of Likert Scales for quality attributes were found not to be normally distributed. Therefore, non-parametric statistical tests were used to explore differences and similarities of the passengers' perceptions to the bus service quality in terms of *importance* independently from *satisfaction*. With reference to those results at a statistical significance at 95% level of confidence, compared with NSR, SR services were found to result in higher *satisfaction* scores for all attributes except buying a ticket at the Travel Centre, journey time, friendliness of drivers and cost of tickets, for which *satisfaction* scores (although higher in all cases), were statistically significantly similar. On the other hand, in terms of statistically significant results for *importance*, NSR differed from SR users for reliability and frequency on Sundays only. This analysis clearly provides evidence that the investment in improving quality of services has made a difference. In the next chapter, the Likert scores for *importance* and *satisfaction* are studied together to establish the extent to which the investment in quality have increased the satisfaction of important attributes.

CHAPTER 5 : IMPORTANCE SATISFACTION AND FACTOR ANALYSES OF PASSENGERS' PERCEPTION

5.1 Introduction

The previous chapter provided a high level analysis of the characteristics of the sample of passengers studied and the extent to which the public transport service provision met their needs. In this chapter, a more in depth analysis is carried out using the analysis techniques of ISA and FA.

Section 5.2 deals with analysis of *Importance* and *Satisfaction*, Section 5.3 presents the results of passenger perception of safety as a quality attribute and Section 5.4 presents the results of Factor Analysis. The final Section 5.5 consolidates the results before presenting the result of CA and OLR in the chapters that follow. The information gathered from the analysis in this chapter is subsequently used in Chapter 8 in a critical interpretation across all steps in the analysis to produce recommendations into which *quality* measures investment should be made in the future to enhance passengers' perceptions.

5.2 Perception of Quality using Importance and Satisfaction Analysis (ISA)

In this section the ISA analysis is presented, initially to gain a general overview of the data to establish how passengers perceive service quality. The first step was to establish appropriate values for the hairlines.

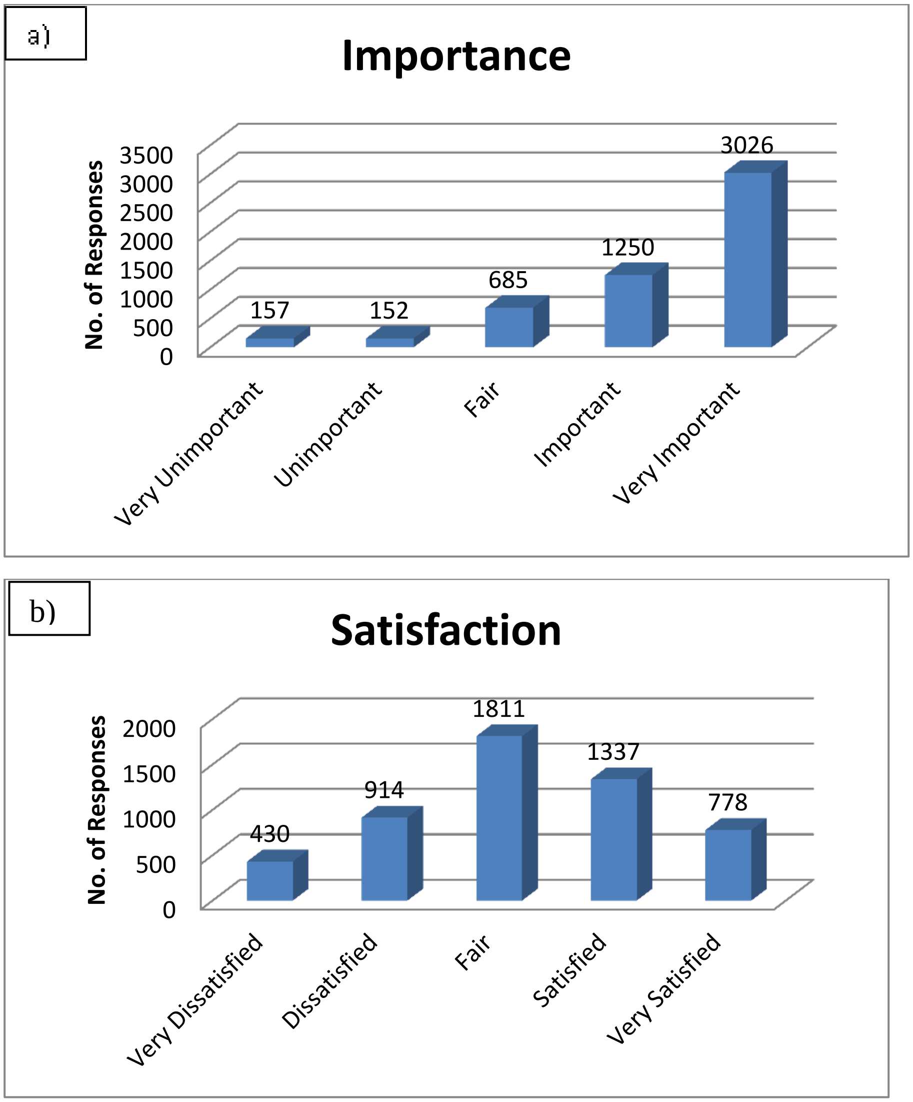

Figure 5.1 : Distribution of responses for a) *Importance* and b) *Satisfaction* for overall survey sample irrespective of quality attribute. The grand average is used as the hairline in the ISA technique.

The distribution of Likert scores were derived for the entire data set for all passengers for all attributes separately for *importance* and *satisfaction* as shown in Figure 5.1 a) and b) respectively. The test for normality demonstrated that the distributions did not conform to a Gaussian Distribution. Therefore, further investigations of the choice of statistic for use in the ISA analysis were carried out. The statistics available for use as the cross hair were the middle value of the Likert score (in this research 3); the grand median (which takes a value of 5 for *importance* and 3 for *satisfaction*) or the grand mean (which takes a value of 4.3 for *importance* and 3.21 for *satisfaction*). Assessing the statistical significance of the individual quality attributes from the cross hair also created issues due to the lack of normality of the distribution of quality attributes and therefore further work was need to explore options. Measures of spread in the data considered included the standard deviation (and standard error) of the mean with values 1.00 (0.01) for *importance* and 1.14 (0.02) for *satisfaction* and for the median values were 1.49 (0.02) for importance and 1.34 (0.02) for *satisfaction*, respectively. An *Importance Satisfaction* Analysis (ISA) was carried out on the entire data set. As discussed in Chapter 3: Methodology, there are important issues highlighted in the literature not only regarding the statistics needed for the location of the cross hair but also the statistic for the *importance* and *satisfaction* score for each parameter and therefore the first step of the ISA was to investigate appropriate statistical parameters. The Likert scores for each quality attribute for both *Importance* and *Satisfaction* and the location of the cross hair are shown in Figures 5.2 to Figure 5.7 and illustrate clearly the problems not only in the choice of cross hair but also the use of the median (given that the distribution of scores are not normal) to show trends in the data.

Figure 5.2 considers the Likert scores as interval data and shows the mean of the responses for each quality attribute for *Importance* and *Satisfaction* and using the grand mean as the cross hair. It is found that the data is distributed across the four quadrants which at a glance reveals the range of perceptions of passengers. On the other hand, in Figure 5.3, the median values are plotted again with the cross hair based on the grand mean. This demonstrates clearly the difficulty in distinguishing the 17 attributes if the median value is used. Figure 5.4 now shows the mean Likert score with the cross hair based on the middle scale of the Likert score which is 3. It is found that the distribution of data mostly lies in Quadrant I suggesting that all respondents are satisfied with the service measured against quality attributes of which none are less important. These results could misinform the interpretation of results of the analysis. This is because the higher proportion of the respondents scored quality attributes of high importance. This exposes the weakness in the use of what is essentially a relative scale to quantify perceptions.

Figure 5.5 shows the median values with the cross hairs based on the middle scale of the Likert score which is 3. Again, it is found that the distribution of data is such that it mostly lies in Quadrant I with all median values co-incident on one of four points which leads to the conclusion that all respondents are satisfied with the service. This demonstrates the inappropriateness of the middle scale as a measure for the cross hair and endorses the fact that using the median score to show differences in the respondent's perception and quality is not as informative as the use of the mean.

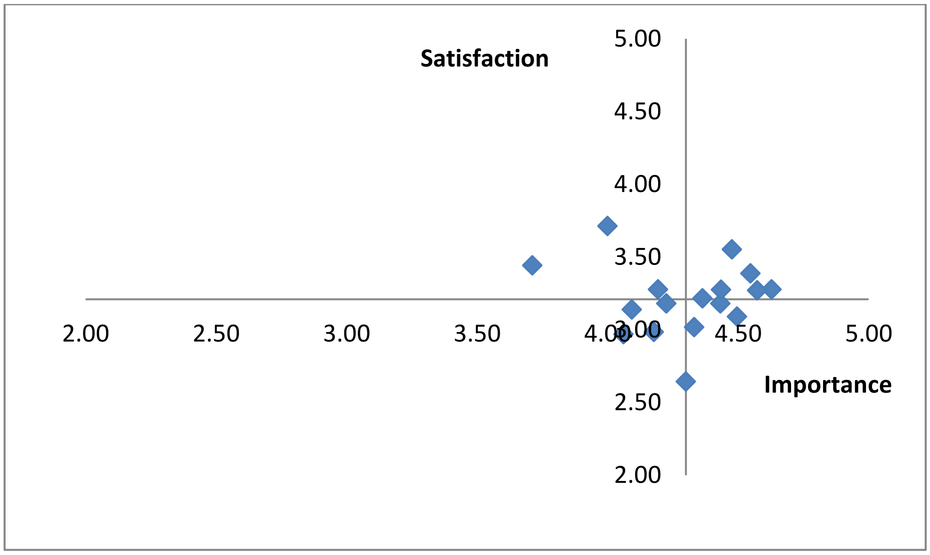

Figure 5.2 : Plotting mean Likert scores of *Importance* and *Satisfaction* using grand mean as cross hair

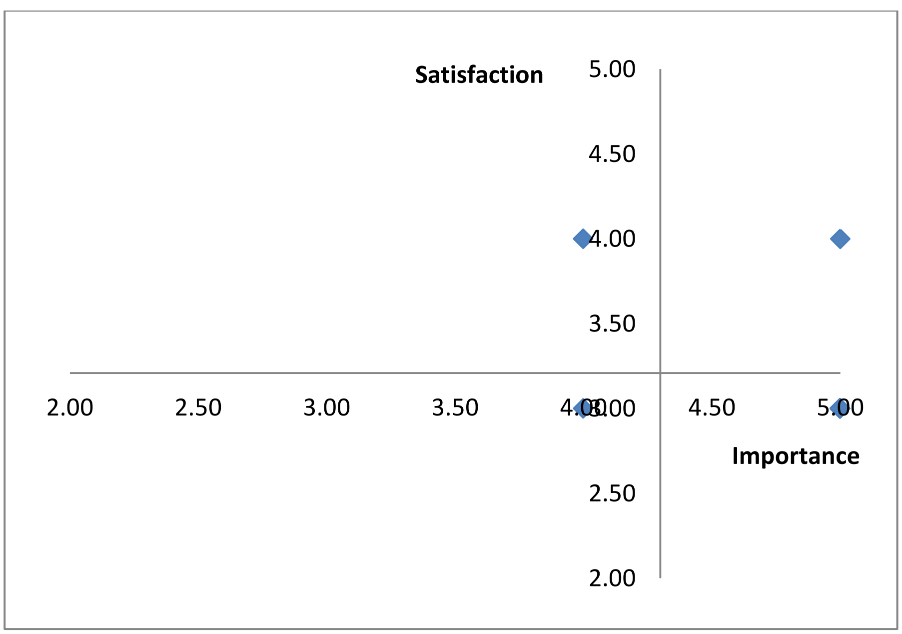

Figure 5.3 : Plotting median Likert scores of *Importance* and *Satisfaction* using grand mean as cross hair

Figure 5.6 shows the mean values for the Likert scores separately for 17 quality attributes using the cross hair based on the median of the Likert scores overall quality attributes over all respondents. The scores now mostly lie in Quadrant IV and the results again do not reveal useful information concerning the actual relative perception of passengers to investment in quality measures.

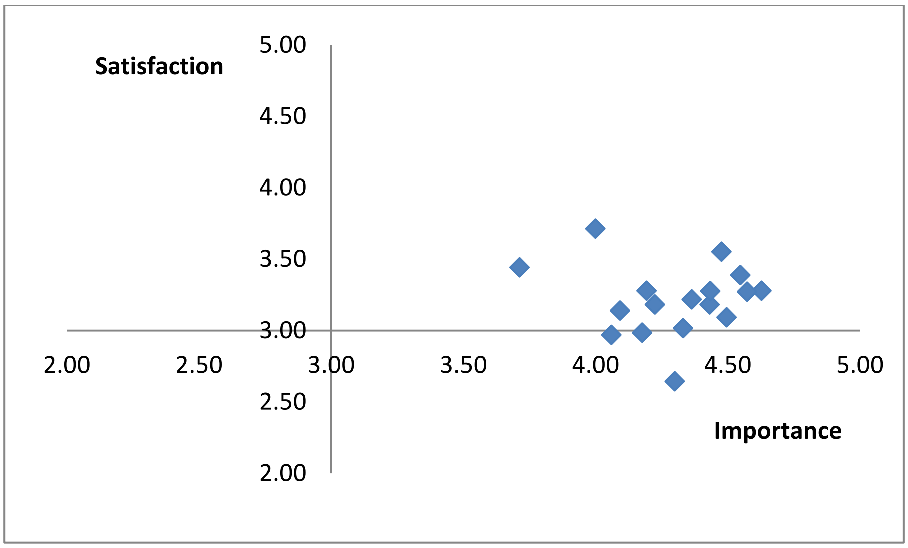

Figure 5.4 : Plotting mean Likert scores of *Importance* and *Satisfaction* using middle scale of Likert Scale as cross hair

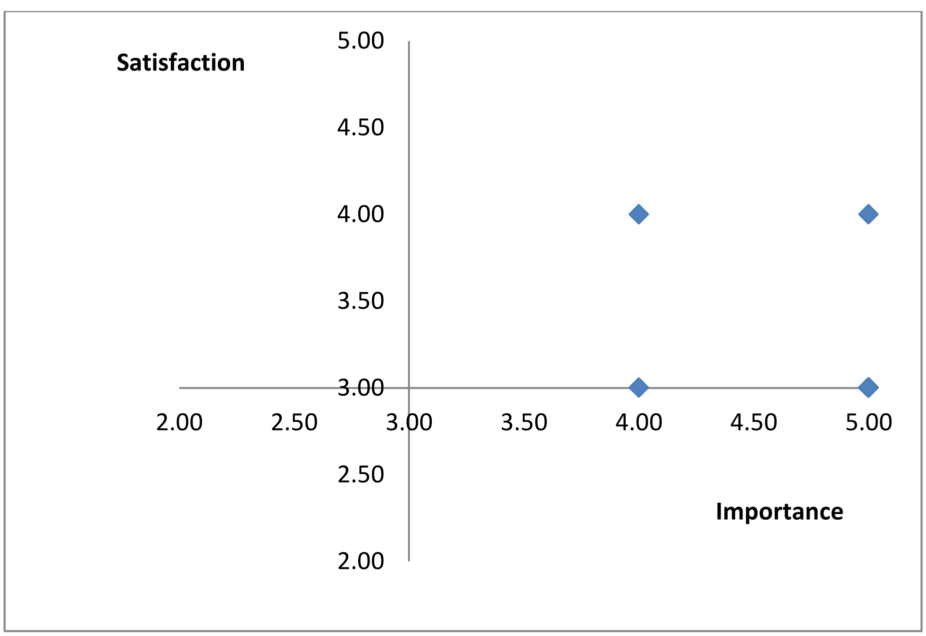

Figure 5.5 : Plotting median Likert scores of *Importance* and *Satisfaction* using middle scale of Likert Scale as cross hair

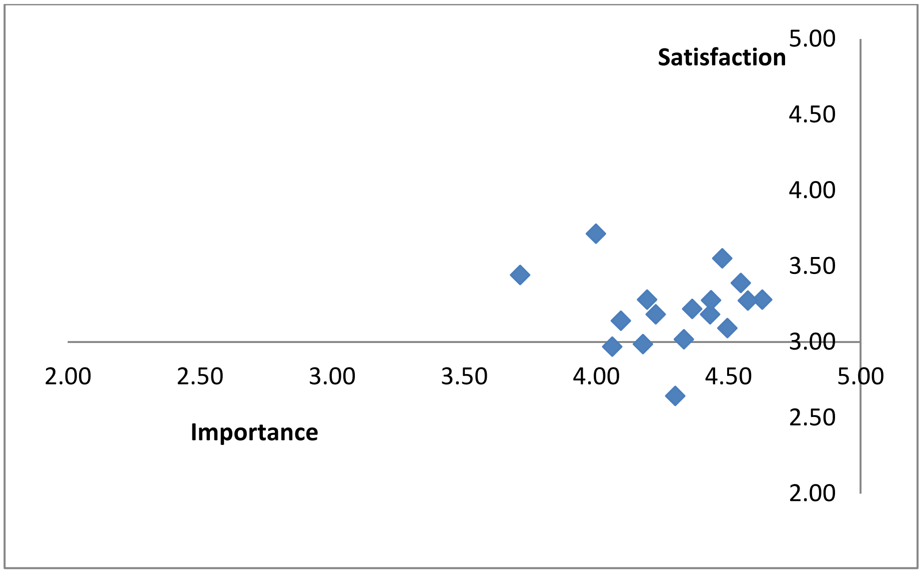

Figure 5.6 : Plotting mean Likert scores of *Importance* and *Satisfaction* using median as cross hair

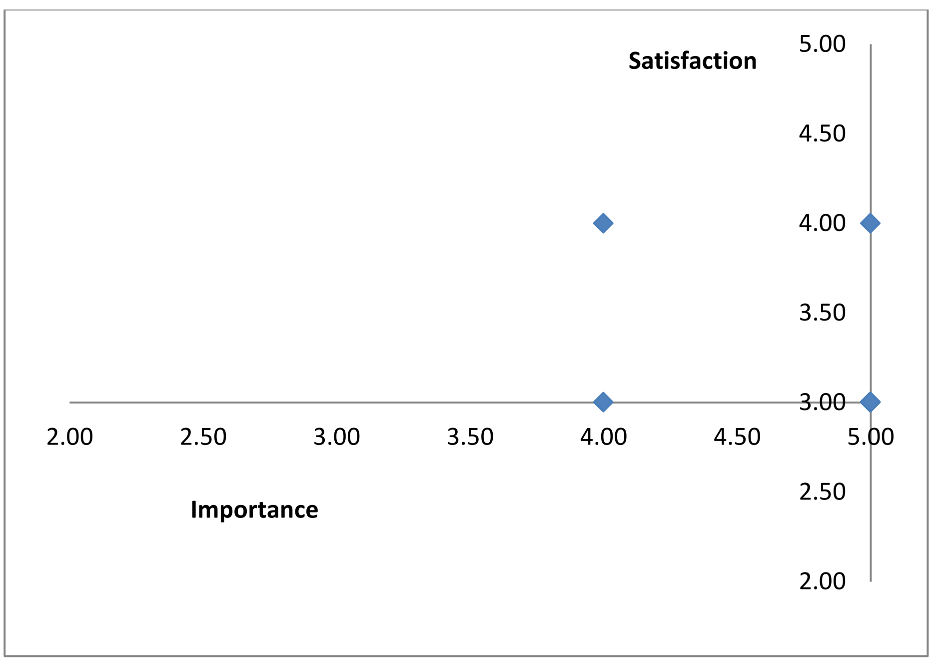

Figure 5.7 : Plotting median Likert scores of *Importance* and *Satisfaction* using median as cross hair

Finally, Figure 5.7 shows the median values for all attributes based on the median of the Likert scores. Now the distribution of data lies almost entirely in Quadrant IV and data was reduced again to only 4 points allowing very limited conclusions to be drawn concerning the actual perceptions of passengers against different quality attributes.

Based on the results of the investigation of the various approaches on the location of the cross hair, it was found that the most informative value to use is the grand mean for both *Importance* and *Satisfaction* plotted as the *x* and y axis respectively and for visual display purpose to use the mean value of the Likert scale scores for each quality attribute. However, it is emphasised that all statistical tests carried out on the data are non - parametric and based on the median.

In conclusion the ISA analysis in this research, adopts the use of the “grand mean score”. This is consistent with the findings of Zhang and Chow (2004) and this initial exercise has clearly demonstrated the need for “care and caution” otherwise ISA “may lead to incorrect interpretation” highlighted in TRB (1999). ISA is just a simple tool or analysis technique to obtain a general overview of the data.

5.2.1 ISA of Overall Respondents

Given a basic understanding of the characteristics of overall sample based on the descriptive analysis reported earlier in this chapter, this section begins to explore the perception of passengers in the context of how *important* and to what extent passengers are *satisfied* with attributes of service *quality*. Clearly, using the grand mean scores as the indicator of how passengers perceived the *importance* of *quality* and how *satisfied* they are with the service provides an assessment of an impression of service *quality* for both types of bus service, albeit for different passenger populations. In Figure 5.8 the mean scores (for each attribute average over all passengers) are plotted for *satisfaction* (*y* axis) as a function of *importance* (*x* axis). The axes or cross hairs mark the average of all the scores over all respondents and over all 17 attributes for *importance* (*x*) and *satisfaction* (*y*) as justified in section 4.3 and will be used throughout all ISA analysis presented in the remainder of the thesis. The numbers alongside the points label each attribute as defined in the key. In this way, this two dimensional grid illustrates perceived *importance* and how satisfied customers were against the *quality* attributes.

By studying the location of each point on the ISA diagram, the 17 quality attributes can be assigned to one of the four quadrants namely I, II, III and IV. From the bus operators' perspective, when interpreting this data, Quadrant I suggests that specific attributes are important and passengers are satisfied, therefore operators should 'keep up the good work'. Obviously lower scores indicated the higher potential to improve. Indeed, scores in Quadrant II highlight those *quality* attributes which need attention, and operators should 'concentrate here' given the dis*satisfaction* of importance of quality attributes. Turning now to those attributes that are, relatively speaking, considered less or not important, Quadrant III (with relatively low scores for *satisfaction*) contains *quality* attributes that one can argue are of lower priority for the bus operator when investment funds are low. The attributes in the final quadrant with relatively high *satisfaction* yet relatively low *importance* are the most difficult to label. Generally these attributes could be considered to have received over-investment; therefore, one can argue that from the operators' perspective there is 'overkill' with no further need to address these attributes. However, on the other hand, as we are dealing with an evaluation of perceptions of existing bus services, it is likely that the status quo has been achieved through the current level of investment, which if withdrawn may shift that *quality* attribute into a different quadrant in a future evaluation. Therefore, this quadrant is named 'Possible Overkill'. Finally, this discussion, as well as demonstrating its ability to provide an insight into the interrelationships between different attributes and their relative *importance* and *satisfaction*, has highlighted the limitations in this approach.

Ideally for this analysis it would be useful to establish whether the score for each attribute is statistically significant from the cross hair however, given the non-normality of the distributions of Likert scores for each quality attribute, it is difficult to establish a mechanism to test for this statistical significance. Therefore, much effort has been placed in developing a statistical framework for the ISA, however, these further limitations due to the fact that the distribution of Likert score are not normally distributed means that a Z test to establish whether or not the cross hair value is located outside the 95% confidence limits either for *satisfaction* or *importance* or for both is not valid. Furthermore, for non-parametric testing it requires the use of the median (50 percentile) for the hair line which was shown above to be inappropriate. Given that the standard error for both the mean and the median were ≤ 0.02 then it may be argued that a 95% confidence level is estimated at 0.02 x 1.96 about 0.04 which is an indicator of the "zone of insignificance." The discussion in the context of the ISA is carried out with due consideration of the location of the mean and the median score of each attribute in relation to the grand mean cross hair only. In this way, an attribute is assigned to a Quadrant. By studying changes in the position of the attributes for different service types trip purposes, etc. any impact on quality due to investment can be understood but with due consideration that the cross hair falls below or above or the left or right of the "zone of insignificance" of the Likert scores distribution. In the remainder of this section features emerging from spatial distribution and the location of each attribute in the ISA space is presented.

With reference to Figure 5.8, in general, service measures such as frequency during the day, punctuality and reliability, along with personal security, as expected, are of high *importance* whilst ticket purchase is of low *importance*. The figure indicates that much of the data lies close to the axes. Also, because these data are representative of the opinions of the whole sample, irrespective of the service type, any differences between the four NSR and two SR services will become diluted. The purpose of looking at the data as a whole here is to explore the features of the "base case" so that when this analysis is repeated in the next section for NSR and SR separately, the differences and similarities in the service types will be highlighted.

With reference to Figure 5.8 and Table 5.1, quality attributes that are both statistically significant for *importance* and *satisfaction* for Quadrant I are how often the bus runs through the day and personal security on the bus. For Quadrant III cleanliness at the bus stops and frequencies on Sundays and Quadrant IV ease of buying tickets on the bus and at the Travel Centre. There are no statistically significant different quality attributes for both *importance* and *satisfaction* for Quadrant II.

Attributes not statistically significant for *satisfaction* but are statistically significant for high *importance* are reliability, punctuality, finding information about bus routes and for low *importance;* how often the bus runs in the evening and on Sunday and cleanliness at bus stops. For quality attributes that are statistically significant for *satisfaction* only (i.e. not statistical significant for *importance*), relate to:

16. Condition of shelters
17. Cost of tickets

Quality attributes that are not statistically significant for either *satisfaction* or *importance* include:

8. Cleanliness on the bus
10. Journey time
11. Friendliness of drivers

An interesting point to make at this stage is that Quadrant IV poses, to some extent, a dilemma: an attribute for example “ease of buying a ticket” genuinely falls in this quadrant (because it has statistical significance) but could be in this quadrant because the current level of ticket purchase service is of good quality, therefore because passengers are satisfied this attribute is not perceived to be important. On the other hand, if the quality of ticket purchase service should deteriorate, the attribute could slip across into Quadrant II where passengers might perceive low *satisfaction* of a quality attribute that is in fact important to them.

As these results are an analysis for services overall, they are sending out a clear message of significant differences in the perceptions of passengers to quality attributes that relate to their experiences of the public transport service they are using at the time of the interview.

Therefore, operators should keep up the good work in relation to frequency of service during the day, reliability, punctuality, and personal security on the bus and at the bus stops. Obviously the influences of the NSR and SR are affecting this overall picture but to understand their relative influences, requires further analysis. The next step was to repeat the ISA analysis for the disaggregated data sets; NSR and SR, and the results are presented in the next section.

Table 5.1 : Mean and Median of Likert Scores for quality attributes for all data (NSR + SR)

	Quality Attributes	*Importance*		*Satisfaction*	
		Mean	Median	Mean	Median
1	Frequency- evening	4.09	5.00	3.14	3.00
2	Frequency - day	4.48	5.00	3.55	4.00
3	Frequency - Sundays	4.06	5.00	2.97	3.00
4	Reliability	4.63	5.00	3.28	3.00
5	Punctuality	4.57	5.00	3.27	3.00
6	Buy ticket - on bus	4.00	4.00	3.71	4.00
7	Buy ticket - at Travel Centre	3.71	4.00	3.44	3.00
8	Cleanliness - on bus	4.19	5.00	3.28	3.00
9	Cleanliness – at bus stops	4.18	5.00	2.98	3.00
10	Journey Time	4.23	5.00	3.18	3.00
11	Friendliness of drivers	4.36	5.00	3.22	3.00
12	Information at bus stops	4.43	5.00	3.18	3.00
13	Finding information	4.50	5.00	3.09	3.00
14	Security - on bus	4.55	5.00	3.39	3.00
15	Security - at bus stops	4.44	5.00	3.27	3.00
16	Condition of shelters	4.33	5.00	3.02	3.00
17	Cost of tickets	4.30	5.00	2.64	3.00

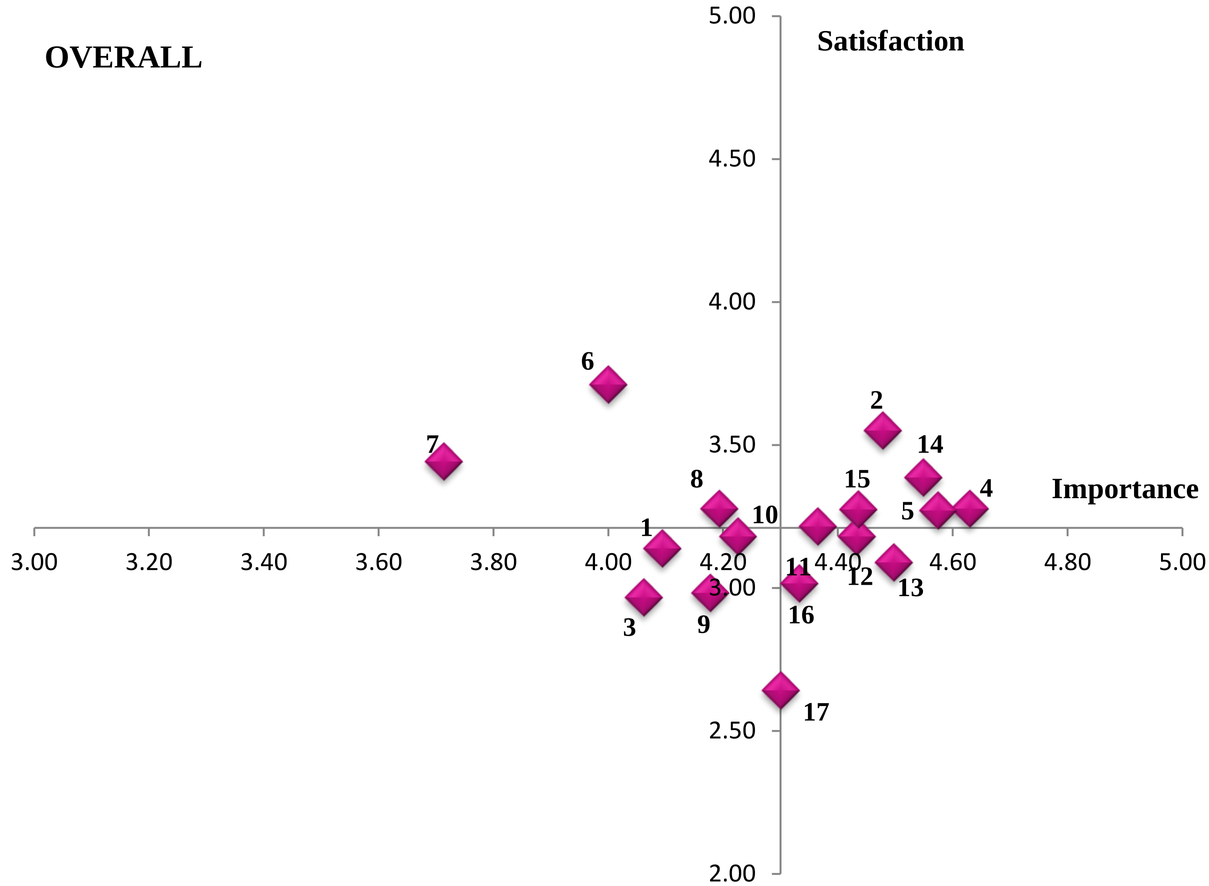

Figure 5.8 : Importance *Satisfaction* Analysis – Overall (NSR +SR)

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

5.2.2 Perception of Quality Using *Importance Satisfaction* Analysis (ISA): Analysis by NSR and SR

The steps in the analysis carried out for the total data set were repeated separating the data into NSR and SR. In all cases the distribution of Likert scores were found not to be normally distributed. The assumption used in ISA is that the data is interval, as before and the mean score for *importance* was plotted against the mean score for *satisfaction* for both NSR and SR. In this way the effect of the quality improvement on *importance* and *satisfaction* can be seen more clearly. Although statistical significance tests cannot be justified for the reasons noted above considering the zone of significance is considered to establish whether attributes fall confidently in a quadrant. The results of ISA for NSR and SR are presented in Figure 5.9 (Table 5.2) and Figure 5.10 (Table 5.3) respectively. The interpretation is made by comparing the quality attributes between both bus services.

It is interesting to highlight that passengers travelling on NSR services found that buying a ticket either on the bus or at the Travel Centre, were of lower importance and they are satisfied. However quality attributes for passengers travelling on SR services are marginally more satisfied with buying a ticket on the bus or at the Travel Centre but with lower importance compared with NSR.

Those quality attributes rated as low *importance* but with high *satisfaction*, give indication to bus operators of what passengers found to be of 'possible overkill' which in turn one can argue do not require future service improvement. However, reservations regarding this Quadrant IV highlighted earlier still prevail. Implying that a status quo has been reached in respect of ticketing and provided this is maintained, these attributes are likely to remain in this quadrant. On the other hand, operators should give high priority to the quality attributes that fall in Quadrant II where most passengers travelling on NSR services found punctuality, reliability and finding information about bus routes important and yet in these respects were not satisfied with the service provided. For SR no attributes rest in Quadrant II with consistent shift to Quadrant I from low to high *satisfaction* of attributes considered *important*.

Table 5.2 : Mean and Median of Likert Scores for quality attributes for NSR

		Importance		***Satisfaction***	
	Non Superoute (NSR)	**Mean**	**Median**	**Mean**	**Median**
1	Frequency- evening	4.19	5.00	3.06	3.00
2	Frequency - day	4.53	5.00	3.42	4.00
3	Frequency - Sundays	4.20	5.00	2.93	3.00
4	Reliability	4.65	5.00	3.09	3.00
5	Punctuality	4.57	5.00	3.10	3.00
6	Buy ticket - on bus	4.12	4.50	3.59	3.50
7	Buy ticket - at Travel Centre	3.85	4.00	3.42	3.00
8	Cleanliness - on bus	4.20	5.00	3.22	3.00
9	Cleanliness – at bus stops	4.26	5.00	2.95	3.00
10	Journey Time	4.28	5.00	3.20	3.00
11	Friendliness of drivers	4.39	5.00	3.10	3.00
12	Information at bus stops	4.51	5.00	3.01	3.00
13	Finding information	4.54	5.00	2.95	3.00
14	Security - on bus	4.62	5.00	3.25	3.00
15	Security - at bus stops	4.47	5.00	3.13	3.00
16	Condition of shelters	4.30	5.00	2.92	3.00
17	Cost of tickets	4.31	5.00	2.58	2.00

For NSR, investment in the condition of bus shelters, information at bus stops and finding route information would be beneficial; however, they are dissatisfied with the high *importance* measures namely punctuality and reliability of the bus in turning up with respect to these two measures SR passengers, compared to NSR, are satisfied thus identifying the key areas of investment within QBP have shown significant improvement given the standard error of the mean and median less than 0.02. Irrespective of whether passengers travel on NSR or SR, they are not satisfied with the cost of tickets and improvements can be made in frequency on Sundays and cleanliness at bus stops and journey time. This analysis has illustrated that SR has increased satisfaction for punctuality, reliability and personal security on the bus and with this deeper understanding of the differences between the NSR and SR, the next section explores differences in the context of journey purpose.

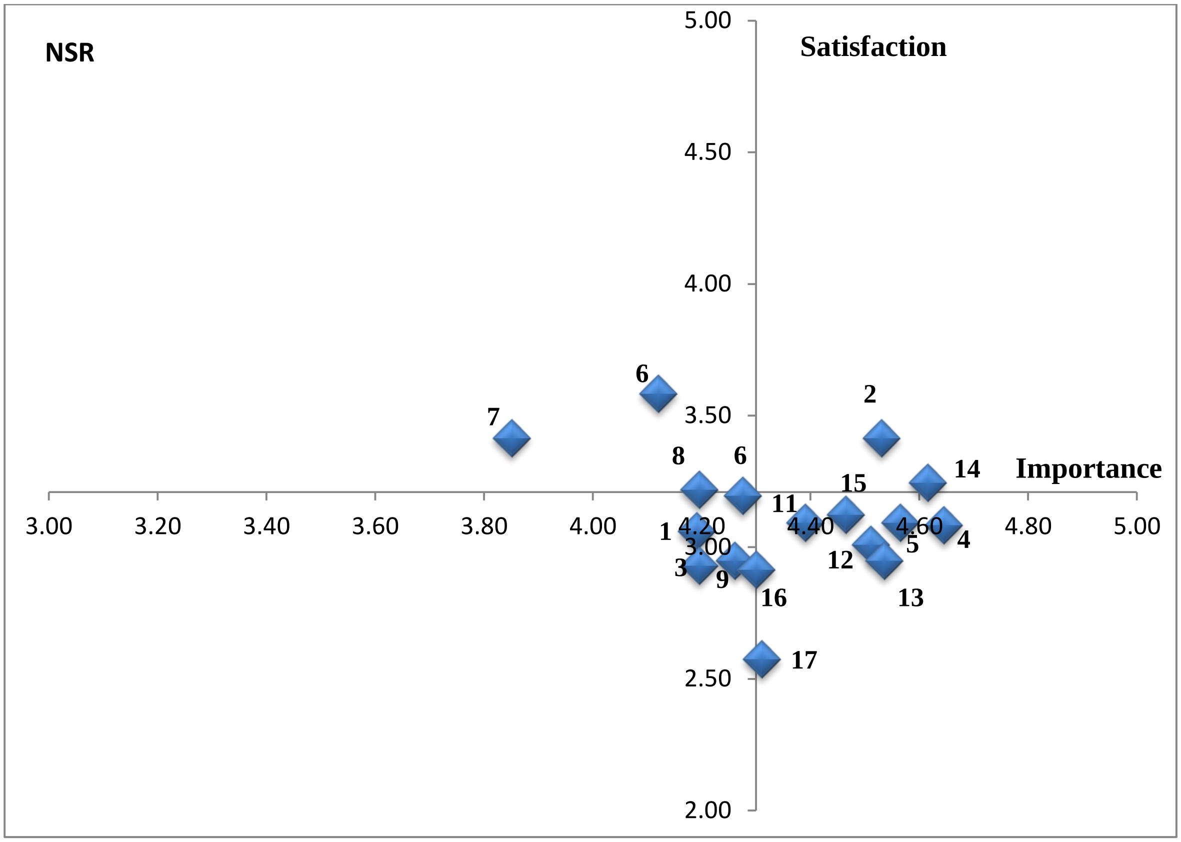

Figure 5.9 : Perceived Importance and Satisfaction by NSR Users

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

Table 5.3 : Mean and Median of Likert Scores for quality attributes for SR

		Importance		*Satisfaction*	
	Superoute (SR)	**Mean**	***Median***	**Mean**	***Median***
1	Frequency- evening	3.92	4.00	3.28	3.00
2	Frequency - day	4.38	5.00	3.80	4.00
3	Frequency - Sundays	3.82	4.00	3.04	3.00
4	Reliability	4.60	5.00	3.63	4.00
5	Punctuality	4.59	5.00	3.59	4.00
6	Buy ticket - on bus	3.78	4.00	3.95	4.00
7	Buy ticket - at Travel Centre	3.46	4.00	3.49	3.50
8	Cleanliness - on bus	4.19	5.00	3.38	4.00
9	Cleanliness – at bus stops	4.03	4.00	3.05	3.00
10	Journey Time	4.14	4.50	3.15	3.00
11	Friendliness of drivers	4.32	5.00	3.44	4.00
12	Information at bus stops	4.29	5.00	3.49	4.00
13	Finding information	4.43	5.00	3.35	4.00
14	Security - on bus	4.43	5.00	3.65	4.00
15	Security - at bus stops	4.38	5.00	3.55	4.00
16	Condition of shelters	4.39	5.00	3.20	3.00
17	Cost of tickets	4.28	5.00	2.76	3.00

5.2.3 Analysis of *Importance* - *Satisfaction* Analysis (ISA) by Journey Purpose: Work

This section discusses the results of the application of ISA by disaggregating the overall data by journey purpose. The aim here is to evaluate any influences the journey purpose has on perception of passengers regardless of on which type of bus service they are travelling. Some passengers, who are commuting to work, might have completely different perceptions of the quality attributes about which they were asked in the survey when compared with passengers who are travelling for leisure or shopping. Adopting the same analysis as before, Figure 5.11 shows the plot of mean scores for *importance* (x) and *satisfaction* (y) and Table 5.4 presents for each attribute the mean and median Likert score of each of the 17 attributes.

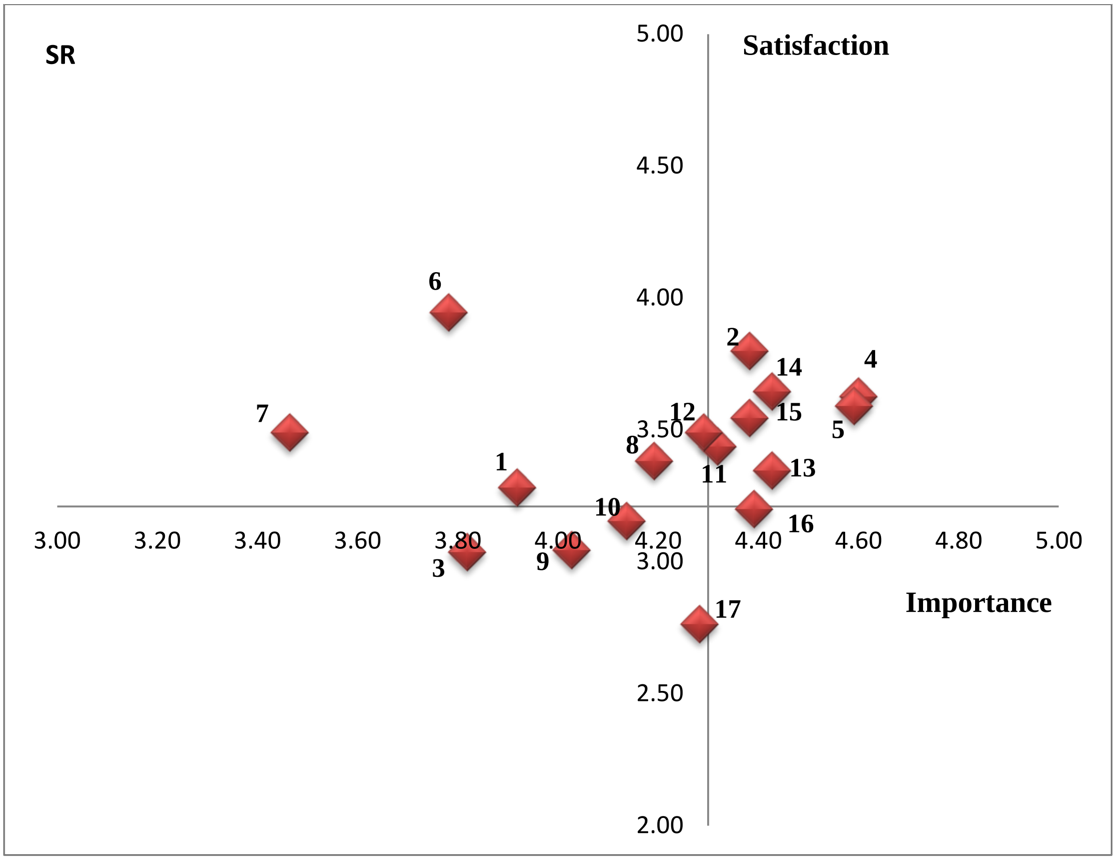

Figure 5.10 : Perceived Importance and Satisfaction by SR Users

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

Figure 5.11 displays the quality attributes falling into each of the four quadrants indicating their relative position to the cross hair as before. These results, when considered against the base case, suggest that passengers travelling to work are less satisfied in the context of all attributes except purchase of tickets either on the bus or at the Travel Centre. Commuters are most dissatisfied with the cost of tickets which is important. As before, conditions of shelters, security and information at bus stops are attributes with which there is dis*satisfaction*.

Table 5.4 : Mean and Median for Importance and *Satisfaction* for Journey Purpose : Work

		Importance		***Satisfaction***	
		Mean	**Median**	**Mean**	**Median**
1	Frequency- evening	4.35	5.00	2.88	3.00
2	Frequency - day	4.54	5.00	3.28	3.00
3	Frequency - Sundays	3.98	4.00	2.783	3.00
4	Reliability	4.71	5.00	3.12	3.00
5	Punctuality	4.65	5.00	3.10	3.00
6	Buy ticket - on bus	4.04	4.00	3.65	4.00
7	Buy ticket - at Travel Centre	3.67	4.00	3.44	3.00
8	Cleanliness - on bus	4.04	4.50	3.19	3.00
9	Cleanliness – at bus stops	4.06	4.00	2.82	3.00
10	Journey Time	4.21	4.50	3.13	3.00
11	Friendliness of drivers	4.32	5.00	3.07	3.00
12	Information at bus stops	4.46	5.00	2.80	3.00
13	Finding information	4.51	5.00	2.99	3.00
14	Security - on bus	4.52	5.00	3.12	3.00
15	Security - at bus stops	4.43	5.00	2.96	3.00
16	Condition of shelters	4.24	5.00	2.77	3.00
17	Cost of tickets	4.35	5.00	2.22	2.00

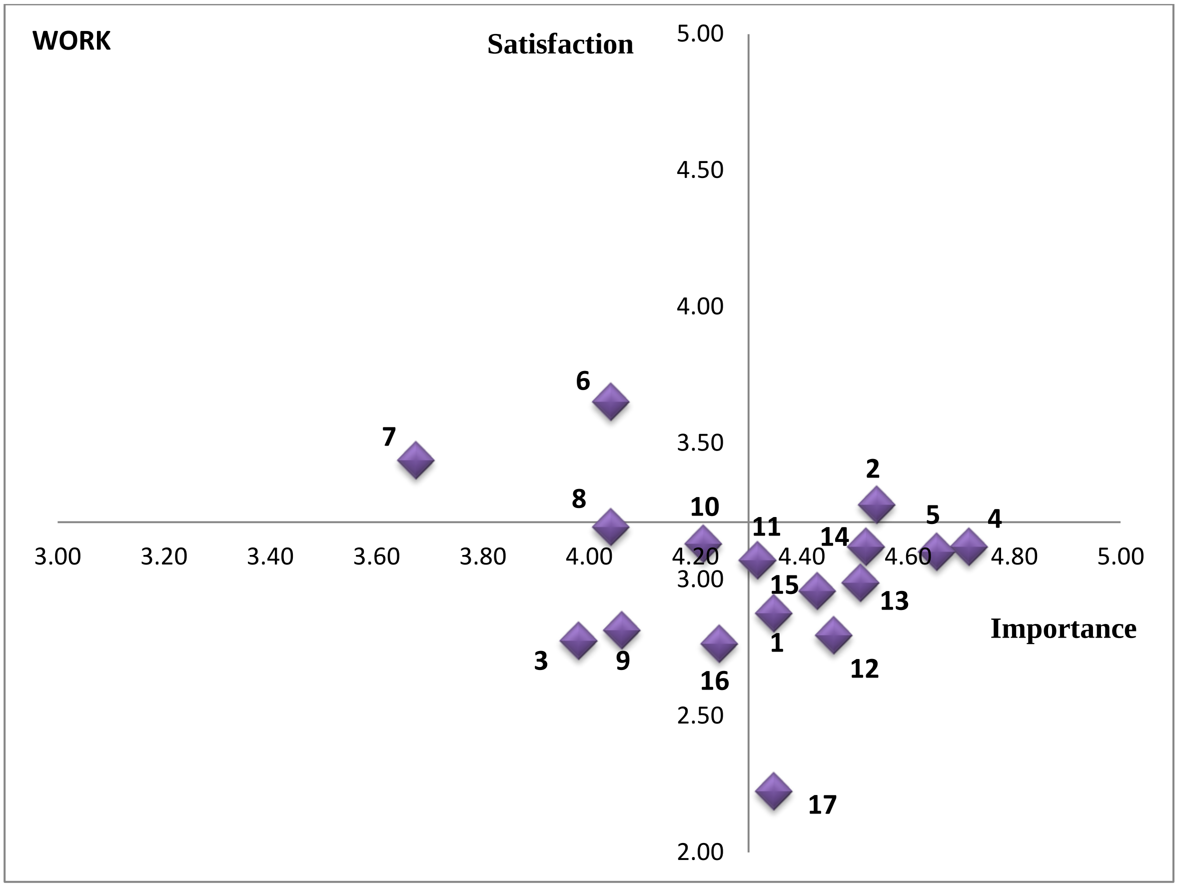

Figure 5.11 : Perceived Importance and Satisfaction for all work journeys (NSR + SR)

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

5.2.4 Analysis of Importance and Satisfaction Analysis for – Leisure Purpose

This section elaborates the analysis for passengers travelling mainly for leisure purposes. The same analysis carried out in the earlier section was repeated in order to reveal differences in the *importance* and *satisfaction* of passengers making trips for leisure purposes. Figure 5.12 shows the mean scores for *importance* and *satisfaction* for passengers whose journey purpose was for leisure and displays the salient attributes in each of the four quadrants and Table 5.5 shows the mean and the median for all the quality attributes.

Table 5.5 : Mean and Median for *Importance* and *Satisfaction* for Journey Purpose: Leisure

		Importance		***Satisfaction***	
		Mean	**Median**	**Mean**	**Median**
1	Frequency- evening	3.98	4.00	3.26	3.00
2	Frequency - day	4.45	5.00	3.68	4.00
3	Frequency - Sundays	4.10	5.00	3.06	3.00
4	Reliability	4.59	5.00	3.35	3.00
5	Punctuality	4.54	5.00	3.35	3.00
6	Buy ticket - on bus	3.98	4.00	3.74	4.00
7	Buy ticket - at Travel Centre	3.73	4.00	3.44	3.00
8	Cleanliness - on bus	4.26	5.00	3.32	3.00
9	Cleanliness – at bus stops	4.23	5.00	3.06	3.00
10	Journey Time	4.23	5.00	3.20	3.00
11	Friendliness of drivers	4.39	5.00	3.28	3.00
12	Information at bus stops	4.42	5.00	3.36	3.00
13	Finding information	4.49	5.00	3.14	3.00
14	Security - on bus	4.56	5.00	3.51	3.00
15	Security - at bus stops	4.44	5.00	3.42	3.00
16	Condition of shelters	4.37	5.00	3.13	3.00
17	Cost of tickets	4.28	5.00	2.83	3.00

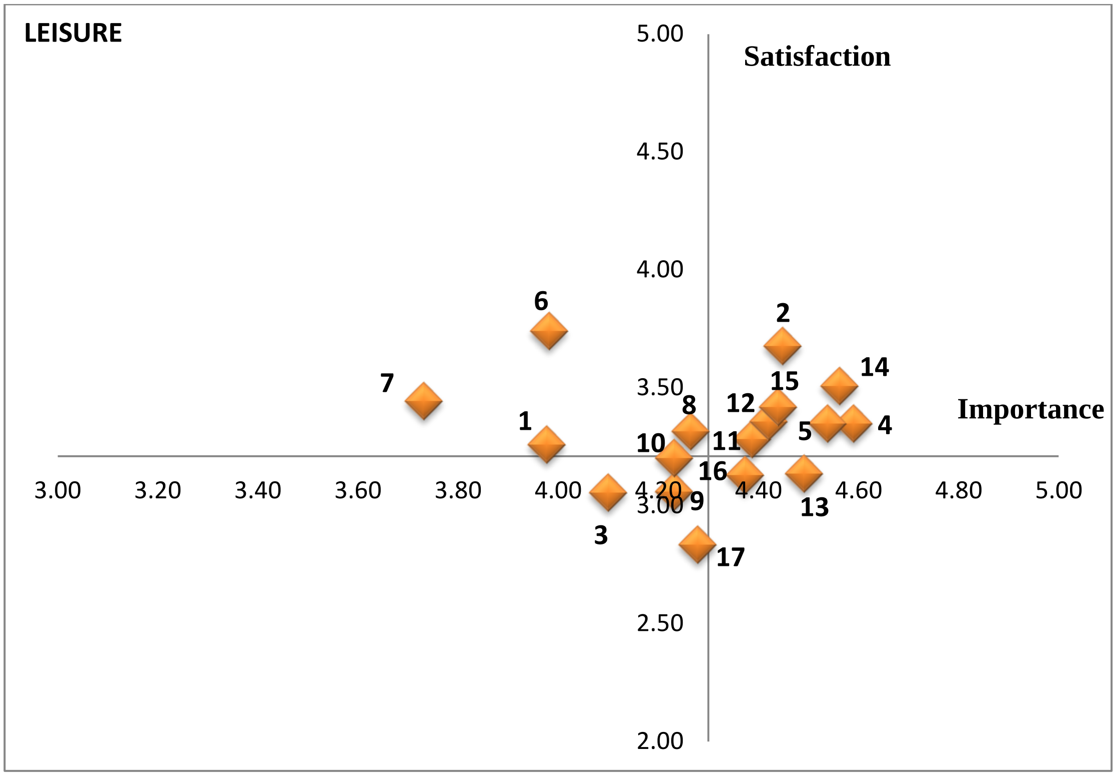

Figure 5.12 : Perceived Importance and Satisfaction for Leisure Purposes for overall Sample (NSR + SR)

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

Compared to work based trips, clear differences in the ISA analysis for leisure emerge. For leisure, there is a significant shift to higher levels of *satisfaction* with levels falling closer to the overall mean (cross hair) for *satisfaction*. Cost of ticket and to a lesser extent finding information about routes and condition of shelter remain an issue. For leisure in contrast to work based trips, attributes that are for both high *importance* and high *satisfaction* are frequency; with frequencies during the day and personal security on the bus and bus stops, reliability and punctuality friendliness of the driver and information at the bus stops; for low *importance* and low *satisfaction* are frequencies on Sundays; high *satisfaction* and low *importance* is ease of buying a ticket on the bus and at the travel centre attributes that sit consistently and firmly in Quadrant IV for most analyses performed in this research.

In summary, for leisure trips finding information about bus routes needs attention. Ease of buying a ticket on the bus is 'possible overkill' but as before if service provision was relaxed attributes would step into one of the lower quadrant and 'keep up the good work' with frequency during the day and security on the bus and finally dis*satisfaction,* but with low *importance* and therefore 'low priority', was Sunday service frequency. The next step in the analysis is to explore differences in the type of service namely NSR and SR for work and leisure.

5.2.5 Analysis at Disaggregated level journey purpose of work for both services (NSR and SR)

Further analysis was carried out by disaggregating the responses between NSR and SR users whose journey purpose was for work as shown in Tables 5.6 and 5.7 for NSR and SR respectively. Figure 5.13 and Figure 5.14 are the ISA plots for NSR and SR respectively where the mean scores for *Importance* (*x*) and *Satisfaction* (*y*) are displayed graphically. Figures 5.13 and 5.14 display the attributes falling into each of the four quadrants. For NSR no data falls in Quadrant I indicating that there is no *satisfaction* for any of the quality attributes considered important whilst *satisfaction* for buying a ticket on the bus and at the Travel Centre considered less important remain in Quadrant IV. Passengers travelling on NSR services have dissatisfaction with information at bus stops and finding information about route, reliability and punctuality which need attention whilst conditions of shelters and costs, frequency in the evening, security on the bus and at bus stops is perceived as lower importance.

Figure 5.14 illustrates respondents on SR services whose journey purpose was travelling to work. It is clear that QBP have addressed the reliability and punctuality and improved services during the day - attributes of high *importance* and high *satisfaction* to SR users. Whilst other attributes move in the direction of higher *satisfaction* they tend to shift also in the direction of lower importance. Again, buying ticket on bus and at Travel Centre rest in Quadrant IV ('Possible Overkill'). SR users are least satisfied with the important attributes, security on bus and at bus stops and of course the cost of tickets. Frequency on Sunday, cleanliness at bus stops and conditions of shelters are other areas for improvement. The discussion here concentrates on the differences revealed for travel to work when comparing results between NSR and SR. This analysis reveals quite significant changes and shifts in the location of attributes in the ISA diagram for the trip to work. Firstly, quality attributes that switch from low to high *satisfaction* at a high level of *importance*, include reliability and punctuality. Secondly, there are indications that QBP have delivered improvements of ticket purchase on the bus at low level of *importance* on SR services. These results suggest that from an operator's perspective the SR has better satisfied the needs of commuters. This result is consistent with the results of the gap analysis and earlier χ^2 statistical tests (See Section 4.2.10) .

Table 5.6 : Mean and Median for *Importance* and *Satisfaction* for Journey Purpose: work (NSR)

		Importance		*Satisfaction*	
		Mean	**Median**	**Mean**	**Median**
1	Frequency- evening	4.40	5.00	2.82	3.00
2	Frequency - day	4.58	5.00	3.17	3.00
3	Frequency - Sundays	4.08	5.00	2.74	3.00
4	Reliability	4.82	5.00	2.91	3.00
5	Punctuality	4.71	5.00	2.85	3.00
6	Buy ticket - on bus	4.14	4.00	3.58	3.00
7	Buy ticket - at Travel Centre	3.83	4.00	3.46	3.00
8	Cleanliness - on bus	4.03	4.00	3.12	3.00
9	Cleanliness – at bus stops	4.12	4.00	2.80	3.00
10	Journey Time	4.18	4.00	3.11	3.00
11	Friendliness of drivers	4.40	5.00	2.97	3.00
12	Information at bus stops	4.66	5.00	2.65	3.00
13	Finding information	4.58	5.00	2.86	3.00
14	Security - on bus	4.57	5.00	3.15	3.00
15	Security - at bus stops	4.48	5.00	2.91	3.00
16	Condition of shelters	4.29	5.00	2.69	3.00
17	Cost of tickets	4.31	5.00	2.12	2.00

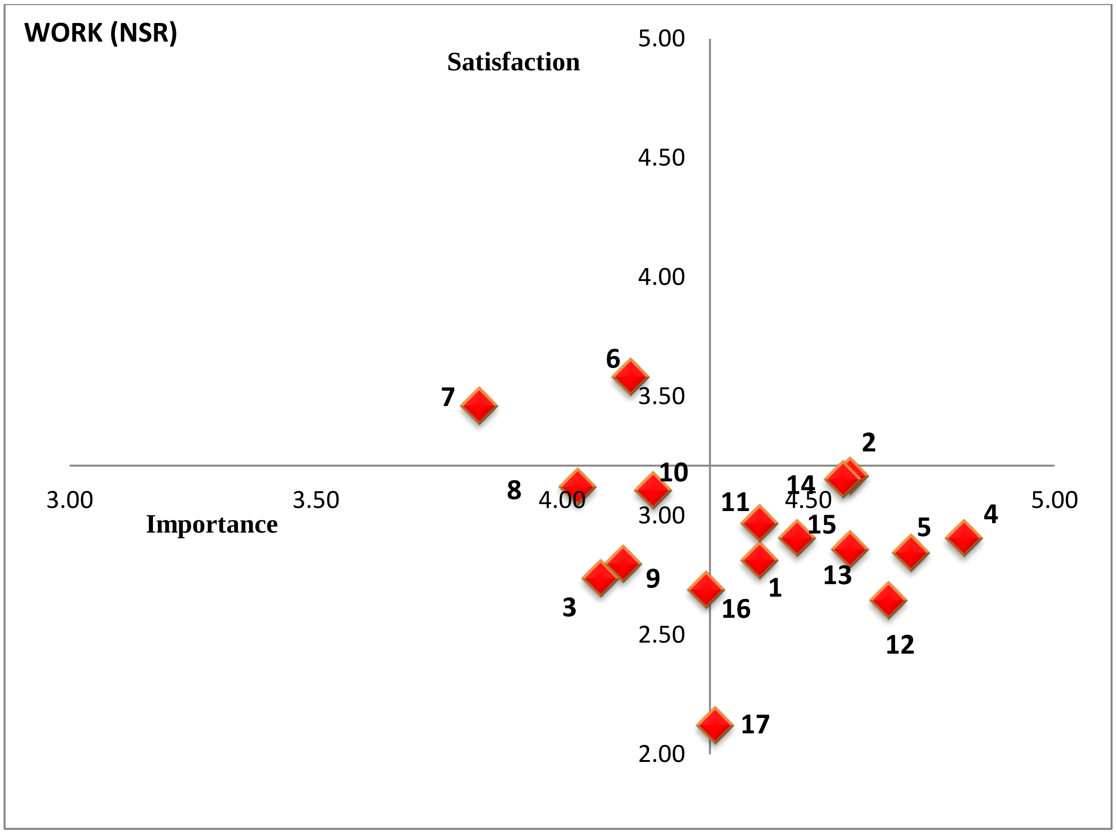

Figure 5.13 : Perceived Importance and Satisfaction for Work Purposes for NSR

Key :

1 = Frequency- evening
2 = Frequency - day
3 = Frequency - Sundays
4 = Reliability
5 = Punctuality
6 = Buy ticket - on bus
7 = Buy ticket - at Travel Centre
8 = Cleanliness - on bus
9 = Cleanliness – at bus stops
10 = Journey Time
11 = Friendliness of drivers
12 = Information at bus stops
13 = Finding information
14 = Security - on bus
15 = Security - at bus stops
16 = Condition of shelters
17 = Cost of tickets

Table 5.7 : Mean and Median for *Importance* and *Satisfaction* for Journey Purpose: work (SR)

		Importance		*Satisfaction*	
		Mean	**Median**	**Mean**	**Median**
1	Frequency- evening	4.24	4.00	3.00	3.00
2	Frequency - day	4.45	5.00	3.48	4.00
3	Frequency - Sundays	3.79	4.00	2.85	3.00
4	Reliability	4.52	5.00	3.55	4.00
5	Punctuality	4.55	5.00	3.61	4.00
6	Buy ticket - on bus	3.85	4.00	3.79	4.00
7	Buy ticket - at Travel Centre	3.36	3.00	3.39	4.00
8	Cleanliness - on bus	4.06	5.00	3.33	4.00
9	Cleanliness – at bus stops	3.94	4.00	2.85	3.00
10	Journey Time	4.27	5.00	3.18	3.00
11	Friendliness of drivers	4.15	4.00	3.27	3.00
12	Information at bus stops	4.06	4.00	3.09	3.00
13	Finding information	4.36	5.00	3.24	3.00
14	Security - on bus	4.42	5.00	3.06	3.00
15	Security - at bus stops	4.33	5.00	3.06	3.00
16	Condition of shelters	4.15	5.00	2.91	3.00
17	Cost of tickets	4.45	5.00	2.42	3.00

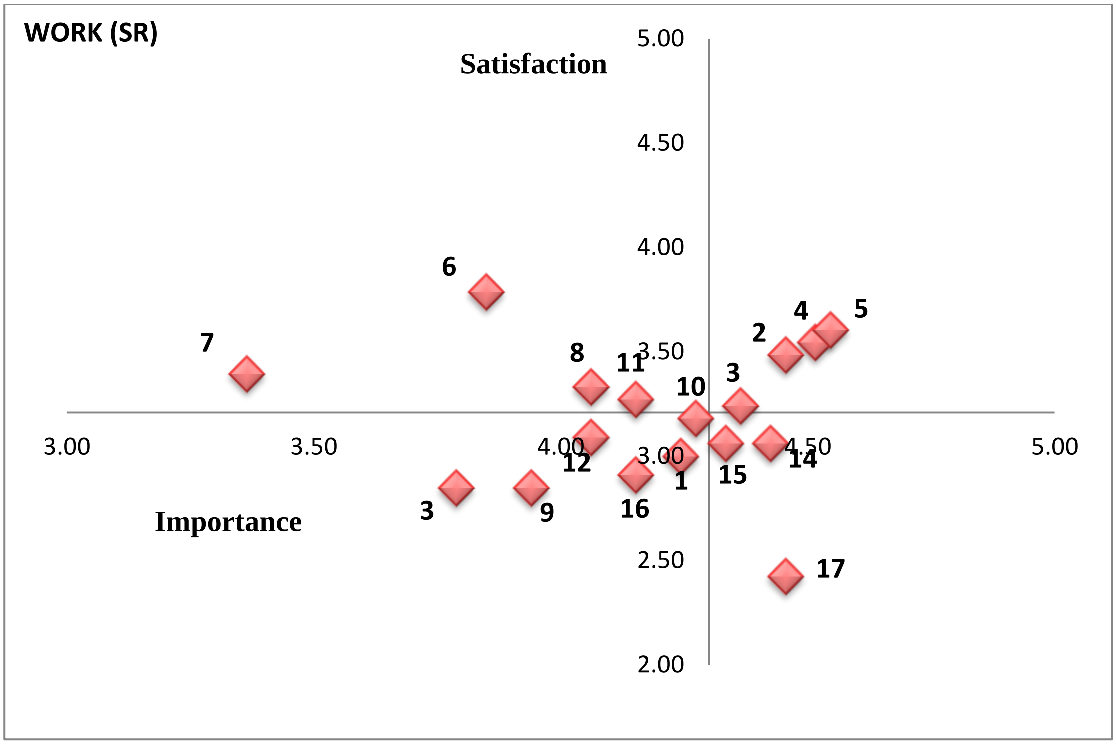

Figure 5.14 : Perceived Importance and Satisfaction for Work Purposes for SR

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

5.3 Passenger Perceptions of Safety as a Quality Attribute

In this section passengers perception of safety is investigated to reveal any difference in responses between bus service type (NSR vs SR) gender, whilst waiting at the bus stop or travelling on the bus.

5.3.1 Personal Safety using bus services

Safety is a very important issue and may be a deciding factor as to whether or not people use buses. In this section, passengers' responses to the question regarding their perceptions concerning personal safety whilst waiting at bus stops and travelling on buses will be analysed. The analysis was carried out by disaggregating the data into the two bus services; NSR and SR, and the results are presented in Tables 5.8 and 5.9 respectively. A higher percentage of respondents travelling on SR service felt either 'fairly safe' or 'very safe' while onboard the bus and waiting at the bus stop, compared with passengers on NSR buses.

The Chi Square Test, at a level of statistical significance at 95% level of confidence, was performed to test that there was no difference between the bus services types NSR and SR. As indicated by the statistics presented as footnote to the Table 5.8 and Table 5.9, there was no statistically significant difference between the two types of bus service (NSR and SR) with regard to passengers' perceptions of safety while waiting at bus stops and travelling on the bus.

Table 5.8 : Cross-Tabulation of Perception of Safety while Waiting at Bus Stops by Type of Bus Service

<table>
<tr><th></th><th></th><th colspan="2">NSR</th><th>Percent</th><th colspan="2">SR</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td rowspan="5">Waiting at bus stops</td><td>Very unsafe</td><td>4</td><td rowspan="2">29</td><td>2</td><td>2</td><td rowspan="2">18</td><td>2</td><td>6</td><td rowspan="2">47</td><td>2</td></tr>
<tr><td>Fairly unsafe</td><td>25</td><td>13</td><td>16</td><td>14</td><td>41</td><td>13</td></tr>
<tr><td>No opinion</td><td colspan="2">19</td><td>10</td><td colspan="2">5</td><td>5</td><td colspan="2">24</td><td>8</td></tr>
<tr><td>Fairly safe</td><td colspan="2">93</td><td>47</td><td colspan="2">67</td><td>61</td><td colspan="2">160</td><td>52</td></tr>
<tr><td>Very safe</td><td colspan="2">59</td><td>30</td><td colspan="2">20</td><td>18</td><td colspan="2">79</td><td>25</td></tr>
<tr><td></td><td></td><td colspan="2">200</td><td>100</td><td colspan="2">110</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df = 4, Chi square 8.909, p > 0.05, ***p* value** = 0.063

Table 5.9 : Cross-Tabulation of Perception of Safety when Travelling on Buses by Type of Bus Service

<table>
<tr><th></th><th></th><th colspan="2">NSR</th><th>Percent</th><th colspan="2">SR</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td rowspan="5">Travelling on buses</td><td>Very unsafe</td><td>3</td><td rowspan="2">35</td><td>2</td><td>5</td><td rowspan="2">21</td><td>5</td><td>8</td><td rowspan="2">56</td><td>3</td></tr>
<tr><td>Fairly unsafe</td><td>32</td><td>16</td><td>16</td><td>14</td><td>48</td><td>15</td></tr>
<tr><td>No opinion</td><td colspan="2">15</td><td>7</td><td colspan="2">6</td><td>6</td><td colspan="2">21</td><td>7</td></tr>
<tr><td>Fairly safe</td><td colspan="2">79</td><td>40</td><td colspan="2">51</td><td>46</td><td colspan="2">130</td><td>42</td></tr>
<tr><td>Very safe</td><td colspan="2">71</td><td>35</td><td colspan="2">32</td><td>29</td><td colspan="2">103</td><td>33</td></tr>
<tr><td></td><td>Total</td><td colspan="2">200</td><td>100</td><td colspan="2">110</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df = 4, Chi square 4.760, $p > 0.05$; ***p* value** = 0.313

5.3.2 Personal Safety by gender

Further analysis was carried out to explore any statistically significant differences at the 95% level of confidence in gender when passengers expressed their opinion on the safety issues.

Safety while waiting at the bus stops

Table 5.10 illustrates the cross-tabulation of rating with regards to the safety factor whilst waiting at the bus stops by gender irrespective of bus service types. A high percentage felt ‘fairly unsafe’ and ‘very unsafe’ when waiting at bus stops; this was 36% for females, compared to 11% for male passengers. A Chi Square test was performed to test that there is no statistically significant difference between genders in terms of safety while waiting at bus stops. Interestingly, the results showed that there was a statistically significant difference between males and females in terms of perception of safety while waiting at bus stops (χ^2 = 10.567, df = 4, p < 0.05 (0.032). From the operators perspective any measures that can increase security for passengers, particularly women, would be an investment.

Table 5.10 : Cross-Tabulation of Safety While Waiting at Bus Stops by Gender Irrespective of Service Types

<table>
<tr><th>Waiting at bus stops</th><th colspan="2">Male</th><th>Percent</th><th colspan="2">Female</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td>Very unsafe</td><td>3</td><td rowspan="2">11</td><td>2</td><td>3</td><td rowspan="2">36</td><td>2</td><td>6</td><td rowspan="2">47</td><td>2</td></tr>
<tr><td>Fairly unsafe</td><td>8</td><td>6</td><td>33</td><td>18</td><td>41</td><td>13</td></tr>
<tr><td>No opinion</td><td colspan="2">12</td><td>9</td><td colspan="2">12</td><td>7</td><td colspan="2">24</td><td>8</td></tr>
<tr><td>Fairly safe</td><td colspan="2">74</td><td>58</td><td colspan="2">86</td><td>47</td><td colspan="2">160</td><td>52</td></tr>
<tr><td>Very safe</td><td colspan="2">32</td><td>25</td><td colspan="2">47</td><td>26</td><td colspan="2">79</td><td>25</td></tr>
<tr><td>Total</td><td colspan="2">129</td><td>100</td><td colspan="2">181</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df = 4, Chi square 10.567, p < 0.05, ***p* value** = 0.032

Safety while travelling on the bus

Table 5.11 illustrates the cross-tabulation of rating with regards to the safety factor whilst travelling on buses by gender irrespective of bus service types. 43% of female passengers felt ‘fairly unsafe’ and ‘very unsafe’ while travelling on the bus compared to 13% of male passengers. A Chi Square statistic was used to test that there is no statistically significant difference at 95% confidence level between genders in terms of their opinion on safety while travelling on the bus. The results showed that there was a statistically significant difference between males and females in terms of perception of safety while travelling on the bus (χ^2 = 10.934, df = 4, p < 0.05).

Table 5.11 : Cross-Tabulation of Safety While Travelling on Buses by Gender Irrespective of Service Types

<table>
<tr><th>Travelling on buses</th><th colspan="2">Male</th><th>Percent</th><th colspan="2">Female</th><th>Percent</th><th colspan="2">Total</th><th>Percent</th></tr>
<tr><td>Very unsafe</td><td>2</td><td rowspan="2">13</td><td>2</td><td>6</td><td rowspan="2">43</td><td>3</td><td>8</td><td rowspan="2">56</td><td>3</td></tr>
<tr><td>Fairly unsafe</td><td>11</td><td>9</td><td>37</td><td>20</td><td>48</td><td>15</td></tr>
<tr><td>No opinion</td><td colspan="2">9</td><td>7</td><td colspan="2">12</td><td>7</td><td colspan="2">21</td><td>7</td></tr>
<tr><td>Fairly safe</td><td colspan="2">64</td><td>49</td><td colspan="2">66</td><td>37</td><td colspan="2">130</td><td>42</td></tr>
<tr><td>Very safe</td><td colspan="2">43</td><td>33</td><td colspan="2">60</td><td>33</td><td colspan="2">103</td><td>33</td></tr>
<tr><td></td><td colspan="2">129</td><td>100</td><td colspan="2">181</td><td>100</td><td colspan="2">310</td><td>100</td></tr>
</table>

Chi Square Test, df = 4, Chi square 10.934, $p < 0.05$, ***p* value** = 0.027

This result is consistent with the findings of Vogel and Pettinari (2002) and Volinski and Tucker (2003) which presented evidence that high assurance while travelling on the bus would encourage people to use the bus (Vogel and Pettinari. 2002; Volinski and Tucker. 2003) and findings are consistent with (Lynch and Atkins, 1988), who found that women are more worried about their safety while waiting at bus stops. Wekerle and Whitzaman (1995) carried out research on crime at bus stops and found that women, children, the elderly and disabled are most insecure at bus stops. In addition, TRB (1996) stated that public transport systems are the most susceptible for security problems. Elderly people are more vulnerable to crime at bus stops. This is supported by Loikaitou *et al.,* (2001) who suggested that the location of bus stops have an impact on the crime and further stated that well maintained and well lit bus stops are less prone for crime incidents. With reference to the case study of this research in Tyne and Wear, Nexus has worked with bus operators to ensure that all buses are equipped with CCTV which records and monitors any anti-social behaviour to the drivers or other passengers.

5.4 Perceptions of Passengers using Factor Analysis (FA)

The third statistical analysis method adopted in this research was Factor Analysis which was used to capture any relationship that may exist between passengers' perceptions of one or more quality attributes both in terms of what they expect (or what is *important*) from the service and their associated degree of *satisfaction*. It is crucial to distinguish between the *importance* of the *quality* attributes of bus service and the *satisfaction* associated with the different quality attributes of the service.

By using FA, an independent scrutiny of the data is achieved in an attempt to confirm or otherwise, any patterns in the data revealed in the other statistical approaches; ISA, CA and OLR. FA was conducted using principal components as the method of extraction, with oblique rotation. As explained by Brown (2003) rotation has been defined in different ways in the body of literature in the Principle Components Analysis and Exploratory Factor Analysis, PCA/ EFA fields. Some definitions are less helpful such as those of McDonald (1985) and Bryant and Yarnold (1995). However, a clearer definition is given by Vogt (1993) who states rotation as 'Any of several methods in Factor Analysis by which the researcher attempts to relate the calculated factors to theoretical entities. This is achieved differently depending upon whether the factors are believed to be correlated (oblique) or uncorrelated (orthogonal). The reason for using rotation is to make the pattern of loading clearer or more pronounced in other words to reveal simple structure. At the exploratory stage of this research, using SPSS orthogonal rotation (factors are uncorrelated) as recommended by Tabachnick and Fidell (2007) to establish, if factor correlations were 0.32 or above. If correlations were found to be more than 0.32, this suggests there is 10% (or more) overlap in variance among factors, justifying the use of oblique rotation. If factors correlations are not driven by the data, the solution remains nearly orthogonal. In this way oblique rotation was used to reduce the 17 quality attributes of bus service listed in the questionnaire by exposing commonality in the data within attributes. FA is widely used to simplify large sets of data into reduced numbers by grouping in a statistical way.

For this analysis, the data input (one set for each passenger) were the 17 *quality* attributes each measured on a Likert Scale of how passengers rated quality in terms of *importance* (ranging from 1 to 5, 'very unimportant' to 'very important'); and *satisfaction* (ranging from 1 to 5, 'very dissatisfied' to 'very satisfied') for the bus service on which the respondents were travelling at the time of completing the questionnaire. As has been discussed earlier (Chapter 3: Methodology), the minimum sample required for FA is 50 samples (Hair *et al.*, 2004) (see Table 2.4). This research has a total sample of 310 respondents and it was found to be sufficient to give statistical confidence in the results. FA is a technique that can accommodate communality in *quality* attributes and reveals multicollinearity between variables. Therefore, by identifying correlation between factors, attributes can be combined into fewer factors and from the analysis, 17 factors of *quality* attributes can be reduced in number.

The assumption of FA was tested using the Bartlett test of Sphericity (Field, 2009; Hair *et al.*, 2010). This test is used to find the significance of all the correlations within the correlation matrix as an indicator of the strength of the relationship among variables. This test is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated. Bartlett's test of Sphericity with Chi Square value of 7015.825, with a significance value of 0.001, was used to confirm that reliability of FA at a statistical confidence of 95%. In this way the statistical significant variables within the matrix can be identified using the eigenvalues that are greater than one for selected factors. The oblique rotation converged in five iterations. The derived factors were used in the next stage of analysis and will be discussed in the next section.

There are 17 quality attributes listed in the questionnaire. Some of the variables are similar and can be associated with one another. The argument is that they can be grouped together as one and given a descriptor or label. The results are presented in Table 5.12. Three factors emerged from the FA for the dataset based on Likert scales of all respondents. The first factor consists of personal security on buses and personal security at bus stops, condition of shelters, finding information about bus routes, finding information at bus stops, friendliness of drivers, cleanliness of buses and at bus stops and costs of ticket. This was labelled 'Service Infrastructure'. The second factor consists of punctuality, reliability, and frequency of services during the day, evening and on a Sunday and was labelled as 'Bus Operation'. The third factor consists of ease of buying a ticket at the Travel Centre and on the bus and was labelled as 'Ticket Purchase'. A Cronbach's test was carried out on the new factors. The higher the inter-correlation among the scale items, the greater the reliability of the scale and this can be supported by the high value of Cronbach's alpha. The results showed that, with the co-efficient Alpha α that ranged from 0.9 down to 0.7 (rounded to one decimal place) which corresponds to an evaluation of meritorious to middling according to the Kaiser Meyer Olkin (KMO) measure of sampling which is an index of comparing magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients; see Table 2.5 sources Hair *et al.*, (2006). However, Nunnally (1978) recommended that this value should be 0.9.

The next step was to explore whether or not there were any differences in the responses of passengers on the NSR and SR services.

Table 5.12 : Factors Based on a Combination of *Importance* and *Satisfaction* Scores

	Loading[a]			**Cronbach's α**
Dimension of Bus Service Improvement	**Factor 1**	**Factor 2**	**Factor 3**	
Factor 1: Service Infrastructure				0.868
Personal security at bus stops	0.834			
Condition of shelters	0.808			
Personal security on bus	0.799			
Finding information about bus routes	0.697			
Information at bus stops	0.659			
Friendliness / helpfulness of drivers	0.634			
Cleanliness at the bus stops	0.550			
Cleanliness of the bus	0.521			
Cost of tickets	0.509			
Journey time	0.502			
Factor 2: Bus Operation				0.869
Frequencies in the evening		0.786		
Reliability		0.743		
Frequencies on Sundays		0.729		
Punctuality		0.728		
Frequencies during the day		0.651		
Factor 3: Ticket Purchase				0.694
Buy ticket at the Travel Centre			0.865	
Buy ticket on the bus			0.795	

[a] *represents the degree of association between the statement and factor*

Extraction method: principal component analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations.
Principal axis, oblique rotation
Eigen Value = 1
KMO measure of sampling adequacy = 0.922
Bartlett test of sphericity = 7015.825, significance < 0.0001

Table 5.13 shows the average Likert scores for the new reduced factors. The result is based on the average of the summation of the raw data (i.e. ten quality attributes for Factor 1, five quality attributes for Factor 2 and two quality attributes for Factor 3, see Table 4.22). The results show that passengers travelling on SR bus services consistently have higher *satisfaction* scores for all three factors as compared to NSR users.

Table 5.14 shows the results of statistical significance test (see footnote to table) at 95% level of confidence. The test was carried out first, by checking the distribution of factor scores for each factor and second, a statistical significance test was carried out depending on the distribution of the factor scores for each factor. In the case where the distributions were normal, a ANOVA test was carried out and a Median Test and Mann Whitney Test for distributions that were not normal. The results show that passengers travelling on the SR service have higher *satisfaction* scores on the first two factors. However, for passengers travelling on the NSR services, the results show that there are variations within the sub-sample. For Ticket Purchase these are statistically significantly different. This is in contrast with the SR sub-sample, where there are no statistical significant differences within samples thus proving that they can be considered as an homogeneous group. In terms of assessing the impact of SR implementation, the factors which have been improved are those relating to Service Infrastructure (Factor 1) and Bus Operation (Factor 2), but not for Ticket Purchase (Factor 3), nevertheless for each of these factors, SR users have statistically significantly different and higher *satisfaction* than NSR users.

Table 5.13 : Average Likert Scores across quality attributes for *satisfaction* within each of the 3 factors over passenger sample

Satisfaction	**NSR**	**SR**
Factor 1: Service Infrastructure	3.03	3.30
Factor 2: Bus Operation	3.12	3.47
Factor 3: Ticket Purchase	3.50	3.72

Table 5.14 : Significance Test for *Satisfaction* Based on 3 Factors (*p* value)

Satisfaction	**NSR**	**SR**	**NSR vs SR**
Factor 1: Service Infrastructure	0.084 [a]	0.096 [a]	**0.002 [a]**
Factor 2: Bus Operation	0.152 [b]	0.842 [b]	**0.012 [c]**
Factor 3: Ticket Purchase	0.001 [b]	0.733 [b]	0.731 [c]

[a] ANOVA, [b] Median test, [c] Mann-Whitney test

5.5 Summary

This chapter has presented the first stage of the ISA and has highlighted the *importance* of the 17 quality attributes based on passengers' expectations and the level of satisfaction with the bus services they used; in addition it has also presented the results of the FA which was used to explore multicolinearity.

The ISA analysis was applied to gain a deeper understanding of the interrelationships between user perception of both the *importance* and *satisfaction* of particular quality attributes of a bus service. Before embarking on the analysis proper, the appropriate statistic for the cross hair was investigated. It was found that the mean Likert score for all quality attributes for all survey responses for *importance* and *satisfaction* separately was the most appropriate. No statistical test was found to be appropriate to test the significance of the individual quality attribute score from the cross hairs due to the lack of normality of the data. Also, due to the lack of granularity of the median score for display purposes the data is considered to be interval rather than categorical and the means and not the medians are plotted in the ISA. However, all statistical tests that compared differences between NSR and SR services used the χ^2 test applied to the distribution of Likert scales for each attribute.

There is clear evidence that both services provided high *satisfaction* in service frequency during the day which was of high *importance*. The SR service has increased *satisfaction* in reliability of the bus turning up, punctuality and personal security on the bus and these three attributes were found to be important for both NSR and SR. There is suggestion that for SR services, passengers are less satisfied with frequency on a Sunday and cleanliness at the bus stops. In addition, the cost of tickets and condition of shelters are found to be of some importance, and have low *satisfaction* even lower than for NSR. These latter findings may suggest a deterioration of standards but equally it could be considered due to a rise in expectation of SR passengers resulting from the investment. Further research and additional data collection is needed to explore this finding in more depth.

Further insights of characteristics of users over all bus services gained from the ISA suggests that passengers travelling to work are less satisfied with respect to all attributes except purchase of tickets (on the bus and at Travel Centres) and most dissatisfied with the cost of tickets, which is important. For all users, although considered less important, passengers are dissatisfied with the condition of shelters. For leisure trips on the other hand there is a significant shift to higher levels of *satisfaction* and with lesser importance on the condition of shelters. However, consistent with commuters, those finding information about routes remains an issue irrespective to NSR and SR. For leisure trips, a higher *satisfaction* is placed on frequency during the day and personal security on the bus, lower *satisfaction* with respect to the condition of shelters and a lower priority placed on the cost of tickets.

Considering the differences found between SR and NSR services for commuter trips, with no quality attributes in Quadrant I for NSR there is clearly increased *satisfaction* of SR users overall but in particular in respect of reliability and punctuality suggesting that from an operator's perspective the SR has improved commuters *satisfaction* as they now perceive journeys to be more reliable. At the same time there is a suggestion that the important attribute the cost of the journey and the conditions and security at bus stops remains an issue for both NSR and SR. There was clear evidence for bus services overall that females felt less safe whilst travelling on the bus or whilst stood at bus stops and therefore, from the operators perspective any measures that can increase security for passengers particularly women would be a worthwhile investment.

Finally, the FA established multicollinearity in the quality attributes and reduced the number that were statistically significantly different from 17 quality attributes and grouped the attributes into three namely; Service infrastructure, Bus operation and Ticket purchase. The first step in FA analysis involved summing the raw data of the quality attributes disaggregated based on the reduced factors. The results showed that passengers travelling on SR bus services have higher *satisfaction* scores for all the three factors (e.g. Service Infrastructure, Bus Operation and Ticket Purchase) compared to NSR users and all but Ticket Purchase was statistically significant. The second step involved comparing factor scores between NSR and SR and the results show that passengers travelling on SR services have higher *satisfaction* scores on the first two factors; Service infrastructure and Bus operation. In terms of assessing the impact of SR implementation, the factors which have been improved are those relating to Service Infrastructure (Factor 1) and Bus Operation (Factor 2), but not for Ticket Purchase (Factor 3). This is consistent with the results emerging from the ISA which clearly showed that the ticket purchase, as a third party responsibility, lies outside the responsibility of the operator and therefore an important area justifying investment by the LA. The next chapter will further investigate the data using Cluster Analysis (CA).

CHAPTER 6 : AN INVESTIGATION OF THE POPULATION DIFFERENCES IN PERCEPTION OF QUALITY USING CLUSTER ANALYSIS (CA)

6.1 Introduction

The first three stages of the analysis presented in Chapter 4 and 5 suggested significant differences in perceptions of bus passengers travelling on SR compared to NSR. Furthermore, marked differences were found depending on the demographic characteristics of passengers as well as their journey purpose, suggesting that population groups may respond differently to the measures put into place to improve quality. Therefore, in this chapter, Cluster Analysis (CA) is used to explore whether passenger groups within the sampled populations have a similar response to *quality* measures and to try to classify respondents into exclusive groups on the basis of their perceptions. Secondly, relationships between the *importance* and *satisfaction* for the groups identified by the CA were investigated further by repeating the ISA for clusters that emerged.

Section 6.2 presents the independent analysis using Cluster Analysis (CA) to identify the characteristics (demographics) of groups of passengers that may provide similar responses towards the *quality* factors, Section 6.3 investigates further the perception of *quality* by clusters using ISA, Section 6.4 examines the awareness of passengers of the Superoute branding and finally, Section 6.5 presents a summary findings of the CA and ISA on clusters to go forward to Chapter 7 which deals with Ordered Logit regression (OLR).

6.2 Cluster Analysis with Respect to Socio Demographic Details of Users

The formation of clusters was based on the respondents' perceptions of *quality* with due consideration of age, gender, journey purpose and type of bus service namely NSR and SR used for their journey at the time of survey. A Two Step Cluster Analysis was chosen because the data was categorical, and the analysis assumes normality for continuous data and multinomial distribution for categorical data. The results from the Two-Step Cluster Analysis are presented in Table 6.1 and showed that four clusters emerged from the sample of 310 respondents with the Bayesian Information Criterion (BIC), (see section 2.8) used as a criterion for model selection.

Normality checks were carried out on the data to decide which statistical test was appropriate. The Likert scores were normally distributed within Clusters and therefore, Analysis of Variance (ANOVA) was carried out to test any similarity within the clusters and any differences between them.

The first test carried out was to establish, a) the homogeneity within the cluster for *importance* and *satisfaction* and the second to test, b) any statistically significant evidence that there are differences between *importance* and *satisfaction* of the perception of quality attributes for passengers' with similar demographic profiles (age, gender, employment status and journey purpose).

The results of the ANOVA presented in Table 6.1 indicated that at the 95% confidence level (p = 0.001), there were statistically significant differences within the clusters for *Importance* and *Satisfaction* and between all clusters. This suggests that for all *quality* factors for *importance* and *satisfaction*, socio-demographic characteristics of the respondents within clusters make a significant contribution to differentiate the four clusters from each other.

The second test specifically, has indicated that there was a statistically significant difference between the four clusters at the 95% confidence level (p = 0.001). These statistical tests have found similarities of perceptions within clusters, each of which exhibit differences in socio-demographic characteristics. The four clusters exhibited high internal (intra-cluster) homogeneity and high external (inter-cluster) heterogeneity.

Table 6.1 : The results of ANOVA comparison of all clusters

		Importance					*Satisfaction*				
	Groups	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Frequencies during Evening	Between	28.123	3	9.374	7.278	.000	42.826	3	14.275	13.642	.000
	Within	394.164	306	1.288			320.209	306	1.046		
Frequencies during the day	Between	19.613	3	6.538	11.786	.000	86.350	3	28.783	31.197	.000
	Within	169.729	306	.555			282.324	306	.923		
Frequencies on Sundays	Between	29.458	3	9.819	7.542	.000	59.942	3	19.981	17.684	.000
	Within	398.377	306	1.302			345.736	306	1.130		
Reliability	Between	9.297	3	3.099	5.816	.001	85.977	3	28.659	26.724	.000
	Within	163.042	306	.533			328.164	306	1.072		
Punctuality	Between	10.211	3	3.404	6.871	.000	87.495	3	29.165	26.581	.000
	Within	151.583	306	.495			335.744	306	1.097		
Buy a ticket on bus	Between	59.150	3	19.717	17.196	.000	47.591	3	15.864	15.272	.000
	Within	350.850	306	1.147			317.858	306	1.039		
Buy ticket at Travel Centre	Between	108.321	3	36.107	22.405	.000	34.342	3	11.447	11.081	.000
	Within	493.128	306	1.612			316.112	306	1.033		
Cleanliness of the bus	Between	96.986	3	32.329	50.114	.000	49.536	3	16.512	15.662	.000
	Within	197.401	306	.645			322.606	306	1.054		
Cleanliness at the bus stops	Between	77.113	3	25.704	32.755	.000	45.790	3	15.263	13.854	.000
	Within	240.129	306	.785			337.129	306	1.102		
Journey time	Between	43.293	3	14.431	17.056	.000	48.966	3	16.322	16.598	.000
	Within	258.901	306	.846			300.918	306	.983		
Friendliness of drivers	Between	38.957	3	12.986	20.605	.000	89.052	3	29.684	31.598	.000
	Within	192.852	306	.630			287.467	306	.939		
Information at bus stops	Between	37.335	3	12.445	22.839	.000	126.837	3	42.279	48.446	.000
	Within	166.742	306	.545			267.047	306	.873		
Information about bus routes	Between	53.712	3	17.904	44.986	.000	98.578	3	32.859	32.979	.000
	Within	121.785	306	.398			304.893	306	.996		
Security on bus	Between	37.610	3	12.537	26.427	.000	146.674	3	48.891	70.947	.000
	Within	145.164	306	.474			210.874	306	.689		
Security at bus stops	Between	40.137	3	13.379	21.539	.000	130.776	3	43.592	56.782	.000
	Within	190.072	306	.621			234.917	306	.768		
Condition of bus shelters	Between	103.439	3	34.480	67.921	.000	62.318	3	20.773	22.334	.000
	Within	155.338	306	.508			284.602	306	.930		
Cost of tickets	Between	33.811	3	11.270	9.339	.000	63.951	3	21.317	14.583	.000
	Within	369.289	306	1.207			447.304	306	1.462		

Table 6.2 summarizes the details of the socio demographics for the respective clusters that emerged from this CA. In terms of gender, there was no statistically significant difference across all clusters (χ^2=2.947, df=3, *p* value=0.400). However, there was a statistically significant difference in age of respondents between all clusters (χ^2=*66.143*, df=3, *p* value = 0.001), Journey Purpose (χ^2=*55.997*, df=12, *p* value = 0.001) and type of bus service (χ^2=*25.830*, df=3, *p* value = 0.001).

Table 6.2 : Demographic Pattern and Characteristics of Respondents

	Clusters								*** *p* value**
	1	**Percent**	**2**	**Percent**	**3**	**Percent**	**4**	**Percent**	
No of Respondents, *N*	89	28.7	86	27.7	59	19.0	76	24.5	
Gender									
Male	39	43.8	36	41.9	19	32.2	35	46.1	0.400
Female	50	56.2	50	58.1	40	67.8	41	53.9	
Age (years)									
12-15	2	2.2	3	3.5	4	6.8	3	3.9	0.001
16-24	26	29.2	8	9.3	0	.0	10	13.2	
25-34	16	18.0	13	15.1	2	3.4	28	36.8	
35-49	17	19.1	23	26.7	13	22.0	11	14.5	
50-59	11	12.4	11	12.8	16	27.1	11	14.5	
60^+	17	19.1	28	32.6	24	40.7	13	17.1	
Journey Purpose									
Work	25	28.1	31	36.0	2	3.4	18	23.7	0.001
School/college	10	11.2	0	.0	2	3.4	10	13.2	
Shopping	20	22.5	23	26.7	34	57.6	36	47.4	
Visiting friends/relatives	12	13.5	10	11.6	10	16.9	4	5.3	
Leisure/recreation	16	18.0	20	23.3	11	18.6	6	7.9	
A Night Out	0	0	2	2.3	0	0	2	2.6	
Other	6	6.7	0	.0	0	0	0	.0	
Type of Bus Service									
NSR	55	61.8	54	62.8	26	44.1	65	85.5	0.001
SR	34	38.2	32	37.2	33	55.9	11	14.5	

*Statistical test at the 95% confidence level p<0.05

** p value is the probability of obtaining a test statistic and test for statistical significance either the null hypothesis is rejected or accepted. Rejects the null hypothesis when the value is less than predetermined significance level (e.g. 0.05)*

6.2.1 Profile of Clusters

A critical interpretation of the statistical analysis presented in Table 6.3 has enabled the key features/descriptors of each of the four clusters identified by the CA. Clearly, there is a degree of overlap of the clusters in the context of the socio-demographic characteristics and gender differences, nevertheless, at this stage of the analysis, the highest percentage of passengers with a particular characteristic within each demographic was used to attach a descriptor or label to separate one cluster from another. Figure 6.1 shows schematically how descriptors for each cluster were derived. This will be revisited in the next section where the ISA analysis is repeated for different clusters. The number and profile of respondents in each cluster are detailed in Table 6.3 bearing in mind that the proportion of females (54%) is higher than males (46%).

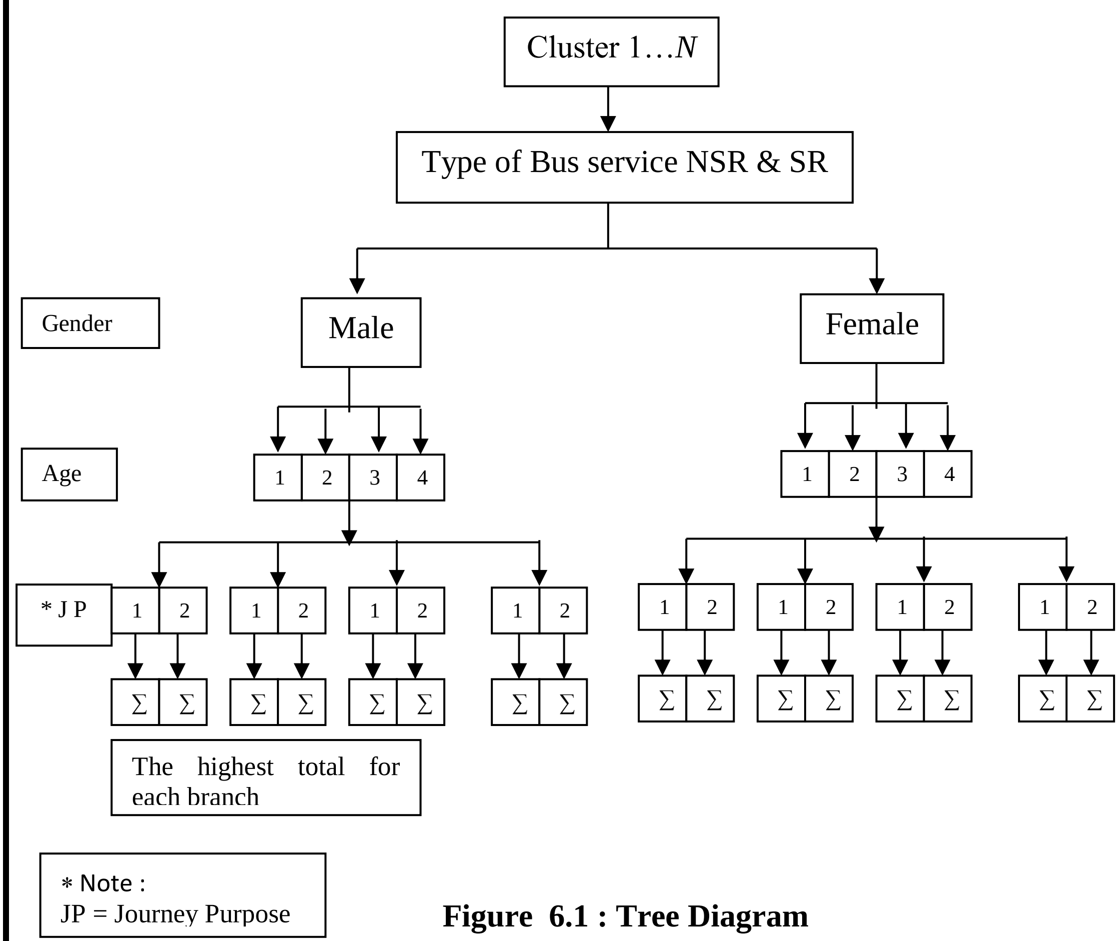

Figure 6.1 : Tree Diagram

Table 6.3 : Characteristics of Respondents Emerging from Cluster Analysis

Characteristics	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Number of respondents	89	86	59	76
Age (years)	25-34	35-49	60^+	60^+
Type of Journey	Commuters	Commuters	Shoppers	Shoppers
Gender	Male	Male	Female	Female
Type of Bus Service	NSR	NSR	SR	NSR

6.2.1.1.1 Cluster 1 (25-34 years/Commuters/NSR)

Cluster 1 comprised 89 respondents, representing 29% of the total sample. This cluster has the highest proportion of passengers in the age group between 25-34 years old and work is the dominant journey purpose. In terms of type of bus service, 62% of respondents were travelling on NSR and 38% on SR.

6.2.1.1.2 Cluster 2 (35-49 years/Commuters/NSR)

Cluster 2 comprised 86 respondents, representing 28% of the total sample. This cluster is also dominated by commuters with 36% of respondents. The highest proportions of respondents are over 60 years however, as work and retirement are in conflict and 27% have work as their journey purpose the characteristics of this group are not so easily defined. As can be seen from the tree diagram presented in Figure 6.1, the association of age group 35-49 is used as the descriptor. The majority of respondents in this cluster were travelling on NSR routes (63%).

6.2.1.1.3 Cluster 3 (Female/60 years and over/Shopping/SR)

With the lowest number of respondents (59) compared to other clusters, Cluster 3 comprised 19% of the overall sample. 41% of respondents are aged 60 years and over and dominated by shoppers with a percentage of 58%. 56% of respondents in this cluster were travelling on SR services.

6.2.1.1.4 Cluster 4 (60 years and over/Shopping/NSR)

Cluster 4 comprised 76 respondents mainly shoppers with a percentage of 47%. The highest percentage of respondents, 37% are between the ages of 25 – 34 years. However, with reference to Figure 6.1, this group is associated more strongly with the 60+ age group. About 86% of respondents in this cluster were travelling on NSR routes.

What is clear about these results is the overlap between the characteristics of these groups suggesting the complex interrelationships between the perception of *importance* and *satisfaction* across the 17 attributes. The next section seeks to begin to reveal some of the structure in the responses using the ISA analysis on the clusters defined by the CA.

6.3 Perception of Quality by Clusters: Application of *Importance-Satisfaction* Analysis (ISA)

The CA has identified four clusters of passengers with different characteristics. In this section the ISA analysis (see Section 4.3) carried out in Stage 2 of the methodology was repeated separately for each cluster and thus the perceptions of the passengers against the 17 *quality* attributes for *importance* and *satisfaction* were investigated. In this way, further understanding of how respondents in each cluster perceived how important and to what degree they were satisfied with the individual *quality* attributes of the bus service, will be explored.

For each cluster in turn the figures present a plot of mean value for *importance* (x) and *satisfaction* (y) and provide a description of the quality attributes that locate themselves into each of the four quadrants.

6.3.1 Cluster 1

Figure 6.2 shows the plot of mean for *importance* (*x*) and *satisfaction* (*y*) as a graph showing the location of the quality attributes on each Quadrant for Cluster 1 and Table 6.4 shows the mean and median for this cluster. As before due to the choice of grand mean for the cross hair and lack of granularity of the median, the mean Likert scores are used in the ISA analysis therefore assuming the data is interval. Interestingly, it is found that most of the quality attributes fall in Quadrant III which represents 'Low Priority', and are as follows:-

1 = Frequency in the evening
3 = Frequency on Sundays
8 = Cleanliness - at bus stops
9 = Cleanliness - on bus
11 = Friendliness of drivers
12 = Information at bus stops
13 = Finding information
14 = Security- on bus
15 = Security - at bus stops
16 = Condition of shelters
17 = Cost of tickets

Table 6.4 : Statistics for the ISA for Cluster 1

		Importance		***Satisfaction***	
		Mean	***Median***	**Mean**	***Median***
1	Frequency- evening	3.84	4.00	3.08	3.00
2	Frequency - day	4.21	4.00	3.43	4.00
3	Frequency - Sundays	3.69	4.00	2.79	3.00
4	Reliability	4.38	4.00	3.02	3.00
5	Punctuality	4.29	4.00	2.94	3.00
6	Buy ticket - on bus	3.45	3.00	3.61	4.00
7	Buy ticket - at Travel Centre	2.96	3.00	3.47	3.00
8	Cleanliness - on bus	3.36	3.00	3.16	3.00
9	Cleanliness – at bus stops	3.46	3.00	3.02	3.00
10	Journey Time	3.67	4.00	3.35	3.00
11	Friendliness of drivers	3.91	4.00	2.89	3.00
12	Information at bus stops	3.89	4.00	2.87	3.00
13	Finding information	3.88	4.00	2.87	3.00
14	Security - on bus	4.01	4.00	3.12	3.00
15	Security - at bus stops	3.91	4.00	3.09	3.00
16	Condition of shelters	3.44	3.00	2.9	3.00
17	Cost of tickets	3.96	4.00	2.47	2.00

The four attributes falling in the ‘overkill’ quadrant expressing *satisfaction* in the attributes considered of lower importance were:

2. Frequency in the day
6. Buy ticket on the bus
7. Buy ticket at the Travel Centre
10. Journey time

However, the clear message that comes from this analysis is that the quality attribute of reliability and to a lesser extent punctuality, have been perceived by passengers as important but with which they are not satisfied. Analysing the characteristics of this cluster with passengers between 25 – 34 years old found that generally, these passengers seem complacent with mostly low importance and low *satisfaction* for the majority of quality attributes. These young commuters, when travelling to work, seem to consider the bus operational components of reliability and punctuality as the most important quality attributes with which they are dissatisfied and therefore, it is these attributes that require careful attention by the operators.

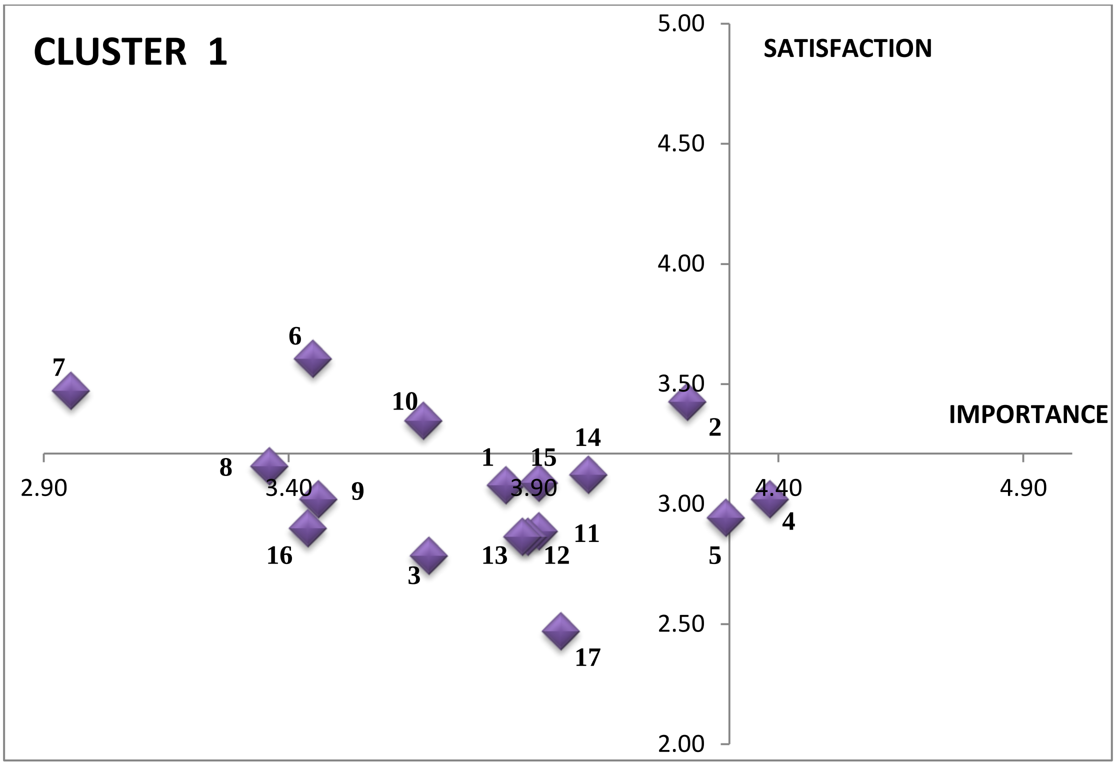

Figure 6.2 : Importance Satisfaction Analysis Cluster 1 (25 – 34/ commuters/ NSR)

Key :

1	=	Frequency- evening
2	=	Frequency - day
3	=	Frequency - Sundays
4	=	Reliability
5	=	Punctuality
6	=	Buy ticket - on bus
7	=	Buy ticket - at Travel Centre
8	=	Cleanliness - on bus
9	=	Cleanliness – at bus stops
10	=	Journey Time
11	=	Friendliness of drivers
12	=	Information at bus stops
13	=	Finding information about bus routes
14	=	Security - on bus
15	=	Security - at bus stops
16	=	Condition of shelters
17	=	Cost of tickets

6.3.2 Cluster 2

The similar analysis carried out earlier was applied to Cluster 2. Figure 6.3 shows the plot of mean for *importance* (*x*) and *satisfaction* (*y*) with the description of attributes located in each quadrant. Table 6.5 shows the statistics of the attributes (mean and median). In contrast to Cluster 1, Cluster 2 has quality attributes that fall mainly in Quadrant II which represents 'Keep Up the Good Work'. They are as follows:-

1. Frequency during the day
4. Reliability
5. Punctuality
9. Cleanliness at the bus stops
11. Friendliness of drivers
12. Information at bus stops
13. Finding information about bus routes
14. Security on bus
15. Security at bus stops
16. Condition of shelters

Understanding the socio-demographic characteristics of Cluster 1, reveals that younger adult commuters, have low *satisfaction* on reliability and punctuality, which were of high importance and whilst cost of tickets had low *satisfaction*, relatively it was considered of lower importance. Considering that they are mostly travelling on NSR services, this gives a message for the need for operations improvement of services. On the other hand Cluster 2, (mainly middle-aged commuters on NSR services 67%), were in stark contrast, not at all complacent and considered these quality attributes of *importance* and were relatively *satisfied*. However, consistent with Cluster 1 there was dis*satisfaction* for cost of tickets and frequency of services on Sundays and to a lesser extent journey time but Cluster 2 had higher Likert scores for *satisfaction*. This may reflect the fact that the older cohort of Cluster 2 have more disposable income. Interestingly Cluster 1 and Cluster 2 have attributes of buying tickets on the bus and at the Travel Centre in Quadrant I with relatively higher Likert scores for both *importance* and *satisfaction*.

Table 6.5 : Statistics for the ISA for Cluster 2

		Importance		***Satisfaction***	
		Mean	***Median***	**Mean**	***Median***
1	Frequency- evening	4.21	5.00	3.31	3.00
2	Frequency – day	4.33	5.00	3.66	4.00
3	Frequency – Sundays	4.09	5.00	2.97	3.00
4	Reliability	4.74	5.00	3.36	3.00
5	Punctuality	4.66	5.00	3.33	3.00
6	Buy ticket - on bus	4.16	4.00	4.01	4.00
7	Buy ticket - at Travel Centre	4.02	4.00	3.64	4.00
8	Cleanliness - on bus	4.28	4.00	3.56	4.00
9	Cleanliness – at bus stops	4.36	4.50	3.27	3.00
10	Journey Time	4.41	5.00	3.17	3.00
11	Friendliness of drivers	4.41	5.00	3.57	4.00
12	Information at bus stops	4.69	5.00	3.3	4.00
13	Finding information	4.76	5.00	3.4	4.00
14	Security - on bus	4.71	5.00	3.65	4.00
15	Security - at bus stops	4.53	5.00	3.63	4.00
16	Condition of shelters	4.62	5.00	3.28	3.00
17	Cost of tickets	4.31	5.00	2.99	3.00

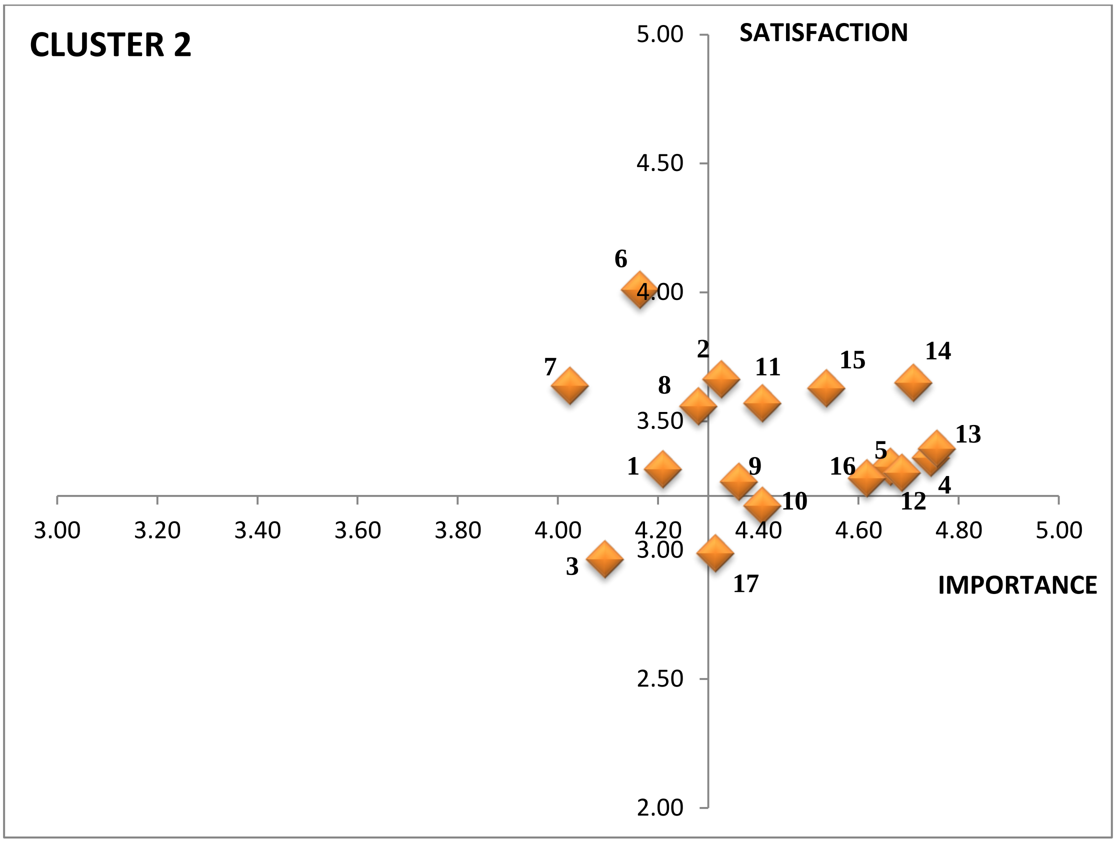

Figure 6.3 : *Importance Satisfaction* Analysis – Cluster 2 (35-49 years/ Commuters/ NSR)

Key :

1 = Frequency- evening
2 = Frequency - day
3 = Frequency - Sundays
4 = Reliability
5 = Punctuality
6 = Buy ticket - on bus
7 = Buy ticket - at Travel Centre
8 = Cleanliness - on bus
9 = Cleanliness – at bus stops
10 = Journey Time
11 = Friendliness of drivers
12 = Information at bus stops
13 = Finding information about bus route
14 = Security - on bus
15 = Security - at bus stops
16 = Condition of shelters
17 = Cost of tickets

6.3.3 Cluster 3

Repeating the same analysis procedure as described above, Figure 6.4 and Table 6.6 show the mean of *importance* (*x*) and *satisfaction* (*y*) for Cluster 3, described as predominantly females over 60 years of age using SR (56%) for shopping purposes (58%).

The Likert scores for this cluster reinforce the significantly higher *satisfaction* of passengers for quality attributes considered to be of high *importance* namely:

2. Frequency during the day
4. Reliability
5. Punctuality
8. Cleanliness of the bus
11. Friendliness of drivers
12. Information at bus stops
13. Finding information about bus routes
14. Security on the bus
15. Security at bus stops
16. Condition of shelters

Passengers in this cluster perceived that service frequencies in the evening and on Sundays, buying tickets on the bus and at the Travel Centre, journey time, cleanliness at the bus stops and cost of tickets as unimportant and they are satisfied. The clear message from Cluster 3 is the need to keep up the good work and consistent with both Cluster 1 and 2 is the least *satisfaction* for cleanliness at the bus stops and cost of tickets and the *satisfaction* of the less *important* attributes of buying a ticket on the bus and at the Travel Centre.

Cluster 3 cohort was the most satisfied group with Likert scores always above the grand average. It is interesting to note that although this cohort has the higher proportion of SR users and female senior citizens for shopping it does not necessarily conflict with the fact that SR passengers are characterised with statistically significantly more commuters because gender differences and age were not statistically different between NSR and SR users. The other 42% of non shoppers in this cohort were also predominantly commuters.

Table 6.6 : Statistics for the ISA for Cluster 3

		Importance		***Satisfaction***	
		Mean	***Median***	**Mean**	***Median***
1	Frequency- evening	3.75	5.00	3.68	4.00
2	Frequency - day	4.63	5.00	4.46	5.00
3	Frequency - Sundays	3.98	5.00	3.81	4.00
4	Reliability	4.59	5.00	4.25	5.00
5	Punctuality	4.66	5.00	4.29	5.00
6	Buy ticket - on bus	3.81	5.00	4.19	5.00
7	Buy ticket - at Travel Centre	3.42	4.00	3.81	5.00
8	Cleanliness - on bus	4.58	5.00	3.80	4.00
9	Cleanliness – at bus stops	4.20	5.00	3.34	3.00
10	Journey Time	4.25	5.00	3.73	4.00
11	Friendliness of drivers	4.32	5.00	4.02	4.00
12	Information at bus stops	4.59	5.00	4.36	5.00
13	Finding information	4.51	5.00	3.95	4.00
14	Security - on bus	4.69	5.00	4.53	5.00
15	Security - at bus stops	4.53	5.00	4.22	5.00
16	Condition of shelters	4.58	5.00	3.64	4.00
17	Cost of tickets	4.12	5.00	3.22	3.00

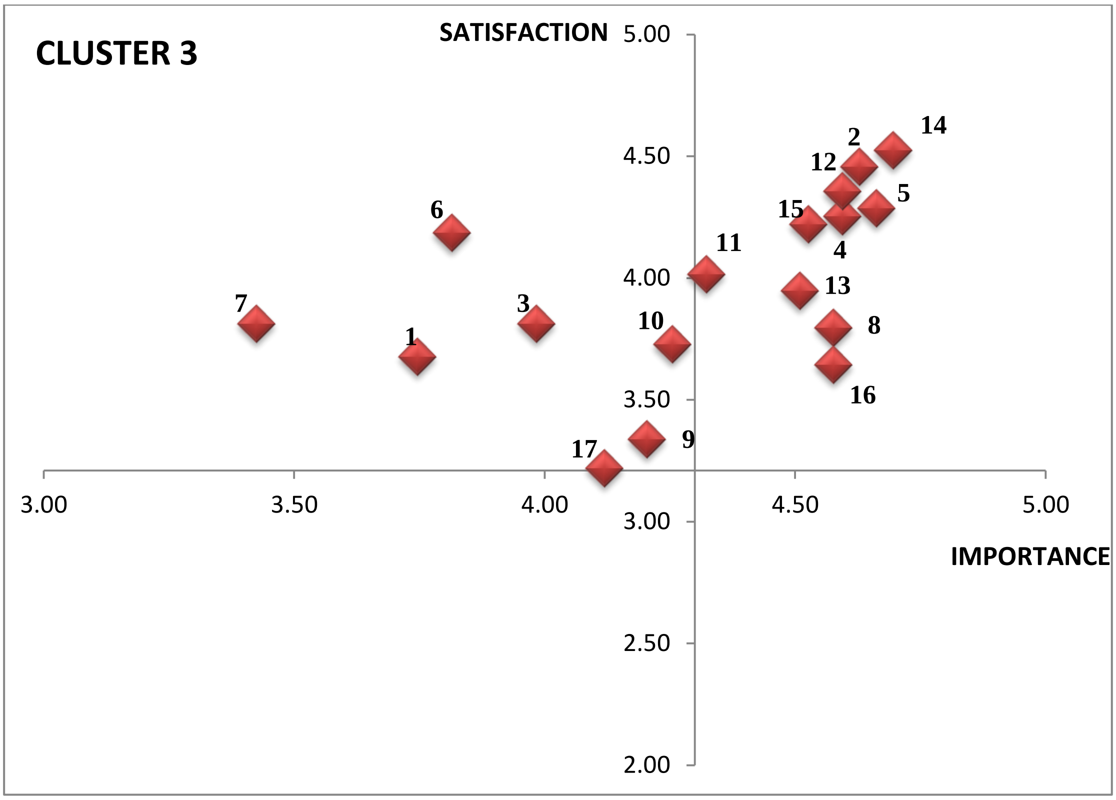

Figure 6.4 : ISA – Cluster 3 (Females/60 years and over/Shopping/ SR)

Key :

1 = Frequency- evening
2 = Frequency - day
3 = Frequency - Sundays
4 = Reliability
5 = Punctuality
6 = Buy ticket - on bus
7 = Buy ticket - at Travel Centre
8 = Cleanliness - on bus
9 = Cleanliness – at bus stops
10 = Journey Time
11 = Friendliness of drivers
12 = Information at bus stops
13 = Finding information
14 = Security - on bus
15 = Security - at bus stops
16 = Condition of shelters
17 = Cost of tickets

6.3.4 Cluster 4

Turning now to Cluster 4, the same analysis procedure as previous clusters was followed. Interestingly, the results (see Table 6.7) show that passengers in Cluster 4, characterised predominantly as shoppers, 60 years and over and using NSR, all assigned quality attributes so that they fall in Quadrant II suggesting that passengers for all the service quality attributes have assigned high *importance* but relative to other clusters with low levels of *satisfaction*. Particular features emerging from the distribution of points within Quadrant II, consistent with all other clusters, is the purchase of tickets on the bus and Travel Centre having (relatively) the highest *satisfaction* and lower importance and the low *satisfaction* and relatively high importance of the cost of tickets. Given that the over 60s will have concessionary passes the cost of tickets was expected not to have such a low *satisfaction* score, however further scrutiny of the demographics of the passengers in Cluster 4 revealed that 32% of this Cluster 4 falls in the 25 – 34 age group, who are likely also to be the commuters (24%). It is likely therefore that it is this sub group of Cluster 4 that may be dominating the low *satisfaction* for cost of tickets.

This particular issue highlights the difficulties in defining the characteristics of clusters. This is because there is a range of perceptions of passengers to quality attributes which may render the respondent to be ‘eligible’ to join any one of the ‘adjacent’ clusters. Also, there is the problem of uniquely defining a metric against which to assess qualitative measures such as *satisfaction* and *importance* which may mean different things to different people. The other limitation that emerges from this analysis is in the short comings of the ISA, particularly in the context of defining the cross hair into which quadrant the attribute becomes located.

Finally, this analysis exposes the degrees of variability and the overlap of the characteristics of the passengers within clusters making it difficult to ‘label’ the cluster leading to the need for care in the interpretation of the results. Based on these findings, for Cluster 4, bus operators should concentrate more resources on all of the service quality attributes across operational, infrastructure and financial. It is advisable to take steps to improve reliability, frequency of services, cleanliness, ease of buying tickets, driver friendliness, personal safety, finding information about routes, ticket price and condition of shelters. Investment in higher quality of service will improve passengers' perception of the overall bus services.

Table 6.7 : Statistics for the ISA for Cluster 4

		Importance		***Satisfaction***	
		Mean	***Median***	**Mean**	***Median***
1	Frequency- evening	4.53	5.00	2.59	3.00
2	Frequency – day	4.84	5.00	2.87	3.00
3	Frequency – Sundays	4.53	5.00	2.53	3.00
4	Reliability	4.82	5.00	2.72	3.00
5	Punctuality	4.74	5.00	2.8	3.00
6	Buy ticket - on bus	4.61	5.00	3.13	3.00
7	Buy ticket - at Travel Centre	4.47	5.00	2.89	3.00
8	Cleanliness - on bus	4.78	5.00	2.7	3.00
9	Cleanliness – at bus stops	4.79	5.00	2.34	2.00
10	Journey Time	4.64	5.00	2.57	3.00
11	Friendliness of drivers	4.88	5.00	2.58	3.00
12	Information at bus stops	4.66	5.00	2.5	2.00
13	Finding information	4.92	5.00	2.34	3.00
14	Security - on bus	4.88	5.00	2.51	2.50
15	Security - at bus stops	4.87	5.00	2.36	2.50
16	Condition of shelters	4.87	5.00	2.37	2.00
17	Cost of tickets	4.83	5.00	2.00	2.00

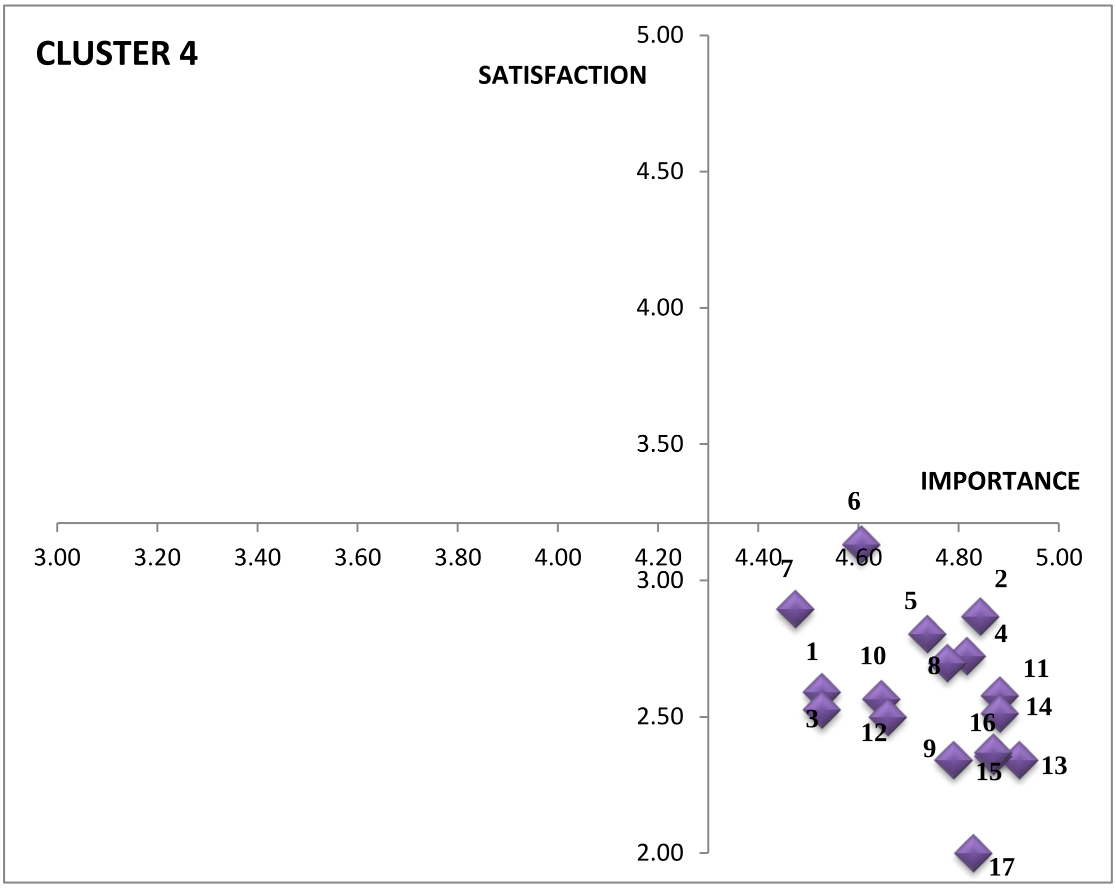

Figure 6.5 : ISA – Cluster 4 (60 years and over/ shopping/ NSR)

Key :

1 = Frequency- evening
2 = Frequency - day
3 = Frequency - Sundays
4 = Reliability
5 = Punctuality
6 = Buy ticket - on bus
7 = Buy ticket - at Travel Centre
8 = Cleanliness - on bus
9 = Cleanliness – at bus stops
10 = Journey Time
11 = Friendliness of drivers
12 = Information at bus stops
13 = Finding information
14 = Security - on bus
15 = Security - at bus stops
16 = Condition of shelters
17 = Cost of tickets

6.4 Awareness of 'Superoute' Branding

In 2004, NEXUS launched the 'Superoute' as a QBP scheme in Tyne and Wear. In this section the awareness, irrespective of service, of all passengers of the 'Superoute' as a brand was explored to examine the effectiveness of the new image given to the bus service as part of the marketing for quality improvement. Further analysis was then carried out comparing the results of the two bus services in order to capture any differences in the perception of passengers who are travelling on the NSR and SR services in respect of the awareness of the branding. Table 6.8 presents the results of the awareness of 'Superoute' on passengers travelling on NSR and SR services.

From the analysis, it was found that overall, the majority of the respondents (60%) were not aware of the 'Superoute' concept. When analysing by service categories, interestingly, it was found that 53 percent of passengers travelling on SR routes were not aware of 'Superoute'. Similar findings were noted for passengers travelling on NSR routes, where 64% were unaware of the branding of 'Superoute'.

Table 6.8 : Awareness of 'Superoute' by Type of Bus Service

	NSR	**Percent**	**SR**	**Percent**	**Total**	**Percent**
Yes	72	36	52	47	124	40
No	128	64	58	53	186	60
Total	200	100	110	100	310	100

Chi Square Test, df = 1, Chi square 3.758, $p > 0.05$, ***p* value** = 0.053

A Chi Square Contingency test was performed on the actual data (NB not on percentages) to test the null hypothesis that there was no statistical differences in the awareness of the 'Superoutes' branding between both types of bus service. The results showed that there was no statistically significant difference for both NSR and SR services in terms of their awareness of ‘Superoute’; ($\chi 2 = 3.758$, df=1, $p>0.05$). This result suggested that the branding of ‘Superoute’ is partially successful and indeed a surprising result that the majority of the passengers travelling on ‘Superoute’ itself were not aware of the branding. The big challenge for bus operators and local authorities is how to promote the bus improvements being made to specific services in Tyne and Wear so that it can help to achieve modal shift. The relationship between brands and customers has been studied by (Veloutsou and Moutinho, 2009) in the context of, marketing as a mechanism to build a relationship between bus operators and passengers.

6.5 Summary

A two-step cluster analysis was carried out on the data and identified four clusters with largely different demographic characteristics. Gender was not found to be statistically significant although the balance of male to female in each cluster was different. The ANOVA analysis showed that all quality factors for *importance* and *satisfaction* and socio demographic characteristics of the respondents within clusters make a significant contribution to differentiate the four clusters from each other. Likert scores were normally distributed within clusters. The four clusters exhibited high internal (intra-cluster) homogeneity and high external (inter-cluster) heterogeneity.

This chapter has presented the results of the CA which identified four clusters with different demographic characteristics. Cluster 1, 2 and 4 were predominantly NSR and Cluster 3 was SR. Cluster 1 was characterised by 25 – 34 year old commuters. The clear message that comes from this analysis is that the majority of attributes rest in Quadrant III (low *importance* and low *satisfaction*). The low *satisfaction* of cost of tickets could be associated with young commuters with lower income jobs , thus, any cost involved for their journey are deemed as important.

Cluster 2 analysis revealed that the younger adult age group of commuters have low *satisfaction* for frequency of service on Sunday but, relative other attributes, is not so important. Cost of tickets was an issue with passengers considering this attribute important and they are not satisfied. Given that passengers are travelling mostly on NSR services, Cluster 2 cohort do experience services with *satisfaction* and most, 10 out of 17, passengers relatively are satisfied with measures considered to be of *importance*.

Cluster 3, the only predominantly SR passenger group of mainly 60+ year old shoppers exhibited significant increase in quality over all attributes compared with the other three clusters that were dominated by NSR services. In particular for this cohort scores were above the cross hair for *satisfaction* and areas for investment by the public transport authority would be to concentrate on reducing fares and cleaning of bus-stops. Frequency of services in the evening and Sundays are other areas needing attention although relatively rated as less important.

Cluster 4, predominantly shoppers aged 60 years old and over, travelling for shopping on NSR services have all quality attributes within the Quarter II being *dissatisfied* with all quality attributes which were all considered to be of *importance*.

In conclusion, this analysis has distinguished groups of respondents that have similar perceptions of the 17 quality attributes. The results from CA showed that socio demographic characteristics can influence the perceptions of service quality. In this way, it has been possible to identify and fine tune the shortfalls in the services allowing bus operators to target investment tailored to match the needs of these specific groups and thus address the needs of passengers more effectively, especially when budgets are limited.

Consistent across all cluster groups buying tickets whether on the bus or at the Travel Centre are attributes consistently of relatively low *importance* and of high *satisfaction*. Whilst the price of tickets was, relative to other attributes, often the lowest of *satisfaction* scores were close to the cross hair for importance perhaps demonstrating a degree of acceptance of the price with little choice especially if the bus is the only option. In general, this integrated Cluster/ISA analysis has shown how the smaller numbers of samples in the clusters does reduce the statistical significance of some variables however the homogeneity of the responses within the clusters is greater with Likert scores normally distributed. Also, whilst the CA has begun to strengthen key messages for specific groups, it remains that there are overlaps in the characteristics of the clusters that emerged from the analysis. Finally the awareness of passengers of the 'Superoute' branding irrespective of NSR and SR services was very poor ($\leq 60\%$) suggesting the need for more effective marketing. The next chapter will apply ordered logit modelling to identify which quality factors are important in influencing the overall rating of bus service quality. This will be an independent approach to identifying those statistically significant attributes which most influence passenger's overall perception of bus service quality.

CHAPTER 7 : EVALUATION OF WHETHER PERCEPTION OF INDIVIDUAL ATTRIBUTES CAN PREDICT OVERALL *QUALITY* OF BUS SERVICES

7.1 Introduction

Chapter 5, Cluster Analysis (CA) has revealed four homogeneous passenger groups that have similar perceptions both in terms of *Importance* and *Satisfaction* of *quality* of a particular bus service type across NSR and SR services. As has been stated by Grimm and Yarnold (2000) the nature of CA however, is not a hypothesis-testing analysis, but one that can be used to enhance the statistical significance of relationships between independent or dependent variables of other data analysis methods by identifying groups or families with statistically similar characteristics and together make up the total data set. So far, the analyses presented have been developed to reveal interesting features and characteristics of sub-groups within the entire sample of passengers with a view to better understanding a pattern in the differences in perceptions of each of the 17 attributes. This was achieved in the simpler descriptive analysis in the context of what was found to be *important* separately from *satisfaction* and in the ISA by clusters aimed to identify how a group of respondents with different characteristics perceived quality in the dimensions of *importance* and *satisfaction* together.

One of the interview questions was asked to capture a score on a Likert scale from 1 to 5 of the rating for (a) overall bus service and (b) service *quality*. This provides an independent measure of the overall *quality* for both NSR and SR services which can be used to explore which one or subset of the 17 quality attributes, irrespective of *importance* or *satisfaction*, influence passenger perceptions.

Therefore, the next step in the analysis was to use Ordered Logit Regression (OLR) in order to achieve the eighth objective of this research, which is to identify which *quality* factors have a predictive effect of the overall bus service and service *quality*.

The analysis was carried out using software STATA (STATA (Data Analysis and Statistical Software, Stata Corp LP). The data analysis involved identifying input errors, filtering out the correct rating by the respondents.

In this chapter, Section 7.2 provides an overview of the OLR methodology, Sections 7.3, 7.4 and 7.5 explain the analysis using Ordered Logit Regression by overall sample, type of bus service and clusters respectively. Section 7.6 provides an overview of the results from OLR and CA in the context of the results from FA and finally Section 7.7 discusses and summarises the findings of the three analysis discussed in Chapters 4, 5 and 6.

7.2 Ordered Logit Regression Methodology

The OLR method is used to explore the strength (β) of the influence on dependent variable y of a particular independent variable x (demographic and *quality* attributes). The unexplained variation is the error term ε as explained in Section 3.8.5.

This analysis, therefore, seeks to reinforce specific *quality* attributes (for *importance* and/or *satisfaction*) that can be associated with different passenger groups which have influence firstly on the overall rating of the bus service and secondly on the perception of overall service *quality*. Evidence of this nature is valuable to the bus operator to target investment to maximise returns. OLR was carried out in three steps; for each overall assessment, first, by the total sample, second, by type of bus services (NSR and SR), and finally, by the four clusters derived from the CA in Stage 3. These three steps of analysis aim to further explore the causal links between perceptions of overall service *quality* and the 17 *quality* attributes for different socio-demographic passenger groups.

The basic reasoning used for this analysis was that, passengers who are receiving high *quality* service in areas that are important to them are more likely to give higher rating on the *overall* bus service. The model development was formulated based on the

Likert scaling scores for *importance* and *satisfaction* based on the 17 *quality* factors and demographic characteristics discussed earlier in Chapter 3 as independent variables.

The analysis involved running STATA with all variables and to find the best fit model. For each scenario studied it was important to carry out sensitivity testing by systematically selecting variables and entering them in turn into the model to identify which attributes contributed to the overall rating of service quality. Three measures of performance namely AIC, BIC and McFadden's R^2 (Green, 2000) as described in Section 2.8 were used to identify the best fit. Several runs were performed to ensure that the order in which the variables were entered into the model did not affect the relative statistical significance of the different quality attributes. As the perception of passengers varies widely for each quality attribute, testing of all variables available from the survey data were included in the analysis. Also, this procedure provided indications of the likely effects of changes in the variables, given that all other attributes remain constant.

After performing numerous model estimation runs, the finalised form of the utility functions associated with all variables are presented in tabular form. The final model was obtained by running STATA on the set of attributes remaining after eliminating the insignificant variables. This process was repeated for the set of scenarios identified in this thesis. These are identified in Figure 7.1 which schematically illustrates the analysis steps taken in OLR. After carrying out the analysis for all the data, the model was applied to the data separating the NSR from SR and finally on each cluster separately. In this chapter for completeness for each scenario, namely, NSR, SR and each Cluster 1, 2, 3 and 4, the outputs for the Initial Run are presented along with that for the Final Run so that the degree of convergence achieved by the sensitivity analysis can be assessed based on the comparison of the three performance measures for the Initial and Final Run.

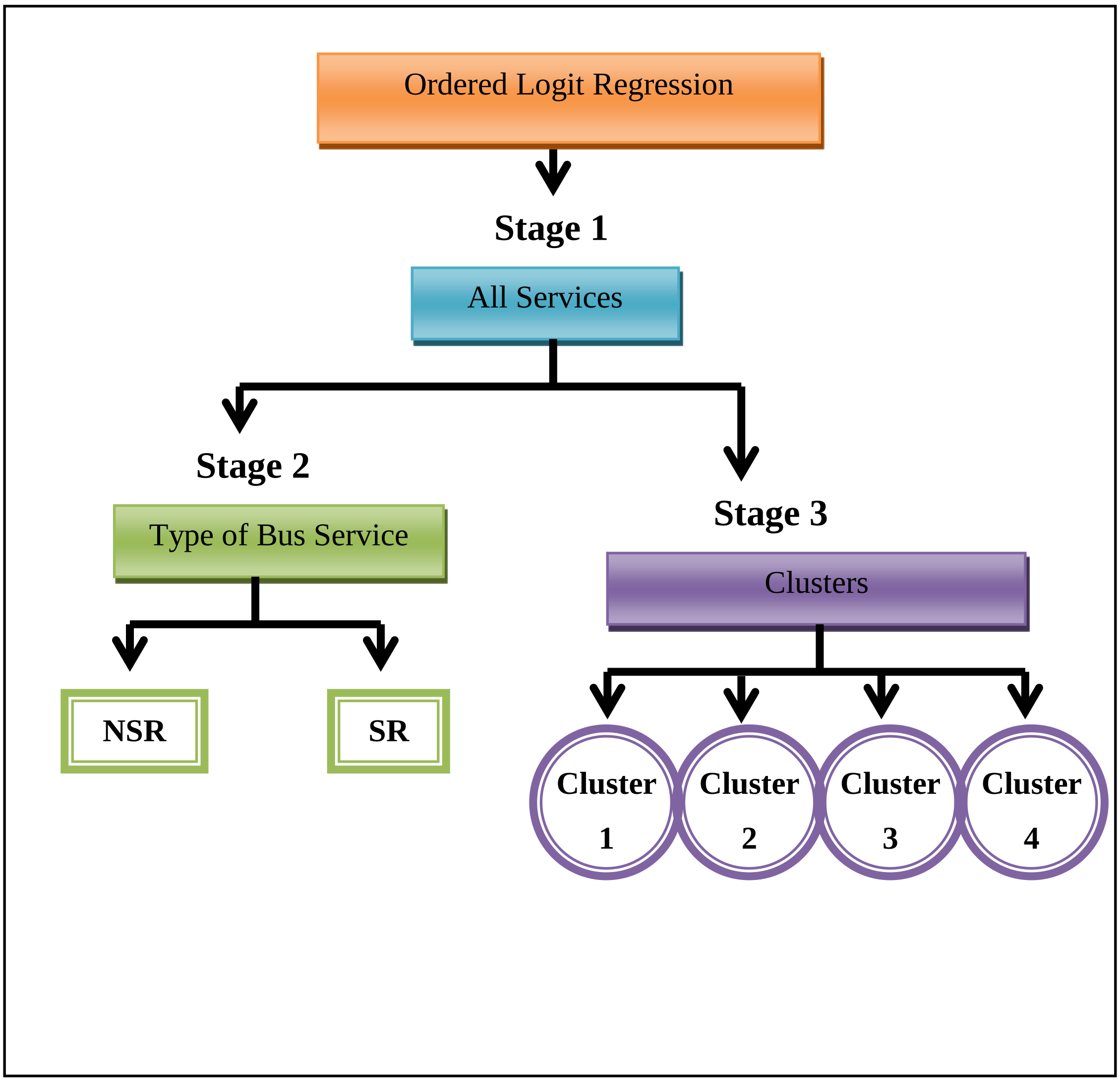

Figure 7.1 : Stages involved in Ordered Logit Regression

Dependent Variables

The dependent variable in this research is the rating of bus service overall with a five point scale; very poor, poor, fair, good and very good. Figure 7.2 shows the frequencies of the responses. However, for this analysis, categories for 'very poor' and 'poor' are combined together due to the low numbers of responses for 'very poor' (see Figure 7.3). As shown in Figure 7.2 only 15 over all respondents assigned very poor, therefore the sample is disaggregated into service type (NSR/SR) and clusters the number of respondents falling in this category which fell to below the five needed for this analysis.

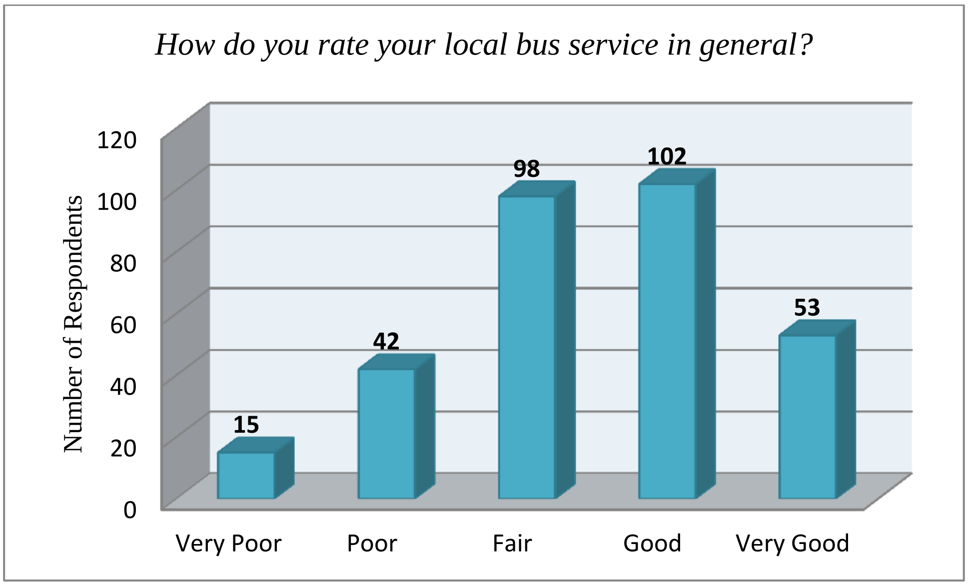

Figure 7.2 : Response for Overall Rating of Bus Service

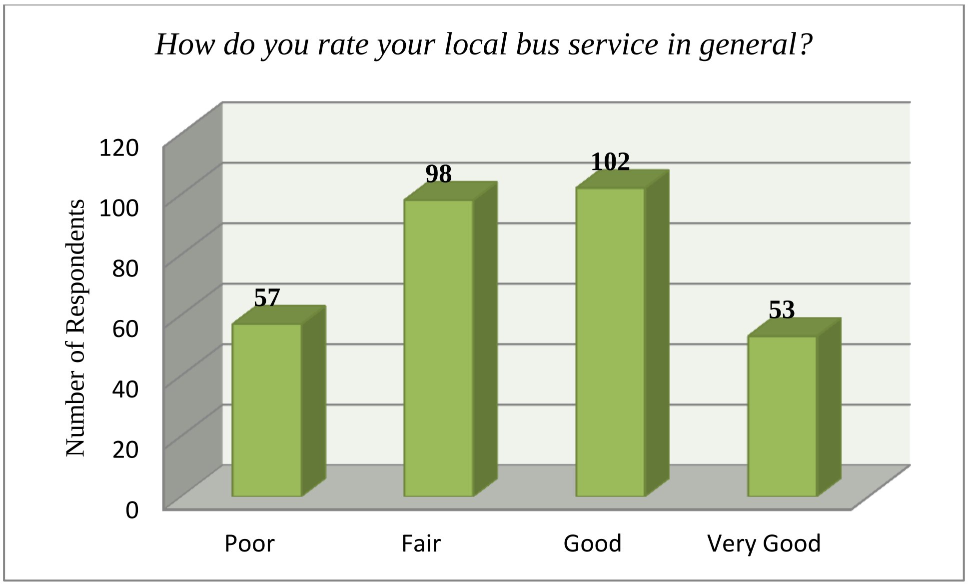

Figure 7.3 : New Response for Overall Rating of Bus Service

7.3 Stage 1: Analysis by Overall Sample (NSR + SR)

This analysis was carried out in two stages, the first considered the Likert score of overall rating of the bus service as the dependent variable and *importance* and *satisfaction* of 17 *quality* attributes and demographic characteristics as the independent variables and the second, considered the rating of service *quality* as the dependent variable and 17 *quality* measures of overall *importance* and *satisfaction* and demographics as the independent variables.

7.3.1 OLR for overall rating of the Service

In this analysis, journey purpose, age, gender and 17 *quality* attributes each for *importance* and *satisfaction* and two safety variables are the independent variables for both services (NSR and SR). There are 40 independent variables entered into the model. In order to aid interpretation of the results from the application of the OLR, factors at the 95% and 90% level of statistical significance are shown in bold and with ** respectively. The coefficient (β) is the strength of the influence of that variable increasing or decreasing depending on whether positive or negative. The t statistic indicates the level of statistical significance whilst the Exp β represents the change in the odds in the dependent variable associated with one unit change on the independent variable. These results are presented in Table 7.1. At the bottom of the table are the threshold parameters μ, which represent the response value of the dependent variable which are considered as the predictors of the model. The threshold values $\mu_{1,}$ μ_2 μ_3 are similar to the intercept in linear regression.

The Brant test was carried out to test the statistically significant differences/similarities of the coefficient for all variables. In order to obtain the robust model, several runs were carried out, the first run of the analysis was carried out by taking all the variables as the independent variables; then systematically, variables were removed. This process was repeated until the best model was achieved by compromise between the minimum values of the performance measures AIC, BIC and McFadden's R^2. This method which tests all variables step by step on every run is called backward elimination.

The results of the overall rating applied to the entire sample have been published by (Hensher *et al.*, 2010). An overview of the results of an independent analysis of that presented in (Hensher *et al.*, 2010) is given here for completeness. Table 7.1 presents the descriptive statistics for the overall responses for four response (Likert scores) categories which were found to fit better than the use of five response categories according to three performance measures which are AIC, BIC and McFadden's R^2.

The results show that passengers travelling on SR have a better experience however commuters, relative to other trip purposes and males relative to females, are less likely to have a good experience with the service. It was found that *importance* on frequencies during the day and *satisfaction* of security on the bus are positive contributory factors in influencing passengers' perceptions of the overall rating of the bus service. On the other hand, *importance* of personal security on the bus had a negative contributory influence on perception of the overall rating.

Table 7.1 : Parameter Estimation Results: by Overall Sample (overall rating of the service as dependent variable)

Variable description	***Overall***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	**-0.74***	-2.85	0.48
Age			
Male	**-0.26***	-3.25	0.77
Type of bus service			
Superoute	**0.75***	3.26	2.12
Importance			
Frequencies during the day	**0.32***	2.29	1.38
Personal security on bus	**-0.32***	-2.29	0.73
Satisfaction			
Personal security on bus	**0.46***	4.18	1.58
Threshold Parameters μ			
μ_1	0.50		
μ_2	2.85		
μ_3	4.92		
Number of observations	310		
L (β)	-355.04		
L (c)	-393.55		
$\rho 2$	0.09		
AIC	*728.08*		
BIC	*761.71*		
Mc Fadden's R^2	*0.09*		

Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
*Critical t-statistic for 95% confidence is 1.96
****** Critical t-statistic for 90% confidence is 1.65

7.3.2 OLR for Overall Service *Quality*

The similar analysis to that described in 7.3.1, but instead using overall service *quality* as the dependent variable was carried out and the results are presented in Table 7.2 for all respondents irrespective of service type.

The overall service *quality* analysis has shown that the *importance* of ‘information at bus stops’ and *satisfaction* in ‘frequencies in the evening’ are positive contributory factors in how passengers perceived the overall *quality* of bus service. Ease of buying a ticket on the bus had a negative contributory influence on the overall rating for bus service *quality*. Gender turned out to be not statistically significant in predicting the overall service *quality* and the negative influence of commuter’s perception of overall *quality* is statistically significant. The OLR suggests for commuters odds will decrease by about 60%. Finally, by dropping the statistical level of confidence to 90% ($t = 1.65$) then punctuality is a variable that influences overall service *quality*.

Comparison of the results for the influence on overall quality of service, rather than overall rating of service, reveals interesting features. The negative influence of commuters’ perceptions are of similar magnitude and whilst gender was significant for overall rating it was not the case for overall quality. Superoute emerged as a significant attribute in positively influencing overall rating but not overall quality. The attributes of *importance* influencing rating were quite different with frequencies during the day having a statistically significant positive effect for overall rating and information at bus stops for overall quality. Whilst there were no negative influences for overall quality, this was not the case for overall rating as personal security on the bus emerged as having a negative effect. For *satisfaction*, one positive attribute influenced the overall rating, namely, personal security on the bus whilst for overall quality, frequencies in the evening and ease of buying a ticket emerged respectively as positive and negative influences. This result was contrary to expectation. A possible explanation for the differences between overall rating and quality rests with the fact that rating has revealed characteristics focussing attention on the attributes from the operations perspective whilst overall quality has resulted in differentiating attributes of importance and satisfaction irrespective of service type thus considering NSR and SR as one cohort and therefore from the passengers' perspective. Consistently the thresholds $\mu_{1}, \mu_{2}, \mu_{3}$ for overall rating and overall quality were lower taking on the value (0.5, 2.85, 4.92) and (1.46, 3.19, 5.04) respectively. The lower scores for overall rating thresholds compared with those for overall quality is probably due to the fact that rating is benchmarked on service provision as a whole rather than quality based on particular service at the time of interview. Given that the OLR research has been published (Hensher *et al*., 2010) already the remainder of this chapter deals which the results of a more in depth study using OLR for modelling overall quality based on 17 *importance* and *satisfaction* scores.

Table 7.2 : Parameter Estimation Results: by Overall Sample (Overall quality of the service as dependent variable)

Variable description	***Overall***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	**-0.61***	-2.33	0.54
Gender			
Male	-0.07	-0.30	0.93
Importance			
Frequencies during the day	0.22	1.35	1.24
Reliability	-0.02	-0.14	0.98
Ease of buying ticket on the bus	0.02	0.14	1.02
Ease of buying ticket at the Travel Centre	-0.12	-1.16	0.89
Information at bus stops	**0.38***	2.52	1.47
Satisfaction			
Frequencies in the evening	**0.35***	2.04	1.42
Frequencies during the day	0.15	0.95	1.16
Frequencies on Sundays	-0.12	-0.79	0.89
Punctuality	**0.22****	1.73	1.25
Cleanliness of the bus	0.05	0.37	1.05
Cleanliness at the bus stops	-0.17	-1.12	0.85
Ease of buying ticket on the bus	**-0.24***	-2.11	0.79
Journey time	-0.10	-0.80	0.90
Information at bus stops	0.12	0.97	1.13
Condition of shelters at bus stops	0.03	0.20	1.03
Personal security on bus	0.18	1.14	1.20
Personal security at bus stops	-0.09	-0.53	0.91
Cost of tickets	0.08	0.82	1.09
Threshold Parameters μ			
μ_1	1.46		
μ_2	3.19		
μ_3	5.04		
Number of observations	310		
L (β)	-382.23		
L (c)	-416.38		
$\rho 2$	0.08		
AIC	812.46		
BIC	902.14		
Mc Fadden's R^2	0.08		

Bold figures are significant at p value < 0.05.

Critical value of the normal distribution was used to assess the statistical significance of parameters. *

*** Critical t-statistic for 95% confidence is 1.96**

**** Critical t-statistic for 90% confidence is 1.65**

7.4 Step 2: Analysis of Two Types of Bus Services Separately

In this stage, OLR was carried out separately for the two types of bus service (NSR and SR), in an attempt to understand whether passengers travelling on buses with improved services have different perceptions of overall quality to those that have not benefited from improvement measures. Variables in the model are assumed to have a causal effect on the dependent variable implying the direction of the effect. Variables included in the models contain measures of respondent views of the 17 quality attributes for both *importance* and *satisfaction*.

Table 7.3 shows the results of the Initial Run and Table 7.4 shows the Final Run when NSR and SR services are considered separately and results are included only for those independent variables shown to have influence on the thresholds. As before coefficients are in bold to show statistical significance at a level of 95% confidence.

With reference to Table 7.4, among socio-economic variables, the passengers on NSR services, who travel to work, have demonstrated statistically significant negative influence of service *quality* measures on their overall perception of service *quality*. In this case, the coefficient is negative confirming that the perception of commuter passengers travelling on NSR services is low which suggests their experience is not favourable. The results from the OLR (Exp β = 1.48) for NSR showed that there was a strong relationship between the *importance* of information at bus stops for which it has shown a positive effect on the perception of passengers towards the overall service *quality*. All other variables for *importance*, and more specifically those associated with *satisfaction*, are not statistically significant for NSR at 95% level of confidence. However, if the statistical significance is lowered to 90%, frequencies of bus services on Sunday became significant.

Comparing the results of Table 7.3 with Table 7.4, the final result is seen to be quite sensitive to the inclusion of more or fewer quality attributes. However, systematically removing and adding the different attributes in turn and scrutiny of the statistical performance measures t, Exp β, $L(\beta)$, $L(c)$ and ρ^2, convergence of the solution is achieved and the significant factors are finally identified at a 95% or 90% level of confidence.

Table 7.3 : Results of Initial Model Run Overall Quality NSR and SR

Variable description	*Non Superoute*			*Superoute*		
	Coeff.	*t-stat.*	Exp β	*Coeff.*	*t-stat.*	Exp β
Journey Purpose						
Commuters	**-0.86**	-3.36	0.42	-0.58	-1.00	0.56
Gender						
Male	0.31	1.04	1.37	-0.42	-0.88	0.66
Satisfaction						
Frequency- evening	**0.50**	1.60	1.65	0.30	0.96	1.35
Frequency - day	0.18	0.54	1.20	0.21	0.62	1.23
Frequency - Sundays	-0.05	-0.11	0.95	-0.07	-0.22	0.93
Reliability	0.20	0.53	1.22	**0.77**	1.93	2.17
Punctuality	-0.17	-0.48	0.84	-0.30	-0.73	0.74
Buy ticket - on bus	-0.02	-0.06	0.98	**-0.60**	-2.35	0.55
Buy ticket - at Travel Centre	-0.10	-0.39	0.91	-0.49	-1.55	0.62
Cleanliness - on bus	0.13	0.33	1.13	**0.70**	2.39	2.01
Cleanliness – at bus stops	-0.05	-0.08	0.95	**-0.78**	-2.48	0.46
Journey Time	-0.32	-0.62	0.72	0.27	1.20	1.31
Friendliness of drivers	**0.50**	0.82	1.65	-0.09	-0.36	0.91
Information at bus stops	-0.25	-0.15	0.78	**0.82**	2.68	2.26
Finding information	-0.28	-0.11	0.75	0.38	1.38	1.47
Security - on bus	**0.34**	0.09	1.40	0.35	1.01	1.43
Security - at bus stops	0.00	0.00	1.00	**-0.88**	-2.20	0.41
Condition of shelters	-0.24	-0.04	0.79	0.39	1.13	1.47
Cost of tickets	0.13	0.02	1.14	0.18	0.96	1.20
Threshold Parameters μ						
μ_1	0.19			-0.2		
μ_2	1.8			2.7		
μ_3	3.2			6.1		
Number of observations	200			110		
L (β)	-252.3			-97.9		
L (c)	-273.0			-129.7		
ρ^2	0.07			0.24		
AIC	*548.67*			*239.94*		
BIC	*621.23*			*299.35*		
Mc Fadden's R^2	*0.07*			*0.24*		

Notes:

Bold figures are significant at p value < 0.05.

Critical value of the normal distribution was used to assess the statistical significance of parameters. * Critical t-statistic for 95% confidence is 1.96

****** Critical t-statistic for 90% confidence is 1.65

Table 7.4 : Parameter Estimation Results for Overall Quality: Non Superoute and Superoute Models (Final Result)

Variable description	*Non Superoute*			*Superoute*		
	Coeff.	*t-stat.*	Exp β	*Coeff.*	*t-stat.*	Exp β
Journey Purpose						
Commuters	**-1.09***	-3.51	0.34	0.26	0.53	1.30
Gender						
Male	0.05	0.19	1.05	-0.37	-0.94	0.69
Importance						
Information at bus stops	**0.39***	2.22	1.48	**0.62***	2.75	1.86
Satisfaction						
Frequencies on Sundays	0.27**	1.88	1.31	**0.49***	2.71	1.63
Ease of buying ticket at the Travel Centre	0.01	0.07	1.01	-0.32	-1.65	0.73
Security						
Security while waiting at bus stops	-0.20	-1.03	0.82	-0.36	-1.28	0.70
Security travelling on buses	0.29	1.63	1.34	**0.47***	2.10	1.60
Threshold Parameters μ						
μ_1	1.47			0.46		
μ_2	3.01			2.69		
μ_3	4.32			5.34		
Number of observations	200			110		
L (β)	-261.1			-119.9		
L (c)	-273.0			-129.8		
ρ^2	0.04			0.08		
AIC	*542.11*			*259.78*		
BIC	*575.09*			*286.79*		
Mc Fadden's R^2	*0.04*			*0.08*		

Notes:
Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters. * * Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

The attributes of security while waiting at bus stops appeared to be not significant in influencing the perception of passengers travelling on NSR services. However security travelling on bus is a contributory factor in influencing their perception of *satisfaction* on service quality (based on Exp $\beta = 1.34$).

Turning now to OLR results for passengers who are travelling on SR services, results are shown in Table 7.3 (Initial) and Table 7.4 (Final Run). Consistent with the NSR, the importance of bus information at bus stops has a positive effect on the perception of overall service quality. Given the size of the coefficient (0.62) and higher t-statistic (2.75), the provision of information at the bus stops seems to have a greater influence on the perception of overall service quality for SR compared to NSR. The information provision on SR includes schedules of bus services and routes. The results from the models also highlighted a positive and significant effect for passengers' *satisfaction* travelling on SR services of frequencies of buses on Sundays. The findings suggest that increasing bus frequencies on Sundays does improve the perception of passengers of overall service quality as does information provision at bus stops. For SR, security whilst travelling on buses also had a significant effect on the perception of passengers towards overall service quality whilst this was not the case for NSR. Finally, an analysis of the threshold parameters ($\mu_{1,}$ μ_2, μ_3 relating to fair, good, very good, see Figure 2.8), a key metric from OLR shows that passengers travelling on SR services expect a higher quality $\mu\,3 = 5.34$ compared to $\mu\,3 = 4.32$ overall service quality than NSR services. However, the lower thresholds with μ_1 and μ_2 taking values respectively for NSR and SR (1.47, 3.01) and (0.46, 2.69) suggest otherwise. The reasons for this are further investigated with the more detailed cluster analysis in the remainder of this chapter.

In summary, these findings have provided clear evidence of the *importance* of information provision on overall *quality* irrespective of service and support the hypothesis that *quality* variables (which in the case for SR result from QBP initiatives) security on buses and improved service frequencies on Sundays can have a positive influence on the passengers' perception of the overall *quality*. It is suggested that *quality* measures influence *satisfaction*, and therefore affects the perception of overall quality of bus service, with the potential to positively influence the passenger retention and mode shift. Again the sensitivity of the model to the numerous variables revealed by the initial run, which includes all variables, and the final one with only those with significant influences is clearly evident.

7.5 Stage 3: Analysis by Four Clusters

This section reports the result of OLR carried out separately on each of the clusters representing mainly different socio-demographic characteristics and journey purposes. This is to further explore the extent to which the perceptions of overall *quality* of service are driven by different *quality* attributes depending on the passenger characteristics in a particular cluster. As before, a similar test was carried out in order to check the robustness of the model. Systematically including the different attributes in different orders and removing those found not to be statistically significant, the model converged to a final solution reaching a compromise in the performance measures AIC, BIC, and McFadden's R^2. The results for Initial Run of the model are shown in Tables 7.5, 7.7, 7.9 and 7.11 for each of Cluster 1, Cluster 2, Cluster 3 and Cluster 4 respectively, whilst the result for Final Run are respectively shown in Tables 7.6, 7.8, 7.10 and 7.12.

The results of the ordered logit regression will be discussed in turn. As before only statistically significant independent variables are discussed and variables at or better than 95% statistical confidence are indicated in bold.

a) Cluster 1

Adopting the same procedure as before, the analysis involved running STATA with all variables to find the best fit model. The initial model estimation results are presented in Table 7.5 showing values of AIC, BIC and McFadden's R^2 (respectively x,y,z). After performing numerous model estimation runs, the finalised form of the utility functions associated with all variables resulted in the improved model with lower values of AIC, BIC and McFadden's R^2 (respectively x2,y1,z1) as shown in

Table 7.6. The Final Run of the model was obtained by running the full model eliminating insignificant variables reducing 40 to 4 variables. Table 7.6 shows the estimated values for the parameters of the variables for Cluster 1 which was characterised in Chapter 5 by being predominantly 25 – 34 year old commuters using mainly NSR services. In this analysis, OLR does not reveal commuters as significant although the scale factor β is negative. Interestingly the age group which is strongly negatively influencing overall perception is the teenager group 12 – 15 years. This category was limited to those who, at the time of the survey, were accompanied by parents who gave permission for them to take part in the survey.

Table 7.5 : Results for Model run 1 for Cluster 1

Variable description	***Non Superoute***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	0.91	1.14	2.49
Gender			
Male	0.66	1.05	1.93
Satisfaction			
Frequency- evening	**2.27**	3.62	9.72
Frequency – day	0.13	0.39	1.15
Frequency – Sundays	-0.37	-0.92	0.69
Reliability	**2.61**	3.51	13.59
Punctuality	**-1.52**	-2.25	0.22
Buy ticket - on bus	-0.51	-1.17	0.60
Buy ticket - at Travel Centre	0.38	0.85	1.46
Cleanliness - on bus	-0.50	-1.29	0.61
Cleanliness – at bus stops	0.45	1.06	1.56
Journey Time	**-1.44**	-2.68	0.24
Friendliness of drivers	**1.47**	2.44	4.33
Information at bus stops	-0.26	-0.58	0.77
Finding information	-0.71	-1.37	0.49
Security - on bus	**1.18**	2.62	3.25
Security - at bus stops	**-1.55**	-2.80	0.21
Condition of shelters	-0.33	-0.64	0.72
Cost of tickets	**0.81**	2.34	2.25
Threshold Parameters μ			
μ_1		2.99	

μ_2	6.78
μ_3	10.16
Number of observations	
L (β)	-68.99
L (c)	-112.81
ρ^2	0.39
AIC	*181.99*
BIC	*236.74*
McFadden's R^2	*0.39*

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters. ***** * Critical t-statistic for 95% confidence is 1.96, ****** Critical t-statistic for 90% confidence is 1.65

Gender was not statistically significant but is a contributory factor influencing the perception of service quality (Exp β = 1.88). A striking result (at better than 99% statistical confidence) is for *importance* journey time (β = 0.81) and for *satisfaction* reliability (β = 1.55) and cost of tickets (β = 0.65). From the analysis, it was found that the factor of *importance* for journey time and *satisfaction* for reliability and cost of tickets appeared to be the contributory factor to influence the perception of overall service *quality*. For the *quality* attribute of *importance* the results suggest that a one unit increase in journey time is associated with a 2.25 increase in the ordered log-odds of increase perception, while holding other variables constant. In terms of *satisfaction* for reliability, one unit increase in reliability is associated with a 4.72 increase in the log-odds of increase in perceived service *quality*, while holding other variables constant. In terms of *satisfaction* for cost of tickets, one unit increase in cost of tickets is associated with 1.92 increase in the log-odds of increased perception of overall service *quality* of the bus service.

Relaxing the confidence to 90%, the *quality* attribute of *importance* is personal security at bus stops which proved to have a negative influence on the perception for the overall rating. Finally, the *quality* attribute of *importance* for punctuality and *satisfaction* of journey time, friendliness of drivers, finding information about bus routes, although were found not to be statistically significant in the model, can still be counted as factors that can influence the passengers' perception categories in this cluster at a 90% level of statistical significance.

The thresholds (μ_1, μ_2, μ_3) take on low values (-0.97, 2.43, 4.99) reflecting the lower expectation of this younger cohort. However, this result is consistent with the observation from ISA analysis of Cluster 1 which suggested a degree of complacency given the lack of available alternative.

Table 7.6 : Parameter Estimation Results: Cluster 1 (Final Result)

Variable description	Coeff.	t-stat.	Exp β
Journey Purpose			
Commuters	-0.38	-0.64	0.68
Gender			
Male	0.63	1.21	1.88
Age			
12-15years old	**-1.63***	2.67	0.20
Importance			
Punctuality	-0.30	-1.02	0.74
Journey time	**0.81***	3.16	2.25
Personal security on bus	-0.55**	-1.76	0.58
Satisfaction			
Reliability	**1.55***	4.65	4.72
Journey time	-0.46	-1.10	0.63
Friendliness of drivers	-0.01	-0.02	0.99
Finding Information about bus routes	-0.38	-1.04	0.69
Condition of shelters	0.06	0.14	1.06
Personal security at bus stops	-0.36	-0.97	0.70
Cost of tickets	**0.65***	2.63	1.92
Threshold Parameters μ			
μ_1	-0.97		
μ_2	2.43		
μ_3	4.99		
Number of observations	89		
L (β)	-82.20		
L (c)	-112.81		
ρ^2	0.27		
AIC	*196.40*		
BIC	*236.22*		
McFadden's R2	*0.27*		

Notes:

Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
***** * Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

7.5.1.1 Cluster 2

Adopting the same procedure as before, the analysis involved running STATA with all variables to find the best fit model. The initial model estimation results are presented in Table 7.7 showing values of AIC, BIC and McFadden's R^2 (respectively x,y,z). After performing numerous model estimation runs, the finalised form of the utility functions associated with all variables resulted in the improved model with lower values of AIC, BIC and McFadden's R^2 (respectively x2,y1,z1) as shown in Table 7.8. The Final Run of the model was obtained by running the full model eliminating statistically insignificant variables. Table 7.8 shows the estimated values for the parameters of the variables for Cluster 2 which was characterised in Chapter 6 by 35-49 years' old of commuters using NSR services.

From Table 7.7, it can be seen that all the estimated coefficients for gender, *satisfaction* for frequencies during evening and during the day, reliability, buying a ticket at the Travel Centre, cleanliness on the bus, journey time, friendliness of drivers, security at bus stops, condition of shelters and cost of tickets were found to have negative signs, and negatively affect overall quality whilst the rest had positive influences. However, the systematic inclusion and removal of attributes scrutinising the performance measures at each stage until convergence resulted in the Final Model Run.

Table 7.8 presents the result of the OLR for Cluster 2 and that the overall model fit is good. The inherent property of ordered logit is parallel regression assumption. Cluster 2 is characterised by commuters 35 – 49 years old using NSR. The OLR analysis in this case at the 95% level of confidence showed that females have a more positive perception of service quality. Interestingly for both *importance* and *satisfaction,* reliability appears to be the factor that has a negative influence on the passengers' perception of the overall service *quality* at a 95% level of statistical confidence. Reliability is not just a function of bus operations but also delay to buses caused by congestion. ITS, UTMC, bus priority and bus only lanes do help to address this issue. This result shows that one unit of decrease in reliability is associated with a reduction of 30% in influencing the overall service *quality*.

Table 7.7 : Results for Model run 1 for Cluster 2

Variable description	***Cluster 2***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	0.33	0.57	1.39
Gender			
Male	**-1.36***	-2.21	0.26
Satisfaction			
Frequency- evening	-0.03	-0.06	0.97
Frequency – day	-0.22	-0.54	0.80
Frequency – Sundays	**1.35***	2.93	3.87
Reliability	-0.48	-1.10	0.61
Punctuality	0.29	0.76	1.35
Buy ticket - on bus	0.29	0.79	1.35
Buy ticket - at Travel Centre	-0.42	-1.32	0.65
Cleanliness - on bus	-0.20	-0.50	0.82
Cleanliness – at bus stops	**0.96***	2.18	2.63
Journey Time	**-0.86***	-2.08	0.42
Friendliness of drivers	-0.39	-0.90	0.68
Information at bus stops	0.18	0.58	1.20
Finding information	0.172	0.50	1.19
Security - on bus	0.47	0.88	1.60
Security - at bus stops	-0.14	-0.33	0.87
Condition of shelters	**-0.82***	-2.33	0.44
Cost of tickets	-0.06	-0.27	0.95
Threshold Parameters μ			
μ_1	-2.89		
μ_2	-0.49		
μ_3	2.74		
Number of observations	86		
L (β)	-85.24		
L (c)	-105.36		
ρ^2	0.19		
AIC	*214.49*		
BIC	*268.48*		
McFadden's R2	*0.19*		

Notes: Bold figures are significant at p value < 0.05.

Critical value of the normal distribution was used to assess the statistical significance of parameters.

- Critical t-statistic for 95% confidence is 1.96

** Critical t-statistic for 90% confidence is 1.65

For *satisfaction*, the results suggest that one unit increase in punctuality is associated with 2.55 increase in log-odds of increased perception on overall service *quality*. The regression carried out for this cluster showed that for both *importance* and *satisfaction* of frequencies during the day, *importance* of frequencies on Sundays, and *satisfaction* of frequencies in the evening and cost of tickets are the positive contributory factors influencing the passengers' perception as individual components but are not in themselves statistically significant. However, the results from the analysis showed that reliability has negative influence both in terms of *importance* and *satisfaction*, however, punctuality has a positive influence on passengers' perception of overall *quality*. The threshold values ($\mu_{1,}$ $\mu_{2,}$ $\mu_{3)}$ for Cluster 2 are much lower (-1.99, 0.06, 2.86) than those for Cluster 1 (-0.97, 2.43, 4.99) illustrating rather different perceptions of the two cohorts of passengers to the NSR services. Certainly these two cohorts observe the services in different contexts. The lack of significant variables for importance emerging from cluster 1 is consistent with there not being a viable alternative whilst for Cluster 2 reliability is <u>important</u> and has negative influence whilst reliability emerges as significant for *satisfaction* for both cohorts it has positive influence for Cluster 1 and negative for Cluster 2. The more mature mainly female population of Cluster 2 emerges as the most dissatisfied. Cluster 1 and Cluster 2 are both mainly commuter groups and the issues of reliability and punctuality/ journey time are in these cohort the most influencing factors. It is likely that it is these groups that will be influencing the lower thresholds in the overall NSR and overall SR analyses presented in Table 7.4.

Table 7.8 : Parameter Estimation Results: Cluster 2 (Final Result)

Variable description	*Coeff.*	*t-stat.*	Exp β
Journey Purpose			
Commuters	0.30	0.62	1.35
Gender			
Female	**1.66***	3.15	5.26
Age			
12-15years old	-0.40	0.60	0.67
Importance			
Frequencies during the day	0.45	1.32	1.57
Frequencies on Sundays	0.14	0.77	1.15
Reliability	**-1.07***	-2.71	0.34
Satisfaction			
Frequencies in the evening	0.30	1.05	1.36
Frequencies during the day	0.28	0.69	1.32
Reliability	**-1.20***	-3.23	0.30
Punctuality	**0.94***	2.61	2.55
Cost of tickets	0.19	0.99	1.21
Threshold Parameters μ			
μ_1	-1.99		
μ_2	0.06		
μ_3	2.86		
Number of observations	86		
L (β)	-94.93		
L (c)	-105.36		
ρ2	0.10		
AIC	*217.86*		
BIC	*252.22*		
Mc Fadden's R2	*0.10*		

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
* * Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

These differences reflect variations between the characteristics of the clusters but also variations across the four bus routes studied.

7.5.1.2 Cluster 3

Adopting the same procedure as before, the analysis involved running STATA with all variables to find the best fit model. The initial model estimation results are presented in Table 7.9 showing values of AIC, BIC and McFadden's R^2 (respectively x,y,z). After performing numerous model estimation runs, the finalised form of the utility functions associated with all variables resulted in the improved model with lower values of AIC, BIC and McFadden's R^2 (respectively x2,y1,z1) as shown in Table 7.9. The Final Run of the model was obtained by running the full model eliminating insignificant variables. Table 7.10 shows the estimated values for the parameters of the variables for Cluster 3 which was characterised in Chapter 5 by senior citizens (60+) shoppers using mainly SR services.

Table 7.9 : Initial Model Run for Cluster 3

Variable description	***Cluster 3***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	**4.52***	2.01	92.20
Gender			
Male	**2.33***	1.99	10.27
Satisfaction			
Frequency- evening	1.61	0.58	4.98
Frequency – day	2.78	1.14	16.06
Frequency – Sundays	-1.89	0.60	0.15
Reliability	3.70	1.46	40.56
Punctuality	-3.18	1.60	0.04
Buy ticket - on bus	-1.66	0.54	0.19
Buy ticket - at Travel Centre	-1.45	0.72	0.23
Cleanliness - on bus	-2.22	0.82	0.11
Cleanliness – at bus stops	0.55	0.59	1.74
Journey Time	2.11	0.69	8.26
Friendliness of drivers	-0.69	0.43	0.50
Information at bus stops	-0.50	0.64	0.61
Finding information	-0.91	0.62	0.40
Security - on bus	0.78	0.60	2.18
Security - at bus stops	-2.77	1.34	0.06
Condition of shelters	1.59	0.88	4.94
Cost of tickets	-0.09	0.29	0.91
Threshold Parameters μ			
μ_1	-11.69		
μ_2	-10.80		
μ_3	-8.09		
Number of observations			
L (β)	-49.89		
L (c)	-75.15		
ρ^2	0.34		
AIC	*143.79*		
BIC	*189.50*		
Mc Fadden's R2	*0.34*		

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
* Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

The results of the final model of OLR analysis are reported in Table 7.10. This cohort is shown to be very strongly influenced by males and statistically significant *quality* attributes at 95% level of confidence include, for *importance* positively for cleanliness at bus stops and for *satisfaction* negatively for ease of buying a ticket at the Travel Centre. It is found that one unit increase in *importance* of cleanliness at the bus stops is associated with 2.24 increase in the log-odds of increased perception on overall service *quality* and for a one unit decrease in ease of buying a ticket at the Travel Centre results in a 41% deterioration in perception of overall service quality.

At a 90% level of confidence those *quality* attributes that have positive influence on the thresholds of passengers' perception of overall service *quality* in this cluster are for *satisfaction* positively on the frequencies in the evening and during the day, reliability, friendliness of drivers and cost of tickets. Whilst, negative influence are for *importance* of frequencies on Sundays and ease of buying a ticket on the bus and for *satisfaction* frequencies on Sundays, punctuality and cleanliness of the bus appeared to have a negative influence on the passengers' perception.

Turning now to the threshold values, (μ_1, μ_2, μ_3) are all positive (1.54, 2.33 and 4.40) which compared with Cluster 1 are much higher at the lower value (μ_1) and lower at the higher value (μ_3). This is consistent with the predominance of SR users compared with NSR in Cluster 1 providing more homogeneity and consistency and service quality attributes having a much greater positive influence on the overall quality of the bus service.

In addition whilst Cluster 1 are predominantly young commuters more concerned with journey time and reliability, passengers in Cluster 3 are mainly travelling for shopping and leisure purposes and are very concerned with the cleanliness at the bus stops and the difficulty of purchasing tickets at the Travel Centre. From the bus operators' perspectives, steps should be taken to enhance the environment at the bus stops providing facilities and improving the condition of the bus stops and making it more easy to purchase a ticket at the Travel Centre. However, it can be argued that as the threshold values for Cluster 3 compared to SR, service as a whole is very much concentrated at the centre of the distribution μ_1, μ_2, μ_3 = 1.54, 2.33, 4.40, for Cluster 3 compared to with μ_1, μ_2, μ_3 = 0.46, 2.69, 5.34, for all respondents on SR. For Cluster 3 μ_1 is higher and μ_3 is lower compared to NSR overall and Cluster 1 and Cluster 2.

Table 7.10 : Parameter Estimation Results: Cluster 3 (Final Result)

Variable description	*Coeff.*	*t-stat.*	Exp β
Journey Purpose			
Commuters	1.26	0.91	3.52
Gender			
Male	**2.28***	2.45	9.82
Importance			
Frequencies on Sundays	-0.08	-0.26	0.93
Ease of buying ticket on bus	-0.27	-1.20	0.76
Cleanliness at the bus stops	**0.81***	2.50	2.24
Satisfaction			
Frequencies in the evening	0.39	0.92	1.48
Frequencies during the day	0.80	1.60	2.24
Frequencies on Sundays	-0.82**	-1.78	0.44
Reliability	1.09	1.47	2.96
Punctuality	-0.46	-0.56	0.63
Ease of buying ticket at Travel Centre	**-0.89***	-2.88	0.41
Cleanliness of the bus	-0.30	-0.99	0.74
Friendliness of drivers	0.06	0.15	1.06
Cost of tickets	0.22	0.90	1.25
Threshold Parameters μ			
μ_1	1.54		
μ_2	2.33		
μ_3	4.40		
Number of observations	59		
L (β)	-59.19		
L (c)	-75.15		
ρ^2	0.21		
AIC	*152.38*		
BIC	*187.69*		
Mc Fadden's R2	*0.21*		

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
* * Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

7.5.1.3 Cluster 4

Adopting the same procedure as before, the analysis involved running STATA with all variables to find the best fit model. The initial model estimation results are presented in Table 6-11 showing values of AIC, BIC and McFadden's R^2 (respectively x,y,z). After performing numerous model estimation runs, the finalised form of the utility functions associated with all variables resulted in the improved model with lower values of AIC, BIC and McFadden's R^2 (respectively x2,y1,z1) as shown in Table 7.11. The Final Run of the model was obtained by running the full model eliminating insignificant variables. Table 7.12 shows the estimated values for the parameters of the variables for Cluster 4 which was characterised in Chapter 6 by senior citizens (60+) shoppers using mainly NSR services.

Table 7.11 : Results from the Initial Run for Cluster 4

Variable description	***Cluster 4***		
	Coeff.	*t-stat.*	Exp β
Journey Purpose			
Commuters	-1.46	-0.65	0.23
Gender			
Male	1.10	0.94	3.01
Satisfaction			
Frequency- evening	**1.21***	2.05	3.34
Frequency – day	0.73	0.64	2.08
Frequency – Sundays	**-1.74***	-2.89	0.18
Reliability	1.35	0.93	3.85
Punctuality	-1.63	-1.02	0.20
Buy ticket - on bus	-0.67	-1.24	0.51
Buy ticket - at Travel Centre	0.91	1.28	2.49
Cleanliness - on bus	0.29	0.35	1.33
Cleanliness – at bus stops	-0.41	-0.69	0.67
Journey Time	0.37	0.54	1.45
Friendliness of drivers	**0.94***	2.17	2.56
Information at bus stops	0.13	0.20	1.14
Finding information	0.12	0.20	1.13
Security - on bus	0.59	1.00	1.82
Security - at bus stops	-1.05	-0.78	0.35
Condition of shelters	-0.09	-0.11	0.91
Cost of tickets	0.34	1.13	1.40
Threshold Parameters μ			
μ_1	2.41		
μ_2	4.64		
μ_3	6.87		
Number of observations	76		
L (β)	-78.04		
L (c)	-101.92		
ρ^2	0.23		
AIC	*200.08*		
BIC	*251.36*		
Mc Fadden's R^2	*0.23*		

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters.
* Critical t-statistic for 95% confidence is 1.96
** Critical t-statistic for 90% confidence is 1.65

Table 7.12 reports the results for Cluster 4. This cluster is dominated by commuters which at 95% level of confidence, have negative influence on overall perception of service *quality*. At the 95% level of statistical confidence no attributes emerge for *importance* however, frequencies on Sundays is significant with a negative influence and frequencies in the evening have a positive influence. Interestingly, one unit change in *satisfaction* of frequencies in the evening is positively associated with 8.64 and at 90% level of confidence cost of tickets is associated positively with a 2.01 increase in log odds of perception on overall quality of service.

Negative influences at 95% level of statistical significance for *satisfaction* are frequencies of services on Sundays with 33% decrease in odds of perception on overall service *quality*. Although not statistically significant in isolation attributes which influence the model include: with a positive influence and *importance* are frequencies on Sundays, for *satisfaction,* include reliability, friendliness of drivers and personal security on the bus.

The *quality* attributes that have a negative influence to the perception of the overall bus rating for *importance* are frequencies during the day, ease of buying a ticket on the bus and finding information about bus routes. In terms of *satisfaction*, punctuality, ease of buying a ticket on the bus, information at bus stops and security at bus stops are the *quality* attributes that have negative influence on the overall perception. These results revealed that frequencies in the evening are the factor that can influence passenger perception considering that most passengers in Cluster 4 are senior citizens and travelling for shopping and leisure. Drawing from these findings, bus operators should concentrate on measures to increase the bus frequencies during the evening to help to influence the rating for the bus service. The OLR on Cluster 4 clearly highlights commuters having negative perceptions of the service. Comparing the thresholds (μ_1, μ_2, μ_3), Cluster 4, whilst maintaining positive values, embraces the tails at both higher and lower levels of the Likert scales. Cluster 3 and Cluster 4 are both predominantly female, shoppers over sixty and differ mainly in the proportion of users of NSR and SR, being respectively (44% and 56%) and (14% and 86%). The threshold scores for Cluster 4 (μ_1, μ_2, μ_3 = 0.82, 3.07, 5.2) compared with Cluster 3

(μ_1, μ_2, μ_3 = 1.54, 2.33, 4.40) reflect the lower quality and more inconsistency across NSR compared with SR services.

Table 7.12 : Parameter Estimation Results: Cluster 4 (Final Run)

Variable description	*Coeff.*	*t-stat.*	Exp β
Journey Purpose			
Commuters	**-1.68***	-2.28	0.19
Gender			
Male	0.14	0.18	1.15
Age			
12-15years old	-1.35	-1.54	0.26
Importance			
Frequencies during the day	-0.44	-0.58	0.64
Frequencies on Sundays	0.98**	1.68	2.65
Ease of buying ticket on bus	-0.28	-0.39	0.76
Finding Information about bus routes	-0.43	-0.28	0.65
Satisfaction			
Frequencies in the evening	**2.16***	2.84	8.64
Frequencies on Sundays	**-1.10***	-2.06	0.33
Reliability	0.97	1.10	2.64
Punctuality	-1.18	-1.60	0.31
Ease of buying ticket on bus	-0.31	-0.66	0.73
Information at bus stops	-0.10	-0.21	0.90
Friendliness of drivers	0.60	1.75	1.82
Security - on bus	0.44	0.95	1.55
Security - at bus stops	-0.45	-0.90	0.64
Cost of tickets	0.70**	1.72	2.01
Threshold Parameters μ			
μ_1	0.82		
μ_2	3.07		
μ_3	5.20		
Number of observations	76		
L (β)	-78.99		
L (c)	-101.92		
$\rho 2$	0.22		
AIC	*197.98*		
BIC	*244.59*		
McFadden's R2	*0.22*		

Notes: Bold figures are significant at p value < 0.05.
Critical value of the normal distribution was used to assess the statistical significance of parameters. * Critical t-statistic for 95% confidence is 1.96; ** Critical t-statistic for 90% confidence is 1.65

7.5.2 Summary of OLR by clusters

Comparing all the clusters, it is found that these *quality* attributes for *satisfaction* are statistically significant and are giving positive or negative contribution towards the overall bus service *quality*:

- Cluster 1 with the majority of respondents aged between 25 – 34 years old, commuters mainly travelling on NSR suggests that quality attributes of reliability (positive) and cost of tickets (positive) are the factors that influence their perception on service quality.
- Cluster 2 (35 – 49 years), commuters also mainly travelling on NSR. Punctuality has a positive and reliability a negative, contributory influence on their perception on the overall rating of service quality.
- Cluster 3 (60 years and over/shopping/ SR). Quality attributes of ease of buying a ticket (negative) and at 90% confidence, frequencies on Sundays (negative) are significant in influencing the perception of service quality
- Cluster 4 (60 years and over/shopping/NSR). Senior citizens going out for shopping and leisure purposes are concerned more with the frequencies in the evening (positive) and on Sundays (negative).

For positive (or negative) influence on overall quality of the bus service attributes considered important were:
For Cluster 1 – journey time (positive) for Cluster 2 reliability (negative), Cluster 3 cleanliness at bus stops (positive), Cluster 4 at 90% confidence frequency on Sundays (positive). However, for *satisfaction*: Cluster 1 reliability (positive), Cluster 2 reliability (negative) punctuality (positive), Cluster 3 ease of buying a ticket (negative) and Cluster 4 frequencies in the evening (positive) and frequency on Sundays (negative).

This chapter has used OLR to establish whether and if so, which specific *quality* attributes influence firstly the overall rating of the service and secondly the overall *quality* of the service. The overall rating of the service has been published elsewhere by Hensher *et al.,* (2010). An independent repetition of the analysis revealed that the overall rating was for *importance* influenced positively by Superoute services and frequencies during the day and negatively for personal security on the bus for both *importance* and *satisfaction*. For overall quality for the whole sample for *importance* information at bus stops was a positive contributory factor, whilst for *satisfaction* frequencies in the evening had a positive and ease of buying a ticket negative influence. An important finding of the OLR analysis is that the quality attributes influencing the overall rating of the bus are not always consistent with those that influence the overall quality of the bus. There is a suggestion that overall rating reflected opinion regarding all services and therefore a more operational perspective. On the other hand the overall quality was more aligned to passengers' perception of the quality of service on which they were travelling at the time of the survey and therefore provided a more user perspective. NSR service quality was judged negatively by commuters whilst for *importance* information at bus stops had a positive influence SR being a greater influence compared to NSR. Finally, no attribute for *satisfaction* influenced NSR but for SR frequencies on Sundays and security whilst travelling on buses had a positive influence.

7.6 Overview of Results from OLR in the context of the results from FA

Table 7.13 shows the summary of results for the overall sample, NSR, SR and by clusters in the context of the three factors (Service Infrastructure, Bus Operation, and Ticket Purchase) obtained from the Factor Analysis that was carried out in Stage 2. Only those attributes that exhibit statistical significance at the 95% level of confidence for each model have been entered into the table. A positive factor (+) means that the *quality* attribute is a contributory factor towards the perception of passengers, whilst a negative (-) value means that the attribute has a detrimental influence or negative contributory effect on perceived overall service *quality*. It is important to note that this analysis presents perception of the overall *quality* of the service on which the passenger was travelling during the questionnaire survey and therefore the results have to be interpreted in the context of the data samples as presented.

OLR by clusters (as defined by cluster analysis above) are shown in columns 5, 6, 7 and 8 respectively whilst three Clusters 1 (Column 5), 2 (Column 6) and 4 (Column 8) were NSR only, Cluster 3 (column 7) was SR. The OLR analysis has opened up some interesting results, not always consistent with the ISA analysis presented earlier. Consistency in the *quality* attribute(s) having a contributory effect (whether positive or negative experiences) in influencing *importance* and or *satisfaction* of overall service *quality* were found in:

- Information at bus stops is important for all respondents irrespective of NSR or SR and clearly this is something that the PTE and local authority should address.
- Commuters are clearly dissatisfied with NSR services.
- The disparity in the four NSR services has revealed itself in the lack of statistical significance of any *quality* attributes influencing overall service *quality* except for information at bus stops the *quality* attributes that are independent of service operation.
- Interestingly, frequencies in the evening are statistically significant in the overall, manifesting itself in Cluster 4 but not in the NSR group.
- Frequencies on Sunday are highlighted for all SR services and in the Cluster 4 at a 90% statistical significance with a negative impact on their perception on overall service quality.
- Cluster 1 (commuters, middle-age group, mainly NSR) journey time is important and has a positive influence on overall *quality* and *satisfaction* in reliability and costs which are clearly evident.
- Cluster 2 (commuters, middle-age group, mainly NSR) female emerged as significant influence on overall *quality* with positive *satisfaction* experience for punctuality. However for reliability for *importance* as well as *satisfaction* both have negative influences on the perception of service *quality*.
- Cluster 3 (older female shoppers, mainly SR) males emerged as significant influence on overall quality with positive experience for cleanliness at bus stops and negative experience for ease of a buying a ticket at the Travel Centre.

- Cluster 4 (mainly older female shoppers, mainly NSR) commuters emerged showing negative influence on overall *quality* but positive experience for *satisfaction* of service frequencies in the evenings and negative experience for frequency on Sundays.

Cluster 2 in OLR, *quality* attribute reliability is seen as being a negative contributory factor to both *importance* and *satisfaction*, however neither of which are significant for overall *quality* for NSR which is consistent with the ISA which identified reliability as being important to passengers who were dissatisfied with the service.

One result requiring further investigation was Cluster 1 where journey time was found to be significant in influencing the perception in OLR. This result is not supported by the ISA (Chapter 4) where this quality attribute was found to have low *importance* (and marginal *satisfaction*). This raises an interesting question in that the services studied in this research penetrate the urban area to an extent that they provide the only public transport option for some passengers. In order to maximise the coverage the journey time, particularly for those passengers who board and alight at the terminal, the service is long. This result suggests that as this sample of the passengers were drawn at random; some will have a longer and some a shorter duration journey. Given that for those with the longer journey, there is likely to be no alternative, they may accept (and therefore be satisfied) or find the journey tiresome (and therefore are not satisfied). Those passengers who are served on the line haul section of the route have available alternative services therefore subconsciously influencing their perceptions.

The results of the OLR have confirmed that *importance* of the provision of information at bus stops and service frequency of buses on Sunday is a contributory factor to the *satisfaction* for SR operation. The results also have shown that the *quality* attributes to improve *satisfaction* of male commuters aged 25-49 years were punctuality, reliability and costs whilst for older female shoppers, cleanliness at the bus stops is important for SR and service frequency in the evening for NSR. The ease of buying a ticket on the bus for SR and frequencies on a Sunday for NSR was highlighted as not an important contributory factor to the perception on the overall rating.

Table 7.13 : Summary of the results when combine with factor and cluster analysis

Labels assigned in this research	**Overall**	**SR**	**NSR**	**Cluster 1** 25-34 yrs, Commuter NSR	**Cluster 2** 35-49 yrs, Commuter NSR	**Cluster 3** Female 60 and over shoppers SR	**Cluster 4** Male 60 and over shoppers NSR
Demographic characteristics	Commuters (-)		Commuters (-)	12 – 15 yrs old (-)	Female (+)	Male (+)	Commuters (-)
Factor 1 Service Infra structure	Info at bus stops(I)(+)	Info at bus stops(I)(+)	Info at bus stops(I) (+)			Cleanliness at the bus stops (I)(+)	
Factor 2 Bus Operation	Frequency in the evening (S)(+)	Frequency on Sundays (S)(+)		Journey time (I)(+)	Punctuality (S)(+)		Frequency in the evening (S) (+)
				Reliability (S)(+)	Reliability (I)(-) & (S)(-)		Frequency on Sundays (S)(-)
				Costs (S)(+)			
Factor 3 Ticket Purchase	Ease of buying ticket on bus (S)(-)					Ease of buying tickets at Travel Centre(S)(-)	

Note :(I) *Importance* (S) *Satisfaction* (+) positive coefficient (-) negative coefficient
Cluster 1 : 25-34 years, commuters, NSR
Cluster 2 :35-49- years, commuters, NSR
Cluster 3 : 60 years and over, shoppers, SR
Cluster 4 : 60 years and over, shoppers, NSR

7.8 Summary

This research has considered important aspects of bus service *quality* improvement through a detailed investigation of current bus operations and service *quality* initiatives in the context of an informal *Quality* Bus Partnership (QBP). The research results suggest that the perceptions of passengers are being influenced by the improvement in '*quality*' delivered by way of the 'Superoute' brand. *Quality* improvements introduced by the bus operators and local authorities can increase passengers *satisfaction* towards the service.

This research has highlighted a number of crucial key issues in understanding what passengers want in order to promote *quality* measures aimed to increase and maintain bus patronage of local buses and confirms the *importance* of passenger *satisfaction* for service continuation. It is found that passengers travelling on SR bus services are more satisfied than passengers travelling on NSR bus services. It is hoped that the evidence provided by the responses obtained from the passengers' perception survey, identifying improved perceived service *quality* with SR services will encourage bus operators to improve the service *quality*, and therefore will help to increase the bus usage.

In terms of OLR analysis by the overall sample, it was shown that the *importance* of 'information at bus stops' and *satisfaction* in 'frequencies in the evening' is a contributory factor in how passengers perceived the overall *quality* of bus service and 'ease of buying a ticket on the bus' and had a negative contributory factor influence on the overall rating for bus service *quality*. Gender turned out to be not statistically significant in predicting the overall service *quality* and the negative influence of commuters perception of overall *quality* is statistically significant. The OLR suggests that dropping the statistical level of confidence to 90% ($t = 1.65$) then, 'punctuality' is a variable that influences the perception on overall *quality*.

OLR by type of bus service; NSR and SR, showed that among socio-economic variables, the passengers on NSR services, who travel to work, demonstrate statistically significant influences from service *quality* measures on their overall perception of service *quality*. In this case the coefficient is negative confirming that the perception of service *quality* on the NSR service is low. All other variables, and more specifically those associated with *satisfaction*, are not statistically significant for NSR. However, results from the OLR for both NSR and SR showed that there was a strong relationship between the *importance* of information at bus stops in which it has shown a positive effect on the perception of passengers towards the overall rating of service *quality*. For SR positive influence was revealed by frequencies in Sundays and safety on buses.

OLR by clusters showed that Cluster 1 defined by CA as respondents aged between 25 – 34 years old, commuters and travelling on NSR showed negative influence of the 12 – 15 year old category. Respondents suggested journey time was important and dissatisfied for reliability and cost of tickets. Cluster 2 described by CA as commuters (35 – 49 years) and travelling on NSR showed concern for punctuality in influencing their perception on the overall rating of service *quality*. Cluster 3 described by CA as shoppers (60 years and over) travelling on SR services found that cleanliness at bus stops was a statistically significant factor in influencing their perception of the service *quality*. Finally, Cluster 4 defined by CA as shoppers (aged 60 years and over) and travelling on NSR services found that improved frequencies in the evening would improve their perception of the bus service overall. The discussion of the integration of the five stages of analysis will be articulated in the next chapter; Chapter 8.

CHAPTER 8 : DISCUSSION OF THE FIVE STAGES OF ANALYSIS

8.1 Introduction

The literature review was very useful in formulating the direction of the research and in particular identifying the technique of *Importance* and *Satisfaction* Analysis (ISA), which has previously had limited application in the public transport sector but is commonly applied in the business and marketing fields. This research combined a multiple faceted analysis approach. Five stages in the analysis method were identified namely descriptive, Importance *Satisfaction* Analysis (ISA), Factor Analysis (FA), Cluster Analysis (CA) and Ordered Logit Regression (OLR). This has provided an in depth view, exploring the data from different angles, from the passengers' view as well as the operators. The results from this research have led to some recommendations that may, in the future enable investment that targets the needs of passengers or user groups to enhance their *satisfaction* which in turn may influence their future behaviour. In Section 8.2 of this chapter the findings of the descriptive analysis, ISA, CA and FA are revisited, integrated and compared in the context of the objectives. The limitations of the approach taken will be elaborated upon in section 8.3 and the final Section 8.4 summarises the key findings.

8.2 Discussion of Findings

The results of the comprehensive analysis carried out in this study are summarised in this section with a view to exploring key messages which emerge consistently from the five different statistical approaches adopted by this research. It was not possible to carry out a systematic *before* and *after* study due to the political uncertainties and commercial sensitivities across competing service providers as well as the timescales of the introduction of the Superoute services in relation to the commencement of the thesis. This situation led to the need to choose services on which interviews were to take place which were considered to represent as far as possible similar passenger cohorts, however this choice was limited by availability and co-operation of service providers. Also, although the intention was to have a similar number of questionnaires completed on each service, due to issues created by third parties this turned out not to be possible. For these reasons the multifaceted statistical approach was adopted to allow independent analyses of the sample of data from the total 310 respondents to reveal from different perspectives any similarities and differences in responses. In this section by comparing and contrasting the outputs from the different approaches, it should reveal key results in which we have statistical confidence at 95%.

8.2.1 Descriptive Analysis

The results of the descriptive analysis are summarised in Figure 8.1 and Figure 8.2. The descriptive analysis confirmed that to a 95% level of statistical significance the sample of passengers represented the population of Tyne and Wear well with a higher proportion of women consistent with research of (Pickett and Gray, 1996; Wall *et al.*, 2008). Also, the sample was consistent with McDonnel *et al.,* (2006), who found that 62% of respondents had stated the lack of car availability as the main reason for choosing the bus service and (Guiver, 2007) who found in her study that 70% of the sample had no access to a car. With a 95% level of statistical significance passengers using NSR services were similar to SR for age and gender. However, more passengers were unemployed and 60 and over on NSR whilst passengers using SR were generally younger and employed.

Service quality scales across the four NSR studied were varied and there was clear evidence that QBP had led to more consistency in perceptions across the SR services studied with high *satisfaction* for punctuality and evening and daily service frequencies. However, the inconsistency in respect of friendliness of drivers between SR and NSR from the Mann Witney and the χ^2 test can be explained in terms of the lack of homogeneity within the bus services revealed by the *post hoc* tests.

STAGE 1	DESCRIPTIVE ANALYSIS

- Age representative of Tyne and Wear population. More females and unemployed use bus.
- no s.s.d between NSR and SR in terms of gender and age, car accessibility, regularity of bus usage, type of tickets used
- s.s.d different on employment status, and knowledge of bus timetable before leaving the house.
- Over all respondents - The highest mean score for *importance* was reliability and the lowest score was buying a ticket at the Travel Centre
- Over all respondents - The highest mean score for *satisfaction* was buying a ticket on the bus and the lowest score was cost of tickets

A Chi square test for differences between NSR and SR showed statistical significant differences for *importance* were frequencies on Sundays and reliability and for *satisfaction* all but buying a ticket at the travel centre, cleanliness at the bus stops, journey time, friendliness of the drivers and costs of tickets.

Chi Square Test between NSR and SR

Not s.s.d. for Importance	***s.s.d for Importance***	***Not s.s.d for Satisfaction***	***s.s.d for Satisfation***
1.Frequencies during the evening 2. Frequencies during the day 4. Punctuality 6. Buy ticket on the bus 7. Buy ticket at the Travel Centre 8. Cleanliness on the bus 9. Cleanliness at the bus stops 10.Journey time 11.Friendliness of drivers 12.Information at bus stops 13. Finding Information 14. Security on the bus 15. Security at bus stops 16. Condition of shelters 17. Cost of tickets	3.Frequencies on Sundays 4. Reliability	7. Buy ticket at the Travel Centre 9. Cleanliness at the bus stops 10. Journey time 11. Friendliness of drivers 17. Cost of tickets	1. Frequencies during the evening 2.Frequencies during the day 3.Frequencies on Sundays 4.Reliability 5.Punctuality 6.Buy tickets on the bus 8.Cleanliness on the bus 12.Information at bus stops 13.Finding Information 14.Security on the bus 15.Security at bus stops 16.Condition of shelters

Figure 8.1 : Summary of Results for Descriptive Analysis

Note:
s.s.d = statistically significantly different

STAGE 1	DESCRIPTIVE ANALYSIS

Mann Whitney Test (between NSR and SR)

No s.s.d. for Importance	***s.s.d for Importance***	***no.s.s.d for Satisfaction***	***s.s.d for Satisfaction***
2.Frequencies during the day 4.Reliability 5.Punctuality 13.Finding Information	12.Information at bus stops 14. Security on bus	3.Frequencies on Sundays 8.Cleanliness on the bus 9.Cleanliness at bus stops 10.Journey time	1.Frequencies during the evening 2.Frequencies during the day 5.Punctuality 11.Friendliness of drivers

Mann Whitney test statistical differences between NSR and SR found for *importance* with regards to information at bus stops and security on the bus and for *satisfaction* frequency during the evening and day, punctuality and friendliness of the drivers.

Figure 8.2 : Summary of Results for Descriptive Analysis (Continue)

STAGE 2	IMPORTANCE *SATISFACTION* ANALYSIS (ISA)

Overall - commuters

Possible Overkill	*Keep up the Good Work*
6.Buy ticket on the bus (S) 7.Buy ticket at theTravel Centre 8.Cleanliness on the bus	2.Frequencies during the day 4.Reliability 5.Punctuality 11.Friendliness of drivers 14.Security on bus 15.Security at the bus stops
Low Priority	***Concentrate Here***
1.Frequencies in the evening (S) 3.Frequencies on Sundays 9.Cleanliness at the bus stops 10.Journey time	12.Information at bus stops (I) 13.Finding information 16.Condition of shelters 17.Cost of tickets

NSR – commuters

Possible Overkill	*Keep up the Good Work*
6.Buy ticket on the bus 7.Buy ticket at the Travel Centre 8.Cleanliness on the bus	2.Frequencies during the day 14.Security on bus
Low Priority	***Concentrate Here***
1.Frequencies in the evening 3.Frequencies on Sundays 9.Cleanliness at the bus stops 10.Journey time	4.Reliability 5.Punctuality 11.Friendliness of drivers 12.Information at bus stops (I) 13.Finding information on bus routes (I) 15.Security at bus stops 16.Condition of shelters 17.Cost of tickets

SR

Possible Overkill	*Keep up the Good Work*
1.Frequencies in the evening 6.Buy ticket on the bus 7.Buy ticket at Travel Centre 8.Cleanliness on the bus 12.Information at bus stops (I)	2.Frequencies during the day 4.Reliability 5.Punctuality 11.Friendliness of drivers 13.Finding information on bus routes (I) 14.Security on the bus 15.Security at bus stops 16.Condition of shelters
Low Priority	***Concentrate Here***
3.Frequencies on Sundays (S) 9.Cleanliness at the bus stops 10.Journey time	17.Cost of tickets

Statistical Significance Key:
(S) *Satisfaction*   (I) *Importance*
Red Highlight = Negative Correlation   Green Highlight = Positive Correlation in OLR

Figure 8.3 : Summary of Results for Importance Satisfaction Analysis

Work SR

Possible Overkill	*Keep up the Good Work*
6.Buy ticket on bus 7.Buy ticket at Travel Centre 8.Cleanliness on the bus 11.Friendliness of drivers	2. Frequencies during the day 4. Reliability 5. Punctuality
Low Priority	***Concentrate Here***
1.Frequencies during the evening 3.Frequencies on Sundays 9.Cleanliness at the bus stops 10.Journey time **W**2.Information at bus stops	14. Security on bus 15. Security at bus stops 17. Cost of tickets

Leisure (NSR + SR)

Possible Overkill	*Keep up the Good Work*
1.Frequencies during evening 5.Punctuality 6.Buy tickets on the bus 7.Buy ticket at Travel Centre 8.Cleanliness on the bus 10.Journey time	2. Frequencies during the day 4. Reliability 5. Punctuality 11. Friendliness of drivers 12. Information at bus stops 14. Security on bus 15. Security at bus stops
Low Priority	***Concentrate Here***
3.Frequencies on Sundays 9.Cleanliness at the bus stops 17. Cost of tickets	13. Finding Information on bus routes 16. Condition of shelters

Figure 8.4 : Summary of Results for Importance Satisfaction Analysis (Continue)

STAGE 3	FACTOR ANALYSIS (FA)

- Three Factors emerged

Factor 1: Service Infrastructure with 10 factors namely cleanliness on the bus and at the bus stops, Journey time, Friendliness of drivers, Information at bus stops, personal security on the bus and at bus stops, Condition of shelters and Cost of tickets
Factor 2: Bus Operation with 5 factors namely frequencies during evening, during the day and on Sundays, reliability and punctuality.
Factor 3: Buy tickets on the bus and Travel Centre

- Statistically significant difference for *satisfaction* between NSR and SR for both Factor 1 and Factor 2
- Statistically significant similar results between NSR and SR for Factor 3

Figure 8.5 : Summary of Results for Factor Analysis

STAGE 4	CLUSTER ANALYSIS (CA)

Cluster 1: 24-35 years commuters, male NSR, 12-15 (negative)

Possible Overkill	***Keep up the Good Work***
2. Frequencies during the day 6.Buy tickets on the bus 7.Buy ticket at Travel Centre 10.Journey time (I)	
Low Priority	***Concentrate Here***
1.Frequencies during evening 3.Frequencies on Sundays 8.Cleanliness on the bus 9. Cleanliness at the bus stops 11. Friendliness of drivers 13.Finding Information on bus routes 14. Security on bus 16. Condition of shelters 17. Cost of tickets (S)	4. Reliability (S)

Cluster 2: 36-45 years commuters male NSR, female (positive)

Possible Overkill	***Keep up the Good Work***
1.Frequencies during evening 6.Buy tickets on the bus 7.Buy ticket at Travel Centre 8.Cleanliness on the bus	2. Frequency during the day 4. Reliability (I) (S) 5. Punctuality (S) 9. Cleanliness at the bus stops 11. Friendliness of drivers 12. Information at bus stops 13. Finding information about bus routes 14. Security on bus 15. Security at bus stops 16. Condition of shelters
Low Priority	***Concentrate Here***
3.Frequencies on Sundays	10. Journey time 17. Cost of tickets

Statistical Significance Key:

(S) *Satisfaction* (I) Importance

Red Highlight = Negative Correlation Green Highlight = Positive Correlation in OLR

Figure 8.6 : Summary of Results for Cluster Analysis

Cluster 3: 60+Shoppers female SR, male (positive)

Possible Overkill	*Keep up the Good Work*
1.Frequencies during evening 3.Frequencies on Sundays 6.Buy tickets on the bus 7.Buy ticket at Travel Centre (S) 9. Cleanliness at the bus stops (I) 11. Friendliness of drivers 17. Cost of tickets	2. Frequency during the day 4. Reliability 5. Punctuality 8. Cleanliness of the bus 11. Friendliness of drivers 12. Information at bus stops 13. Finding information about bus routes 14. Security on bus 15. Security at bus stops 16. Condition of shelters
Low Priority	***Concentrate Here***

Cluster 4: 60+ Shoppers, female NSR , commuters (negative)

Possible Overkill	*Keep up the Good Work*
Low Priority	***Concentrate Here***
	1. Frequencies during evening (S) 2. Frequencies during the day 3. Frequencies on Sundays (S) 4. Reliability 5. Punctuality 6. Buy tickets on the bus 7. Buy ticket at Travel Centre 8. Cleanliness on the bus 9. Cleanliness at the bus stops 10. Journey time 11. Friendliness of drivers 12. Information at bus stops 13. Finding Information 14. Security on the bus 15. Security at bus stops 16. Condition of shelters 17. Cost of tickets

Figure 8.7 : Summary of Results for Cluster Analysis (Continue)

In addition those attributes found not to be statistically significantly different in the χ^2 (attributes 7,9,10,11,17) and the Mann Witney (3. 8, 9, and 10), see Tables 4.12 and 4.13, are likely also to be explained by the variations in the passengers' experiences travelling on the four NSR bus services studied. Wall and McDonald (2007) and Hensher *et al.,* (2010) and evidence from the City of Winchester and the Tyne and Wear region, suggest that a high frequency service is the most important pre-requisite to encourage modal shift. Also Horowita (1981) suggested that travellers aim to minimise walking time as far as possible especially in poor weather conditions which was offered by Wall and McDonald (2007) as helping to explain why 81% of respondents in Winchester felt that 'turn-up-and-go' frequency is necessary.

8.2.2 Overview of the ISA

The ISA results are summarised in Figure 8.3 for overall sample and for NSR and SR separately and in Figure 8.4 for overall trips and for NSR and SR trips to work and for leisure. The results of the OLR are indicated by green highlighted text when attributes are significant with positive correlations and in red for significant negative correlation for *importance* (I) and *satisfaction* (S). These will be discussed later in this section.

There is clear evidence that both NSR and SR services provided high *satisfaction* in service frequency during the day and security on the bus which was of high importance. Both NSR and SR services expressed *satisfaction* with respect to frequencies during the day and security on the bus stops but with SR more *satisfied* than NSR. *The* SR service has high *satisfaction* in reliability, punctuality, friendliness of drivers, finding information on bus routes, security on the bus and at bus stops and condition of shelters. Both NSR and SR passengers are dissatisfied with the costs of tickets with a suggestion that for NSR services, passengers are marginally less satisfied based on the score mean (median) (NSR=2.58 (2), compared with SR=2.76 (2)). Possible Overkill (with high *satisfaction* of quality measures considered to be less important) for SR included frequency in the evenings, purchase of ticket on the bus and at the Travel Centre, cleanliness on the bus and information at the bus stops. However, it is important that bus companies maintain standards in these respects because the investment in quality measures leads to *satisfaction* and therefore may lower the importance. In other words these latter findings may suggest a deterioration of standards but equally can be explained by a resulting rise in expectation of SR passengers. Further research and additional data collection is needed to explore this finding in more depth. On the other hand the quality attributes falling in Low Priority for both NSR and SR are the frequencies on Sundays; this is clearly an area needing further attention in SR whilst cleanliness at the bus stops and journey time are mainly associated with third party responsibilities which should be addressed by the Local Authority. Investment in frequency of services in the evening needs to be addressed in NSR but clearly emerges as an improvement from the QBP.

Further insights of the characteristics of users of overall bus services gained from the ISA suggest that passengers travelling to work place high *importance* and high *satisfaction* on frequencies during the day and are satisfied with buying a ticket on the bus and at the Travel Centre but these are of low importance. Overall for commuters there is dis*satisfaction* with all other attributes; this in contrast with leisure trips which have a higher *satisfaction* is placed on all high importance attributes except finding information about routes and cost. However consistent with commuters leisure purpose trips expressed *satisfaction* in regard to buying tickets on the bus and at the Travel Centre although considered of low *importance*.

Considering the differences found between NSR and SR services for commuter trips, large differences are apparent. In the case of NSR there is no *satisfaction* revealed for any of the attributes considered important. Whilst for SR services quality attributes of high *importance* and high *satisfaction* for frequencies during the day, reliability and punctuality. *Satisfaction* for buying a ticket on the bus and at the Travel Centre (although of *low importance*) emerged as before, as significant in both NSR and SR for work trips. SR services also revealed improved *satisfaction* for cleanliness of the bus and friendliness of the driver suggesting that the QBP has increased *satisfaction*, however cost of tickets and security on the bus and bus stops still remain an issue.

8.2.3 Factor Analysis (FA)

The first step in FA was to explore commonality within the 17 quality attributes for *importance* and *satisfaction* and the results are summarised in Figure 8.5. The 17 attributes were reduced to three factors as follows:

Factor 1: Service Infrastructure with 10 *quality* attributes, namely cleanliness on the bus and at the bus stops, journey time, friendliness of drivers, information at bus stops, personal security on the bus and at bus stops, condition of shelters and cost of tickets

Factor 2: Bus Operation with 5 *quality* attributes namely frequencies during the evening, during the day and on Sundays, reliability, punctuality; and,

Factor 3: Ticketing with 2 *quality* attributes buying tickets on the bus and at Travel Centres.

The results show that passengers scores for *importance* were not statistically significant different for NSR and SR. However, passengers travelling on SR services have statistically significant higher *satisfaction* scores on the first two factors; Service infrastructure and Bus Operation. For passengers travelling on NSR services, the results show that there are variations within the sub-sample for Ticket Purchase. In terms of assessing the impact of SR implementation, the factors which have been improved in the context of QBP are those relating to Service Infrastructure (Factor 1) and Bus Operation (Factor 2), but not for Ticket Purchase (Factor 3) which remained statistically significantly similar for NSR and SR services, with *low importance* and *high satisfaction*.

8.2.4 Analysis of results established in FA, CA, ISA and OLR

Descriptive analysis showed no differences between NSR and SR in terms of gender and age, car accessibility and regularity of bus usage and type of tickets used, however Cluster Analysis revealed clear differences when clustered into four sub groups or cohorts. Figure 8.6 provides summary of the ISA analysis for each cluster described by passengers with different demographic characteristics. It can be seen that passengers in each cluster respond quite differently, suggesting that marketing strategies need to be targeted for different cohorts of passengers as their perceptions are different. Cluster 1 young adults mainly NSR commuters were dissatisfied with the one attribute considered important namely reliability, whilst older male adults using mainly NSR were dissatisfied with two important attributes, journey time and the cost of ticket. Whilst Cluster 1 considered no other attribute important Cluster 2 considered 10 attributes as important with which they were satisfied. Cluster 3 mainly female 60+ shoppers which were mainly SR users, were satisfied with all quality attributes. On the other hand Cluster 4 female shoppers on NSR were dissatisfied with all attributes, all of which were deemed important. Consistently the cost of tickets emerges as the attribute with the lowest *satisfaction* score for all clusters, falling below the *satisfaction* hairline except for Cluster 3, suggesting that the SR quality investment has improved perceptions and therefore it is considered better value for money. Interestingly for Service Infrastructure and Operational Factors revealed by the FA, there are clear differences between the cohorts, whilst the two quality attributes namely buying a ticket on the bus and at the Travel Centre were the only two quality attributes consistently appearing in the low *importance* / high *satisfaction* quadrant except for Cluster 4. These quality attributes emerged as the third Factor from the FA. The ISA and the Cluster Analysis are consistent with the conclusions drawn from the χ^2 test and the Mann Whitney tests.

For comparison with the outputs from the FA and ISA for clusters, the attributes statistically significant at the 95% level of confidence in the OLR and considered to have positive influence, are shown in green font and those with negative influence in red font in Figure 7.6. Whether the significance is for *importance* (I) and/or for *satisfaction* (S) is indicated in brackets. The results show that information at bus stops was the single most important driver in influencing the perception of the overall quality for all respondents, for both NSR and SR services. However this attribute does not specifically emerge as important for Cluster 1 and 2 but does for Cluster 3 and 4. In OLR, the driver for *satisfaction* across all services was found to be frequencies in the evening and certainly this is seen to fall below the *satisfaction* hairline for all mainly NSR Clusters. Interestingly this attribute, in the χ^2 analysis showed statistically significant differences between NSR and SR with the former respondents dissatisfied and the latter satisfied. In ISA, evening service provision was statistically significant for *importance* and *satisfaction* for both NSR and SR and SR passengers showed *satisfaction* whilst NSR were *dissatisfied*. Similarly, in OLR, ease of buying a ticket on the bus influenced overall service *satisfaction*. This attribute was found to be statistically significant for both *importance* and *satisfaction* for NSR and SR but with a negative coefficient.

A driver for *satisfaction* on SR was governed by two main attributes, firstly frequencies on Sundays and secondly passenger safety while travelling on the bus. Critically significant in the χ^2 analysis, NSR responses were statistically significantly different from the SR and the ISA analysis and have revealed that passenger *satisfaction* in both NSR and SR services was for security on the bus but with a higher score for the latter (mean 3.65, median 3) compared to the former (mean 3.25, median 3). This attribute was found to be very important for female passengers borne out by the *importance* and *satisfaction* score for Cluster 2 mainly female (mean 4.71, median 4 and mean 3.65 median 3) respectively. Therefore, from the operators' perspective any measures that can increase security for passengers would be a worthwhile investment. Frequency on a Sunday, whilst of relatively medium to low *importance*, emerged from the ISA analysis consistently as being a quality attribute with which passengers were dissatisfied whether overall, for NSR, for SR, Cluster 1, 2 or 3. This suggests to the operators that it may be worth considering carrying out market research to explore the potential patronage for improvement of Sunday services.

The statistically significant driver of quality for Cluster 1 was the *importance* of the journey time. Interestingly journey time emerged from the descriptive statistics as there being no statistically significant differences for NSR and SR. However, in ISA, this service quality was found to be statistically significant for both *importance*, although median score, and for *dissatisfaction* with a relatively high score. Journey time emerged consistently as a cause for dis*satisfaction*. Delay can be due to many different reasons and within the current study could not be elaborated upon. Given the delay may be associated with congestion it can be argued that it is more of a responsibility of the Local Authority rather than the bus operator. On the other hand the fact that the bus service routes were in some cases circuitous and a high proportion of passengers purchased a ticket (not concessionary) there is potential for bus operators to look more carefully at the duration of the route itself and for the introduction of smart ticketing to reduce the dwell time at the bus stops. For Cluster 2 reliability emerged as a driver for overall quality for both importance and *satisfaction*. The descriptive analysis also showed statistical differences between NSR and SR for reliability confirmed by the ISA with importance scores respectively for NSR and SR, mean 4.65 (median 4) and mean 4.60 (median 4) for both *importance* and mean 3.09 (median 3) and mean 3.63 (median 3) for *satisfaction*, clearly showing the SR far outperforming NSR.

In terms of '*satisfaction*', the OLR revealed that reliability and costs of tickets had a positive influence on the overall quality of service in Cluster 1. The descriptive statistics showed for cost of tickets no statistical difference between NSR and SR for *importance* and for *satisfaction*. Also, for *importance* and for the responses overall, for NSR and SR scores were close or higher than the grand mean of the cross hair confirming the general consensus of the *importance* of cost of tickets. On the other hand for commuters irrespective of NSR or SR and specifically 36-45 commuters in Cluster 2 there were larger differences with the cross hair in the context of *satisfaction* with one exception. As expected for Cluster 3 senior citizens who were shoppers, there was complete *satisfaction* with cost as a high proportion of this cohort received concessionary fares. These results clearly reveal that bus companies should look for ways to keeping prices low whilst also improving service quality.

For Cluster 2, OLR exhibited *satisfaction* on punctuality influencing the overall rating for service quality. For punctuality the descriptive statistics revealed no statistically significant differences between NSR and SR however for *satisfaction* there was a statistically significant difference between the service quality offered by NSR and SR. The ISA, showed statistically significant differences in the cross hairs for both *importance*, and for *satisfaction*, with SR outperforming NSR with respective scores *importance (mean-median): satisfaction (mean-median*) scores 4.59(-4), 3.59(-3) and 4.57(-5) 3.10(-3). Bus companies need to consider carefully the reasons for lack of punctuality of their bus services. Whilst this can be attributable to delay due to traffic it is also due to bus scheduling and the discipline of drivers to adhere to timetables. This is not only because buses may arrive late at bus stops during peak times, but also due to early arrival at bus stops during off peak periods. There is much potential for the QBP with Local Authority to address delays to buses due to traffic congestion and implementation of bus priority and smart ticketing measures to keep buses on time.

For Cluster 3, OLR shows that cleanliness at the bus stops had a positive influence on overall quality for *importance* and emerged systematically throughout the descriptive and ISA analyses. Cleanliness at the bus stops in the descriptive statistics emerged as no statistical differences between NSR and SR for *importance* and for *satisfaction*. The difference between the cross hair and this quality attribute was fairly similar to the cross hair for *importance* for NSR and yet in all cases for *satisfaction* for statistically significantly different from the cross hair. The ISA identified this attribute as consistently falling in the **Low Priority** quadrant with low *satisfaction* and low importance. This attribute, given that it is a driver for overall service quality and in particular for the only predominantly SR cluster, suggests that much more effort is needed to keep bus stops clean. Again this is a third party responsibility and one that should be considered very strongly within the QBP initiatives as the mechanism to deliver this quality attribute, is consistent and can be facilitated by the QBP objectives.

Ease of buying a ticket at the Travel Centre was identified in OLR as having a negative effect on overall service quality and indeed the ISA confirmed this finding. The mean Likert score for ease of buying a ticket consistently was substantially different from the cross hair for both *importance* and *satisfaction*. Throughout ISA analysis this quality attribute remained in the quadrant Possible Overkill, suggesting high *satisfaction* and low *importance*. This result suggested that this attribute was located in this quadrant because in general there is a good provision for purchase of tickets at the Travel Centre. However, equally, it was acknowledged that the reason for this attribute being considered as low importance was possible because the quality of service was delivering a high *satisfaction* score. Indeed whilst labelled as ‘Possible overkill’ the quadrant should also bring with it a message of ‘Not to Rest on Laurels’. This was borne out by the negative coefficient on the OLR for *satisfaction* confirming that ticket purchase for predominantly male commuters using mainly SR services.

Schemes such as the annual travel card purchased by monthly payments from passengers' salaries, should be encouraged especially if incentives (say 25% less an a yearly subscription) can be given.

For Cluster 4, overall service quality was influenced (a) positively for *satisfaction* by frequency in the evening. In the ISA this attribute was always found to be substantially different from the cross hair for both *importance* and *satisfaction*. However, its quadrant location whilst never in 'Keep up the Good Work' varied depending on the ISA analysis scenario: namely for NSR, Cluster 1 Commuters (NSR) and Cluster 3, 60+ shoppers (SR) it was located in Low Priority and yet for SR, Leisure (NSR+SR) and Cluster 2, 36-45 age commuters (NSR) in 'Possible Overkill' and finally for all services, NSR + SR, for commuters and Cluster 4, 60+ shoppers (NSR) in 'Concentrate Here'. This result, whilst rather mixed, presents the clear message that there is a potential market for improved evening services and it is recommended that bus operators carry out market research to further explore opportunities in this respect.

Finally the OLR revealed that in Cluster 4 the driver for overall quality was negative for *satisfaction* for frequencies on Sunday implying that the overall quality of the service was driven by the dis*satisfaction* of Sunday services. This was consistent with the statistically significant results from the ISA for senior citizen shoppers using NSR, but it was also a quality attribute that consistently located itself in all the scenarios (cluster 1, 2 and 3, overall leisure etc) studied, in the Low Priority quadrant demonstrating low *satisfaction* of *low importance*, suggesting that consideration should be given to improving Sunday services.

For further clarity of these results, the quality attributes that were found to be statistically significant in OLR are mapped onto the four quadrants in ISA. As an indication, positive quality factors have been highlighted in green and negative quality factors highlighted in red. These are shown in Figure 8.3 for overall, NSR and SR and in Figure 8.6 for Cluster 1, 2, 3, and 4.

It can be seen that those quality measures of *importance* and *satisfaction* that are influencing the overall perception of service quality never coincide with Quadrant I. Instead the OLR is highlighting quality measures which are negatively influencing passengers' perceptions and therefore those measures that require action respectively.

The results from OLR found that there was a strong influence of perception of *importance* and *satisfaction* of individual *quality* attributes on the overall rating of quality of bus service. This confirms previous research findings that a relationship between *satisfaction* and the overall rating of bus service exists and is consistent with Ekinci (2004) and (Gonzalez *et al.*, 2007). However, attributes influencing overall rating were quite different from overall quality the former driving more from the operators' and the latter passenger's perspective.

8.3 Limitations

This research has strived to obtain a greater understanding of passengers' perception to bus service provision with and without investment delivered through QBP. In spite of its extensive analysis beyond what is currently available in the literature on service *quality* and bus service provision, this research has some limitations. The limitations encountered are discussed in detail and in context throughout this thesis however they can be summarised as follows:

8.3.1 Data Collection

The questionnaire used for this research filled two sides of an A4 sheet and one of the problems encountered during the interviews was the time taken to complete the questionnaire relative to the length of a typical bus journey. This led to a limitation in the number of interviews carried out. Although every effort was made to ensure that the final sample was representative of the passenger population it was found that the diverse quality of the NSR services (rendering significant variation of Likert score within the NSR sample) limited the statistical confidence of some of the results. Also, there may have been some bias due to the differences in the demographics of passengers through the day with more commuters in the peaks and senior citizens in the off peak coupled with the higher levels of passengers travelling during peak hours relative to off peak travel.

Whilst every effort was taken to make the sample representative it is not certain that the correct balance between journey purpose commuters, leisure and shopping was achieved. This was because due to commercial confidentiality passenger data from the bus companies running the services in the North East were not available. It is recommended that for future research, a larger sample across a wider range of NSR services be made and efforts to collect an independent data set to inform the correct balance between data collection during peak and off-peak periods would increase confidence in the sample being representative. Furthermore, due to the limited time spent by the passengers on their bus journeys, there were several incomplete questionnaires which reduced the efficiency of the time spent collecting the data. In the future, it is recommended that some questions could be shortened and made simpler in order to achieve a higher sampling rate. In certain circumstances, it is difficult to control the time of the surveys which mostly depends on the respondents responses at that time. Arrangements of the questions may sometimes lead the passengers to agree with statements in the questionnaire which in this case might influence their choices and may not therefore be truly representative of their actual perceptions. However, given that some of the more open ended questions at the conclusion of the questionnaire were not completed and therefore not useful in this research, retrospectively these questions could have been removed.

8.3.2 Importance Satisfaction Analysis

The application of ISA analysis was found to give interesting insights into this data. However, one of the most challenging aspects of the ISA and one that resulted in hours of discussion was how to define the cross hair at each step in the analysis, namely over all the data, disaggregated into NSR and SR, and subsequently for the four clusters. In addition whether the mean, median or middle value should be chosen as the hairline and whether the mean or the median attribute should be used in displaying the data in tabular and graphical form.

In order to more clearly identify key findings across all steps in the analysis, several options were carried out to identify the appropriate statistic to be used as the cross hair as discussed in Chapter 3 Methodology. The Likert scores for both *Importance* and *Satisfaction* and the location of the cross hair illustrate clearly the problems, not only in the choice of cross hair but also in the use of the median (given that the distribution of scores are not normal) to show trends in the data. ISA was carried out on several options by plotting:

1. Mean scores and grand mean as the cross hair
2. Mean scores and median as the cross hair
3. Median scores and median as the cross hair
4. Median scores and grand means as the cross hair
5. Mean scores and middle scale as the cross hair
6. Median scores and middle scale as the cross hair

The first assumption in ISA was that the Likert scores were interval data and the mean scores of the responses for each quality attribute for *Importance* and *Satisfaction* were plotted using the grand mean as the cross hair. It is found that the data is distributed reasonably across the four quadrants which at a glance reveal the range of perceptions of passengers across all services. When the median values were plotted, again with the cross hair based on the grand mean, it was evident there was difficulty in distinguishing the 17 attributes if the median value is used as only four points resulted.

Using mean scores with the cross hair based on the middle scale found that the distribution of data mostly lies in Quadrant I assuming that all respondents are satisfied with the service, this clearly is unhelpful. In the interpretation, these results could be misleading because the higher proportion of the respondents scored quality attributes of high importance. This exposes a weakness in the use of what is essentially a relative scale to quantify perceptions.

Using the median value and the cross hair based on the middle scale of the Likert score which is 3, again, it is found that the distribution of data mostly lies in Quadrant I with all median values co-incident on one of four points which leads to the conclusion that all respondents are satisfied with the service. This demonstrated clearly the inappropriateness of the use of any statistic for the cross hair other than the mean value and endorses the inappropriateness of the use of the median score to show differences in the respondents' perception of quality as it is not as informative as the use of the mean.

Therefore, in each case the 'grand mean score' (Zhang and Chow, 2002) was adopted for the hairline because it best represented the overall score over all attributes over all respondents and did not create a bias towards the lower perceived quality of the NSR and higher quality of the SR. In all cases, this grand mean score remained the same for all scenarios thus keeping a 'base case' or a 'benchmarked' set of axes against which all scenarios systematically could be compared. Due to the lack of normality of the distribution of the cross hair and that for each of the Likert scores for 17 importance and 17 satisfaction attributes, it was difficult to establish a robust test for whether or not the mean (or median) was statistically similar to or different from the cross hair value. The standard error of mean and standard error of the median were always lower than 0.02 suggesting a ± 95% confidence of less than 0.04 which does provide some indication of how distant the attribute was from the hairline. Clearly the choice of cross hair governs into which quadrant each quality attribute 'falls'. In all cases, whilst non parametric tests were carried out due to the lack of normality of the distributions of Likert scores for each attribute, the means were plotted simply because of the lack of granularity if the median was plotted. In this way, the ISA provides an indication of the relative *importance* and *satisfaction* of the respondent's perception to 17 quality attributes which can be judged visually on the graphs provided.

The challenge of defining the cross hair has been recognised in other applications by Oh (1999) who was of the opinion that ISA failed to give clarity of decision making and TRB (1999) demonstrated that if used without care and caution may lead to incorrect interpretation. Indeed this research has endorsed these earlier findings. However, although not an exact science by considering the attributes position on the ISA two dimensional surface for *importance* and *satisfaction*, the method has provided evidence to assist bus operators in their decision making by advising in which quality measures to invest to be commercially competitive thus ensuring provision of high *quality* of service to the passengers. However, this method performs best with large samples to ensure that the sample represents the perception of the public transport population. Furthermore, the use of the average of the five scale for the *importance* and *satisfaction* may give the wrong interpretation due to the lack of normality in the distribution of the Likert scale. Where possible non parametric tests were employed to be sure the analysis did not introduce bias in the results.

Another issue is in the use of the middle point on the five scale; '3' to be categorised as 'no opinion'. Whilst the average point can be interpreted to represent a wide range of views, the scale of 'no opinion' could be interpreted in different ways too, for example 'no option to choose' or 'lack of interest'. Furthermore, respondents might have different levels of *satisfaction* of different *quality* factors, which in this case may not reveal the actual *satisfaction*.

8.3.3 Cluster Analysis

Cluster Analysis is very useful in determining segments or groups of respondents. However, the major disadvantage of CA is it does not provide any justification or explanation of 'why' and 'how' such groupings of respondents were made. It has been found that sometimes the final results are not robust by forming different clusters after running the analysis even though the analysis were run repeatedly on the same input data but introduced in different order. Therefore, in this research a degree of caution was taken in the interpretation of the results. Certainly much of the deviation between the OLR and the ISA could be explained through the definition of or descriptor labels assigned to the clusters. The problems of CA were revealed when running the analysis and it was necessary to re-run the analysis several times on the same data to ensure robustness of the final result.

8.3.4 Ordered Logit Regression

Ordered Logit Regression (OLR) used in this research is able to show the relationship between dependent and independent variables. However, even though correlation results have shown that there was a relationship between *importance*, *satisfaction* and overall rating and overall quality of service, the findings are however, unable to prove that one variable causes a specific change in another variable only in the independent variable.

8.4 Summary

A qualitative and quantitative approach was adopted to assess passengers' views of *quality* of bus service by comparing routes which have not, with those that have, experienced significant investment in improvements in *quality*. The research adopted five complementary analysis techniques in an attempt to reveal causal links between *quality* attributes and perceptions in the context of both *importance* and *satisfaction* with a known level of statistical confidence. The descriptive analysis confirmed that a fairly good representative sample of the passengers was achieved with a higher proportion of women consistent with (Pickett and Gray, 1996; Wall and McDonald, 2007), a higher proportion of elderly due to concessionary fares and a spread of journey purposes consistent with the catchment area of the bus services.

The Factor Analysis grouped *quality* attributes, the first related to Service infrastructure (including cleanliness of buses and stops, personal security duration of journey and cost of tickets), Bus Operation (including frequency of services at weekends and on Sunday, reliability of bus arrival) and finally Ticket Purchase (whether purchased on the bus or travel centre). Four clusters of passengers emerged from the data and these were used as a basis of gaining improved understanding of the attributes of *importance* to particular passenger groups using both ISA and OLR. The results show that *quality* factors that are important and lead to passenger *satisfaction* can be perceived differently by passenger groups with different characteristics such as gender, age and trip purpose.

These findings underline the difference in *satisfaction* of respondents from the two different types of bus services and thus it can be said that *Quality* Bus Partnerships have led to a significant degree of change in passenger perception. SR services, as a voluntary QBP, seem to be successful at delivering enhanced *satisfaction* for those quality attributes that are deemed important to passengers. It is hoped that the desired positive effect on passengers, would improve perceived service *quality* and encourage operators to improve the service *quality*, and therefore, consequently, patronage would increase. Finally, the research, which compared the perceptions of passengers travelling on SR and NSR services, with distinct differences in terms of *quality*, has shown that service *quality* has proved to have a statistically significant influence on the level of *satisfaction.* A strong relationship between perception of bus service *quality* and *satisfaction* was found with passengers travelling on the improved *quality* SR services. Thus, the findings support the evidence that *quality* can affect the level of *satisfaction* of passengers. Finally, adopting five different stages of analysis, served to endorse the results that emerged from each analysis and created a much richer understanding of the complex relationships governing the factors affecting bus passengers' perceptions of service *quality.* Notwithstanding the limitations identified in the data collection method suggest that given the constraints imposed by the bus operator restricting access to the services and the timing of the introduction of the Superoute has reduced the statistical confidence of the results presented. However, the analytical approaches enabled consistent key message to emerge from the analysis. In the next and final chapter the research in this thesis is concluded and the implications for bus operation and future research are presented.

CHAPTER 9 : CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

9.1 Introduction

The policy to deregulate the bus industry introduced in 1985 empowered bus operators to control the operation of services and fares of local buses in the UK (except London). The open market allowed direct competition which is based on price, service and quality (Hibbs, 1997a; Hibbs, 1997b). White and Farringdon (1998) found that 13 years after deregulation, whilst passenger journeys since 1985 had increased by twenty five percent in London, they had fallen in the rest of the UK by thirty five percent and Docherty and Shaw (2003) presented evidence to show that fares had increased in real terms. Therefore, by 2012, in general there has been a steady decline in patronage in all other areas except London.

The general opinion suggests the current demise of the bus industry, outside London, is due to the failure of deregulation (White and Farrington, 1998; Docherty and Shaw, 2003). Consequently, the government, under the Transport Act 2000, has introduced the idea of voluntary Quality Bus Partnerships (QBP) to encourage local authorities and bus operators to work together to deliver schemes with more emphasis on the *importance* of quality in bus service provision. QBPs have enabled local authorities to be proactive in reducing, or limiting, traffic congestion and improving reliability of bus journey times as a consequence. TRB (1999) reported three measures to evaluate success, which are based on the vehicles performance and operation from passengers' perspectives.

However, as identified by Knowles (2005) there is a lack of research, which has dealt specifically with passengers' *satisfaction* of *quality* in relation to QBP. This was the key motivation for this research. The main goal of bus operation is to provide a high *quality* of service to passengers in order to fulfill their expectations. The difference between what passengers perceived as important and how satisfied they are, is measured as the '*gap*' in service quality. The desire of operators to create revenue and make profit from bus service provision sometimes means under investment in quality attributes and losing sight of passenger's needs leading to an increase in gap.

This chapter provides outputs from this research by first presenting the overall aim and steps taken in this research to achieve the objectives in Section 9.2. In Section 9.3 an overview of what was achieved from the analysis is presented before the original contributions of this research to knowledge is highlighted in Section 9.4. Next recommendations for bus operations are outlined in section 9.5 followed by section 9.6 which covers future research arising from this work. The thesis concludes with final remarks in Section 9.7.

9.2 Overall Aim and Steps of the Research to Achieve Objectives

An important aspect of this research was to develop a detailed understanding of the perceptions of *quality* of current bus services exploring deeply into whether demographic characteristics of passengers have any influence. Such knowledge would help to design marketing strategies. The overall aim of this research was **'to provide evidence that bus service improvement has influenced passenger *satisfaction*'.** The first step in this research was to carry out an in-depth state of art review to define the policy context, to inform the research methodology and potential analytical approaches. The second step was to develop a data collection methodology and identify analysis procedures appropriate for a study of passenger perceptions of *quality* of bus services. The third step was to design the survey, carry out a data collection exercise and analyse the data to understand the characteristics of the sample population of bus passengers engaged in this research. The fourth step was to identify which factors are *important* and contribute to passenger *satisfaction* with particular reference to *quality* measures implemented by a Quality Bus Partnership. The fifth step was to explore how *quality* can influence passengers' perception by comparing their perception of two different types of bus services; a sample of those with and without bus service improvement. The sixth step was to establish any differences in the perceptions of which quality attributes are *important* to passengers and result in *satisfaction* as a function of socio-demographic characteristics such as age, gender, employment status and purpose of journey. The seventh step was to explore the effectiveness of the branding of the services in raising the awareness of passengers for the improvements in service quality through QBP initiatives, and the eighth, to identify which *quality* factors for *importance* and *satisfaction* have a predictive effect on the overall rating of bus services and overall quality of bus services. Finally, the findings of the different analytical approaches adopted are collated to inform the most significant impacts of the QBP to inform future investment strategies for bus operators.

9.3 Overview of Findings

In this section the key messages emerging from each objective of the research will be reported in turn. This is aided by an overview of the results of the research presented in Figures 9.1 and 9.2 in a format consistent with the analysis method highlighted in Figure 3.5, Chapter 3. The characteristics of passengers taking part in the survey were found to be representative of the Tyne and Wear population in terms of age but not gender, there being higher proportion of females that use public transport (Pickett and Gray, 1996; Wall and McDonald, 2007).

9.3.1 Literature Review

A state of art review revealed that whilst deregulation had stimulated investment in service provision, a two tiered service has emerged with a decline of bus patronage overall. Given competition for the high patronage, high revenue routes other services systematically ceased with little service integration. Quality Bus Partnerships were seen to provide a mechanism for bus operators to co-operate with local authorities and concentrate on the provision improvements in service quality. A comprehensive review of quality performance measures resulted in 39 different and similar quality measures. Discussion with the bus operators and Nexus compromised on 17 attributes for this study as these were consistent with the quality measures implemented in the SR investment. The quality attributes investigated in this research were:

1. How often the bus runs in the evening;

2. How often the bus runs during the day;
3. How often the bus runs on Sundays;
4. How reliable the bus is in turning up;
5. How punctual the service is;
6. Ease of buying a ticket on the bus;
7. Ease of buying a ticket at the Travel Centre;
8. Cleanliness of the bus;
9. Cleanliness at the bus stops;
10. How long the journey takes;
11. Friendliness / helpfulness of drivers;
12. Information at bus stops;
13. Finding information about bus routes;
14. Your personal security on the bus;
15. Your personal security at bus stops;
16. Condition of shelters at bus stops and,
17. Cost of tickets.

Importance and *satisfaction* surveys carried out in previous studies informed the type of questions formulated in this study and provided the details of the analysis procedures. ISA was identified as a potential candidate to explore the relationships between *importance* and *satisfaction* with due consideration of the socio-demographic characteristics of the passengers and trip purpose. Clearly, while bus operators are aiming to provide a high quality of service, they must also consider what passengers expect from the service. By understanding the connection between these two (*importance* and *satisfaction*), bus operators can set up strategies to increase patronage. The differences between the *importance* and *satisfaction* defined the 'gap' and thus identified areas in need of improvement. Research in the marketing world has confirmed that customer retention is linked with consumer *satisfaction* and a major key to the ability of a service provider to generate (Zeithaml *et al.*, 1996). Therefore, identifying those attributes with large gaps is useful to bus operators to make investment decisions. Further, it was demonstrated that different attributes of service quality were found to be more/less important to different cohorts of travellers, therefore, marketing of services can target specific cohorts to obtain even better value from investment. It was Cluster Analysis that was identified as a statistical method to establish whether there were any groups of passengers with particular characteristics but similar perceptions of *importance* and *satisfaction* of bus service quality. Factor Analysis was established as an appropriate statistic to establish commonality within sub-sets of quality attributes and to minimize multi-collinearity, (Field 2005). In order to identify which of the 17 attributes for *importance* and *satisfaction* had most influence on the overall rating and overall quality of the service was investigated using OLR.

9.3.2 Data collection and Analysis Methods

Due to the timing of the implementation of the SR, it was not possible to carry out "before" and "after" surveys. Therefore, the approach adopted in this thesis was to choose a sample of NSR services with similar characteristics to an independent sample of SR services. A questionnaire was designed and a similar set of surveys carried out on NSR and SR services. Initially it was planned to collect 200 surveys on each service, whilst 200 interviews were achieved for NSR services, due to constraints in gaining access to SR services, outside the author's control, only 110 questionnaires were completed. The data were subject to a thorough data cleaning and processing before being analysed. A simple analysis using descriptive statistics with the software package SPSS was carried out before carrying out a gap analysis. This informed whether or not the investments in improving bus quality had revealed improved *satisfaction* ratings.

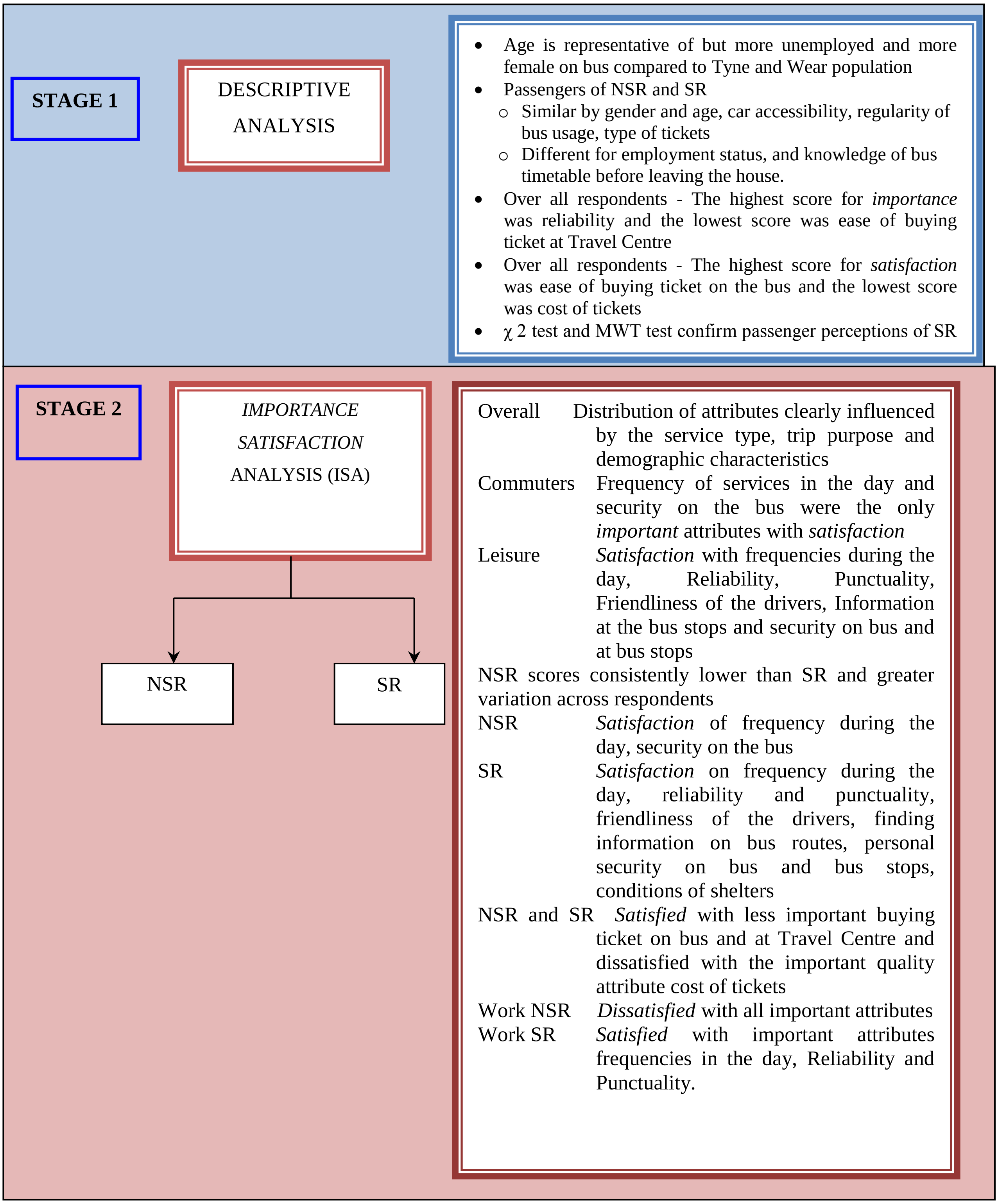

Figure 9.1: Summary of Key Findings

STAGE 3

FACTOR ANALYSIS (FA)

NSR

SR

- Reduced 17 attributes to three statistically significant different factors namely :
  - Factor 1: Service Infrastructure with 10 factors
  - Factor 2 : Bus Operation with 5 factors
  - Factor 3: Buy Tickets on the bus and at Travel Centre 2 Factors
- Differences in Factor 1 and 2 for NSR and SR but not for Factor 3

STAGE 4

CLUSTER ANALYSIS (CA)

Four Clusters emerged

<u>ISA on Clusters</u>

Cluster 1: 24-35 years commuters mainly NSR 63%

- Low *satisfaction* for single high *important* quality attribute reliability
- Low importance on all 16 other attributes
- Suggests no alternative mode available.

Cluster 2: 36-45 years commuters mainly NSR 62%

- High *satisfaction* of high *importance* attributes frequency during the day, reliability, punctuality, cleanliness of bus stops, friendliness of drivers, information about bus routes, security at bus stops and on the bus conditions of shelters.
- Low *satisfaction* high *importance* journey time, tickets cost

Cluster 3: 60+ Shoppers mainly SR 56%

- All attributes positive for *satisfaction*

Cluster 4: 60+ Shoppers mainly NSR 47%

- High *importance* and low *satisfaction* for all attributes
- *Importance* attribute on cost of tickets, for all mainly NSR, Cluster 1, 2 and 4 *dissatisfaction* whilst predominantly SR Cluster 3 higher *satisfaction* of lower *importance* cost better value for money

Figure 9.2 : Summary of Key Findings (Cont'd)

9.3.3 Survey Design and Characteristics of Bus Users

This research focused on three bus services (namely Bus No. 308 and 39/40) branded as Superoute (SR). Five services (namely Bus No. E1, 639, 20 and 10/11), that experienced no improvement and referred to as Non Superoute (NSR), were also studied, to create a set of control data for comparison. A questionnaire was designed to explore which quality attributes were considered to be of *importance* and measure the level of *satisfaction* of the passengers.

The use of the mean, median, central Likert score as the measure for the hairlines for the ISA were explored to identify the location of the cross hair. The most informative value was to use was the grand mean over all attributes, over all respondents, separately for both *Importance* and *Satisfaction* to define the location of the x and y axis respectively. For visual display and interpretation purposes the mean of the quality attributes was used.

This was consistent with the findings of Zhang and Chow (2004) and the need for "care and caution" otherwise ISA "may lead to incorrect interpretation" highlighted in TRB (1999) has been clearly demonstrated in this exercise. It was appropriate to use the same cross hair, for all scenarios to compare NSR, SR and Clusters 1, 2, 3 and 4, so that the relative quality of the different services could be revealed. Notwithstanding these limitations of the definition of the cross hairs and use of mean and not the median, the ISA was found to be a useful simple tool of analysis to obtain a general overview of the data and reveal patterns in responses across passenger cohorts. However, it must be emphasised that all statistical tests carried out on the data were non - parametric and based on the median when possible. But specifically for ISA no robust statistical test to assess the distance from the hairline was found. The ISA was therefore qualitative.

9.3.4 Factors of Importance and Satisfaction

In discussion with the Local Authorities and bus operators 17 quality attributes were identified to explore their relative *importance* and *satisfaction*. The scores for *importance* were generally higher than for *satisfaction* showing that there is room for improvement irrespective of service or route across all attributes. The 17 attributes were shown to be a subset of those studied in previous research and the highest score of *importance* was reliability and the lowest ease of buying a ticket at the travel centre. It was evident that to some extent that if passengers were satisfied with service qualities of low importance then the *importance* rating tended to be lower. Over all respondents for *satisfaction* the highest, and lowest, score for *satisfaction* was ease of buying a ticket on the bus and cost of tickets respectively. In order to explore commonality within the 17 quality attributes for both *importance* and *satisfaction* FA was used and three factors emerged namely Service Infrastructure with 10 quality attributes; Bus Operation with 5 quality attributes; and, Ticketing with 2 quality attributes.

The ISA analysis of all respondents showed a distribution of the quality attributes across the four quadrants and it was clear that the position of the attribute in a particular quadrant was very much influenced by the service type, NSR and SR and the demographics and trip purpose of the responder. It was for this reason that a more in-depth analysis was carried out using CA and further ISA analysis on the disaggregated cohorts namely NSR, SR and the four clusters which emerged. Ticket purchase at the Travel Centre except for female senior citizen shoppers mainly NSR users consistently emerged as an attribute with low *importance* but high *satisfaction* for all responders, whether NSR, SR or Cluster 1, 2 and 3 which suggests that this facility offers a good service. However, one should be mindful that the low importance rating could be due to the good quality of the current service provision. Whilst this quadrant may be referred to as ‘possible overkill’ it equally could be renamed ‘Do not become complacent’ and investment should continue. Cleanliness at bus stops and journey time emerged as attributes of low *satisfaction* consistently across NSR and SR suggesting these quality attributes are consistent with the Service Infrastructure and attributes outside the control of the operator and fall more under the responsibility of the Local Authority. Investment in new technologies, UTMC and

ITS and provision of bus lanes would help to reduce delay however, integrated smart ticketing would also cut down journey times by reducing dwell time at bus stops. Cleanliness at bus stops often depends on budgetary constraints. Indeed Nathanail (2007) in a study of measuring *quality* of a rail service in Greece highlighted that low performance was due to cleanliness and lack of information provision. The latter emerged as an issue with passengers on NSR but not on SR services.

9.3.5 Difference in Quality of NSR compared with SR

The demographic characteristics of passengers using NSR and SR services were similar except for users of NSR who were those more likely to be retired or unemployed compared with SR users. The gap analysis, which highlighted the shortfall of the *satisfaction* scores from those for *importance,* for NSR and SR showed that within error of measurement, NSR is consistently, across all attributes, larger than for SR. The analysis of the gap revealed that the investment through QBP, has systematically increased *satisfaction* by one unit of Likert score. It is argued that the consistency of change across all attributes adds credence to this not to have occurred by chance but attributable to QBP. The results demonstrated that the QBP has closed the gap for all attributes by at least one unit of Likert scale, except for information, conditions of shelters and cost of tickets for which there is room for improvement on SR Services. Scores were found to be consistently higher and significantly different for SR compared to NSR for Service Infrastructure and Bus Operation attributes however there was no difference between NSR and SR for perceptions for Ticket Purchase, a quality attribute with which passengers were satisfied but considered to be of low importance. This is consistent with the results of the FA which showed that there was no statistical difference in Factor 3 (which was purchase of the ticket on bus and travel centre) as well as for the ISA analysis and the descriptive analysis (which found the ease of buying a ticket over all services was the lowest for *importance* and high for *satisfaction*). Passengers on both NSR and SR services were generally satisfied with frequency of bus services during the day and security on the bus and this was a consistent finding across all statistical analyses. However, there was clear evidence that SR service passengers also showed *satisfaction* for reliability and punctuality, friendliness of the drivers, finding information on bus routes, personal security at bus stops and conditions of shelters and this observation was borne out by the FA confirming statistical differences between NSR and SR for Service Infrastructure and Bus Operations which include these quality attributes. Interestingly, consistently out of all statistical approaches both NSR and SR users were dissatisfied with cost of tickets, the former more so than the latter. Given that SR users also assigned a lower *importance* to cost of tickets it may be argued that this suggests that the QBP has achieved a perception of 'better value for money'.

The descriptive statistics demonstrated that the NSR Likert scores for *satisfaction* were consistently lower than SR and a greater variation across respondents and the range was smaller for SR compared with NSR. This result was borne out in the ISA analysis which demonstrated that the QBP had reduced the variability in the *satisfaction* scores. Commuter passengers on NSR services were not satisfied with any attribute considered to be important on the other hand SR commuters were satisfied with frequencies during the day, reliability and punctuality.

The variation and inconsistencies in the Likert scores in the NSR and SR *importance* and *satisfaction* when considered alongside the descriptive analysis suggested that potentially there were sub groups of responses within the total cohort. Indeed CA revealed four statistically significant clusters that showed internal consistency. The results of CA will be presented in the next section.

9.3.6 Influence of socio- demographic and trip purpose on quality attributes

The ISA analysis showed that overall services for commuters only frequencies during the day revealed *satisfaction* whilst those using buses for leisure journeys whilst also satisfied with services during the day also showed *satisfaction* with reliability, punctuality, friendliness of the drivers, information at the bus stops and security on the bus and at bus stops. This suggests that the urgency to be at work on time and travelling during the peak hours demands a much higher level of service quality. This indicates the need for targeted investment in peak hour services. In fact, NSR commuters were dissatisfied with the important attributes reliability (identified as the most important attribute across all services), punctuality, friendliness of the drivers, information at the bus stops, finding information on bus routes, security at the bus stops, conditions of shelters and cost of tickets.

CA was used to gain a richer understanding of how the characteristics of passengers affected their perceptions. Labelling Clusters was not straight forward as the predominance of any characteristic was never much more than about 60%. Three mainly NSR clusters emerged two, Clusters 1 and 2 were mainly male commuters and differed mainly in the age grouping: Cluster 1 were mainly young adult (24-35years) and Cluster 2 mainly middle aged (36-45years). The other NSR cohort Cluster 4 was mainly senior citizen female shoppers. Cluster 3 was the only mainly SR passenger group and was mainly senior citizens using the service for shopping and leisure. The ISA analysis of clusters further confirmed that different quality attributes have different relative *importance* and *satisfaction* scores suggesting ways in which investment should be tailored differently depending on the main usage of the service. Young adult commuters did not assign any quality attribute to the 'keep up the good work' quadrant and was dissatisfied with the only attribute, considered important namely reliability. This suggests that there was no real alternative mode available to this cohort and therefore relative to other passengers, assigned a lower Likert score to *importance*. On the other hand middle aged commuters assigned 10 quality attributes to Quadrant I 'Keep up the good work' and were dissatisfied only with the important attributes journey time and cost of tickets. A deeper understanding of the marked difference between Cluster 1 and Cluster 2 using OLR showed marked differences in gender driving those quality attributes that affect overall service quality. In fact young male commuters emerged as having a negative experience on overall quality for Cluster 1 and middle aged females who were outnumbered by their male counterparts (trip purpose was not significant) revealed a positive influence on overall quality in Cluster 2. Cluster 4 the other mainly NSR in stark contrast had all attributes in the second quadrant 'Concentrate here' suggesting that mainly female senior citizen shoppers were completely dissatisfied with the NSR services available to them. Indeed the OLR revealed negative influence of commuters although they were outnumbered by shoppers and statistically significant drivers for overall quality were for *satisfaction* positive for frequencies in the evening and negatively on Sundays. Finally, Cluster 3 was similar demographic characteristics to Cluster 4 but instead user of mainly SR, and emerged as the cohort of passengers who were (relative to other passengers) *satisfied* with all quality attributes with a full range of *importance* scores.

9.3.7 Branding and Raising Awareness

The awareness of passengers of the 'Superoute' branding irrespective of NSR and SR services was very poor (≤ 60%) suggesting the need for more effective marketing. SR branding made passenger perceptions to quality more consistent than NSR.

9.3.8 Factors affecting overall rating and quality of bus services

The results of the factors affecting the overall rating of a bus service has been reported in Hensher *et al.,* (2010) and an independent analysis of the overall service rating was carried out. The results from OLR found that there was a strong influence of perceptions of *importance* and *satisfaction* of individual *quality* attributes on the overall rating of quality of bus service. Passengers travelling on SR had better experience however commuters relative to other trip purposes and males relative to females were less likely to have good experience with bus services. Importance of frequencies during the day and *satisfaction* of security on the bus are positive contributory factors in influencing passengers overall rating of bus service. This confirms previous research findings that a relationship between *satisfaction* and the overall rating of bus service exists and is consistent with Ekinci (2004) and (Gonzalez *et al.*, 2007). In contrast, for overall quality of service commuters relative to other trip purposes, only on NSR were less likely to have positive experience and there was no gender difference. Information at bus stops was found important for both NSR and SR. This also emerged from the ISA analysis and should be seen to be an important driver for continued investment. Ease of buying a ticket emerged as having a negative influence on *satisfaction* for Cluster 3 suggesting that there is still room for improvement on SR services. As senior citizens have concessionary travel cards it will be the commuters in this cohort driving this negative perception demonstrated to be statistically significant in the OLR. Female shoppers who were senior citizens found frequencies in the evenings being a positive influence on, whilst frequencies on Sundays were detrimental to, overall service quality. Young and middle aged adult commuters identified reliability as having a negative influence for *satisfaction* on overall quality. For SR services mainly female senior citizens all of whom will possess concessionary travel cards were the only cohort who identified room for improvement in services at the Travel Centre.

9.4 Contribution of this research

This research aimed to address and explore how *quality* is seen from passenger perspectives acknowledging that passengers' views are important and they have to be taken into account in the formulation of policy and delivery of successful bus operation. The research targeted services that had recently received investment in order to evaluate how QBP had impacted on quality of service provision, particularly from the passengers' perspective. The novelty of this research rests with the application of the ISA analysis and the adoption of five separate statistical modelling approaches, namely DA, ISA, FA, CA and OLR, to provide independent results in one dimension, DA and FA, in two or more dimensions ISA and CA, with interpretations from both the passenger (DA, ISA FA and OLR for overall quality) and operator perspective (CA and OLR for overall rating). All analysis approaches sought to gain improved understanding of the relationships between *importance* and *satisfaction* and highlighting the quality attributes in which operators can invest to maximize their return for pound sterling spent. This research brings benefit to passengers, bus operators and local authorities and contributes to policy making in confirming the positive impact of QBP, as an alternative way of reregulating the bus industry. Overall rating of a service was found to be driven by quite different attributes to overall quality of a service. The former were dominated by frequencies in the day and security whilst the latter information at bus stops (positive for *importance*) and frequencies in the evening and ticket purchase on the bus (negative for *satisfaction*). In some respects overall rating focused attention on the operational aspects whilst overall quality provided more of a passenger perspective and resulted in differentiation between NSR and SR.

Also, this research has highlighted important evidence to suggest ways of tackling the passenger decline in Tyne and Wear by identifying service *quality* attributes of importance to different passenger cohorts.

9.5 Recommendations to the Bus Companies

The central premise of this research is that various factors from the service *quality* attributes can influence passenger *satisfaction.* Each individual passenger who is satisfied will actively reuse the bus services and this is likely to further affect their perception of the overall bus service. The behaviour of passengers can be driven by their *satisfaction* and the most important is to help the bus operators to manage their business better in the future to win passengers as regular customers. Bus operators should focus on delivering the best services that can improve passengers experience while travelling on the bus, then, *satisfaction* can be the best measure for evaluation of service quality. Satisfied passengers indicate positive perception on *quality* and it is important for bus operators to fulfill passengers' expectation which in turn will improve profit to the bus companies.

The strongest recommendations emerging from this research include:

1) Engage with QBP to work with LA to ensure investment in:

a) Regular maintenance and cleanliness of bus stops

b) Provision of information specifically on bus routes at bus stops and Travel Centres

c) Provision of measures to reduce journey times such as smart ticketing, bus priority, bus lanes

2) Target quality improvements according to specific demographic groups

3) Market service improvements regularly

4) Deliver reliable services that maintain bus timetables

5) Maintain services in the evening and on Sundays

5) Keep fares low

The findings from this research are suggesting that partnerships between operators and local authorities can be maintained are worthwhile and could increase passenger numbers. The conclusions from this research together with other studies, suggest efficient ways to measure the *quality* of bus service. The research has highlighted it is beneficial to bus operators to evaluate their service and operation performances from the passengers' perspectives. Key factors to attract people to use buses more often are to 'win their hearts' as this was found to be a way to influence travel behaviour. Putting greater emphasis on marketing may attract passengers and increase their belief in public transport.

9.6 Future Research

Recommendations for future research are to further explore exactly what motivates passengers to use bus services and be proactive in exploring what steps can be taken to increase patronage. Such a study could employ stated preference techniques and whether passengers are willing to pay. Controlled study of passenger perceptions can be carried out for 'before' and 'after' the introduction of bus service improvements resulting from a QBP initiative and simultaneous monitoring of bus patronage. This research has concentrated on understanding those quality measures that are *important* and lead to *satisfaction* of bus users. A study of non-users would be able to identify and better understand the barriers to using public transport which in turn will inform in which quality attributes of current services need to be modified to attract non users to use public transport.

Although statistically significant results have emerged from this research, the single most important shortcoming of this research was the sample size. An improved sample size would better inform and even establish the strength and direction of any relationships between *importance* and *satisfaction* of the different quality attributes that may exist. Therefore, a follow-on piece of research adopting the principles developed in this research would be of value provided resources were available to carry out substantially more interviews.

A particular issue with the ISA was the definition of the cross hair and the masking of features in the data due to small samples particularly in the clusters and the assumption of the data to be treated both as interval and categorical and depending on which the assumption may influence the results. Further work on the use of a 7, 9 or even an 11 point scale would be interesting, also, to establish whether indeed Normal distributions can emerge from the assessments of perceptions and thus to allow deeper exploration of the ways to deal with the issues of parametric and non-parametric statistical testing given the lack of normality of the current Likert scale distributions. However, it remains that Likert scales are simply not normal distributed.

9.7 Final Remarks

This research has carried out an in depth examination of the effect of bus service improvements brought about by a Quality Bus Partnership (QBP) initiative from the passenger's perspectives. The research has identified ways to improve passenger *satisfaction* in the context of services provided by the bus operator. The stance taken in this research was, by gaining a better understanding of which *quality* attributes passengers regard as important and consequently what are their corresponding level of *satisfaction*, wiser decisions regarding investment in quality measures can be made based on the evidence obtained. Improved *quality* subsequently is expected to retain existing passengers and attract new ones. Congestion on roads currently continues for long periods of the day (causing poor air *quality* which exacerbates health and remains an issue in residential urban areas) and faced with the challenges of climate change, there is a need to deliver mode shift to public transport. This has never been so urgent. The challenges facing the bus operators, and the government in formulating policy, is how to make the bus journey, experienced by passengers, on a par or even better than by car in terms of convenience and comfort while travelling and cost.

More strategies on marketing and promotional measures in the future to encourage increase in bus use is needed for example, attractive fares that would encourage people to change their normal mode, especially car users. Relaying the message to private car owners that the cost of bus fares compared to the full cost of motoring rather than simply their out of pocket fuel consumption and improving reliability and punctuality are worthwhile. Improved marketing strategies would raise public awareness of the available services offered by bus companies. In particular repeated marketing of SR services on a regular basis and raising awareness of the branding is required. The local authorities must prioritize the *important* policies that can help in tackling the decline in the short term and this is becoming more important with ever shrinking budgets and tighter control on spending.

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Date :	
Bus No.:	
Route :	

How Do You Get About?

In collaboration with Nexus, the Transport Operations Research Group (TORG) at Newcastle University is conducting a survey about the quality aspects of bus improvements which are seen as a pivotal factor in increasing the attractiveness of public transport, particularly buses. In order to get the best out of the transport services, we first need to know how you currently get about in Tyne and Wear.

Please answer questions by putting an '**X**' in the right box like this ~~(a)~~

Section 1: Your Journey -Today

Q1. Please indicate the purpose of your journey today?

Work	(a)
School/college	(b)
Shopping	(c)
Visiting friends /relatives	(d)
Leisure/Recreation	(e)
A Night Out	(f)
Other (please specify)	(g)

____

Q2. Did you have access to a car for this journey?

Yes (a) No (b)

Q3. For this journey, did you know the time of the bus before you left the house?

Yes (a) No (b)

Q4. How often do you use buses in Tyne and Wear?

Daily	(a)	5 times a week	(d)
2 times a week	(b)	Rarely	(e)
3-4 times a week	(c)	First time	(f)

Q5. **If you RARELY or this is your FIRST TIME to use a bus in Tyne and Wear, please state your reason(s).** ***Please give each a rating- 5 (highest) to 1 (lowest)***

Not enough information…………………..	5	4	3	2	1
I just don't like using public transport……	5	4	3	2	1
Journey too uncomfortable………………	5	4	3	2	1
Fare too expensive………………………..	5	4	3	2	1
Service too infrequent……………………..	5	4	3	2	1
Don't feel safe on public transport……….	5	4	3	2	1
Service too unreliable……………………..	5	4	3	2	1
Not clean enough………………………….	5	4	3	2	1
Too crowded………………………………..	5	4	3	2	1
Bad access for wheelchairs/ prams, etc ..	5	4	3	2	1
Not convenient for me …………………….	5	4	3	2	1
Don't need to - have a car………………..	5	4	3	2	1
No parking at bus stop, train station, etc..	5	4	3	2	1
Have other option of Public Transport…..	5	4	3	2	1
Other (please specify)……………………	5	4	3	2	1

____

Q6. **What type of ticket do you normally use?**

Single ticket…………………	(a)
Return Ticket………………	(b)
DayRider (All day ticket)…..	(c)
Day Rover…………………..	(d)
Network Travel Ticket……..	(e)
Stagecoach UniRider………	(f)
Teentravel …………………..	(g)
Transfares ………………….	(h)
Arriva Student Ticket……….	(i)
Other (please state)………..	(j)

____

Section 2 : Your Opinion on Your Local Bus Service

Q7. **When travelling in your local area, how safe do you feel?**

	Very safe	Fairly safe	Fair	Fairly unsafe	Very unsafe
Waiting at bus stops					
Travelling on buses					

Q8. **If you feel unsafe or insecure, please explain:**

____

____

Q9. Would any of the following encourage you to use bus services more frequently?
Please give each a rating- 5 (highest) to 1 (lowest)

Better information………………………..	5	4	3	2	1
More direct bus routes …………..........	5	4	3	2	1
More comfortable bus…………………..	5	4	3	2	1
Cheaper bus fare………………………..	5	4	3	2	1
More discount tickets available ……….	5	4	3	2	1
More frequent bus services……………	5	4	3	2	1
More reliable bus services……………..	5	4	3	2	1
More convenient bus stops.……..........	5	4	3	2	1
Better connections with train. …...........	5	4	3	2	1
Better lighting at bus shelters…………	5	4	3	2	1
Better access for wheelchairs/prams,etc………………….	5	4	3	2	1
No car parking spaces at destination….	5	4	3	2	1
Cleaner bus ……………………………..	5	4	3	2	1
Other (please specify)…………………..	5	4	3	2	1

Q10. How important are the following to you?
Please give each factor a score on a scale of 5 (=Very Important) to 1 (=Very Unimportant)

How often the bus runs in the evening……...	5	4	3	2	1
How often the bus runs during the day……...	5	4	3	2	1
How often the bus runs on Sundays………..	5	4	3	2	1
How reliable the bus is in turning up………...	5	4	3	2	1
How punctual the service is. …………………	5	4	3	2	1
Ease of buying a ticket on the bus…………..	5	4	3	2	1
Ease of buying a ticket at the Travel Centre..	5	4	3	2	1
Cleanliness of the bus………………………...	5	4	3	2	1
Cleanliness at the bus stops…………………	5	4	3	2	1
How long the journey takes…………………..	5	4	3	2	1
Friendliness / helpfulness of drivers…………	5	4	3	2	1
Information at bus stops………………………	5	4	3	2	1
Finding information about bus routes…….	5	4	3	2	1
Your personal security on bus………………..	5	4	3	2	1
Your personal security at bus stops…………	5	4	3	2	1
Condition of shelters at bus stops…………...	5	4	3	2	1
Cost of tickets………………………………….	5	4	3	2	1

Q11. **How satisfied are you with the following?**
Please give each factor a score on a scale of 5 (=Very Satisfied) to 1 (=Very Dissatisfied)

How often the bus runs in the evening……...	5	4	3	2	1
How often the bus runs during the day……...	5	4	3	2	1
How often the bus runs on Sundays………..	5	4	3	2	1
How reliable the bus is in turning up………...	5	4	3	2	1
How punctual the service is …………………	5	4	3	2	1
Ease of buying a ticket on the bus…………..	5	4	3	2	1
Ease of buying a ticket at the Travel Centre..	5	4	3	2	1
Cleanliness of the bus………………………...	5	4	3	2	1
Cleanliness at the bus stops…………………	5	4	3	2	1
How long the journey takes…………………...	5	4	3	2	1
Friendliness / helpfulness of drivers…………	5	4	3	2	1
Information at bus stops………………………	5	4	3	2	1
Finding information about bus routes…….	5	4	3	2	1
Your personal security on bus………………	5	4	3	2	1
Your personal security at bus stops…………	5	4	3	2	1
Condition of shelters at bus stops…………...	5	4	3	2	1
Cost of tickets………………………………….	5	4	3	2	1

Q12 **How do you rate your local bus service in general?**
Please give each a rating 5 =(Very Good) to 1= (Poor)

Quality of Service……………	5	4	3	2	1
Fares…………………………	5	4	3	2	1
Service Information…………	5	4	3	2	1

Q13. **Is there something additional that you want to tell about the experiences you have had with the bus services in Tyne and Wear?**

____

____

____

Q14. **Have you heard of Superoute?**

Yes (a) No (b)

Q15. **If yes, what do you know about it?**

____

____

____

Q16. **What could bus companies do to improve your local bus service?**

____

____

____

____

Q17. **Overall, how would you describe your experience of travelling by bus in Tyne and Wear.**
Please give a rating- 5 (very good) to 1 (poor)

Overall Service………………	5	4	3	2	1

Section 3: About You

Q18. **Are you:**

Male (a) Female (b)

Q19. **What age group do you fall into?**

12 – 15 years	(a)	35 – 49 years	(d)
16 – 24 years	(b)	50 – 59 years	(e)
25 – 34 years	(c)	60 years or over	(f)

Q20. **Can you please tell me where you live?**
Postcode : ____________________

Q21. **Can you please tell me where are you going?**

____

Q22. **Which of these best describes your situation?**

Employed full time..	(a)	Unemployed.....	(d)
Employed part time	(b)	Retired………..	(e)
Self employed…….	(c)	Student………..	(f)
		Other (please state)…..	(g)

____

Q23. **Can you tell me your income range (annual)?**

Under £9,999	(a)	£30,000 – £49,999	(d)
£10,000 – £19,999	(b)	£50,000 – £79,999	(e)
£20,000 – £29,999	(c)	£80,000 or more	(f)

Thank you for taking part in the research. We really do appreciate it.

WIN £100

Complete this survey and return by 31st August 2006 and you could win £100 in our prize draw.

If you would be willing to participate for Part 2 survey in one year's time, please give me your contact details below:

Name : ______________________________

Address : ______________________________

____

Tel. No. : ______________________________

(please turn over)

How Do You Get About

In order to get the best out of the transport services, we first need to know how you currently get about.

Section 1: About You

(Please tick appropriate box)

Q1. Sex: Male | Female

Q2. What age group do you fall into?

12 – 15	☐	(a)
16 - 24	☐	(b)
25 - 34	☐	(c)
35 - 49	☐	(d)
50 – 64	☐	(e)
65 or over	☐	(f)

Q3. Can you please tell me where you are from? Postcode : ______

Q4. What is your occupation?

Professional	☐	(a)
Semi-professional	☐	(b)
Salesperson	☐	(c)
Skilled worker or foreman/forewoman	☐	(d)
Service or Protective	☐	(e)
Student	☐	(f)
Unemployed	☐	(g)
Retired	☐	(h)

Q5. Please state your type of work. Full time/Part Time

Section 2: Your Journey

Q6. Please indicate your purpose of journey?

Work		(a)
School/college		(b)
Shopping		(c)
Leisure/Recreation		(d)
Visiting friends and relatives		(e)
A Night Out		(f)
Going to the City Centre		(g)

Q7. Do you have a car?

Yes		(a)
No		(b)

Q8. Do you normally plan your journey?

Yes	a
No	b

Q9. How often do you use public transport in Tyne and Wear? Please indicate your frequency for each transport option.

	Bus	Metro	Train	Taxi
Daily				
5 times a week				
3-4 times a week				
1-2 times a week				
Rarely				
Never				

(If respondents choose rarely and never, answer Question 10)

Q10. If you RARELY or NEVER use public transport in Newcastle, why not? Please tick only three(3) that apply.

Not enough information		(a)
I just don't like using public transport		(b)
Journey too uncomfortable		(c)
Public transport too expensive		(d)
Service too infrequent		(e)
Don't feel safe on public transport		(f)
Service too unreliable		(g)
Public transport is not clean enough		(h)
Public transport is too crowded		(i)
Inadequate access for wheelchairs/prams/shopping, luggage,etc		(j)
Public transport is not convenient for me		(k)
Don't need to - have a car		(l)
Lack of parking at bus stop, train station, etc.		(m)
Other (please specify)		(n)

Q11. What type of ticket do you normally buy?

Single ticket	☐	(a)
(All day ticket) DayRider	☐	(b)
Day Rover	☐	(c)
Network Travelticket	☐	(d)
Stagecoach UniRider	☐	(e)
Arriva Student Ticket	☐	(f)
Teentravel	☐	(g)
Transfares	☐	(h)
Other please state	☐	(i)

Section 3 : Your Opinion on Local Public Transport

Q12. How satisfied or dissatisfied are you with the levels of punctuality in your area?

Generally satisfied	☐	(a)
Neither	☐	(b)
Generally dissatisfied	☐	(c)
Don't know	☐	(d)
Don't use service	☐	(e)

Q13. When travelling in your local area, how safe do you feel?

	Very safe	Fairly safe	No view	Fairly unsafe	unsafe
Waiting at bus stops					
Travelling on buses					

Q14. If you feel unsafe or insecure, please explain:

Q15. Would any of the following encourage you to use Public Transport more frequently?
*(Please give each a rating- **5 highest to 1 lowest**)*

More direct bus routes	1	2	3	4	5
Cheaper bus fare	1	2	3	4	5
More frequent bus services	1	2	3	4	5
More convenient bus drop off points	1	2	3	4	5
More frequent Metro services	1	2	3	4	5
More frequent train services	1	2	3	4	5
Better bus connections from train station to work and home	1	2	3	4	5
Better bus connections from home to Metro	1	2	3	4	5
Better lighting at bus shelters	1	2	3	4	5
Discount tickets/passess available	1	2	3	4	5
Lack of availability of car parking spaces	1	2	3	4	5
Better Public Transport information	1	2	3	4	5
Other (please specify)					

Q16. How important are the following to you?
Please give each factor a score on a scale of 5 (=Very Important) to 1 (=Very Unimportant)

How often the bus runs in the evening……….......................................	5	4	3	2	1
How often the bus runs during the day………......................................	5	4	3	2	1
How often the bus runs on Sundays…………....................................	5	4	3	2	1
How reliable the bus is in turning up………......................................	5	4	3	2	1
How punctual the service is …………………...................................	5	4	3	2	1
Ease of buying a ticket on the bus…………....................................	5	4	3	2	1
Ease of buying a ticket at the Travel Centre..	5	4	3	2	1
Cleanliness of the bus………………………...................................	5	4	3	2	1
Cleanliness at the bus stops………………….................................	5	4	3	2	1
How long the journey takes………………….................................	5	4	3	2	1
Friendliness / helpfulness of drivers…………..................................	5	4	3	2	1
Information at bus stops……………………...................................	5	4	3	2	1
Finding information about bus routes……...	5	4	3	2	1
Your personal security on bus………………....................................	5	4	3	2	1
Your personal security at bus stops…………..................................	5	4	3	2	1
Condition of shelters at bus stops…………..	5	4	3	2	1
Cost of tickets……………………………....................................	5	4	3	2	1

Q17. How satisfied are you with the following?
Please give each factor a score on a scale of 5 (=Very Satisfied) to 1 (=Very Dissatisfied)

How often the bus runs in the evening……….......................................	5	4	3	2	1
How often the bus runs during the day………......................................	5	4	3	2	1
How often the bus runs on Sundays…………....................................	5	4	3	2	1
How reliable the bus is in turning up………......................................	5	4	3	2	1
How punctual the service is …………………...................................	5	4	3	2	1
Ease of buying a ticket on the bus…………....................................	5	4	3	2	1
Ease of buying a ticket at the Travel Centre..	5	4	3	2	1
Cleanliness of the bus………………………...................................	5	4	3	2	1
Cleanliness at the bus stops………………….................................	5	4	3	2	1
How long the journey takes………………….................................	5	4	3	2	1
Friendliness / helpfulness of drivers…………..................................	5	4	3	2	1
Information at bus stops……………………...................................	5	4	3	2	1
Finding information about bus routes……...	5	4	3	2	1
Your personal security on bus………………....................................	5	4	3	2	1
Your personal security at bus stops…………..................................	5	4	3	2	1
Condition of shelters at bus stops…………..	5	4	3	2	1
Cost of tickets……………………………....................................	5	4	3	2	1

Q18. How do you rate the local bus service in general?

*(Please give each a rating- **1 lowest to 5 highest**)*

Overall Image	1	2	3	4	5
Quality of Service	1	2	3	4	5
Levels of Service	1	2	3	4	5
Level of Fares	1	2	3	4	5
Service Information	1	2	3	4	5
Station/Vehicle Accessibility	1	2	3	4	5

Q19. Please indicate how satisfied or dissatisfied you generally are with bus services in Tyne and Wear

Generally satisfied ☐ (a)
Neither ☐ (b)
Generally dissatisfied ☐ (c)
Don't know ☐ (d)
Don't use service ☐ (e)

Q20. If you feel dissatisfied, please explain:

____

____

Final Thoughts

Q21. Is there something additional that you want to tell about the experiences you had with the bus systems?

____

____

Q22. Have you heard of Superoute?

Yes ☐ (a)
No ☐ (b)

Q23. What could bus companies do to improve your local bus service?

____

____

____

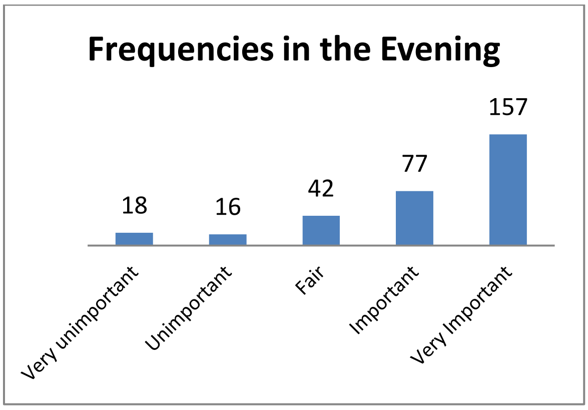
Thank you very much for your help

____

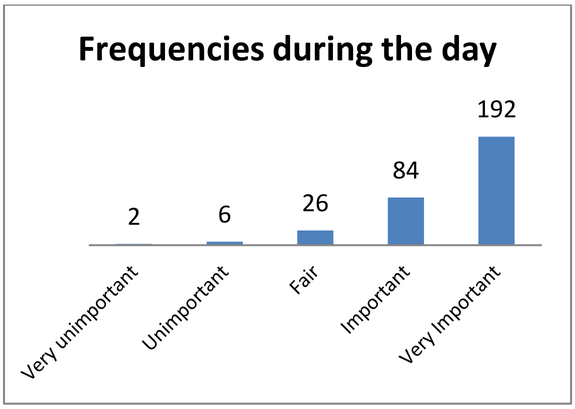
APPENDIX C

Distribution for Importance

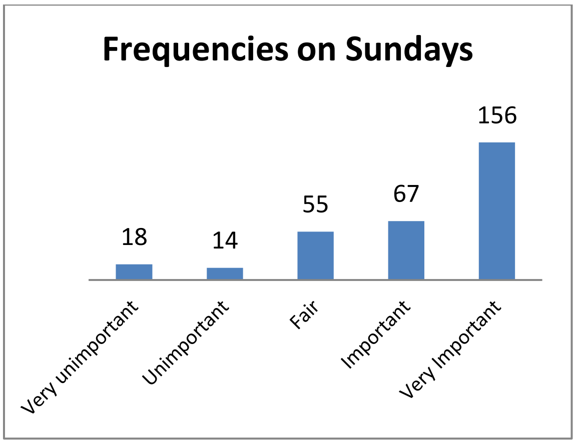
a) Frequencies in the Evening



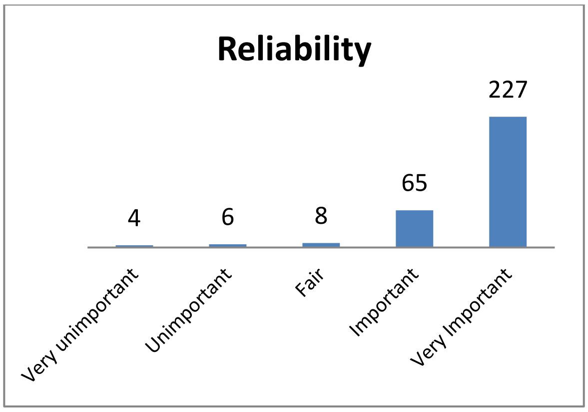
b) Frequencies during the day



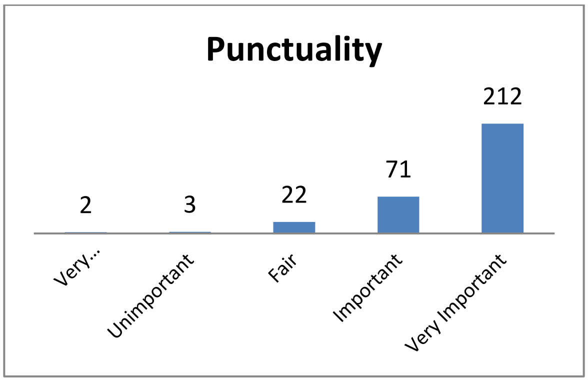
c) Frequencies on Sundays



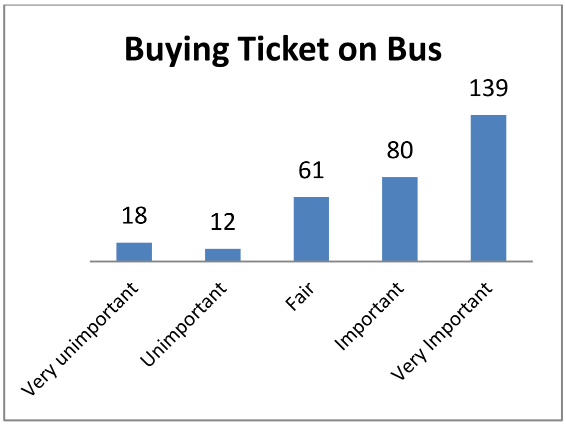
d) Reliability



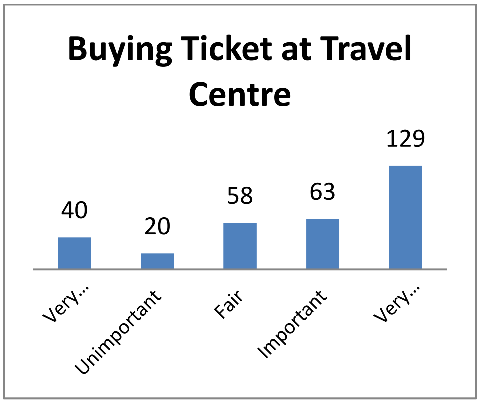
e) Punctuality



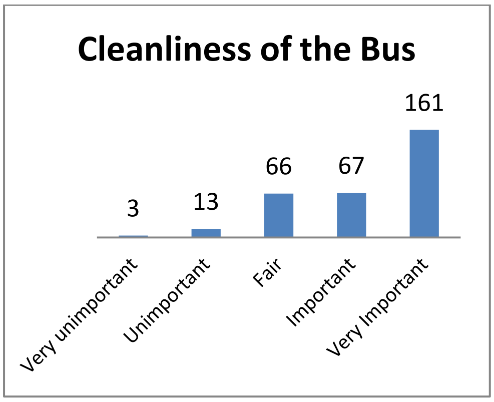
f) Buying Ticket on Bus



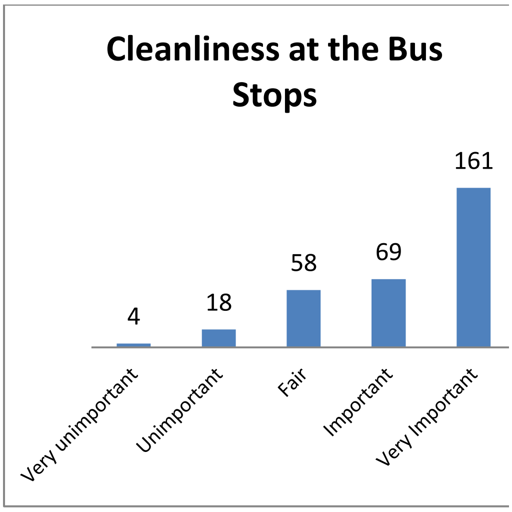
g) Buying Ticket at Travel Centre



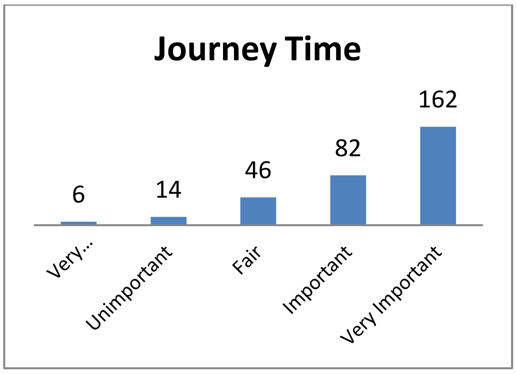
h) Cleanliness of the Bus



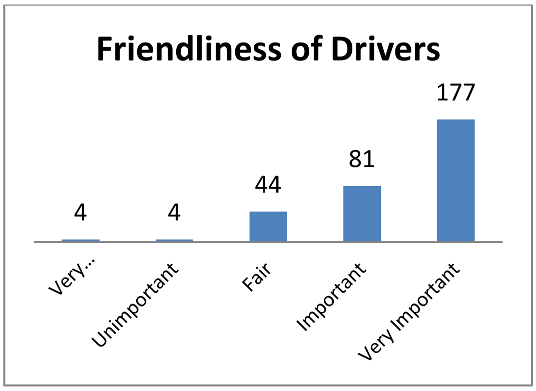
i) Cleanliness at the Bus Stops



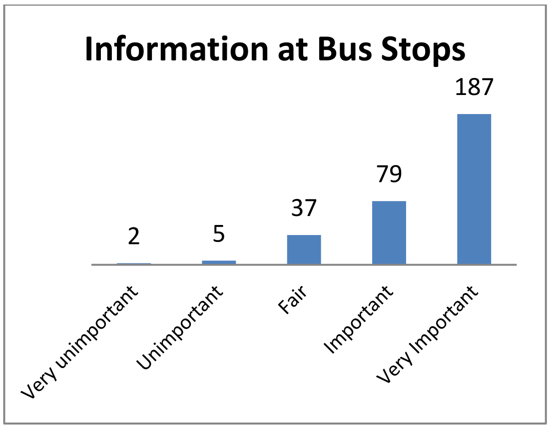
j) Journey Time



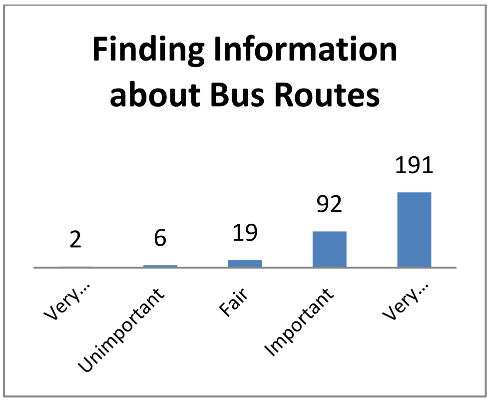
k) Friendliness of Drivers



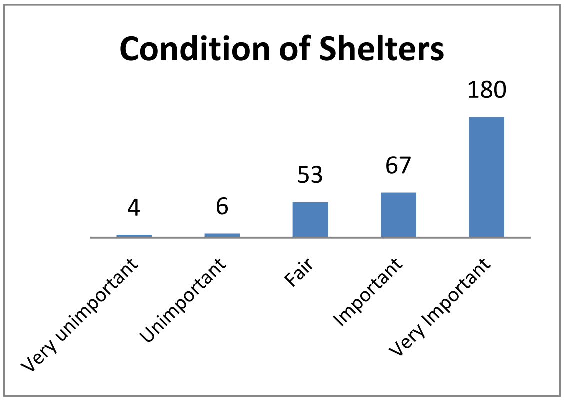
l) Information at Bus Stops



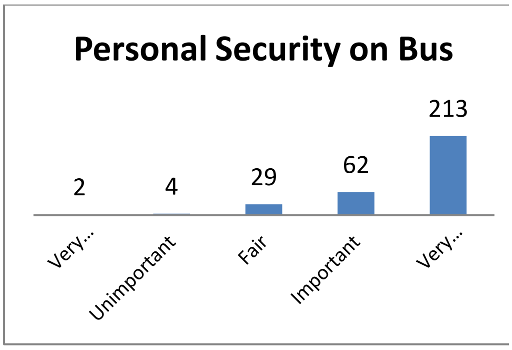
m) Finding Information about Bus Routes



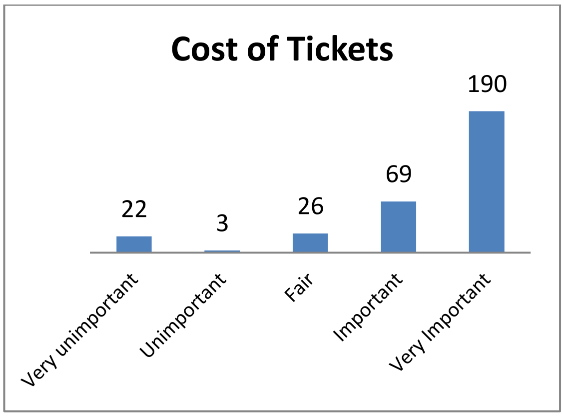
p) Conditions of Shelters



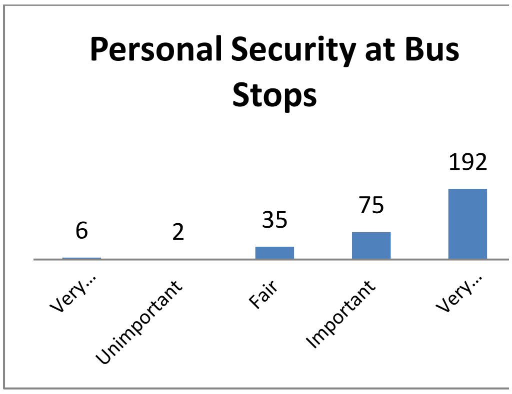
n) Personal Security on Bus



q) Cost of Tickets

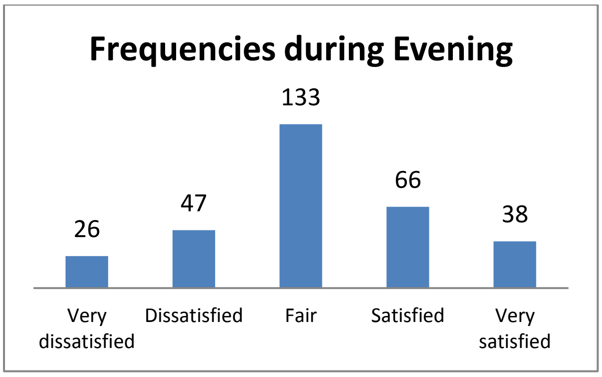


o) Personal Security at Bus Stops

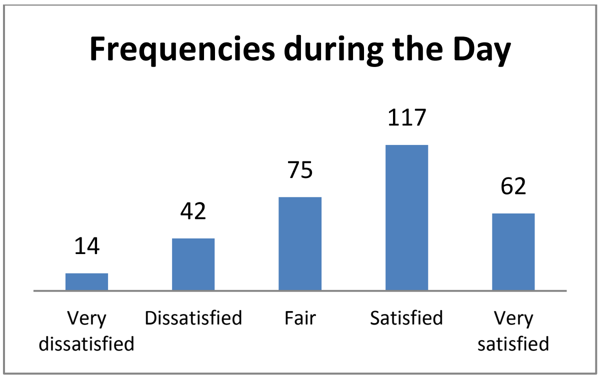


Distribution for Satisfaction

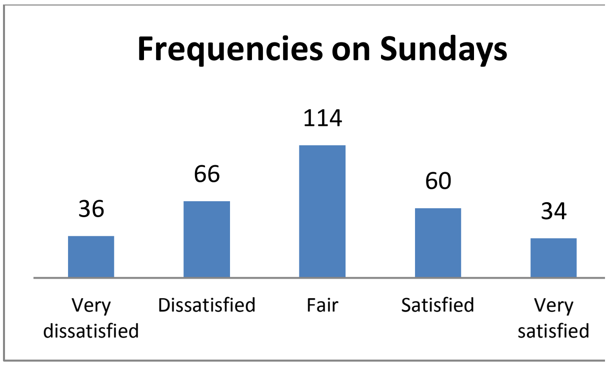
a) Frequencies in the Evening



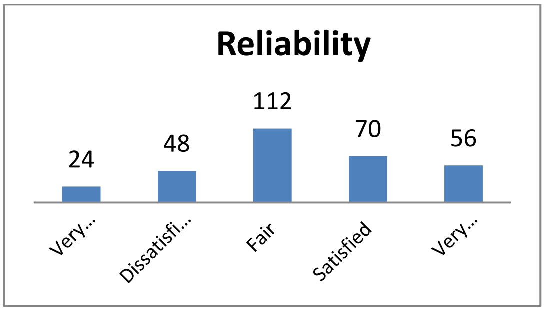
b) Frequencies during the day



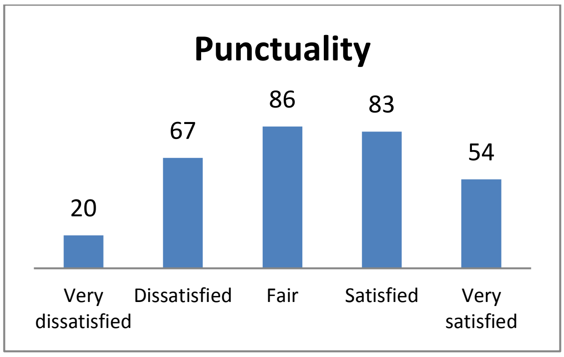
c) Frequencies on Sundays



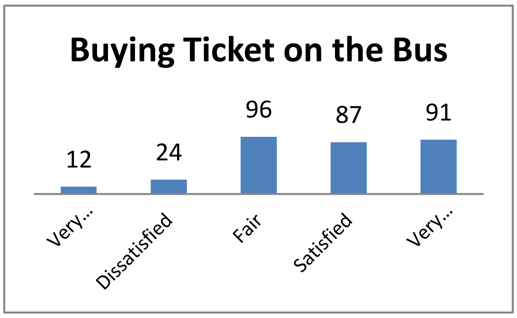
d) Reliability



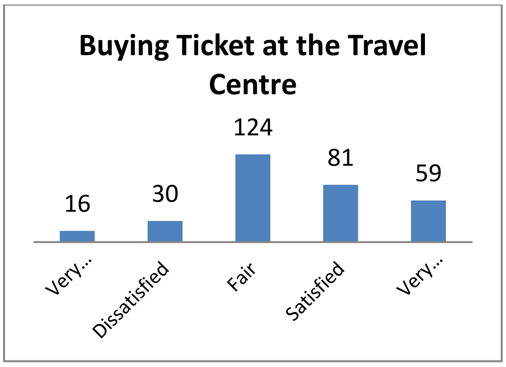
e) Punctuality



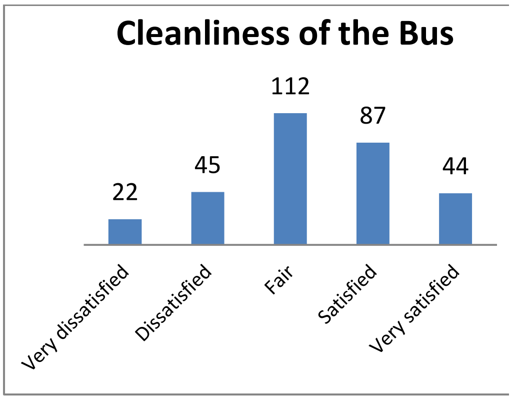
f) Buying Ticket on Bus



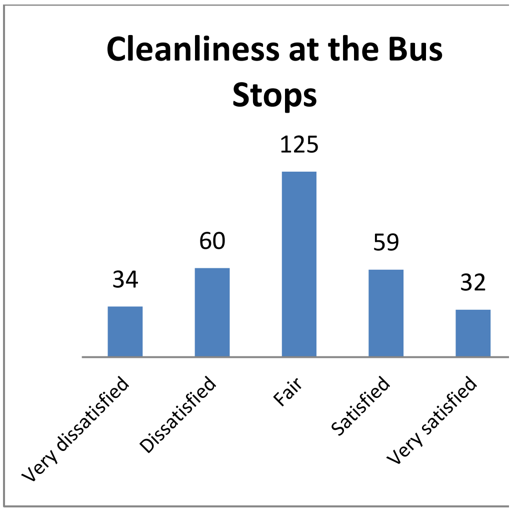
g) Buying Ticket at Travel Centre



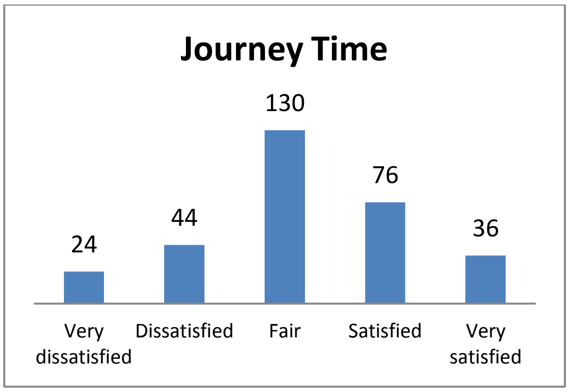
h) Cleanliness of the Bus



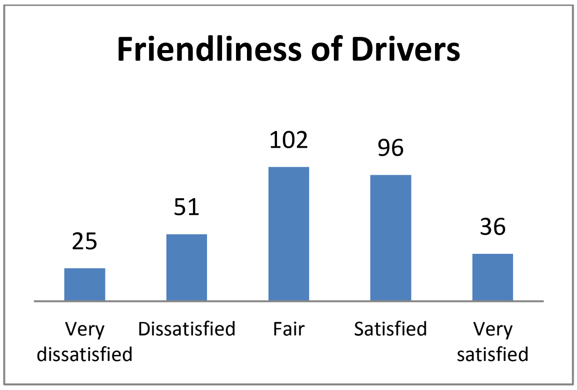
i) Cleanliness at the Bus Stops



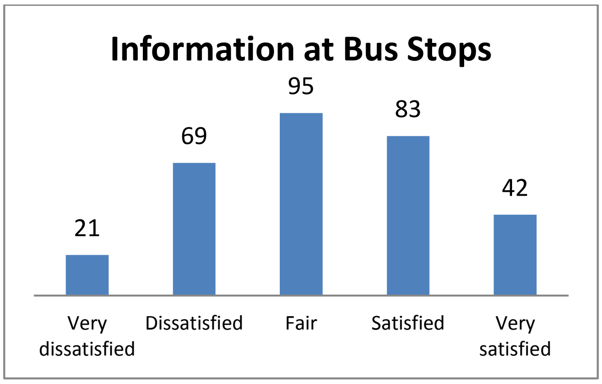
j) Journey Time



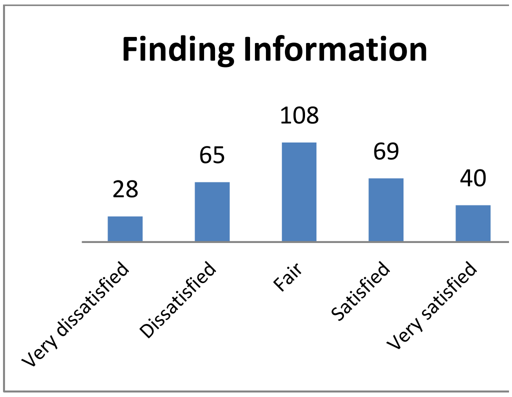
k) Friendliness of Drivers



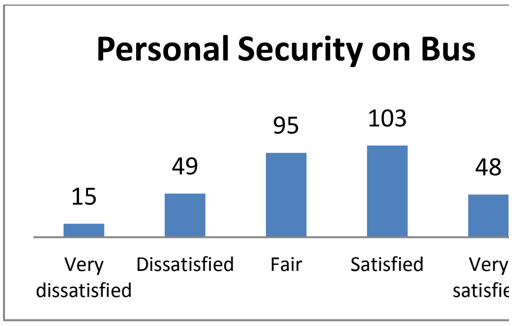
l) Information at Bus Stops



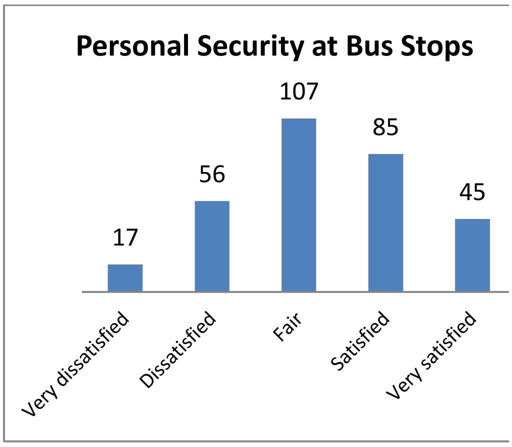
m) Finding Information about Bus Routes



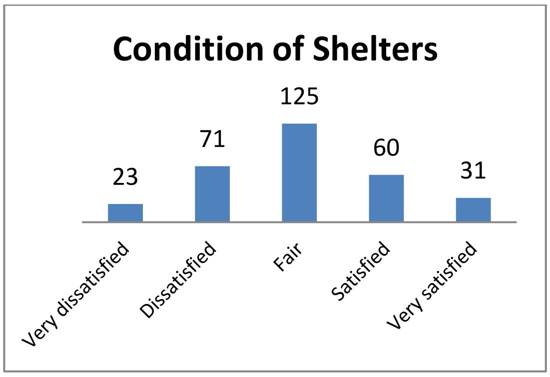
n) Personal Security on Bus



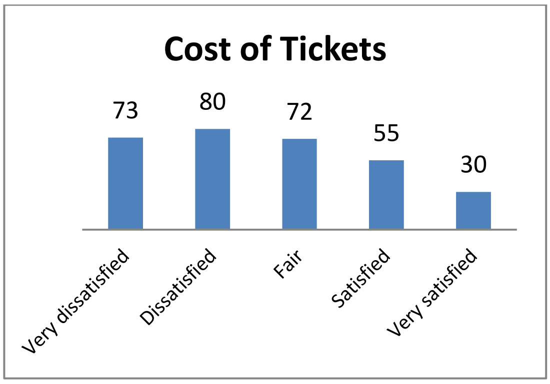
o) Personal Security at Bus Stops



p) Conditions of Shelters



q) Cost of Tickets



Results for Normality Test for Importance and Satisfaction

Tests of Normality for Importance

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
How often the bus runs in the evening	.287	310	.000	.759	310	.000
How often the bus runs during the day	.367	310	.000	.685	310	.000
How often the bus runs on Sundays	.291	310	.000	.771	310	.000
How reliable the bus is in turning up	.423	310	.000	.546	310	.000
How punctual the service is	.406	310	.000	.629	310	.000
Ease of buying a ticket on the bus	.256	310	.000	.798	310	.000
Ease of buying a ticket at the Travel Centre	.238	310	.000	.813	310	.000
Cleanliness of the bus	.315	310	.000	.774	310	.000
Cleanliness at the bus stops	.311	310	.000	.775	310	.000
How long the journey takes	.306	310	.000	.762	310	.000
Friendliness / helpfulness of drivers	.339	310	.000	.726	310	.000
Information at bus stops	.361	310	.000	.707	310	.000
Finding information about bus routes	.364	310	.000	.676	310	.000
Your personal security on bus	.409	310	.000	.634	310	.000
Your personal security at bus stops	.363	310	.000	.677	310	.000
Condition of shelters at bus stops	.348	310	.000	.727	310	.000
Cost of tickets	.345	310	.000	.652	310	.000

a. Lilliefors Significance Correction

Tests of Normality for Satisfaction

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
How often the bus runs in the evening	.215	310	.000	.904	310	.000
How often the bus runs during the day	.237	310	.000	.891	310	.000
How often the bus runs on Sundays	.186	310	.000	.915	310	.000
How reliable the bus is in turning up	.188	310	.000	.907	310	.000
How punctual the service is	.175	310	.000	.910	310	.000
Ease of buying a ticket on the bus	.178	310	.000	.875	310	.000
Ease of buying a ticket at the Travel Centre	.209	310	.000	.893	310	.000
Cleanliness of the bus	.184	310	.000	.909	310	.000
Cleanliness at the bus stops	.203	310	.000	.911	310	.000
How long the journey takes	.213	310	.000	.905	310	.000
Friendliness / helpfulness of drivers	.187	310	.000	.910	310	.000
Information at bus stops	.169	310	.000	.915	310	.000
Finding information about bus routes	.180	310	.000	.916	310	.000
Your personal security on bus	.203	310	.000	.906	310	.000
Your personal security at bus stops	.180	310	.000	.912	310	.000
Condition of shelters at bus stops	.213	310	.000	.910	310	.000
Cost of tickets	.185	310	.000	.904	310	.000

a. Lilliefors Significance Correction