Determinants for intention to change travel mode choice behaviour of NHS hospital staff

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Abstract

The UK's NHS is the largest employer in Europe with approximately 1.3 million staff. Around 83% of the journeys associated with the NHS are made by private car. In this context, every healthcare authority was required to produce a travel plan by December 2010, including an emphasis on promoting walking and cycling as a means of accessing hospitals. Evidence shows that although the take–up of travel plans is increasing across the NHS, the impact of travel plans in promoting walking as a travel option is relatively low among hospital staff. A scoping study has been conducted aiming to bridge the gap between research and practice by capturing the views of the NHS representatives on hospital travel plans by a nationwide survey and review of hospital travel plans. The survey findings show that despite having a high potential to promote walking as a key travel option among the hospital staff, the measures to promote walking were cited as the least effective. A Spearman's ρ correlation coefficient test was performed to evaluate the correlation between travel plan measures to promote walking and restrictive measures to reduce the use of cars. The results show that the effectiveness of measures to reduce the use of cars is positively correlated with the effectiveness of measures to promote walking. The effectiveness of travel plan measures to secure the targeted outcome is attributed to the methods used to address the determinants for changing travel behaviour whilst designing travel plan measures and the successful adoption of innovative strategies in the given context.

A theoretical framework has been developed based on the Theory of Planned Behaviour and five key research hypotheses have been proposed to demonstrate the key determinants for changing travel behaviour. The analysis was based on a nationwide survey among the NHS hospital staff in England in 2013. There were 863 completed responses, out of which 459 responses were from hospital staff, who solely relied on car journeys for commuting purposes. Structural equation modelling was performed to investigate the effects of socio–economic, psychological and situational factors in determining intention to change travel behaviour among the car users only. The model estimation results show that the effects of cognitive attitude towards walking and objective mobility were significant on determining intention to change travel behaviour. The respondents exhibited a habitual nature of travel behaviour, which is characterised by longer commuting distance and journey time than the national UK average. The practical implications of the study were addressed by providing recommendations that need to be considered whilst designing travel plan measures. The recommendations were based on the concept of Model for Planned Promotion. This study provides a basis for further conceptualisation of travel behaviour change and identifies several areas that need further investigation in relation to designing interventions to promote walking in the context of healthcare.

Statement of originality

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgements or footnotes, and that neither the thesis nor the original work contained therein has been submitted to Loughborough University or any other institution for a degree.

Fahmida Khandokar

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Chapter 1

Introduction

1.1. Background

The National Health Service (NHS), the largest organisation in Europe, employs approximately 1.3 million staff and provides healthcare services to over 57 million people (NHS, 2012). The use of cars to access NHS facilities has been a common practice for many years. Around 83% of the journeys associated with the NHS are made by car (NHS SDU, 2007). Alongside general motives (e.g. convenience, independence, social status) for using cars, several factors including shift working patterns, limited accessibility to hospital sites, and provision of free parking spaces have contributed to the increased car–dependency among hospital staff (Curtis and Headicar, 1997; Rye, 1999; Stokes, 1996). The Department for Transport (DfT) conducted a study in 2011 to compare the relative accessibility to seven key services in England, which found hospitals to be the least accessible service by public transport, walking, cycling, and car (DfT, 2012). The average minimum travel times by public transport/walking, cycling, and car to hospitals were 30 minutes, 21 minutes and 9 minutes respectively. Hospitals were accessible by public transport/walking in a *reasonable* time by over a quarter (29%) of the population.

The growing concerns over the impacts of high car use by the NHS has led to several policy initiatives with a focus on reducing car use to access healthcare facilities. Carbon footprint[1] is an important indicator of environmental impact by an organisation, as well as of the contribution to anthropogenic climate change. The carbon footprint of the NHS in England was approximately 25 $MtCO_2e$[2] in 2012 (see Figure 1.1), which accounted for over a quarter (26.6%) of the public sector emissions in England (94 $MtCO_2e$) in the same year (NHS SDU, 2013). NHS's carbon footprint is

[1] *Carbon footprint* refers to the total greenhouse gas (GHG) emissions, typically using the term *equivalent carbon dioxide* (CO_2e) emissions.
[2] Million tonnes CO_2 equivalent.

projected to decrease to 23 $MtCO_2e$ by 2020. However, the organisation is required to reduce its footprint by a further 5.06 $MtCO_2e$ by 2020 to meet the 34% reduction target as set out in the Climate Change Act 2008 from the 1990 baseline of 15 $MtCO_2e$ (NHS SDU, 2013). Moreover, the NHS needs to make a significant contribution towards the legally binding national emissions reduction target of 80% by 2050. The latest statistics shows that transport accounts for 13% of the total CO_2e emissions by NHS in 2012, which includes journeys to and from NHS sites by patients, visitors, and staff for commuting and business purposes (NHS SDU, 2013). In response to the policy concerns the NHS has identified *travel and transport* as one of the carbon hotspots that requires a significant reduction in carbon emissions (NHS SDU, 2014).

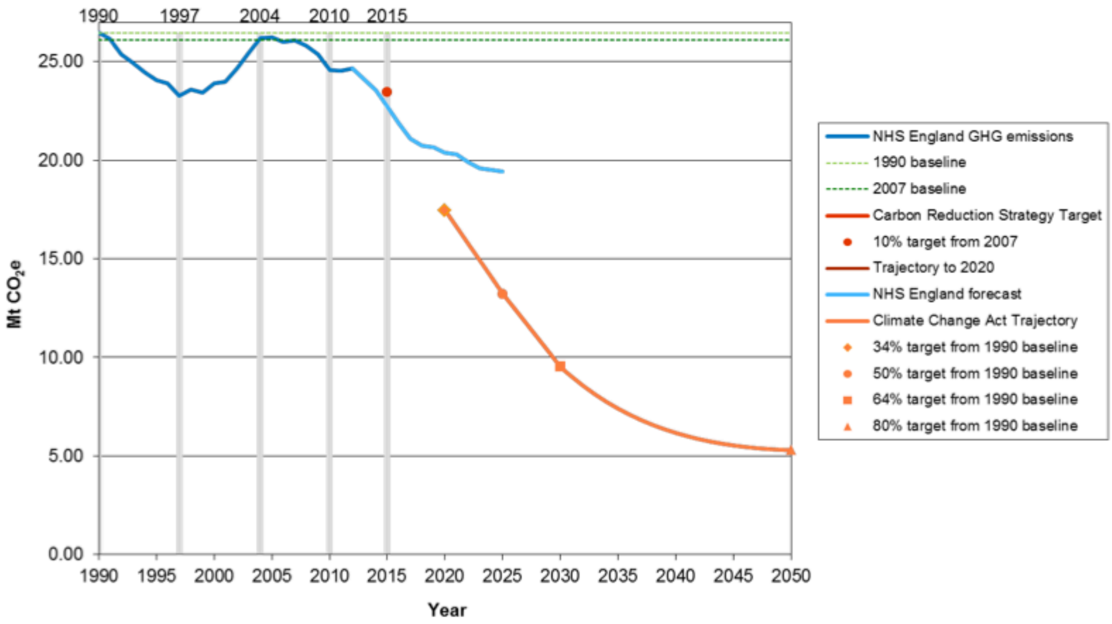

Figure 1.1: The carbon footprint of NHS England. The graph shows the actual NHS England CO_2e emissions from 1990 to 2012 and projected CO_2e emissions to 2025 at the current rate. The orange line represents the projected CO_2 emissions to 2050 with Climate Change Act 2008 targets. Figure collected from the "Update on NHS Carbon Footprint 2012" report (NHS SDU, 2013).

Besides, the Sustainable Development Commission introduced a toolkit titled "The NHS Good Corporate Citizenship Assessment Model" in 2006 to help NHS organisations to become good corporate citizens (NHS SDU, 2009b). An important aspect of the model was the NHS's transition to a low carbon organisation. According to Caroline Flint, the former Minister of State for Public Health (Sustainable Development Commission, 2007):

> *"The NHS can make a significant contribution to tackling the public health challenges of obesity and climate change by promoting active travel and reducing dependency on the car by encouraging people to travel by bicycle, on foot or by public transport".*
>
> — Caroline Flint

In addition, there is a growing concern over the health risks associated with the lack of physical activities among the UK population (Sir Derek Wanless and HM Treasury, 2002). The estimated cost of physical inactivity to the UK is approximately 8.3 billion pounds every year (NHS, 2014). In addition, in a report titled "Securing our Future Health: Taking a Long–Term View" Derek Wanless predicts that the of lack of physical activity among the adults may pose a serious threat to the future of the NHS (Sir Derek Wanless and HM Treasury, 2002). There is a call for a preventative approach that promotes active travel among all (Sir Derek Wanless and HM Treasury, 2002). In recent years, the NHS has placed a high emphasis on implementing health initiatives for all. The role of healthcare service providers in taking a lead to promote the health benefits of walking and cycling was emphasised in a Transport White Paper (DETR, 1998). The significance of implementing travel plans across the NHS sites to tackle the transport, environmental and health issues is highlighted in several reports published by the National Institute for Health and Clinical Excellence (NICE), the Department for Transport (DfT), and the NHS Sustainable Development Unit (NHS SDU) (NHS SDU, 2009a).

In the policy context, all NHS Trusts were required to produce a board approved travel plan as part of their Sustainable Development Management Plan by December 2010 by the Strategic Health Authorities (NHS SDU, 2009b). The key objective of the travel plan is to promote the use of alternative modes of transport and reduce the use of cars. According to Rye (2002):

> *"A travel plan provides a strategy for an organisation to reduce its transportation impacts and to influence the travel behaviour of its employees, suppliers, visitors and customers. It involves the development of a set of mechanisms, initiatives and targets tailored to meet the needs of an organisation when promoting the use of sustainable modes of transport and reducing the reliance on single occupancy cars".*

Carbon emissions from commuting trips by the NHS staff is projected to increase by 44% from 0.59 $MtCO_2e$ to 0.85 $MtCO_2e$ between 1990 to 2020 (NHS SDU, 2009a). Moreover, reducing the demand for car parking spaces and traffic congestion during peak travel periods have become increasingly important and remained the key focus of the travel plans produced by different organisations, including hospitals. Therefore, this study will mainly focus on travel plans designed to address commuter journeys. The justification behind focussing on commute journeys is further discussed in the following sections.

1.2. National policy context of travel plans

In the UK, recent trends in travel behaviour are characterised by a modal shift towards private car, decline in walking for short trips and increase in trip distance. According to the findings from the National Travel Survey 2013, commuting trips accounted for 16% of all trips in the UK, which were associated mostly with peak demands on both road and rail resources (DfT, 2014). More than two third of the commuting trips (68%) were made during two peak periods (i.e. 6.00am to 8.59am and 16.00pm to 18.59pm) between Monday and Friday. In 2013 on average, an individual made 145 trips to work out of which more than two third (69%) were made by car. Walking, cycling and public transport accounted for around 9%, 3% and 16% of the commuting trips respectively. Moreover, the use of cars is found to be high for short trips. In 2013, almost one–fifth (19%) of the all trips under a mile and more than half of the trips (59%) between one to two miles were made by car (DfT, 2014).

The high use of cars for commuting trips could be attributed to several factors, including increase in travel distance, travel time, and car ownership; and changing lifestyle (DfT, 2014; Scheiner, 2010). Between 1995/1997 and 2013 the average commuting distance has increased by 0.6 miles from 8.2 miles to 8.8 miles; and the duration of the average commuting trip has increased by 5 minutes from 24 minutes to 29 minutes. Public transport and car are often considered as acceptable travel modes for distance over five miles. In 2013, around 81% of the trips between 5 miles and 10 miles were made by car. The preference for using cars over public transport is well documented in recent research (Jakobsson, 2007). Between 1995/1997 and 2013, the proportion of households with access to a car has increased from 70% to 75% (DfT, 2014).

Interests in travel plans have grown steadily in the UK following the recognition of *soft* factor interventions or *smarter choice* measures since the early 1990s (Cairns et al., 2008). A travel plan attempts to promote the use of alternative travel options (i.e. preferably public transport for long and medium trips; and walking and cycling for trips under five miles) through a combination of marketing, information, incentives, and disincentives (DCLG, 2011; DfT, 2002; DfT, 2010; TfL, 2005). At first, the use of travel plans was mostly limited to large organisations for commuting and business trips. Boots, Nottinghamshire County Council, The Body Shop, Hewlett Packard, Derriford Hospital, and the Stockport Health Care Trust were the first organisations to introduce travel plans in the UK (Coleman, 2000). Among them, The Body Shop introduced several measures to discourage the use of cars. Hewlett Packard had taken initiatives to encourage the use of cycle to access their sites in Bristol. Notably, Boots in Nottingham developed a comprehensive travel plan with successful car–sharing schemes and work buses with a target to reduce the use of cars by 20% by 2005 to the company's Beeston site (DETR, 1998; Newson, 1997).

The planning policies and best–practice guidelines played a key role in initiating the involvement of public and private organisations in the travel planning process. *Section (106)* of the *Town and Country Planning Act* played a significant role in promoting the use of travel plans among public and private organisations (DETR, 2001). In 2005, the Department for Transport acknowledged that soft travel measures should be integrated as an essential part of local transport strategies (DfT, 2005). Despite the recent funding cut, a four year *Local sustainable transport fund* was allocated during 2011 to 2015 period to support the implementation of the soft measures/Smarter Travel Choice packages at the local and regional levels (DfT, 2012).

In *Planning Policy Guidance 13* (PPG 13), travel planning was stated as an integrated part of land use planning (DCLG, 2011). Planning applications for new developments are required to submit a travel plan demonstrating the satisfactory provision of transport access to and from the development. Developers are required to provide funding and/or certain facilities to improve the transport access to and from the proposed development. Several best–practice guidance documents and reports have been introduced for local authorities, developers and employers centring around the process of preparing a travel plan, such as "Using the planning process to secure travel plans: Best practice guidance for local authorities, developers and occupiers", and "A Guide on Travel Plans for Developers" (DETR, 1998, 2001; DfT, 2005, 2008, 2009c). A report titled "Towards a Sustainable Transport System" published by the Department for Transport sets out the Government's strategies to deliver a sustainable transport system [3] (DfT, 2007).

Despite the high policy emphasis, many argue that *the planning system has been less effective in sustaining travel plans in the longer–term* (Enoch and Potter, 2003; Roby, 2010; Rye et al., 2011). The planning agreement for a travel plan is generally enforced for a limited period while the planning consent is being sought. There is also a lack of regulatory measures to monitor the effectiveness of travel plans by local authorities. A study conducted by Rye et al. (2011) shows that nearly 41% of the local authorities participated either did not monitor or were unable to demonstrate any specific measures used to monitor their travel plans. The authors argue that although the government guidance offers useful advice on how to use the planning system to secure travel plans, the local authorities are often reluctant to enforce laws to secure travel plans in the longer term.

In addition, Enoch and Potter (2003) argue that there is no real financial benefit from the Gov-

[3] According to the Centre for Sustainable Transport, University of Plymouth: "a sustainable transportation system is one that allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations; is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; limits emissions and waste within the planets ability to absorb them, minimises consumption of non–renewable resources to the sustainable yield level, reuses and recycles its components, and minimises the use of land and the production of noise."

ernment for the employers' for developing travel plans in the UK. Therefore, organisations tend to reduce partially or entirely cut their travel plan funding or suspend their travel plans during financial difficulties. Rye et al. (2011) recommended that a combination of legal requirement to have a travel plan over a longer period and regular monitoring by the local authorities may help to sustain travel plans for longer. Many studies also highlighted the importance of integrating travel planning into the organisational goals to maximise its benefits to the organisation and sustain it for longer (Roby, 2010; TfL, 2005).

1.3. International policy context of travel plans

Travel plans were first introduced in the United States in response to the oil crisis during the 1970s (Martz, 2006). Private organisations such as Amoco in Houston, 3M in Minneapolis–St Paul, and Aerospace Corporation in Los Angeles introduced measures with a focus to reduce the use of cars for long commuting trips. The measures include: subsidised bus passes, flexi–hour schemes, car–sharing schemes, and vanpool schemes. Following a positive response from the private sector, the potential of travel plans as a travel demand management tool for high economic growth areas was recognised by the public sector in the 1980s (Coleman, 2000; Enoch and Zhang, 2008; Enoch, 2012). The US Federal Government introduced several policy interventions to support the use of travel plans as a travel demand management tool. For example, Regulation XV of the Southern California Air Quality Management District was introduced in December 1987, which required companies with more than 100 employees to appoint a *Transport Co–ordinator* to help achieve the targets set out by their *Trip Reduction Programme*.

In 1990, amendments made to the Clean Air Act 1970 required large employers located in polluted cities to submit *Employee Commute Options* or *ECO - annual trip reduction plans* (Enoch, 2012). This was considered as a big step forward towards implementing travel plans as a travel demand management tool. New developments were required to submit a travel plan demonstrating the satisfactory provision of transport to qualify for planning consent. The Netherlands was the first country to introduce travel plans in Europe. A study by Rye (1999) shows that although a large proportion of employers acknowledged their responsibility towards managing their staff travel patterns only 15% of those had a travel plan in place. In Italy, some large employers have been required to have a travel plan in place by law (Enoch, 2012).

1.4. Research problem

The research problem has been explored in light of relevant important issues experienced by the healthcare authorities in recent years.

1.4.1. Increasing demand for car parking spaces

Between 2003 and 2013, the proportion of the NHS workforce has increased by 12.5% from 1,212,585 to 1,364,165 (HSCIC, 2014b). As a result, the demand for hospital car parking spaces is increasing across the NHS. In response to the increasing demand, on average around one–third of the land at new NHS hospitals are allocated for car parking spaces (Transport and Travel Research Ltd, 2010). However, despite having the provision of additional car parking spaces the existing car parking facilities is projected to be insufficient to meet the combined demand of staff, patients, and visitors car parking at the busiest times. Data on the future parking demand for the whole NHS are not available. However, a study by the Halcrow Group found that if no constraints were imposed to reduce the use of cars, there would be a substantial growth in car travel over the next 15 years by the Norfolk and Norwich University Hospital (Norfolk and Norwich University Hospital NHS Trust, 2006). Such prediction, therefore, could be applied to hospitals with similar situational circumstances [4].

This increasing demand for the car parking spaces could be addressed in two ways: (1) by supplying additional car parking spaces; and (2) changing the travel behaviour of the hospital staff (see Figure 1.2).

[4] i.e. Norfolk and Norwich University Hospital is a teaching hospital with more than 6,500 staff, which is located on the outskirts of Norwich, Norfolk (Norfolk and Norwich University Hospital NHS Trust, 2006). The hospital serves around 800,000 people from Norfolk and neighbouring counties every year.

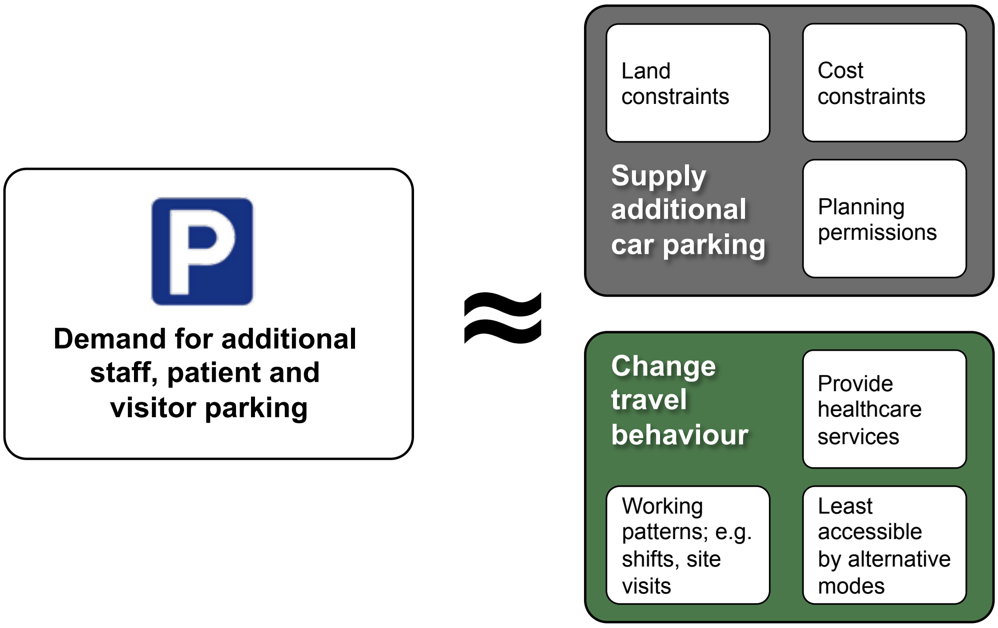

Figure 1.2: Ways to manage the demand for the NHS car parking spaces: (a) supply of additional car parking spaces; and (b) change travel behaviour.

1.4.1.1. Supply of additional car parking spaces

The provision of additional car parking spaces is subject to several constraints, including lack of free land, lack of resources (e.g. financial resources, staff time), difficulty with acquiring senior management approval, and planning permissions. Many hospitals are constrained from expanding their existing car parking spaces because of lack of free land. Some NHS Trusts reported to have provided off–site car parks to accommodate the demand for additional car parking spaces, such as Glenfield Hospital (NHS Northamptonshire, 2010). Besides, a report titled "The NHS Productivity Challenge" by the King's Fund revealed that the NHS has been experiencing widespread financial crisis since 2010/2011 (Appleby et al., 2014). The NHS Trusts are responding to the financial crisis by maximising the productivity of their existing services. Under the circumstances securing senior management approval to fund additional car parking spaces is often difficult to obtain unless providing additional staff car parking spaces appears essential to ensure the delivery of quality healthcare services. Similarly, the local authorities grant planning permissions for additional car parking spaces only if this is the only option to manage the increasing travel demand.

1.4.1.2. Changing travel mode choice behaviour

Many healthcare authorities attempted to manage the demand for car parking spaces by encouraging voluntary change in staff travel behaviour by introducing travel plan measures such as car–

[5] (a) The map was created by drawing the footprint of relatively larger car parks on the satellite image of the site sourced from `http://maps.google.co.uk/`; (b) The underlying map was obtained from Apple, Inc.'s Maps application, `http://www.apple.com/`); and (c) Image source: Coventry Telegraph, `http://www.coventrytelegraph.net/`.

Figure 1.3: Extent of car parking provisions at the University Hospitals Coventry and Warwickshire NHS Trust: (a) Footprint of car parks on the site showing extent of land used for car parking provisions; (b) Location of the site in the context of the city; and (c) Multi–storied car parking on the site indicating the extent of car densities in larger car parks, typical of NHS sites.[5]

sharing schemes, and incentives for using alternative modes of transport. For example, travel plans by Addenbrooke's Hospital and Derby NHS Hospitals Foundation Trust were successful in reducing the use of cars and increasing the share of alternatives through such schemes (Cambridge University Hospitals NHS Foundation Trust, 2004; Derby Hospitals NHS Foundation Trust, 2014). An effective travel plan can reduce up to 35% of car use (Cairns et al., 2008). However, previous research highlighted the importance of the widespread implementation of effective travel plans to achieve a higher impact in reducing car use (Cairns et al., 2010; Rye et al., 2011). A study by the NHS Sustainable Development Commission estimated that effective implementation of travel plans by 100% of the NHS estates can reduce 0.36 million tonnes CO_2 emissions (NHS SDU, 2009b). Evidence shows that although the take–up of hospital travel plans is increasing across the NHS, only 5% of the healthcare authorities had fully implemented travel plans in 2008 that could reduce carbon emissions by up to 10% (NHS SDU, 2009a). According to a study by Möser and Bamberg (2008), there is a lack of solid empirical evidence to support if the wider implementation of soft transport policy measures (i.e. travel plans) has been effective in reducing car use. The authors highlighted the significance of systematically exploring the determinants of effective soft policy measures.

The use of cars for both short (i.e. up to five miles) and long commuting trips (i.e. over five miles) have contributed to the high use of cars and have become the areas of policy concerns (Mackett, 2003; Schwanen et al., 2004). For short trips, there are three alternatives to car use: (a) walking, (b) cycling, and (c) public transport. Providing better access by public transport may involve an allocation of additional resources, improving the existing transport infrastructure, negotiation with local public transport providers, and regular liaison with the local authority. In many cases, the necessary actions required to provide better access by public transport is either beyond the scope of the travel plan or require long–term planning (Watts and Stephenson, 2000). Encouraging the use of other alternatives (e.g. walking and cycling) is vital to reduce car use for hospitals with limited access by public transport. The popularity of cycling is relatively higher in some European countries. For example, in the Netherlands and Denmark, trips by cycling accounted for 26% and 16% of the total trips respectively (Cycling Embassy of Denmark; Ministry of Transport Public Works, 2009). The popularity of cycling in the Netherlands is attributed to excellent cycling infrastructure (i.e. safe and wider cycle lanes, ubiquitous bicycle parking facilities, protected intersections, see Figure 1.4, Figure 1.5) [6].

Figure 1.4: A three–storyed cycle parking parade in Amsterdam, Netherlands. Source: Dr Muhammad Ahsanul Habib, Assistant Professor, School of Planning, Civil and Resource Engineering, Dalhousie University, Halifax, Canada.

Besides, the latest statistics published by the Information Centre for Health and Social Care shows that most of the staff (77.7%) working for the NHS hospitals and community services are females

[6]The standard width for a one–way bicycle lane in the Netherlands is a minimum of 2.5 metre (8 feet) (NL Cycling, 2014). However, in exceptional cases the width of the narrow cycle lanes may vary between 1.5 to 2.1 metre (5 to 7 feet).

Figure 1.5: An example of a narrow one–way cycling lane in Amsterdam (width = 5 to 7 feet), Netherlands. Source: Dr Muhammad Ahsanul Habib, Assistant Professor, School of Planning, Civil and Resource Engineering, Dalhousie University, Halifax, Canada.

(HSCIC, 2014b, c). Evidence emerged from the literature suggests that men with access to a cycle are more likely cycle to work if the distance criteria is met and the cycling conditions are satisfactory (DfT, 2014; Dickinson et al., 2003; Garrard). Commuting trips are generally complex in nature, especially for women with children (McGuckin and Murakami, 1999; Root and Schintler, 1999). Transporting children (i.e. dropping off children at school or nursery) limit the opportunity for cycling among women (Pooley and Turnbull, 2000). With this regard Dickinson et al. (2003) stated that:

> *"Organisational initiatives to increase cycle commuting were perceived more positively by men than women and this suggests provision of cycling facilities in travel plans will not be effective for organisations employing a large proportion of women"*.

Therefore, there is a need for theoretically underpinned empirical studies to identify the factors that may facilitate or constraint cycling behaviour among female commuters.

Irrespective of age, gender, and physical conditions walking is considered as a common form of physical activity for all (Charles and Carolyn, 2006). The health benefits of walking are also well documented in previous research. Walking for 30 minutes a day helps to maintain a healthy weight; increase levels of high–density lipoprotein (HDL); improve sleep; and reduce the risk of suffering from several diseases such as type 2 diabetes, coronary heart disease, high blood pressure, cancer, and mental health problems (Fletcher, 1999; Gracia, 2006; Plotnikoff et al., 2010).

However, the transport trends in the UK shows that between 1995/1997 and 2013, the average number of trips made by per person per year by walking has fallen at a higher rate (i.e. by 30% from 100 to 70, see Figure 1.6) when compared with car, public transport, and cycling (DfT, 2014). So, the questions arise: "what factors may have contributed to the falling trend of walking trips within this short period?"; and "if this trend continues what implications would that may have on the health-care sector?". Walking is widely recognised as a cost effective, environmentally–friendly, reliable, and healthy mode of transport. However, the viability of walking as a travel option for commuting purposes has been subject to a debate among the academics and practitioners. Pooley et al. (2011b) argue that despite acknowledging the benefits of walking, people often hold ambiguous and contradictory views about the viability of walking, unless they are organised and committed to walking. Other studies also suggested that people are reluctant to take part in environmentally friendly behaviour such as walking as it requires physical effort, and is subject to situational and personal constraints (Gärling et al., 2002; Mackett, 2003). Moreover, walking is a relatively slow travel option especially in comparison with car journeys and subject to walking distance (i.e. up to two miles for commuting) (DfT, 2014; Frank et al., 2008; García-Palomares, 2010).

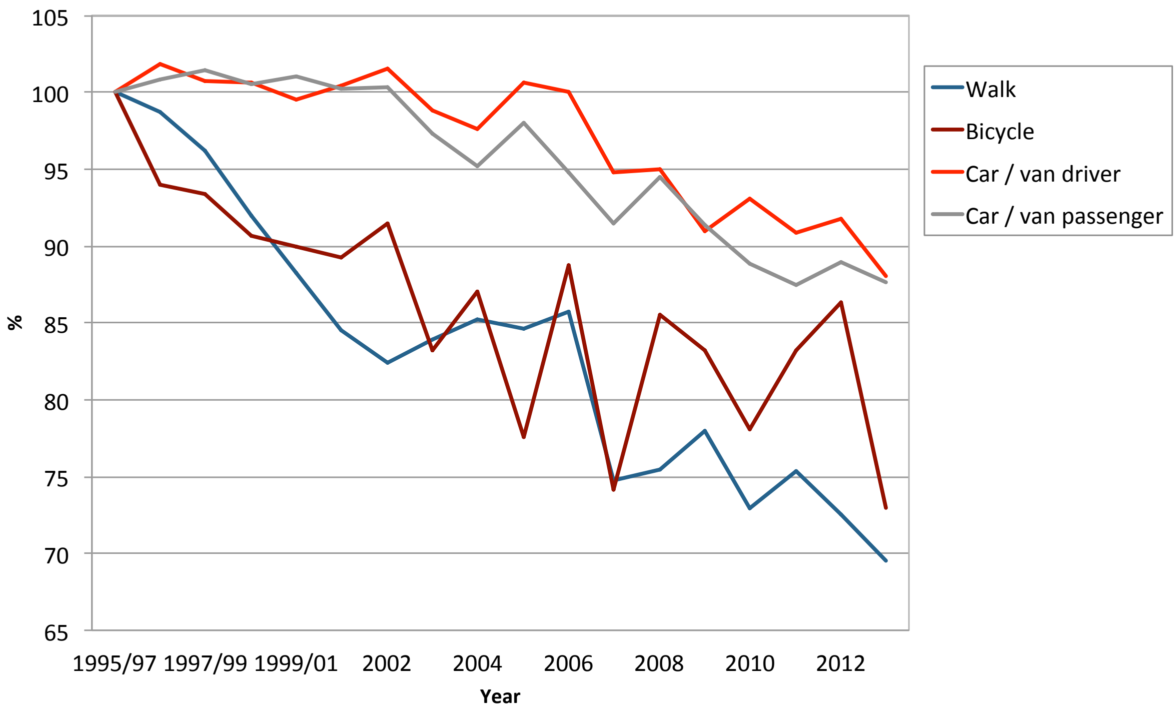

Figure 1.6: Average number of trips made by private travel modes in England between 1995/1997 and 2013.

Hospital travel plans are designed with a high emphasis on reducing car use and promoting walking as the most preferred travel option for commuting trips. Despite the high policy emphasis on reducing car use, many argue that in the absence of frequent, reliable, and cost–effective public transport, car becomes the only viable travel option for trips over five miles (Curtis and Headicar, 1997). Therefore, within the scope of this study changing travel behaviour represents a prominent and visible change in travel mode options from cars to walking in its own right and in conjunction with car journeys (i.e. walking for 10 to 15 minutes with car journeys). Developing effective travel plan measures to promote walking among healthcare staff is considered as a challenging task in practice. Therefore, the research problem of the study broadly lies on the issue that "what are the key determinants of changing intention to change travel mode choice behaviour?"[7]"

1.5. Significance of the research problem

The issues emerge from the policy and local context (e.g. CO_2 emissions reduction, increasing demand for car parking spaces) call for a high reduction in car use among the hospital staff. Previous research suggests that the success or failure of interventions to secure the targeted outcome is largely attributed to several factors including the knowledge and methods used to address the determinants of changing travel behaviour within a given context (Cairns et al., 2010; Macmillan et al., 2013; Marieke van Stralen, 2010; Roby, 2010; Sanko et al., 2013). However, Macmillan et al. (2013) argued that although the benefits of travel plans as a complex social intervention are well documented, there is a lack of reliable studies with a focus to the effectiveness of travel plans. Moreover, Melia (2012) highlighted that there is a limited academic research with a focus on the travel plans of healthcare professionals[8]. The unique travel context of hospitals is likely a higher challenge for designing travel plan measures than other organisations. Lack of prior research with a focus to the transport issues of the healthcare staff has constrained the development of reliable knowledge–base to design interventions (Melia, 2012). Therefore, the issues that may have affected the success of hospital travel plans remain unclear.

The propensity of forming habitual behaviour is higher among commuters, who frequently travel by cars within a stable context (Friedrichsmeier et al., 2013; Gardner, 2008, 2009; Thøgersen and Møller, 2008; Verhetsel and Vanelslander, 2010). However, Triandis (1977) suggested that individuals with weak habits may exhibit deliberate or reasoned action behaviour. The use of a combination of travel options for commuting to and from work is a good example of a deliberate or consciousness decision–making process. Therefore, this study assumes that the hospital staff, who commute by car alone are more likely to adopt habitual behaviour. The assumption will be considered true only if supported by the evidence collected as part of the study.

Interventions designed based on rational arguments have found to have failed to achieve the tar-

[7] *Determinant* is a term that refers to a factor, which decisively affects the nature or outcome of something. In the context of this study, the term *determinant* has been used on two occasions. First, *the determinants of a successful travel plan* refers to several factors that emerged from the literature as having impacts on determining the success of a travel plan, namely contextual factors, travel plan measures, travel plan implementation process, monitoring process. Secondly, the determinants for changing travel mode choice behaviour can be defined as a combination of interrelated variables that mediate or influence behavioural change.

[8] The healthcare authorities produce hospital travel plans based on data related to the travel context and staff travel behaviour (Trust, 2010). As there is a lack of academic studies on hospital travel plans, the travel plans produced by the NHS trusts have been reviewed as part of this study and discussed in Chapter 7.

geted outcome in practice for the following reasons (Bartholomew et al., 2006). First, individuals with strong car use habits act by their habits, not with their intentions. Strong habit is perceived to block the more deliberate processing prior to behaviour (Eriksson et al., 2008). A choice that is non–deliberate may, in fact, be difficult to influence with rational arguments (e.g. increased costs) (Bartholomew et al., 2006). Second, due to the force of habits individuals with habitual behaviour may continue to carry out the same behaviour despite the changes made in situational context and presence of a non–chosen preferable travel option (Klöckner and Friedrichsmeier, 2011). Strong habits interfere with the willingness to search for new information and the perceived ability to select a different travel option. As a result, habitual car users tend to make less elaborate travel mode choice. Third, habitual car users have a lack of awareness towards the problems associated with car use. Breaking a chain of beliefs associated with the habitual behaviour that has been held and reinforced for a long time and has proven to be a formidable challenge.

Information campaigns are designed to influence attitudes and personal norm based on the assumption that travel behaviour is guided by intentions (Gärling et al., 2002). However, such measures were found to have little or no impact on changing habitual behaviour (Wright and Egan, 2000). Attitude–based information campaigns are found to be useful in cases where habits are yet to be developed (Gärling et al., 2002). Building on this line of argument the importance of breaking car use habits to achieve a significant reduction in car use is highlighted by previous studies (Matthies et al., 2006; Ouellette and Wood, 1998; Stanbridge et al., 2004; Verplanken and Wood, 2006). Verplanken et al. (1997) suggested that the habits can be overruled by forcing individuals to pay attention to the decision options or increasing the functional importance of information acquisition.

The systematic development of travel plan measures is, in particular, important for promoting walking among car users. Theory–driven interventions are considered as more effective in securing long–term change in travel mode choice behaviour in comparison with non–theoretical interventions (Bartholomew et al., 2006). Despite having a strong body of travel behaviour research, there is a lack of widely acknowledged framework to provide guidance on how the knowledge–base may contribute to the development of interventions, especially in the context of healthcare (Melia, 2012; Ogilvie et al., 2007). Therefore, the factors affecting travel mode choice behaviour are often examined in isolation from the intervention development standpoint. In public health research, the applications of theoretically underpinned behavioural change interventions have been proven to be successful in promoting healthy behaviour such as physical activity, quit smoking, and drug addiction. However, in transport the explicit theoretical rationale between interventions and their intended effects on changing travel behaviour is not clearly known (Gärling and Fujii, 2009). The success or failure to achieve the targeted outcome cannot be attributed to the interventions alone. It is, therefore, become difficult to distinguish the actual effects of the interventions from effects due to changes in external circumstances and improve the interventions accordingly based on their actual performance.

The Theory of Planned Behaviour is widely used as a reliable tool to understand the underlying principles behind travel mode choice behaviour (Ajzen, 1991; Bamberg and Schmidt, 2003; Klöckner and Friedrichsmeier, 2011). According to the Theory of Planned Behaviour, the travel mode choice behaviour is driven by a socio–psychological process that is embedded within the context and builds upon the perceptions towards the contextual or situational factors (Ajzen, 1985). Travel plan measures attempt to change travel mode choice behaviour by altering the situational and psychological beliefs that can be changed within the of a travel plan (Gardner and Abraham, 2008). In real–life circumstances, changing the situational factors is either subject to individual or organisational constraints (e.g. lack of resources) (Associates, 2008; De Gruyter et al., 2014); or beyond the scope of the travel plan (e.g. major improvement of infrastructure). Based on a review of 17 workplace travel plans, Macmillan et al. (2013) found that the travel plans mostly included information strategies with a lack of measures to improve the travel environment, such as improving local walking, and cycling environment.

Effective, persuasive campaigns, and interventions are underpinned by the knowledge of the underlying modifiable psychological constructs behind car use (Bartholomew et al., 2006; Fujii and Taniguchi, 2005). The impacts of situational factors on the socio–psychological process can be manifested in the form of perceptions towards the situational factors. Therefore, it is important to understand how person–related constructs are influenced by situational factors and how psychological factors shape up the perceptions of situational aspects (Collins and Chambers, 2005). In comparison with the situational factors the psychological constructs such as intentions, habits, attitude, perceived behavioural control, and subjective norm have a high stability; therefore, account for a higher impact on changing travel mode choice behaviour (Anable and Gatersleben, 2005). The success of travel plan measures depend on individuals' ability to recognise and respond to the changing circumstances and integrate these signals into their decision–making process (Gärling et al., 2002). Behavioural interventions such as travel plans are designed to influence the beliefs (i.e. behavioural, normative, and control beliefs) held by car users to more favourable beliefs towards the alternative modes of transport. Thereby, the impacts of travel plans may enable the corresponding changes in attitude, subjective norm, perceived behavioural control, and intention to change travel behaviour. However, intention to change travel behaviour may not always result in change in travel behaviour. The association between intention and behaviour may vary with respect to the characteristics of the existing behaviour and travel context. The gap between intention and behaviour is stronger among individuals with habitual behaviour (Verplanken et al., 2008).

Previous studies provide an extensive knowledge on the key determinants of travel mode choice behaviour. However, the distinct situational factors (e.g. priority for patient and visitor parking) and working patterns of the hospital staff present a challenge in generalising existing knowledge in the context of healthcare (Enoch, 2012). Failing to address the factors that may facilitate or constrain walking behaviour is likely to affect the success of travel plan measures. Moreover, Gardner and Abraham (2008) conducted a systematic review to identify potentially modifiable constructs associated with car use intentions and behaviour. According to the study findings, there is a lack of reliable evidence–base to design interventions to reduce car use.

Previous research highlighted the need for further research to operationalise intention to change travel behaviour (Sanko et al., 2013). Existing literature on travel mode choice for commuting mostly focussed on investigating the factors and constraints associated with switching travel mode from car to public transport (e.g. Jakobsson (2007); Stokes (1996)). As a result, in transport research the viability of promoting walking as an alternative to car use for commuting purposes has also been little explored. Moreover, previous research aimed at investigating the intention to use a travel mode mostly used constructs related to that specific travel mode. Many argue that the inclusion of alternative travel modes would provide a more comprehensive picture of the psychological antecedents of a specific travel mode (Gardner, 2008). Moreover, the Theory of Planned Behaviour used to support the design of interventions to change behaviour are often strongly grounded on the cognitive beliefs of the individuals (Conner et al., 2011). Models underpinned by the Theory of Planned Behaviour should incorporate both affective and cognitive (instrumental) attitudes (Ajzen and Fishbein, 2005; Gardner, 2008). The above research gaps call for further research into practical approaches to develop effective travel plan measures based on the in–depth knowledge of changing travel mode choice behaviour from car to walking. This study attempts to answer the research question through some what questions.

1.6. Research aim and objectives

In the context, this PhD aims to address the knowledge gaps by exploring the key socio–economic, psychological, and situational determinants intention to change travel mode choice behaviour of hospital staff within the scope of a travel plan based on the principles of Theory of Planned Behaviour. The specific objectives to achieve of the study are:

- to examine workplace travel plans with a focus to the key determinants of a successful travel plan;
- to develop a theoretical framework to demonstrate the impacts of socio–economic, situational and psychological determinants for intention to change travel mode choice behaviour based on the Theory of Planned Behaviour[9];
- to examine the travel mode choice behaviour of the NHS hospital staff within the context of travel plans;
- to identify the key determinants for intention to change travel mode choice behaviour of hospital staff; and
- to provide recommendations to inform the design of effective travel plan measures for hospital staff.

The timeline for the PhD project was divided into three different phases, which are:

- **Review phase**: Identifying the research gaps and designing the PhD work–plan;
- **Phase 1**: Defining the scope of the study; and
- **Phase 2**: Investigating the travel behaviour of hospital staff.

The key research activities carried out during the three phases to achieve the research objectives are presented in Figure 1.7.

1.7. Structure of the thesis

The presentation of this doctoral thesis is structured in a logical manner as suggested by Perry (1998). This PhD aims to contribute to the knowledge gap by exploring the key determinants for intention to change travel mode choice behaviour of the NHS hospital staff based of the principles of Theory of Planned Behaviour. The study begins with outlining the research problem in the present policy and research context. The thesis comprises nine chapters. The structure of the thesis is outlined below.

Chapter 1: Introduction highlights the research problem by exploring present policy and research context of hospital travel plans. Secondly, the significance of the research is discussed in the light of the research gaps identified in Chapter 2 and Chapter 3. The final section of the chapter includes the PhD aim and objectives and a brief summary on the methodological approach used to achieve the objectives of the PhD.

Chapter 2: Key aspects of workplace travel plans attempts to demonstrate the significance of

[9] A theoretical framework is a structure that describes a theory being used as part of a research study and explains why the research problem is being investigated.

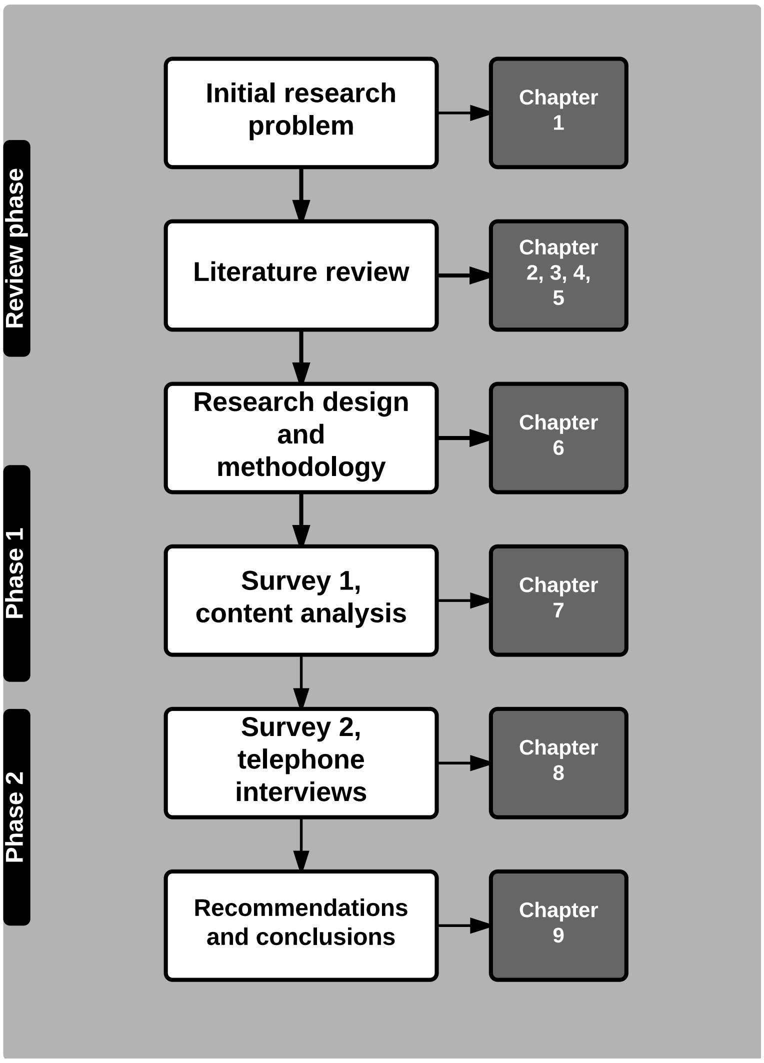

Figure 1.7: Research methodology used to achieve the research objectives.

workplace travel plans as a travel demand management tool within the present travel context is discussed. The following sections cover several topics to acquire a better understanding of the travel plan including motivations to introduce travel plans, the take–up of travel plans in the UK, employers' attitude towards travel plans, the key benefits of a travel plan and the key steps of preparing a travel plan in practice. The final section includes a description of the types of travel plan measures generally used to change travel behaviour in the UK and abroad.

Chapter 3: Literature review on workplace travel plans outlines a review on the key determinants of a successful travel plan, which is followed by a travel plan case study on Sheffield University. Finally, the research gaps found in the exiting literature are summarised.

Chapter 4: Determinants of travel mode choice behaviour outlines the factors that are closely associated with travel mode choice behaviour. This is followed by a description on the key issues associated with changing travel mode choice behaviour.

Chapter 5: Theoretical framework provides a brief description of the theoretical underpinning of the study. This is followed by describing the hypothesised relationships between the latent constructs within the theoretical framework developed based on the concept of Theory of Planned Behaviour.

Chapter 6: Methodology illustrates the rationale behind using the methodological approaches for this study and sequential actions used to conduct the research based on a methodological framework developed as part of the study.

Chapter 7: Analysis of hospital travel plans discusses the results found in Phase 1, which include a nationwide survey on hospital travel plans and content analysis on travel plans. First, the statistical analysis of the survey data are described. This is followed by discussing the results found from the qualitative analysis of hospital travel plans following a coding framework. The final section includes a discussion on existing hospital travel plans with a focus to travel plan measures based on the evidence found from the two studies.

Chapter 8: Analysis of hospital staff travel behaviour discusses the results found in Phase 2, which include a nationwide survey among hospital staff and follow–up telephone interviews. First, the sample profile is discussed using descriptive statistics. Secondly, the difference between the demographics and travel behaviour characteristics of the two travel mode(s) user groups (e.g. car users, other mode users) is examined using Mann–Whitney U tests. The correlation between the individual's beliefs towards the importance of the modal attributes are measured using Spearman's ρ correlation tests. In the second section, all latent constructs are assessed individually and finally an overall measurement model is estimated using confirmatory factor analysis to verify the unidimensionality between the measures. Finally, the structural model has been estimated and compared with the measurement model to verify the overall fit to the data, which is followed by a description on construct validity and reliability.

Chapter 9: Conclusions and recommendations consolidates the overall research findings and demonstrates how the research objectives are achieved. Secondly, the transport policy and research implications of the study are discussed. Thirdly, contributions to the body of knowledge are discussed, which is followed a discussion on the limitations of the research. Finally, in the light of the research findings directions for future research are suggested.

Chapter 2

Key aspects of workplace travel plans

2.1. Introduction

This chapter provides an introduction to the fundamental aspects of a workplace travel plans as a demand management tool in the UK travel context. Literature reviewed includes national and local policy documents; academic journals; books; conference papers; information available on–line and reports produced by public and private organisations. The initial search for relevant literature was guided by the following keywords; travel plan; workplace travel plan; employer's transport plan; and travel plan for healthcare professionals. To avoid bias findings, literature with a reliable theoretical and empirical underpinning was reviewed.

As highlighted in a study by Melia (2012), it was found that there is a lack of academic research with a focus to the travel plans of the healthcare professionals apart from the travel plans produced by the NHS Trusts. Therefore, relevant workplace travel plan literature in other contexts were reviewed to seek answer to the following research questions.

- What is the policy context of workplace travel plans?
- What are the key motivations behind developing travel plans in the UK?
- What are the benefits of a travel plan?

The structure of the chapter is outlined below. The impacts of high car use within the present travel context is discussed in Section 2.2. Section 2.3 discusses the key methods used to manage demand travel in the UK. In Section 2.4, the steps of preparing a travel plan is outlined with a brief discussion on travel plan measures. Section 2.5 discusses the key motivations behind introducing travel plans in the generic and healthcare context followed by a description on the benefits of a travel plan in Section 2.6. The chapter is summarised in Section 2.7.

2.2. Background

The increased use of cars has contributed to high volume of traffic on the roads during peak periods of traffic demand during peak hours, congestion, emissions of greenhouse gases (GHG)[1] [2], noise, accidents, depletion of resources and inaccessibility to amenities and services. As a result, there is a growing concern over the negative impacts of the increased mobility trends. The impacts of transport are discussed in the following sub–sections.

2.2.1. Economic impact

The estimated cost of the externalities associated with congestion is around 100 billion euro each year, which accounts for 1% of the European GDP (EC, 2006). In the UK, the overall economic growth and productivity is affected by the growing congestion in urban areas. A study by the Centre for Economics and Business Research Limited found that traffic congestion costs 4.3 billion pounds every year to the UK economy (Inrix, 2012).

2.2.2. Climate change

In 2009, road transport accounted for 19% of the total CO_2 emissions from all sources with a high contribution from cars and taxis (43%) (DfT, 2011a). The projected CO_2 emissions from road transport between 2003 and 2035 are expected to rise by 43%. The environmental damage caused by the total CO_2 emissions from transport may cost up to 4 billion pounds by 2025 (Steer Davies Gleave, 2006). The possible ways to reduce the negative impacts of transport on the environment have been highlighted in studies such as "The King Review of low–carbon cars" (King, 2008).

In addition, under the Climate Change Act 2008, the UK Government has set out a target to reduce CO_2 emissions by 34% by 2020 and and by 80% by 2050 against the 1990 baseline emissions respectively. In 2009, a carbon budgeting system was introduced to limit the CO_2 emissions over a five–year period to achieve the targeted CO_2 emissions by 2050 by the department of energy and climate change (DECC, 2010). The first phase of carbon budget was implemented between 2008 and 2012. In 2009, a best–practice guidance on the "Delivering Sustainable Low Carbon Travel: An Essential Guide for Local Authorities" was published by the Department for Transport outlining the necessary actions required by the local authorities to reduce transport related CO_2 emissions.

[1] Greenhouse gases comprise carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbon (HFC), perfluorocarbon (PFC), sulphur hexafluoride (SF_6), and local air pollutants.

[2] There are five key pollutants that affect human health and wellbeing: particulate matters (PM), carbon monoxide (CO), nitrogen oxides (NO_x), and benzene and hydrocarbons (HCs).

2.2.3. Social exclusion

Evidence shows that on average people from households without a car make more walking trips, fewer number of long trips and fewer number of total trips than those from households with car(s) (DfT, 2007). A lower proportion of the people from low–income households have access to a car than the remaining population (Social Exclusion Unit, 2003). They primarily depend on walking, public transport, and lifts from family and friends to access services, such as hospitals. According to a study by the Social Exclusion Unit (SEU), more people without access to a car reported to have experienced difficulty in accessing services such as healthcare, food shops (retail), education (school/when escorting to school), social, cultural, and sporting than those with access to car(s) (Social Exclusion Unit, 2003).

Moreover, a report titled "Sustainable Transport and Active Travel" produced by the Sustainable Development Commission stated that around 1.4 million people with a lack of access to private car missed, turned down or chose not to seek medical help due to difficulty in accessing the health-care services (Sustainable Development Commission, 2007). Thus, this is likely to have an impact on their day–to–day life and participation in social activities. Limited opportunities for social interactions may reinforce the social isolation for most disadvantaged groups from the wider communities. On the other hand, in the absence of accessible services certain groups of people such as elderly, women, people with children, and people with impairments may become more car–dependent. Each local authority is now obliged to carry out a study to assess the accessibility to the key services by walking and public transport, particularly by the low–income groups and people without access to private cars.

2.2.4. Health problems

Over a quarter (26%) of the adults aged 16 or over were classified as obese (i.e. with a Body Mass Index ≥ 30 kg/m^2 or over) in England in 2010 (ASO, 2012). The obesity rate in England is one of the highest in the European Union. The estimated cost of obesity to the UK economy is around 4.2 billion pounds (Department of Health, 2011). Research suggests that the obesity rate at a national level is positively associated with a lack of physical activity. According to a report by Sir Derek Wanless providing healthcare services for the increasing number of people suffering from health–conditions associated with obesity alone is going to pose a serious threat to the future of the NHS in England (Sir Derek Wanless et al., 2007). According to the Department of Health, the estimated cost of physical inactivity to the National Health Service (NHS) is between 1 billion to 1.8 billion pounds (NHS, 2014). Health experts are promoting the concept of 'Active Living' - a preventative approach that aims to accumulate at least 30 minutes of physical activity into daily routines everyday (WHO, 2004). Regular physical activity reduces the risk of obesity and suffering from other health–conditions (Hamer and Chida, 2008; Hou et al., 2004; Kwaśniewska et al., 2010). Commuting is an obligatory routine activity. Therefore, as part of the active living initiative the NHS is encouraging their employees to walk to work on a regular basis.

2.3. Travel demand management

In 1998, in the "Transport White Paper" the UK Government acknowledged that allowing the current practice of the unrestricted traffic growth was no longer feasible and highlighted the importance of changing and reducing the demand for car use to match the capacity of existing transport networks (DETR, 1998). This is referred to as travel demand management (TDM) (Kitamura et al., 1997). Managing travel demand is commonly known as (site based) *mobility management* in continental Europe and in the USA, as *transportation demand management* (Rye, 2002). Transport demand management measures are consist of a set of actions designed to influence the short–term and/or long–term individual decisions associated with travel mode choice, trip length, frequency of trips and the route taken. To date, several system–based and demand–based measures have been introduced worldwide to encourage change in travel behaviour including road user charging, improving transport infrastructure, land–use policy and travel plan (Ben-Elia and Ettema, 2009; Brög, 1998; Cleland and Cooper, 2003; Meyer, 1999; Organizational Coaching and ESTC, 1996).

During the 1980s, the applications of TDM measures were limited to metropolitan areas with high rate of population, high density areas with mixed use activities, lack of parking spaces and congestion problems (Hensher, 1998). The future travel demand of England is projected to increase by 19% between 2015 and 2025 alongside the recovery from the recession and the decreasing fuel costs for driving (DfT, 2013). The increasing traffic growth will cause an increasing pressure on the already saturated existing infra–structure and result in higher level of congestion. In response to increasing traffic growth travel demand are generally applied in the form of (Banister and Gallent, 1999) (see Figure 2.1):

- reducing the number of trips made by car, which is called trip degeneration;
- promoting the use of sustainable modes of transport, e.g. walking, cycling and public transport; and
- reducing the distance travelled by car and increase vehicle occupancy levels, e.g. travel shorter trips, more trips by transit or para–transit travel modes and car–sharing.

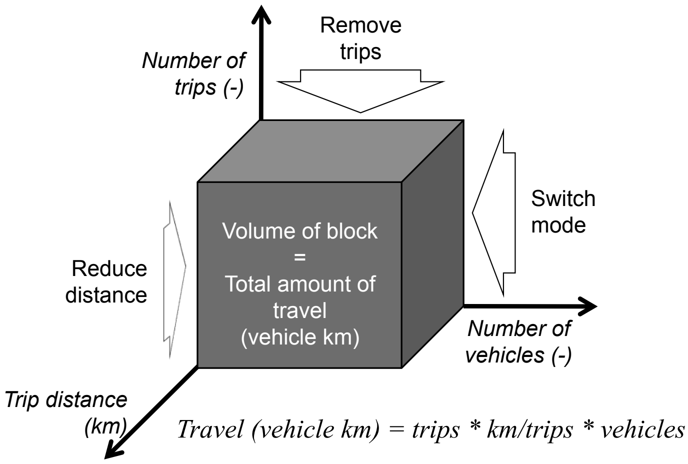

Figure 2.1: Options for reducing travel, adapted from (Banister and Gallent, 1999).

2.3.1. Integrated land–use and transport policy

Integrated land–use and transport policy is widely acknowledged as an effective travel demand management measure to promote sustainable travel behaviour (Halden, 2002). Accessibility measures determine the links between transport and land–use. Improving access to and from service facilities is considered as a key to reduce travel demand (DfT, 2006). Therefore, a comprehensive understanding of the concepts of accessibility is fundamental to inform integrated land–use and transport policy. Conducting an accessibility analysis is recommended at various stages of the planning decision making process, such as selecting sites for new developments, transport assessment, assessing traffic management proposals, and determining parking standards. According to the Scottish Executive (2000), accessibility analysis is more effective when the following issues are considered:

- transport and land–use policies such as health, education, and regional development are consistent with each other; and
- access to local opportunities is examined for walking, cycling and public transport.

In the UK, there has been a renewed interest in the relationship between land use planning and transport planning following the introduction of *Planning Policy Guidance 13: Transport* (PPG13) in March 1994 (Curtis, 1996; DCLG, 2001). PPG13 recommends the local authorities to identify locations for new developments that are accessible by alternative modes of transport. Previous research attempted to explore the association between local accessibility; location of housing and workplaces; socio–economic changes, and travel patterns (Curtis and Headicar, 1997; Halden, 2002). Singapore is one of the few places, which managed to mitigate traffic congestion successfully by integrating TDM with a combined land–use and transport policy (Sim et al., 2001). However, the implementation of integrated transport and land–use policy has not been common practice in the UK and has contributed to the growing separation between the origin and destination of journey trips.

2.3.2. Road user charging

Road user charging is a demand management tool that attempts to discourage the use of certain types of vehicles or fuel sources during peak hour and reduce traffic congestion by imposing direct charges for using the roads (Small and Gomez-Ibanez, 1998). Road user charging is implemented in the form of congestion charges, pollution pricing schemes, *mileage–based usage fees* (MBUF) or distance based charging, and toll charging. The application of congestion charges is limited to major metropolitan areas with a high level of congestion (DfT, 2007). For example, the *London Congestion Charge*, *Stockholm Congestion Tax*, *Electronic Road Pricing* in Singapore and *High–occupancy Toll Lanes* in the United States (Small and Verhoef, 2007). The *London Low Emission Zone* is an example of the pollution pricing schemes. *Mileage Based Usage Fees* (MBUF) or distance based charging are applied to heavy vehicles with respect to their weight and distance travelled. The countries that implemented MBUF include the United States, New Zealand (RUC), Switzerland (LSVA), Germany (LKW–Maut), Austria (Go–Maut), Czech Republic, Slovakia and Poland (Scott Wilson, 2012). The revenue generated through road user charging is often used for improving road infrastructure. Toll charging for roads, bridges and tunnels are often introduced to generate finance to repay the existing debt or future management issues associated with the toll facility itself.

However, the public acceptance of many road user charging schemes have been subject to debate, and some of the schemes have been either delayed or discontinued due to lack of public acceptance and protest. A proposal to introduce nationwide per–mile road user charges by the UK government in 2007 was opposed by a petition participated by 1.8 million people, which accounted for the 6% of the driving population in the UK (Gardner, 2008). It is argued that road user charging such as congestion pricing is another form of tax, which is not equitable and has a negative impact on retail, and economic activities. The transport economists mostly agree that road user charging is one of the most economically viable solutions to alleviate traffic congestion, but there is a disagreement about in what form it should be implemented (Ben-Elia and Ettema, 2009). Research suggests that the public acceptance of road user charging policies depend on the subjective perception of the fairness and effectiveness of the issues for which they are being implemented (Eriksson et al., 2008; Schuitema and Steg, 2008).

2.3.3. Improving transport infrastructure

This TDM measure attempts to encourage individuals to use alternative modes of transport through the improvement of infrastructure for public transport (e.g. public transport routes, building park and ride service); development of pedestrian (e.g. sidewalks, pedestrian crossing, plantation, pedestrian routes) and cycling facilities (e.g. cycling lanes, bicycle parking space). During the 1990s, in response to the recommendations to improve the performance of existing networks by transport experts, the UK Government allocated nearly 180 billion pounds budget over a ten year period to implement initiatives to improve the road and networks; and public transport services (DfT, 2006).

In 2009, 87% of the households were living within six minutes walking distance from a bus stop (DfT, 2009b). The percentage of households reported to have access to frequent and reliable public transport have increased by 7% from 77% to 84% between 2002 and 2009 (DfT, 2009b). In 2008, 82.4% of the working age population in England had access to workplace by walking or public transport. Access to good quality transport infrastructure is key to promote the use of alternatives. However, the key shortcomings of this measure are: (a) the implementation of this measure is often subject to the availability of government fundings; and (b) improving transport infrastructure may not always lead to the targeted change in travel behaviour.

2.3.4. Travel plans

Travel plans are becoming an increasingly popular TDM measure because of three key reasons: *(a) a higher public acceptance (Gardner and Abraham, 2008); (b) cost effective to implement (Cairns et al., 2010);* and *(c) offer a wide range of benefits to individuals and organisations if designed effectively* (Bamberg and Möser, 2007; Brög, 1998; Emmerink et al., 1995; Gardner, 2008; Taylor and Ampt, 2003).

A wide range of alternative terminologies are also used to denote travel plans such as *site–based mobility management*, *site–based transport demand management*, *workplace transport demand management*, *employer–based trip reduction programmes*, *company mobility management*, *corporate mobility management*, *employer transport plans*, *employer commute option programmes*, and *green transport plans* (Enoch, 2012). During the early 1980s, travel plans were commonly referred to as *green transport plan* to emphasise the importance of environmental agendas in reducing workplace travel demand (DETR, 1998). However, the employers preferred the term *travel plan*, as a travel plan represented the wider organisational travel management strategy beyond the environmental issues (DfT, 2009c). The important aspects related to the travel plans are discussed in the following sections.

2.3.4.1. Definitions of travel plans

A clear understanding of the definitions of a travel plan is essential to understand the objectives and scope of a travel plan as a TDM measure. The most widely cited and adopted definitions of a workplace travel plan are presented below.

According to EEBPP (2001):

> *"A travel plan is a general term for a package of measures tailored to meet the needs of individual sites and aimed at promoting greener, cleaner travel choices and reducing reliance on the car. It involves the development of a set of mechanisms, initiatives and targets that together can enable an organisation to reduce the impact of travel and transport in the environment, whilst also bringing several other benefits to the organisation as an employer and to staff".*

According to (Rye, 2002):

> *"A travel plan provides a strategy for an organisation to reduce its transportation impacts and to influence the travel behaviour of its employees, suppliers, visitors and customers. A travel plan is a long–term management strategy for an occupier or site that seeks to deliver sustainable transport objectives through positive actions and is articulated in a document that is regularly reviewed by local authorities".*

The Department for Transport (DfT, 2008) defines a workplace travel plan as a strategy for managing the travel generated by your organisation, with the aim of reducing its environmental impact. According to Möser and Bamberg (2008), a workplace travel plan includes a bundle of measures introduced by an employer that attempt to increase the sustainable travel and reduce the use of single occupancy car use.

According to the above definitions, the key objective of a travel plan is to promote the use of alternative modes of transport and reduce the use of cars. To a great extent, a travel plan is regarded as a long–term strategic approach that attempts to manage the travel demand of an organisation through a set of objectives and context–specific actions. The key objectives of a travel plan include (DfT, 2006):

- to provide easier access to and movement around the site by all users;
- to identify the organisational and physical barriers to alternative modes of transport;

- to reduce commuting time, commuting distance and the need for travel on work purposes;
- to response to changing needs of the site users; and
- to ensure parking for those who needed the most.

2.3.4.2. Classification of travel plans

Travel plans are generally classified into two groups: (a) *origin travel plan*; and (b) *destination travel plan* (Enoch and Zhang, 2008). The key difference between these travel plans is destination travel plan focuses on increasing the use of sustainable modes of transport from multiple origins to a specific single destination such as workplace, school, hospital, university or leisure attraction, whilst origin travel plans focuses on the access from a single origin to multiple destinations, such as residential travel plans. Compared to destination travel plans the use of origin travel plans is relatively new in practice. A destination travel plan can address different types of journeys associated with organisational activities such as commuting trips; business travel by staff; visitor travelling to and from the site; deliveries, contractors, and fleet vehicles (ambulance) operating as part of the organisational activities. Therefore, a travel plan for the hospital staff is example of a destination travel plan.

2.4. Steps of producing a travel plan

Travel plan is a living document, and usually include background information on the national, local, and organisational policy context; aim and objectives of the travel plan; scope of the travel plan; targets of the travel plan[3] (DfT, 2009a). The process of preparing a travel plan is an iterative process as shown in Figure 2.2. The key steps of producing a travel plan as recommended by the Department for Transport are: *(1) set out the scope of the travel plan; (2) collect the evidence–base; (3) develop travel plan measures; (4) amend the travel plan; (5) approve the travel plan; (6)implement the travel plan; and (7) monitor and review the travel plan* (DfT, 2009a).

The first step of preparing a travel plan involves setting out the scope of the travel plan considering the issues identified in the travel audit conducted by the employer. The second step involves collection of extensive range of data, which provide the basis for designing the travel plan measures. Guidelines produced by the Department for Transport recommend that travel plans should be supported by in–depth information on the current staff travel patterns within the given context (DfT, 2006). The following data collection methods are recommended by the Department for Transport to collect the data required to support the travel planning process (DfT, 2006):

[3]There are two types of targets: *(a) action–type: non–quantifiable targets that take place in the form actions with target dates; and (b) aim–type: quantifiable targets.*; travel plan measures; actions and strategies to implement the travel plan; and the travel plan monitoring process.

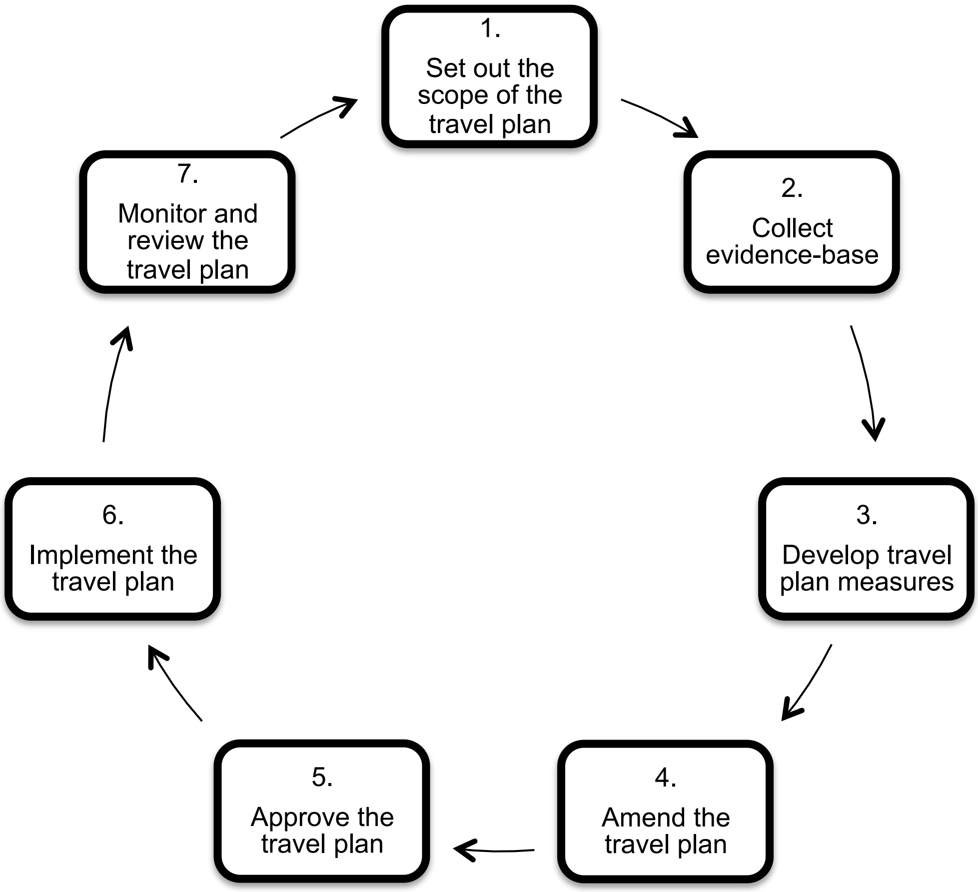

Figure 2.2: The key steps of developing a travel plan. Adopted from: (DfT, 2009a).

- a site assessment;
- staff travel survey; and
- travel audits.

The third step involves identifying travel plan measures based on the evidence–base, which is followed by amending and approving the measures by the senior management. The sixth step involves implement the travel plan following an action plan. The implementation process involves raising awareness towards the travel plan by formulating a clear marketing campaign; and producing publicity materials and branding the travel plan. The final step involves monitoring the impacts of the travel plan in achieving the targets set out for the period. However, the key limitation of the travel planning process recommended by the Department for Transport is it makes little reference to how to design travel plan measures to influence travel behaviour change.

The significance of using robust methods to inform the travel planning process to secure the success of travel plans as highlighted by previous research (Cairns et al., 2002, 2004, 2008; Gärling and Axhausen, 2003; Rye, 2002). Theory–driven measures or interventions are regarded as more effective in changing travel behaviour, however, the systematic development of interventions based on theoretical rationale is limited in practice (Bamberg and Schmidt, 2001; Bartholomew et al., 2006). Nevertheless, the use of the Theory of Planned Behaviour approach and other models such as PRECEDE/PROCEED model, the intervention mapping approach, and the Model for Planned Promotion of population health are widely used to promote healthy behaviour (Conner and Sparks, 2005).

The concept of the Model for Planned Promotion was developed by integrating the aspects of the PRECEDE and PROCEED model (Green and Kreuter, 1999) and the Intervention Mapping Approach (Bartholomew et al., 2006). This model is widely used in public health research to design interventions to promote healthy behaviour. The model includes six steps: (1) *problem analysis*; (2) *risk behaviour analysis*; (3) *analysis of behavioural determinants*; (4) *development of intervention*; (5) *implementation and dissemination*; and (6) *evaluation of the intervention*, which is shown in Figure 2.3. The model differs in principle from the approaches suggested by the Department for Transport (DfT, 2009a) by providing a systematic and flexible structure that establishes the link between changing behaviour and designing interventions. The model proposes that each step needs to be supported by an evidence–base underpinned by established theories of changing behaviour, and evaluated by rigorous methods to ensure the successful completion of the step. Travel plan measures are the core elements of a travel plan. The types of travel plan measures used in practice are discussed below.

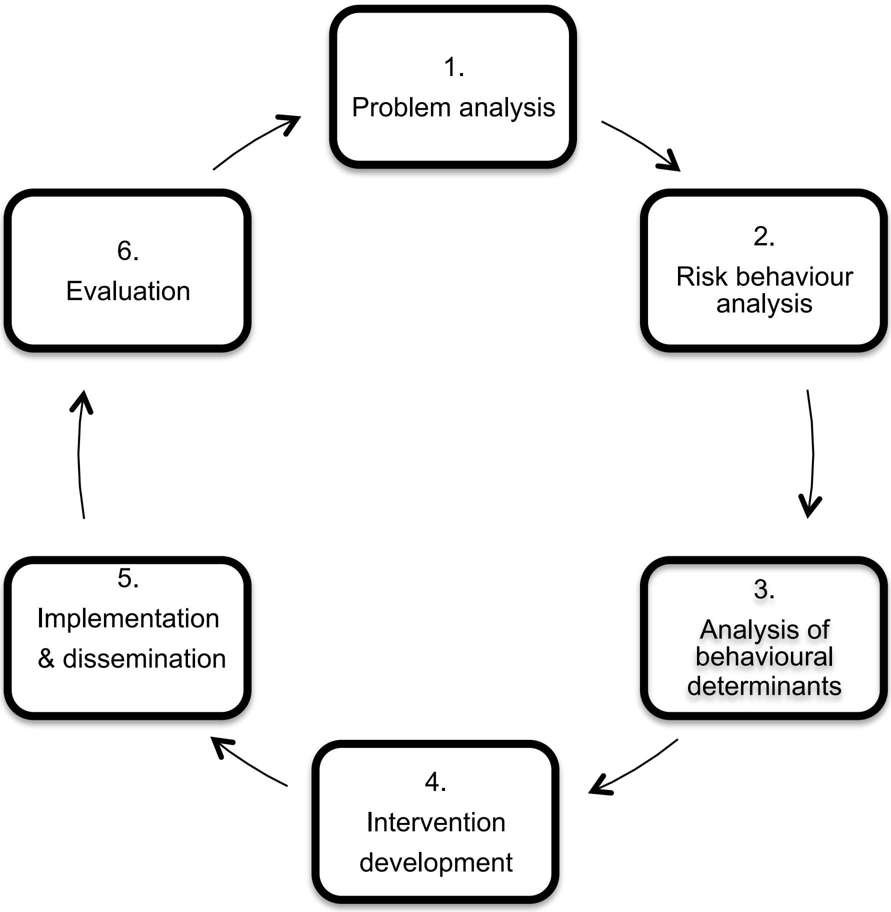

Figure 2.3: The key steps of the Model for Planned Promotion (Conner and Sparks, 2005).

2.4.1. Travel plan measures

Travel plan measures are often classified into different categories to serve different situations (Sim et al., 2001). Meyer (1999) classified the travel plan measures into three categories:

1. *alternative transport modes* refer to measures that encourage alternative transport modes, such as walking, cycling, public transport, and car–sharing;
2. *incentives or disincentives* refer to measures that provide incentives for encouraging the use of alternative modes of transport and disincentives for discouraging the use of single occupancy car; and
3. *non–transport means* refer to measures or policies that attempt to reduce the needs for travel and discourage the use of cars.

A travel plan consists of a broad range of measures to reduce car use and promote the use of alternative modes of transport, which are presented in Table 2.1.

Table 2.1: Key travel plan measures used in practice.

Type	Measures
Public transport	• Provide generic and tailored public transport information • Access to rail planner • Liaise with local operator for new/better services • Liaise with local operator for cheaper price • Pay for new services • Provide discounted fare on public transport
Cycling	• Pool bikes • Provide better facilities; e.g. changing/shower/parking • Encourage cycling; e.g. training, free bike maintenance • Bike loan scheme (Incentive) • Discounted purchase of cycles and equipment
Walking	• Provide better facilities; e.g. lighting or walkways at site • Encourage walking map; e.g. walking map • Walking buddies • discounted purchase of walking clothes and shoes
Car sharing	• Priority parking spaces for car sharers • Guaranteed ride home scheme
Car parking management	• Reduce supply for car parking spaces • Car parking management policy • Car parking charges • Car parking permits • Company car initiatives
Non–transport means	• Flexible working hours • Telecommuting/teleworking/teleconferencing • Creating a car–free culture campaign

Source: Adopted from (Enoch and Zhang, 2008).

Incentives and disincentives are often used to refer to positive and restrictive measures respectively. Previous literature has also classified travel demand management measures as (a) *push measure*; and (b) *pull measure* (Steg et al., 1997), which are also used in practice to classify travel plan measures. Push measures refer to the measures that discourage the use of cars by introducing disincentives, such as car parking charges, and car parking permit. Pull measures refer to the measures that encourage the use of alternative modes of transport by introducing incentives such as income generated from car parking charges can be used to promote alternatives, and discounted purchase of walking clothes and shoes. Pull measures are considered as more acceptable and easy to implement in comparison with push measures (Fujii et al., 2001). Marshall and Banister (2000) reviewed the impacts of travel demand management measures implemented in European cities and concluded that a combination of measures (e.g. restricting car use in the city centre and improving facilities for cyclists and pedestrians) are likely to be more effective in reducing car use and encouraging alternatives. However, Eriksson et al. (2010) argued that there is a lack of empirical studies with a focus to behavioural responses to a combination of push and pull measures.

Travel plan measures are also classified as (Hanson, 1995; Möser and Bamberg, 2008): (a) *soft measure;* and (b) *hard measure.* There are no widely acknowledged definition for soft measures. Soft measures attempt to persuade individuals to use alternatives by influencing their perceptions, motivations, and judgements of the consequences associated with their use instead of using force and restrictions (Möser and Bamberg, 2008; Rose and Ampt, 2001). For example, travel feedback programmes (TFPs) provides personally tailored information based on individuals' reported travel patterns to encourage change in travel behaviour. Individualised marketing is a sub–type of TFPs that allows the individuals to receive information in accordance to their needs.

Möser and Bamberg (2008) performed a meta–analysis on a dataset of 141 published studies evaluating the impact of three types of soft policy measures. According to the study, the effect of the measures accounted for 39% to 46% increase in alternatives. Hard measures attempt to change the relative attractiveness of travel options by altering the objective environment (e.g. improving the physical environment) or the value of the travel options (e.g. change in car parking charges). The implementation of hard measures may lead to changes in travel behaviour if the individuals can systematically consider: (1) what changes are made to the environment; (2) deliberately reflect on the possible consequences of the changing circumstances on their travel situation; and (3) decide whether these consequences provide sufficient reasons to change current car travel mode choice. For example, a blocked freeway lane may increase commuting time by car. A car user may change travel mode to public transport only if saving travel time outweighs the consequences associated with the mode switch.

2.5. Motivations behind introducing travel plans

Reducing traffic congestion around the work–site and improving environmental quality were the key motivations behind adopting travel plans by different organisations during the late 1990s (Rye, 2002). The motivations behind adopting a travel plan vary between private and public organisations. Public sector organisations are obliged to develop travel plans to meet regulatory requirements, improve environmental image, and set an example for other organisations Steer Davies Gleave (2001). On the other hand, private sector organisations generally develop travel plans to secure planning permission, portray organisational values, to address transport problems (e.g. parking pressures, on–site congestion), and/or internal issues (e.g. saving money/time/fuel) concerning the organisation (Roby, 2010). Besides, organisations are more likely to develop travel plans to fulfil their corporate social responsibility (CSR) and meet Environmental Audit agenda (Enoch and Ison, 2007). The key motivations behind developing travel plans are discussed in the following sections.

2.5.1. Planning regulations

Planning regulations are considered as one of the most powerful and common motivators behind the development of travel plans in the UK. Under the *Section 106 agreement (Section 75 in Scotland)* of the *Town and Country Planning Act (1990)* developers are required to demonstrate the provision of satisfactory travel options to and from the proposed development for the approval of planning permission (HMSO, 1990). However, the role of travel plans in reducing the use of cars was further emphasised in the UK Governments' integrated transport strategy as outlined in the 1998 Transport White Paper, "A New Deal for Transport" (DETR, 1998; TfL, 2008) and "The Travel Choices for Scotland" (Scottish Executive, 1998). The existing organisations were also encouraged to produce travel plans on a voluntary basis for their sites.

In 2002, an updated version of the national guidance on workplace travel plans was issued to provide suggestions for good practice (Newson, 2002). In 2004, the effectiveness of workplace travel plans as a travel demand management tool was re–emphasised in the Smarter Choices' report (Cairns et al., 2004) published by the Department for Transport (DfT) alongside a White Paper on "The Future of Transport" (DfT, 2004). Despite the policy emphasis, the level of travel plan take–up in practice remains poor (Cairns et al., 2004). The role of local government in promoting travel plans was highlighted in the "Making Smarter Choices Work" report published by the Department for Transport (DfT) in 2005. In 2007, the private and public organisations became more aware of reducing their carbon footprint and the organisational cost associated with transport. At the same time, many organisations have introduced travel plans in response to the policy emphasis on reducing the peak–hour traffic on major commuter roads (DfT, 2007).

Planning Policy Guidance 13 (DCLG, 2011; TfL, 2008) highlighted that local authorities should encourage employers including the health and education providers to develop travel plans tailored to the needs of specific sites (DfT, 2006). Public organisations are required to produce travel plans for their buildings to set examples for other local organisations. Local authorities in England are also required by the DfT (then DETR) to incorporate strategies to encourage other organisations to adopt travel plans into their Local Transport Plan. As part of a survey carried out among 284 local authorities in England, 58% of the respondents reported to have used a legally binding planning agreement to encourage the adoption of travel plans among organisations (DETR, 2001).

According to *PPG13*, proposals for all major developments (e.g. hospitals) are required to submit a travel plan or transport assessment report alongside the planning application for the approval of planning permission (DCLG, 2011). A travel plan for a proposed development are required to include the following information:

- existing access to the site by all modes of transport;
- a forecast of the likely modal split of journeys to and from the site;
- proposed measures to improve access by public transport, walking and cycling to the site; and
- proposed measures to mitigate transport impacts and reduce the need for parking associated with the proposed development.

As discussed in Chapter 1, it is mandatory for all NHS Acute Trusts to produce a travel plan as part of their sustainable development management plan (NHS SDU, 2009b). The take–up of travel plans by the NHS Acute Trusts has increased since 2002. Between 2002 and 2013, the proportion of the NHS Acute Trusts with a travel plan has increased by 43% from 45.5% to 88.5% (HSCIC, 2014a).

2.5.2. Site–specific issues

Many organisations have introduced travel plans in response to meet the increasing travel demand and site–specific problems such as limited car parking spaces, and congestion on local roads (Cairns et al., 2004; Cleland and Cooper, 2003). Expansion of car parking spaces is often subject to availability of resources (e.g. funding and land) and planning permissions (Associates, 2008; De Gruyter et al., 2014). Many organisations including hospitals fail to provide the additional car parking spaces in response to the demand. A travel plan is considered as a more cost–effective solution to address the site–specific issues. For example, many organisations reported to have introduced travel plan measures in an attempt:

- to free–up car parking spaces so that the land could be used for more commercially viable options; and
- to reduce the inconvenience caused to employees during large scale construction/maintenance work near the workplace or relocation/expansion of the existing facilities.

Organisations with easy access by travel modes are regarded as environmentally friendly and sustainable. Such organisations are less likely to experience problems associated with recruiting staff and more likely to retain staff for longer.

2.5.3. Organisational values

According to Rokeach (1973), *“an organisational value is a belief that a specific mode of conduct is preferable to an opposite or contrary mode of conduct”*. Organisational values are embedded within the organisational culture to use travel modes. A travel plan or transport policies by an organisation also reflects their values towards travel. A small number of organisations such as The Body Shop, and Royal Society for the Protection of Birds have developed travel plans inspired by their environmental values and ethos (Rye, 2002). However, in case of ISO or EMAS (Environmental Management and Audit Scheme) accredited organisations, the key motivation for developing travel plans was to comply with environmental legislation (Buchan, 2001). Organisations with a higher commitments towards corporate social responsibility (CSR) and environmental issues are more likely recruit and retain a skilled workforce. Pricewaterhouse Coopers conducted a survey among new graduates and found that 71.2% of the respondents prefer to work for organisations with values similar to their values (Pepper et al., 2007).

2.5.3.1. The impacts of changing organisational motivations on travel plans

Many studies have highlighted the importance of organisational motivations for developing a travel plan in determining its long–term success (Coleman, 2000; Enoch and Zhang, 2008; Roby, 2010). Organisational motivations can be defined as *the organisational culture and incentives that influence the use of capacities in pursuit of the organisation's goals* (Horton, 2002). The development of a travel plan is often regulated by the changing motivations of organisations. Roby (2010) provided an insight into the association between the organisational goals and travel plans by exploring how the organisational motivations for a travel plan have evolved over time within an organisational context. The data analysis was based on in–depth telephone surveys with 25 organisations on the following aspects:

- original, current and future motivations;
- links to other departments;
- departmental responsibility;
- what sustained the travel plan to date;
- time span of the travel plan, travel plan performance; and
- background of the travel plan co–ordinator.

The author classified the motivations into three broad categories: *(1) primary motivations*, *(2) secondary motivations*, and *(3) future motivations*. Around 68% of the organisations participated in the survey reported that obtaining a planning consent was the original motivation to develop travel plans. A small proportion of the organisations implemented travel plans on a voluntary basis to address issues associated with facility management (i.e. accessibility problems) and the environmental agenda. External reactive motivations such as planning regulations played a role in initiating the development of travel plans for a high proportion of the organisations. Once a travel plan was developed, the motivations for travel plans had changed to more internally driven proactive motivations related to several areas within the organisation. Organisations that developed travel plans to address short–term issues such as freeing–up parking spaces due to employee redundancy were more likely to abandon their travel plan once the needs were fulfilled. The motivations behind developing a travel plan changed over time and differ from organisation to organisation. Roby (2010) argued that the motivations behind developing travel plans should be based on a balanced approach. A wide range of motivations for a travel plan help to broaden–up the scope to engage with other organisations for support and also help to sustain it for longer.

2.5.3.2. Employer's attitude towards travel plans

Employer's attitude towards travel plans shows how committed the members of senior management are towards the use of alternative modes of transport, which in turn influence the organisation's propensity to adopt a travel plan. The formation of attitudes towards a travel plan is influenced by several factors, including senior management's outlook towards resolving transport problems experienced by the organisation and perceptions towards alternative modes of transport.

Employers, who are experiencing concrete problems with parking or accessibility; and have positive perceptions towards alternative modes of transport are more likely to exhibit positive attitude towards travel plans and vice versa (Bradshaw and Lane, 1997; Ligtermoet, 1998; Rye, 1999). Organisational policies towards car parking management and the use of cars to perform work duties reflect employer's attitude towards travel plans. Two key research projects investigated the attitudes of the large employers towards travel plans in detail. Bradshaw and Lane (1997) conducted a study among 83 large employer (i.e. average number of employees per organisation was 305) across Nottinghamshire to examine employers' views on changing the travel patterns of their employees and several key areas related to transport, such as environmental issues and transport problems. Drawing upon the findings of the study, the author attempted to identify issues specific to the organisations that may encourage the adoption of travel plans. The research findings show that 90% of the organisations provided on–site parking for employees. Therefore, the employers' interest in staff travel was largely influenced by the issues associated with car parking provision. It was suggested that the wider impact of travel plans in managing traffic congestion and environmental pollution could be achieved when implemented in conjunction with national and local transport policies, such as taxation changes, and co–ordinated policies were.

Rye and MacLeod (1998) conducted a study among 154 UK and Dutch organisations with over 100 employees to examine their understanding of and attitude towards transport plans (i.e. travel plans). The study suggested that organisations who are already experiencing traffic congestion issues and planning to locate or expand in an area with congestion problems should be encouraged to adopt a travel plan. In conclusion, it was suggested that there was a need to develop a more customer–focussed marketing strategy directly targeting at the employers to promote the use of public transport; and employers offering subsidies for public transport tickets should be exempt from income tax penalties.

2.6. Benefits of travel plans

Travel plans are generally adopted to comply with the planning policy requirements or on a voluntary basis to promote the provision of sustainable travel choices and reduce the impact of developments on existing infrastructure. However, the potential benefits of an effective travel plan are often not fully understood in practice. The socio–economic and environmental benefits of effective travel plans are far–reaching and contribute at national, regional, local, organisational, and individual levels (DfT, 2004, 2008; Rye, 1999).

Organisation's commitments towards corporate social responsibility and environmental issues are becoming increasingly important to recruit and retain a skilled workforce. UCAS conducted a survey among 54,240 potential university and college candidates. According to the survey findings, employers attitude towards environmental issues was cited as an important consideration to the preference for future employers by 49% female and 43% male participants (Goodman, 2007).

2.6.1. Benefits to organisations

Previous studies highlighted the direct and indirect benefits of a travel plan at an organisational level with a view to encourage the voluntary take–up of travel plans. The key benefits of a travel plan to an organisation, include reducing on–site traffic congestion, improving access to workplaces, increasing staff efficiency, and maintaining organisational reputation and retention of employees (Enoch and Zhang, 2008; Enoch, 2012). A travel plan is tailor–made to facilitate better access by all modes to and from an employment site by taking into account the transport issues experienced by the site. Improved accessibility can help to reduce the level of stress associated with looking for a parking space, waiting time in traffic congestion, and increase the satisfaction with the travel experience. Thereby, organisations with better accessibility can improve their productivity and public reputation.

Several studies suggested that the employee retention rate is higher for well reputed organisations (Coleman, 2000; Enoch and Zhang, 2008; Roby, 2010). Sustaining high level of staff retention help to save the cost associated with recruiting and re–training new people. Regular communication, consultation and facilitation with the employees during the travel planning process opens up a window of opportunity to improve the overall working environment within the organisation. Besides, it helps to reduce the demand for car parking spaces and enables the release of land for more productive use (Rye, 2002). However, many argue that the potential benefits of a travel planning have not been realised in practice yet (Cairns et al., 2010; Coleman, 2000; Enoch and Zhang, 2008; Roby, 2010). It is recommended that the travel plan objectives should be aligned with the organisational strategies related to transport, finance, and environment to maximise its benefits.

2.6.2. Benefits to employees

A travel plan offers a wide range of benefits to employees working for an organisation. Travel plan measures are designed to reduce the cost of commuting by alternatives. A travel plan also offers a range of flexible working options such as changing working hours, tele–working tailored to meet individual circumstances and job responsibilities (Enoch, 2012). Walking for 30 minutes a day is highly beneficial for physical and mental health. Previous research in public health indicate that walking to work is associated with an increased level of physical activity (Besser and Dannenberg, 2005; Pucher et al., 2010; Renne, 2005; Sahlqvist et al., 2013; Wanner et al., 2012; Yang et al., 2012). The World Health Organisation (WHO) introduced the "Global Strategy on Diet, Physical Activity and Health" with a high emphasis on the concept of *active lifestyle* that recommends all adults to accumulate 30 minutes of moderate physical activity such as walking everyday (WHO, 2004). The key health benefits of walking for 30 minutes (3000 steps) five times a week include (Hamer and Chida, 2008; Hou et al., 2004; Kwaśniewska et al., 2010):

- reducing the risk of coronary heart disease by 19%;
- reducing the risk of developing colon cancer, type 2 diabetes, obesity, high blood pressure, high blood sugar level, high BMI level;
- improving good high–density lipoprotein (HDL) level; and
- reducing bad low–density lipoprotein (LDL) cholesterol level.

Recent studies on mental health have also demonstrated a link between walking and reduction in the symptoms of depression, stress and anxiety; and an improvement the cognitive performance of thinking, understanding and remembering (Asztalos et al., 2009; Mammen and Faulkner, 2013; Rockwood and Middleton, 2007). Thereby, walking can improve the overall quality of life of the staff and reduce the cost associated with absents due to sickness or stress.

2.6.3. Wider benefits

A travel plan has a high potential to bring a wide range of benefits to the wider community at a low–cost (Fujii et al., 2001). The wider benefits of a travel plan include: reducing peak–hour traffic congestion, CO_2 emissions, energy consumption, and noise pollution; and promoting sustainable economic growth, social inclusion, healthy lifestyle, and regeneration (DfT, 2009a).

2.7. Summary

This chapter provides an essential background knowledge and understanding of workplace travel plans based on the review of existing literature. First, the importance of travel plans as a travel demand management measure relative to other measures has been discussed. This is followed by a review on key aspects of a travel plan including the review of several definitions related to a travel plan. The literature review drew attention to the importance of travel plan measures in changing travel mode change behaviour, which has been consistently found to be the main element of an effective travel plan. However, it was also found that the number of studies with a focus to the key elements of a travel plan, particularly, within the healthcare context is still limited. This identified knowledge gap is further addressed in Chapter 3.

Chapter **3**

Literature review on workplace travel plans

3.1. Introduction

The main purpose of this chapter is to provide a comprehensive review of the existing literature pertinent to the key determinants of a successful travel plan mostly within the generic context. The chapter begins with outlining the structure of the chapter followed by an introduction on the key factors of a successful travel plan in Section 3.2. Section 3.3, discusses the key findings from a travel plan case study by Sheffield University investigated by (Watts and Stephenson, 2000). Section 3.4 identifies the research gaps based on the literature review, and finally the chapter is summarised in Section 3.5.

3.2. Determinants of a successful travel plan

The adoption of workplace travel plans reported to have reduced peak hour traffic congestion, relieved parking pressure, made sites more accessible, raised awareness about sustainable travel options, improved staff travel, and aided staff retention. It is claimed that travel plans have removed just over 158,000 car two–way trips per day from British roads each working day, or 1.14 billion km per year, which is equivalent to around three-quarters of one percent (0.74%) of the total vehicle kilometres travelled to work by car overall (Rye, 2002). However, transport experts argue that the potential applications of travel plans as a workplace travel demand management tool has not been fully understood yet (Cairns et al., 2010; Roby, 2010; Rye, 2002).

The take-up of travel plans is increasing among the public and private organisations in recent years. However, the impacts of travel plans on reducing the use of cars were found to have varied from organisation to organisation. Cairns et al. (2008) conducted a study among 26 organisations and found that the impacts of travel plans on reducing the proportion of car use varied from 1% to 35%. Only a small proportion of the organisations with relatively well–developed travel plans have achieved a relatively high reduction (i.e. up to 35%) in car use. In the context of healthcare, Addenbrooke's Hospital reported to have reduced car use by 32% from 74% to 42% between 1993 and 2003 through the implementation of a travel plan (Cambridge University Hospitals NHS Foundation Trust, 2004). In contrast, the Weston General Hospital introduced their travel plan in 2010 (Transport and Travel Research Ltd, 2010). The staff travel survey carried out to inform the travel planning process shows that most of the staff (82%) used cars to travel to the hospital site. Therefore, similar to previous research it could be suggested that organisations with relatively successful travel plans are more likely to reduce a relatively higher percentage of car driver kilometres than the organisations with new (i.e. just started) or average travel plans (Cairns et al., 2008).

According to a report titled "NHS England Carbon Emissions: Carbon Footprint Modelling to 2020" by the NHS Sustainable Development Unit, only 5% of the healthcare authorities had travel plans that could reduce CO_2 emissions by up to 10% (NHS SDU, 2009a). The NHS carbon footprint projection for 2020 was made by assuming the full implementation of travel plans by 100% of the NHS authorities. Several studies show that fully fledged travel plans with a parking management strategy in place can achieve up to 15% to 20% reduction in car use (Cairns et al., 2002, 2004, 2010). Cairns et al. (2010) also highlighted that failure to achieve the expected outcomes over a period may deter an employer's interest in funding travel plans. However, designing and implementing a travel plan is a resource intensive and lengthy process. A well–developed travel plan with long–term programmes generally requires more resources than travel plans with simple measures.

The overriding factors that emerge from the literature as the key factors for determining the success of a travel plan are considered as the determinants of a travel plan. The determinants of a travel plan are context specific and remain an area of debate. Previous research attempted to investigate the issue from different standpoints. The importance of organisational aspects such as employer's attitude towards and motivations behind developing the travel plan in determining the success of a travel plan has already been discussed in Chapter 2. An employer's attitude towards a travel plan is closely associated with the motivations behind developing the travel plan, which can be summarised as: policy requirement, reduction in CO_2 emissions, promotion of healthy lifestyle, management of parking demand, and addressing the site-specific transport issues of the organisation (Coleman, 2000; Rye, 1999; Roby, 2010). The evidence from these studies suggests that employers with a positive attitude towards the travel plan are more likely to allocate the resources required to develop and maintain a travel plan over a longer period. Travel plans that are developed based on a more balanced approach allow opportunities for partnership working, sharing resources, and help to gain staff ownership for the travel plan and thereby help to sustain the travel plan for longer.

Steer Davies Gleave (2001) explored the adoption and implementation of travel plans, predominantly within the public sector and suggested to integrate travel plans within business practice to maximise the outcome. A similar conclusion was drawn by Roby (2010) based on a study among several business organisations. A similar conclusion was made by a study Litman (2007) by summarising the evidence found by other studies, which are:

- the combination of selected travel plan measures;
- the extent to which travel plan measures are applied and adopted;
- the robustness of the implementation process; and
- the methods used to assess the travel plans with respect to the characteristics of the site and its operation, as well as the demographic profile and travel patterns of the commuters.

However, some studies made no clear reference to the methods used to identify the relative importance of the factors in securing the success. Macmillan et al. (2013) claimed that there was an insufficient evidence to conclude which factors may have affected the success of the workplace travel plans.

At present, there is no widely acknowledged standard framework in practice to evaluate the effectiveness of a travel plan. Best practice guidance for travel plan has centred around providing advice on successfully designing and implementing travel plans with a focus to change individual travel behaviour (DfT, 2002, 2006; Wright, 2010). According to the best-practice guidance, the following factors play a key role in determining the success of travel plans:

- involve partnership working;
- identify site-specific opportunities and barriers;
- focus on progressive change in travel behaviour;
- gain staff ownership for the travel plan;
- raise the profile of travel initiatives with imaginative promotions and publicity;
- reach key groups of staff;
- change the organisational culture; and
- assess the impact of individual strategies in reducing car use and modify the measures accordingly.

Fujii and Taniguchi (2006) reviewed ten travel feedback programmes (i.e. soft measures designed to change travel mode choice behaviour) implemented in Japan between 2000 and 2003. The travel feedback programmes (TFPs) were characterised by location, target, main objective, techniques employed, and effect. The characteristics of the TFPs and their corresponding effects were found to be different from each other. According to the study, *TFPs that requested a behavioural plan* and *provided quality information to the participants* had a higher impact on changing travel behaviour. Therefore, it could be suggested that the context-specific issues and elements of the TFPs played a key role in determining their success.

Different factors have been identified from the literature, and based on the findings it became evident that the overall success of the travel plan depends on the successful completion of the life-cycle stages of the travel plan. The life-cycle stages of travel plans have been reviewed based on the steps proposed by the Model for Planned Promotion (Conner and Norman, 2005). The reason for this is that the steps used in practice make little reference to the process of changing travel mode choice behaviour.

3.2.1. Step 1: Problem analysis

This step involves the identification of the problem behaviour that should be targeted by the travel plan measures. The central premise of the study lies broadly within the issue that although the take–up of hospital travel plans is increasing across the NHS only 5% of the healthcare authorities had fully implemented travel plans in 2008 that can reduce carbon emissions by up to 10% (NHS SDU, 2009a). The negative implications of high car use among the NHS staff were discussed in detail in Chapter 1. To what extent car is being used by the staff within an organisational context determines the magnitude of the problem. Davies (2012) attempted to identify the key determinants of successful travel behavioural change campaigns based on twenty UK case studies of behavioural change. According to the study, access to funding, and resources were the key to determine the success of the campaigns. Lack of funding to support the issues experienced during the implementation of the campaigns, and negative perceptions towards cycling were identified as the key barriers to secure the targeted outcome in behaviour change.

The success of a travel plan to a large extent depends on the quality of the evidence base used to inform the travel planning process (Fujii and Taniguchi, 2006). The use of reliable evidence-base to inform the travel planning process has been highlighted by various best-practice guidance (DCLG, 2011; DfT, 2006; TfL, 2006). The data quality and methods used to collect and analyse the data determine the reliability of the evidence–base (DCLG, 2011; DfT, 2006; Sanko et al., 2013; TfL, 2006). A skilled workforce with expertise in: (a) survey design and execution; (b) data processing and analysis using statistical techniques; and (c) reporting and disseminating study findings is key to produce reliable evidence–base to inform the travel planning process (Kaseje et al., 2015). Thereby, a lack of allocated resources and skilled worked workforce with the necessary expertise to carry out the travel planning process could significantly affect the success of the travel plans.

A study by Kaseje et al. (2015) reported that how these issues could be addressed by involving an academic institution with national surveys designed for healthcare facilities in Kenya. In this study, structured and semi–structured questionnaires were used to collect data from 1448 healthcare facilities managed by the Ministry of Health. Prior to the data collection, 90 senior staff, 70 research assistants, and 20 data entry clerks were trained to collect and analyse the data using rigorous methods by the collaborating academic institution - GLUK. The involvement of the academic institution in the survey process significantly reduced the resources and cost required to carry out this large–scale project. Wartman et al. (2009) suggested that the involvement of academic institutions in public sector surveys will create a platform for knowledge creation through sharing information and research experience. Besides, the collaboration between the academic and public sector organisations help to create a balance between academic research and relevant issues experienced in practice (Horton, 2000). Thereby, such collaborations could contribute to better decision making in practice.

A guide published by the Department for Transport titled "The travel plan resources pack for employers" suggests the employers to collect the following information as presented in Table 3.1 (DfT, 2006). The Department for Transport and Transport for London recommend the use of a combination of data collection methods such as staff travel survey, and a site assessment to inform the travel planning process (DfT, 2006; TfL, 2006). The staff travel survey is conducted to collect a range of information about the socio-economic conditions and travel patterns of the staff.

Effective communication is vital to collect accurate information from the staff. Previous research suggested that face-to-face interviews and mail are more effective methods of communication in comparison with internet communication (Davies, 2012; Fujii and Taniguchi, 2006). A site assessment is performed to collect a range of information related to the local (e.g. hospital location, access by different travel modes, transport issues) and organisational (e.g. existing car parking facilities, on-site provision for walking) transport context. The importance of setting up SMART (i.e. specific, measurable, achievable, realistic, time–bound) targets to achieve the overall success of the travel plan is highlighted by the Department for Transport and previous research (DfT, 2006; Doran, 1981; Fujii and Taniguchi, 2006). Setting up SMART targets involves careful analysis of the available information related to the policy, local and organisational context; and staff.

Table 3.1: Key information required to prepare a travel plan.

Action	Information
Site assessment	• Transport links to and within the site • Location of the facility • Site characteristics and site-specific issues • Access to the site all travel modes • Staff access points to the building • Demand for cycling and walking routes to the site • Rail and underground services • Catchment area • Capacity of the organisation • Number of employees • Availability of a range of services nearby • Type of services provided by the organisation • Organisational strategy • Resource availability
Car parking assessment	• Car parking provision • Current demand for car parking • Parking policy • Organisational policy
Staff travel pattern survey	• Staff travel patterns • Socio-demographic information • Identifying where people live • Travel mode used • Travel time • Distance travelled • Complex travel needs of staff
Travel audits	• Business travel audit • Audit of visitors • Audit of deliveries/suppliers • Audit of fleet vehicles

Source: Adopted from (DfT, 2006).

Moreover, TfL (2006) recommended that the travel plan measures should be designed considering three key issues, which are:

- the reasons for the existing travel patterns of the staff;
- the barriers to changing travel behaviour of the staff; and
- the changing travel needs of the staff.

A question arises *"whether the hospital travel plans are designed as recommended by the best practice guidance?"*. A coding framework has been developed with a focus to the issues that should be considered during the travel planning process as suggested by the best–practice guidance, and presented in Table 3.2. The coding framework included the following topics:

- existing staff travel patterns;
- important organisational and contextual issues pertinent to the travel plans;

- motivations behind adopting the travel plans;
- data collection methods;
- travel plan measures;
- travel plan monitoring process; and
- specific issues concerning the travel plans.

Table 3.2: Coding framework based on existing literature and best-practice guidance.

Guidance document	Criteria	Details
(Doran, 1981; DfT, 2006)	Travel plan targets	SMART travel plan targets(specific, measurable, achievable, realistic, time bound). For example, reduce single occupancy car use and increase walking trips.
(DfT, 2006; TfL, 2006)	Data collection method	Conducted a site assessment
		Conducted a staff travel survey
(DfT, 2006; TfL, 2006)	Data collected	Travel mode used (e.g. car, walking)
		Percentage of staff living within walking distance
		Commuting time
		Pedestrian access
		On-site provision for walking
		Vehicular access
		On-site congestion
		Congestion on local roads
		Car park availability
		Car park use
		Road side parking
(TfL, 2006)	Issues considered	Identified the reasons for the present travel patterns.
		Identified the barriers to changing travel behaviour.
		Addressed the changing travel needs of the staff.
(DfT, 2006; TfL, 2006)	Measures to manage car use	Car parking management policy
		Restrictions on parking permits
		Car parking charges
(DfT, 2006; TfL, 2006)	Measures to promote walking	Incentives for walking
		Improved facilities for walking
		Improved access by walking
		Promotional materials and activities to encourage walking

3.2.2. Step 2: Risk behaviour analysis

This step involves determining the key target groups for changing travel behaviour based on the analysis of existing staff travel behaviour. The clear identification and operationalisation of the behaviour under consideration is regarded as one of the most important steps while investigating behaviour to design interventions (Fishbein and Ajzen, 2010).

There is a growing concern over the frequent use of cars for short trips (i.e. two miles) (DfT, 2014). The use of cars alone for commuting trips is also viewed as a risk behaviour (Gardner, 2009). As the use of cars alone within a stable context may lead the formation of habitual car use behaviour (Gardner, 2009; Gärling et al., 2000, 2002; Thøgersen and Møller, 2008; Verplanken et al., 1997; Verhetsel and Vanelslander, 2010). Habitual behaviour requires a small amount of attention and perceives to block the deliberate process of decision making prior to a behaviour.

Travel plan measures are designed with a focus on: (a) reduce the use of cars for short trips; and (b) break the influence of habitual car use behaviour by activating the deliberate decision making process (DfT, 2014; Gardner, 2009; Thøgersen and Møller, 2008; Verhetsel and Vanelslander, 2010). The deliberate decision–making refers to the process of having the ability to choose the right travel option depending on the nature of the trip. For example, in case of bad weather or changing circumstances (i.e. visiting sites) the staff, who commute by alternatives may require to use cars for short trips.

A choice that is non–deliberate may, in fact, be difficult to influence with interventions designed based on rational arguments (e.g. increased costs). Therefore, identifying the proportion of the NHS staff with the prevalence of habitual car use behaviour is key to develop effective travel plan measures. Several methods have been introduced to date to measure habitual behaviour, such as response frequency measure (RFM) (Verplanken et al., 1994), and self-report habit index (SRHI) (Verplanken and Orbell, 2003). The characteristics of habitual behaviour is discussed in detail in Section 5.3.4.

3.2.3. Step 3: Analysis of behavioural determinants

This step involves assessing the relative impacts of the socio-economic, psychological, and situational factors in changing travel behaviour. The development of effective interventions to change staff travel mode choice of an organisation largely depends on identifying the determinants of their travel mode choice behaviour, and knowing how to influence these determinants to stimulate change in their behaviour (Egmond et al., 2005). The need for a deeper understanding of the key determinants of changing travel mode choice behaviour to inform the travel planning process was highlighted by various studies (Egmond et al., 2005; Government Communication Network, 2009; Sanko et al., 2013). Determinants can be defined as a combination of interrelated variables that mediate or influence behavioural change.

Findings from previous research demonstrate the influence of a range of factors in determining travel mode choice behaviour. The classification of the determinants is often inspired by the research design and methods used for the specific study. More specifically Cao et al. (2006) classified the variables that influence the consideration of travel strategies as objective mobility, subjective mobility, relative desired mobility, travel liking, attitudes, personality, lifestyle, mobility constraints, and socio–economic and demographic (SED) characteristics. Besides, Van Acker et al. (2010) proposed a conceptual framework to depict the relationships between reasoned influences, unreasoned influences, and behaviours recognising the effects of the opportunities and constraints at individual, social, and environmental levels. The constructs of the conceptual framework are listed below:

1. *reasoned influences*: (a) locational perceptions, attitudes, and preferences; (b) activity perceptions, attitudes, and preferences; (c) travel perceptions, attitudes, and preferences;
2. *unreasoned influences*: (a) locational habits and impulsiveness; (b) activity habits and impulsiveness; and (c) travel habits and impulsiveness; and
3. *behaviours*: (a) lifestyle; (b) locational behaviour; (c) activity behaviour; and (d) travel behaviour.

The conceptual framework attempted to integrate theoretical constructs stemming from transport geography (e.g. time geography, activity–based approach) and social psychology (e.g. Theory of Planned Behaviour, Theory of Repeated Behaviour). However, the key limitations of the framework are extensive data required to implement the framework, and the validity of the framework has not been tested based on empirical data. Moreover, the framework includes constructs about a range of behaviour including, lifestyle; locational behaviour; activity behaviour and travel behaviour. More recently, Panter et al. (2013) examined the key determinants of walking and cycling with car use for commuting trips based on a cross–sectional study. The determinants are classified as personal characteristics, socio–economic characteristics, workplace–related characteristics, perceptions of the route environment and psychological measures related car use. However, the classification did not include key modal attributes such as travel time, convenience, comfort, which were found to have a significant impact on determining travel mode choice behaviour (Anable and Gatersleben, 2005; Mackett, 2003; Morency et al., 2014; Ortuzar and Willumsen, 1994; Small, 2012; Johansson et al., 2006).

Several studies attempted to investigate the impacts of the above factors from different standpoints using different methods including correlational, cross–sectional, and longitudinal. The impacts of the factors in determining travel mode choice behaviour depend on specific individual circumstances, and vary across time and place. There is no universal consensus about the stability of the functional relationships between the determinants of travel mode choice behaviour. However, some patterns of the relationships between the factors are more widely acknowledged than the other. The impacts of socio–economic and demographic factors on determining travel mode choice behaviour are generally examined in association with other factors. Personal circumstances are generally described by socio–demographic factors on the individual level. The impacts of gender, age, income, car ownership, number of children under the age of 16 years, household structure, and employment status are found to have a higher impact on determining the use of travel modes to work in comparison with other factors (Curtis and Headicar, 1997; Dieleman et al., 2002; Klöckner and Friedrichsmeier, 2011). Especially car ownership acts as a mediator between socio–economic and demographic variables; built environment characteristics; and car use. Besides, the influence of personal commitments and work commitments are also found to be significant and closely associated with other socio–demographic factors (Mackett, 2003).

The key determinants for changing travel mode choice behaviour can also be broadly categorised into two groups, changeable and non–changeable. The determinants that are changeable and strongly related to at least one of the stages of changing travel behaviour are targeted by the travel plan measures (Prochaska and DiClemente, 1984). The changeable determinants include psychological, situational, and modal factors (Bartholomew et al., 2006); and the non–changeable determinants include, socio-economic factors. In real–life circumstances addressing the situational constraints (i.e. major improvement of infrastructure) experienced by staff could be subject to organisational constraints (i.e. lack of resources) or beyond the scope of the travel plan (Watts and Stephenson, 2000). Therefore, travel plan measures are designed with a higher focus to influencing the socio–psychological constructs of the individuals, which is embedded within the context (Bartholomew et al., 2006).

The psychological factors that can be changed or influenced by travel plan measures/policy interventions include the cognitive and affective dimensions of knowing, feeling, believing, valuing, and having self–confidence or having a sense of efficacy (Anable, 2005). In general, a combination of interventions are designed to influence the determinants for changing travel behaviour. Therefore, achieving the desired change in travel behaviour to a great extent depends on identifying the determinants of changing travel behaviour. Several classifications of the determinants of travel mode choice behaviour have emerged from the literature mostly inspired by the research design of the specific studies. However, the widely discussed key determinants of travel mode choice behaviour in travel behaviour literature are classified into four groups: (a) socio-economic and demographic, (b) modal, (c) psychological, and (d) situational. The interrelationships between the determinants are discussed in detail in Chapter 4.

3.2.4. Step 4: Development of intervention

This step includes the development of travel plan measures to address the relevant and modifiable determinants for changing behaviour. The significance of travel plan measures in determining the overall success of a travel plan is well documented in previous research (Cairns et al., 2010; Enoch, 2012). Travel plans measures attempt to encourage change in travel behaviour by maximising the utility of sustainable modes of transport and reducing the constraints to facilitate the use alternative modes of transport. As discussed earlier as part of this study change in travel behaviour represents changing travel mode from car to walking on its own or in conjunction with car. The take-up of hospital travel plans has been increasing (NHS SDU, 2009a). However, the number of cases with a significant outcome in reducing car use and promoting walking is quite small.

The factors or aspects that determine the success of travel plan measures have been subject to debate. Three interconnected issues emerge from the literature that determine the overall success of travel plan measures (Bamberg and Möser, 2007; Cairns et al., 2010; Enoch, 2012): (a) the combination of travel plan measures used; (b) context-specific factors; and (c) the methods used to design and implement the travel plans measures, which are illustrated in the following sections in detail.

3.2.4.1. Strategic approach to design travel plan measures

Travel plans are designed to facilitate change in travel behaviour (Gärling et al., 2002). People tend to respond to different ways to different travel plan measures (DfT, 2009a). Commuting trips are characterised as relatively long and indirect journeys, as they involve dropping off and picking up children and/or, picking up essentials (e.g. shopping), and other household activities (e.g. visiting the gym) (AASHTO, 2013). According to the National Travel Survey, the average trip length for commuting trips (8.8 miles) in 2013 was higher than those of education (3.6 miles), shopping (4.3 miles), personal business (5 miles), entertainment/public activity and all purposes (7.1 miles) trips for England (DfT, 2014).

Soft is often used to distinguish initiatives from *hard* measures, but *soft* measures may include hard elements. For example, improving the situational context or walking environment to facilitate walking is a prerequisite to implement soft measures focus on changing people's perceptions and motivations towards walking by persuasion. As part of the "Smarter choices: changing the way we travel" project, Cairns et al. (2004) evaluated the effectiveness of soft factor transport measures in two different future policy scenarios, namely *low-intensity* and *high–intensity*. *High intensity* scenario considers the widespread implementation of best–practice activities related to soft measures at local and national levels. On the other hand *low intensity* scenario considers the projected level of activities at the 2003/04 rate. The study found that in *high–intensity* scenarios a consistent implementation of comprehensive soft factor measures could reduce the use of single-occupancy car use by up to 11%.

The effectiveness of travel plan measures depends on how the context specific issues and travel needs are addressed while developing travel plan measures and how people will respond to them. Several studies suggest that travel plans with a combination of positive measures (e.g. incentives to promote sustainable modes of transport) and restrictive measures (e.g. car parking management strategies) are more effective in reducing single occupancy car use than travel plans with only positive measures (Cairns et al., 2010; Enoch, 2012). Positive measures to promote walking are more effective when implemented in conjunction with restrictive measures to reduce the use of cars. However, there is a lack of studies where such claims are supported by robust statistical analysis of the data.

3.2.4.2. Designing travel plan measures to change travel behaviour

Two largely separate body of literatures provide evidence related to walking: (a) public health; and (b) transport. In travel behaviour research, walking is primarily studied as a travel mode and in public health research, walking is primarily examined as a form of physical activity. Several studies evaluated the impacts of interventions in promoting physical activity. However, only a few studies investigated the impacts of interventions on promoting walking as a commute mode alternative to car use. Ogilvie et al. (2007) systematically reviewed 19 randomised controlled and 29 non–randomised controlled published studies from across the world about evaluate the impacts of interventions in promoting walking. Twenty–one studies examined the impacts of interventions in promoting walking as a mode of transport among either workplace employees or school children or members of a community. The study concluded that the most successful interventions could increase walking among the targeted population by up to 30 to 60 minutes a week on average.

Previous studies found that introducing subsidies by employers to discourage commuting to work significantly increased walking to work (Shoup, 1997). Mutrie et al. (2002) conducted a randomised controlled trial among 295 employees working for three large public organisations located in the city of Glasgow, Scotland, UK including an NHS Acute Trust with around 4,000 employees as part of the “Walk to work out” campaign. The sample was ascertained through screening those with a willingness to contemplate or prepare to commute by active modes of transport and was randomly divided into two groups, namely intervention ($n = 145$) and control ($n = 150$) groups. The intervention group received a “Walk in to work out” containing interactive materials based on the Transtheoretical Model of behaviour change (Prochaska and DiClemente, 1984), local information about distances and routes, and safety information. Both groups took part in two surveys at six months interval. The data were analysed using sequential logistic regression model. The intervention group exhibited a significantly higher change in walking to work behaviour between the baseline and end of the trial periods than the controlled group. The study concluded that the intervention was successful in increasing walking to work. One of the limitations of the study was the participants were mostly economically advantaged women, who were already considering to walk. However, previous research argued that information campaigns are unlikely to have a significant impact on promoting walking (Ogilvie et al., 2007; Kahn et al., 2002). According to a systematic review on interventions to promote physical activities by Kahn et al. (2002), alongside media–based information provision the formation of self–help and social support groups were successful in promoting physical activity, such as walking.

According to Rye (2002), the success of travel plans largely depends on the effectiveness of travel plan measures designed to address site–specific issues, such as with congestion and parking. A Department for Transport sponsored project titled “Making travel plans work” examined 44 case studies using a narrative analysis (Newson, 2002). The study findings showed that the impacts of the travel plans include, on average 14% reduction in car use; an increase in the proportion of staff travelling by bus, walking and cycling; and an increase in car sharing among the staff. The study concluded that a comprehensive parking management policy was a key determinant for the success of a workplace travel plan with little evidence to suggest the impact of other factors. However, a different conclusion was drawn by Bamberg and Möser (2007), who performed a meta–analysis on the same dataset and found that the situational factors such as the organisational and site characteristics were significantly associated with the success of workplace travel plans. There is no clear evidence to override the findings of one study over the other, therefore, it could be suggested that the effectiveness of the travel plan is closely associated with a combination of the context–specific factors and the robustness of the methods used to design and implement effective travel plan measures. Several other studies also concluded that the impacts of travel plans in changing travel behaviour vary with respect to the travel context (Cairns et al., 2008, 2010; Roby, 2010).

The current study proposes the following hypotheses based on the above discussions.

- **Hypothesis 1 (H1)**: The effectiveness of measures to promote walking is positively correlated with the effectiveness of measures to discourage the use of cars.
- **Hypothesis 2 (H2)**: The effectiveness of soft measures to promote walking is positively correlated with measures to change situational context of the walking environment.

A detailed understanding of the psychological aspects such as perceptions, values, attitudes, subjective norms or perceived self-efficacy is considered essential as to design effective travel plan measures (Gardner and Abraham, 2008). There is a growing interest to explore the effects of psychological aspects on changing travel behaviour in the transport research area. However, in practice, the soft travel plan measures often lack the psychological underpinning to changing travel behaviour. The key reason for this is collecting and synthesising the relevant psychological data is seen as a time–consuming, complex and add–on task, while designing travel plan measures (Hayes-Roth, 1994). Investigating the quality of the data collected and methods used to analyse the data in practice require in–depth interviews with the NHS Trust representatives involved in the hospital travel planning process. In many instances, the NHS representatives refuse to provide detail information about the travel planning process unless an agreement is reached between the NHS Trust and the researcher, which is a lengthy process. Due to time constraints, information collected about this topic was limited to the type of methods used to collect the data and the type of information used to produce the travel plans. Future studies may attempt to disentangle the process involved in collecting and analysing the data to produce travel plans through in–depth case studies.

3.2.5. Step 5: Implementation and dissemination

This step involves the implementation and dissemination of the interventions attempting to change travel mode choice behaviour of the targeted population. A study conducted by Ison and Rye (2003) assessed the key elements of a travel plan with respect to 10 conditions to achieve its perfect implementation proposed by Gunn (1978). The key conditions include external circumstances, time and resources, cause and effect theory, single implementing agency, specific tasks, maintain regular communication, and regulatory compliance. Drawing upon the findings of the study the authors concluded that further research was required to identify the ways to apply the Gunn's framework to improve the implementation of travel plan in practice. The implementation of travel plan is often constrained by several factors, such as (Gärling et al., 2002; Rye et al., 2011; Watts and Stephenson, 2000):

- companies' self–interest and internal organisational barriers;
- poor perceptions of alternatives;

- the provision of alternatives;
- lack of regulatory requirements for travel plans; and
- public acceptance.

Developing and implementing a travel plan was beyond the scope of the study. However, the issues that reported to have played a key role in ensuring the success of a travel plan are discussed below.

Availability of funding and resources is an important pre–requisite of the successful implementation of travel plans (Rye et al., 2011), which is often regulated by the employer's attitude towards the travel plan. Policies aiming to secure the effective implementation of travel plans, therefore, need to be informed by a comprehensive understanding of employers' views on travel plans. Previous research suggests that employers with poor perceptions towards the alternatives are less likely to have a positive attitude towards a travel plan (Bradshaw and Lane, 1997; Ligtermoet, 1998; Rye, 1999). Employers with a negative attitude towards a travel plans are less likely to allocate a higher amount of resources to implement the travel plan, which in turn may affect their long-term success.

However, Macmillan et al. (2013) argued that the organisational travel plans are generally implemented within funding constraints. In response to this issue, the authors suggested that when a same set of interventions are being implemented by several organisations over a period, randomising the order of implementation may offer practical and ethical benefits to the organisations. The process involves taking into account the lessons learnt by other organisations to ensure the successful implementation of an intervention. The process of randomising the order of the interventions is called *stepped wedge* design (Brown and Lilford, 2006). Thereby, the NHS Acute Trusts could implement the travel plans successfully in a cost–effective manner through working in partnership with other NHS organisations that enables a shared and mutual learning environment.

Evidence shows that employers have limited control over several areas (e.g. Providing specialist advice with policy formulation, reducing the availability of free on-street parking, introducing bus lanes and cycle routes, negotiating with public transport operators for improved services subsidise a particular bus route) and requires assistance from the local authority to facilitate the conditions required to secure the effective implementation of the transport plan (Walker, 2000; Watts and Stephenson, 2000). However, such collaborative efforts between local authorities and employers could be constrained if there is a lack of funding. The potential of raising funding to support such schemes through work parking tax was suggested in the in the 1998 Transport White Paper titled "A New Deal for Transport" (DETR, 1998; TfL, 2008).

Rye et al. (2011) suggested that a more formal approach is required to establish the collaboration between employers and local authorities to address the difficulties experienced by the employers while developing and implementing travel plans. Many argue that the academics and practitioners have overlooked the potential of using land–use planning system as a mechanism to secure and encourage the wider uptake of travel plans for a long time (Enoch and Ison, 2008; Enoch and Zhang, 2008; Roby, 2010; Rye et al., 2011). Future research should examine the association between availability of resources among the local authorities and use the planning system to secure, monitor, and enforce travel plans through the planning system.

The quality of the information presented to the staff is also an important determinant of a travel plan (Fujii and Taniguchi, 2006). Previous research suggests that *individualised information* is more effective than *generalised information*, as they reduce the cognitive cost of searching for information (Gärling et al., 2001). However, Fujii and Taniguchi (2006) argued *individualised information* may not always be necessary if the participants are requested to produce a behavioural plan.

Introducing measures to restrict the use of cars often causes strong emotions and negative reactions among the staff and may result in unintended consequences, such as illegal parking on local roads (Anable, 2005). Effective implementation of travel plan measures will, therefore, depend on their acceptability among the staff. The term acceptability refers to the individual's relative evaluation of an intervention that may be implemented in the future. Gärling and Axhausen (2003) proposed a model to demonstrate the association between acceptability and effectiveness. The model suggests that acceptability of an intervention is important for sustaining the senior management support, which in turn influence the effectiveness. Previous research suggests that the acceptability of travel plan measures is closely associated with psychological characteristics of the employees, type of measures, perceived fairness and effectiveness of the measures, and the quality of the information presented in support of the measures (Eriksson et al., 2008; Steg and Schuitema, 2007). If the motivation to use cars is stronger, push measures to restrict or limit the use of cars may appear less acceptable. Therefore, the acceptability of push measures to restrict the use of cars needs to be assessed based on the in–depth knowledge of the factors that may facilitate or constrain the use of alternative modes of transport.

Eriksson et al. (2008) studied the acceptability of a range of transport policy measures among 71 car users and found that the acceptability of push measures was relatively low in comparison with pull measures. According to the study, personalised information about public transport was perceived to be acceptable by a higher proportion of the car users in comparison with generalised information campaign. It was suggested that as part of the generalised information campaign the utility of the alternative travel options may not be disseminated at a level that would generate interest among the car users. Interestingly, some push measures (e.g. extended car–free centre) were found to be acceptable despite restricting the use of cars.

Steg and Schuitema (2007) pointed out the importance of examining individual characteristics to understand their acceptability towards the transport policies. According to the study, individuals with stronger problem awareness, personal norm to reduce car use, and willingness to act are more likely to evaluate the policies positively. Moreover, public acceptance of the transport policies were closely associated with their perceived fairness and effectiveness. In particular, the transport pricing was found to be more acceptable when the people perceived that the collective problems would be solved; incurring higher individual cost was irrelevant; and evaluated them as fair with respect to environmental justice and equality.

3.2.6. Step 6: Evaluation or monitoring of interventions

This step includes evaluating the impacts of the travel plan measures/interventions in changing behaviour of the target population. Monitoring a travel plan is a resource intensive complex task, which involves evaluating the direct and indirect impacts of a travel plan over a period considering the changing organisational, situational, and personal circumstances. In general, *a reduction in car use* is commonly used in the USA, UK, and Dutch literature to evaluate the effectiveness of a travel plan (Cairns et al., 2004; Organizational Coaching and ESTC, 1996; Steer Davies Gleave, 2001). However, Enoch (2012) argued that the use of a single indicator does not provide a clear understanding of the impacts of a travel plan in changing travel behaviour within an organisational setting. In other words, the use of a single indicator does not provide sufficient information to compare the impacts of travel plans with organisations with similar circumstances.

Other commonly used indicators by different studies include (Cairns et al., 2002; Ferguson, 1990; Ligtermoet, 1998; Steer Davies Gleave, 2001):

- change in modal share;
- number of car parking spaces given up or car/employee ratio;
- reduction in vehicle kilometres;
- average vehicle occupancy status;
- cost per employee; and
- cost reduction per trip.

Möser and Bamberg (2008) performed a meta–analysis on a data set of 44 studies evaluating the effectiveness of workplace travel plans. The effect size based on the sample studies indicated that on average there was 12% increase in commuting trips by alternatives. Out of the 44 studies reviewed by Möser and Bamberg (2008), seven primary studies evaluating the impact of workplace travel plans for hospitals are presented in Table 3.3. According to the findings, the duration of the evaluation period was varied (range from 1 to 6 years) across the studies. The impact of the travel plans evaluated over a longer duration (i.e. three years or over) was relatively higher ranged from 12% to 24% except for the Dental Hospital. Besides, there was a 12% decrease in the proportion of employees commuting by alternatives for the Royal Orthopaedic Hospital.

Table 3.3: Primary studies evaluating the impact of workplace travel plans for hospitals.

Primary study	**Study period**		**Data source**	**n**	**% alternatives**		**Impact**
	Start	End			Before	After	
Oxford Radcliffe Hospital NHS Trust	Mar 00	Mar 01	1	5170	42	46	4
Nottingham City Hospital NHS Trust	Nov 97	Nov 00	1	3500	27	39	12
Addenbrooke's NHS Trust	Oct 93	Oct 99	1	4977	26	40	14
Plymouth Hospital NHS Trust	1995	Oct 01	1	4193	22	46	24
Royal Orthopaedic Hospital	2000	2002	2	500	38	26	-12
The priory Hospital	1998	2001	2	300	21	41	20
The Dental Hospital	1998	2001	2	400	66	72	6

n = sample size, source: (Möser and Bamberg, 2008) .

Apart from the varied methodology used to evaluate the travel plans, the contextual factors are likely to have an impact on behaviour change. Evaluating travel plans based on the above indicators alone may either underestimate or overestimate the impact of a travel plan. Individuals may change travel behaviour because of changes in personal and situational circumstances. A lack of consideration to such issues may raise a concern with regard to the actual impact of the travel plans on changing travel behaviour.

A study by Macmillan et al. (2013) reviewed five studies evaluating the impact of workplace travel plans. The summary of the findings are presented in Table 3.4. Different indicators were used to evaluate the travel plans. As reported in other studies the impact of the travel plans in reducing car use was varied range from 0.2% to -14.7%. The authors reported that there was an insufficient evidence to indicate what factors may have affected the effectiveness of the travel plans. However, it was also suggested that a lack of consideration to improving the physical environment to support the use of alternatives may have affected their success.

The Department for Transport introduced the *Workplace travel plan evaluation tool* to evaluate the impacts of travel plans (DfT, 2008). However, the recommended evaluation process is largely dom-

Table 3.4: Studies evaluating the impact of workplace travel plans.

Study	**Intervention**	**Location**	**Participant**	$n(W)$	**Follow–up** (Months)	**Net reported effect**	**Net change in car use** (%)
Mutrie et al. (2002)	(a) Interactive self–help active travel information, safety accessories, (b) delivered at baseline	Scotland	Working adults	295 (3)	6 and 12	1500m net increase in weekly distanced walked for those in *contemplation* stage of behaviour change	–
Sargeant et al. (2004) Adden-brooke	(a) Personalised travel advice, travel information pack, (b) ongoing travel advice	England	Working adults	330 (1)	3	1500m net increase in weekly distanced walked for those in *contemplation* stage of behaviour change	0.2
Sargeant et al. (2004) Council car park	(a) Personalised travel advice, (b) travel information pack, (c) ongoing travel advice	England	Working adults	281 (1)	3	14.7% decrease in single–occupant car use in 5 days previous to survey	-14.7
Sargeant et al. (2004) Council new recruit	(a) Personalised travel advice, (b) travel information pack, (c) ongoing travel advice	England	Working adults	103 (1)	3	4.7% decrease in single–occupant car use in 5 days previous to survey	-4.7
Atherton et al. (1982)	(a) Introduction to compressed work week	USA	Working adults	748 (29)	Up to 12	18% net decrease in car mileage per week	–

n = sample size, W = work places, source: (Macmillan et al., 2013)

inated by a checklist approach guided by organisational motivations towards travel plans. Previous studies suggest that the evidence emerges from the evaluation of soft policy measures is weak and further rigorous studies are required to assess their impacts on travel mode choice behaviour (Fujii and Taniguchi, 2005; Macmillan et al., 2013; Möser and Bamberg, 2008). There is a lack of literature with a focus to introducing alternative ways to evaluate the effectiveness of travel plans.

A robust monitoring method plays a key role in determining the overall success of a travel plan, as, the measures are modified in response to their performance. Möser and Bamberg (2008) also highlighted the importance of developing a mandatory guideline specifying the format of the information to be presented in a travel plan evaluation report. Ways to design effective methods to monitor the travel plan and monitoring the impacts of hospital travel plans were beyond the scope of the study. Within the scope of the study, data were collected on the type of indicators used to monitor the travel plan and the frequency of monitoring the hospital travel plans.

3.3. An example of a travel plan: Sheffield University

The travel plan literature is highly motivated by the policy issues emerging from several studies instead of findings from a single case study. In support of this argument Möser and Bamberg (2008) suggested that the policy makers are often interested in the general picture emerging from the available empirical evidence in relation soft transportation measures. Therefore, there is a limited number of studies with a focus to the context–specific issues that may determine the success of a travel plan. Watts and Stephenson (2000) investigated the effectiveness of an employer transport plan implemented by the University of Sheffield in 1997. The study by Watts and Stephenson (2000) was reviewed to acquire a better understanding of the impact of a travel plan within a given context and how the lessons learnt from the study could be applied in the context of healthcare.

The data collection methods include a questionnaire survey and five focus groups. The questionnaire was distributed through the internal mail system among the University staff and 182 usable responses were received. The focus group comprised of two car user groups and three non–car user groups. The study found that a relatively marginal 7% reduction in car use, 1.8% increase in public transport (bus) and 0.5% increase in walking were achieved through the travel plan. Objection to car parking charges too high, not having a car parking permit, environmental considerations, and change in personal circumstances were cited as the key reasons for switching travel mode from car (driver) to other modes.

The enforcement of parking charges and restrictions on parking permits were partially successful in reducing the use of cars; a number factors have worked against having a significant impact on changing travel behaviour. The factors included, employees perceptions of the employer's motivations for introducing the transport plan, attitude towards car use and public transport; availability of on-street parking; and problems associated with public transport, walking and cycling. The study found that 32% of the employees participated in the study parked cars outside the university car parks and a further 21.5% parked their cars on the local streets near the university area. The average journey time by public transport was considerably longer than the car for commuting trips over five kilometres. This may have increased the use of cars among staff without a work car parking permit.

Public transport was viewed as a feasible transport for those with a up to five kilometres commuting distance. The data show that 34 respondents could have used public transport, but continued to use cars despite having the provision of new public transport. Some of the participants reported that *long journeys and waiting time by public transport prolonged the working day* as a key reason for not using public transport for commuting purposes. The reasons for not switching to public transport despite being a feasible travel option included, lack of direct public transport routes, slow, infrequent and unreliable service especially in the evening and difficulty accessing the timetable using public transport.

The key issues emerged from this case study that should be taken into account while designing travel plan in the context of healthcare include:

- the context specific issues and personal factors that may constrain the use of alternative travel modes should be assessed at the most elementary level of the travel planning process. Watts and Stephenson (2000) suggested that substantial improvement of the quality and availability of alternatives were required to encourage the use of alternative modes of transport; and
- the impacts of disincentives in changing travel mode choice behaviour were slightly higher than the incentives. Availability of car parking spaces in the surrounding areas suggest that the staff are likely to continue using cars unless the potential of using alternative travel modes as viable travel options is fully realised. Individuals evaluate the feasibility of using each travel option by assessing the value of different modal attributes within the given travel context. The car users often place higher values for car journeys than travelling by other modes of transport. Designing travel plan measures to increase the relative attractiveness of alternatives modes of transport require an in–depth understanding of the psychological constructs of the car users within the specific context (Bartholomew et al., 2006). The psychological constructs include the motivations behind and attitude towards using different travel options, perceived behavioural control, and subjective norm.

3.4. Literature gaps on travel plans

The following research gaps were identified from the literature review. There is a lack of research with a focus to transport in the context of healthcare.

First, theory-driven interventions are regarded as more effective in changing travel behaviour (Bartholomew et al., 2006). However, the systematic development of interventions based on theoretical rationale is limited in transport (Bamberg and Schmidt, 2001). There is a scope to do research on how to establish the link between behavioural change theories and designing interventions. The use of Theory of Planned Behaviour approach and other models such as PRECEDE/PROCEED model, the intervention mapping approach, and the Model for Planned Promotion of population health are widely used to design interventions to promote healthy behaviour in public health research (Conner and Norman, 2005). The key factors that determine the success of a travel plan have been reviewed following the steps proposed by the Model for Planned Promotion.

Second, previous research suggests that a combination of positive measures and restrictive measures are more effective in promoting walking (Cairns et al., 2010). However, there is a lack of studies where such claims are supported by robust statistical analysis of the data. Thirdly, travel plans are designed with a higher emphasis on soft measures that focus on changing peoples perceptions and motivations towards travelling by persuasions. A detailed understanding of the psychological aspects such as perceptions, values, attitudes, social norms, and perceived self–efficacy, is considered essential to design effective soft measures (Ajzen and Fishbein, 2005; Conner et al., 2011).

However, in practice the soft measures often lack the psychological underpinning to changing travel behaviour. The key reason for this is collecting and synthesising the relevant psychological data is seen as a time-consuming, complex, and an add–on task, in the design of travel plan measures (Hayes-Roth, 1994). Despite a growing body of research on the psychological correlates of car use, there is a lack of research with a focus to the factors that may constrain or facilitate change in travel behaviour within the scope of a travel plan. Consequently, it remains unclear how to address the modifiable antecedents while designing interventions to reduce car use. Therefore, a deeper understanding of the social, psychological, and situational determinants for changing travel behaviour is needed to inform the design of effective interventions (Government Communication Network, 2009).

Finally, several methods and tools have been introduced by different organisations, including the "Workplace travel plan evaluation tool" by the Department for Transport (DfT, 2008). The travel plan evaluation process is largely dominated by a checklist approach guided by organisational motivations towards the travel plans. It is widely acknowledged that travel mode choice behaviour is a complex phenomenon. Therefore, the reliability of the evaluation processes used to capture the wider direct and indirect impacts of a travel plan over a period of time considering the changing future circumstances is predominantly lies on the organisation's commitment to the travel plan (Cairns et al., 2010). There is a lack of literature with a focus to introducing alternative ways to evaluate the effectiveness travel plans. Examining the impacts of hospital travel plans was beyond the scope of the study. However, future research may explore how to design a tool that will best capture the actual effects of travel plans in changing travel behaviour.

3.5. Summary

At present, there is no widely acknowledged standard framework in practice to develop and evaluate the effectiveness of travel plan measures. The concept of the model for Planned Promotion is developed by integrating the aspects of the PRECEDE and PROCEED model (Green and Kreuter, 1999) and the intervention mapping approach (Bartholomew et al., 2006). This model is widely used in public health research to design interventions to promote healthy behaviour following six steps (Conner and Norman, 2005): (1) problem analysis, (2) risk behaviour analysis, (3) analysis of behavioural determinants, (4) development of intervention, (5) implementation and dissemination, and (6) evaluation of the intervention. The model proposes that each step needs to be supported by an evidence-base underpinned by established theories of changing behaviour and evaluated by rigorous methods to ensure the satisfactory completion of the step. In this chapter, the key factors that determine the success of a travel plan have been reviewed following the steps proposed by the Model for Planned Promotion.

Chapter 4

Literature review on travel mode choice behaviour

4.1. Introduction

This chapter discusses the literature reviewed with a focus to the key determinants of travel mode choice behaviour. This chapter begins by outlining the structure of the chapter followed by an introduction on travel mode choice for commuting trips in Section 4.2. Section 4.3 provides a review of existing literature with a focus to the key determinants of travel mode choice behaviour. Section 4.4 discusses the key issues associated with changing travel mode choice behaviour. Section 4.5 summarises the research gaps identified during the literature review and finally, the chapter is summarised in 4.6.

The literature review has been conducted to answer the following research questions.

- Which factors have greater importance for work journeys?
- What are the motivations behind using cars and walking?
- Who are more susceptible to change travel mode choice behaviour?

4.2. Travel mode choice for commuting trips

Commuting trips are considered as obligatory activities and generally receive higher priority than discretionary activities, such as shopping, and recreational activities (Buliung and Kanaroglou, 2007). Individuals tend to schedule their lower priority activities around the higher priority activities (Roodra and Miller, 2005). Therefore, once the trip to workplace is scheduled, other activities (e.g. school trip, giving a lift, shopping, gym) and their corresponding attributes (e.g. timing, location, route, joint or independent) are determined with respect to it. Due to the complex nature of the trip and likelihood of experiencing delays during peak hours, the trip to workplace is bound to time pressure (McGuckin and Murakami, 1999; Root and Schintler, 1999). As for many, some of the travel attributes of a trip to workplace, such as departure time location of workplace, and trip distance remain the same. As going to work is a routine activity it is also assumed that the commuters will usually choose the same path(s) to get to and from work. Therefore, investigating the travel mode choice behaviour is the prime focus of the study. Thøgersen (2006) broadly characterised travel mode choice behaviour into two categories:

1. repetitive and performed in a stable context; and
2. volitional (with conscious or deliberate intention), but with a limited number of viable travel options.

Three types of travel mode choice behaviours are commonly discussed in literature with a focus on changing travel behaviour including rational or deliberate (Aleskerov et al., 2007; Conner and Sparks, 2005; Fishbein and Ajzen, 2010; Chen and Chao, 2011), habitual (Bamberg et al., 2003; Chen and Lai, 2011; Chen and Chao, 2011; Eriksson et al., 2008; Gärling and Axhausen, 2003), and pro-environmental behaviours (Steg and Vlek, 2009; Johansson et al., 2006). Deliberate or rational travel mode choice behaviour is underpinned by the of Utility Maximisation Theory (Aleskerov et al., 2007), the Theory of Reasoned Action (Fishbein and Ajzen, 2010), and the Theory of Planned Behaviour (Ajzen and Fishbein, 1980).

Rational behaviour facilitates the decision making that enables individuals to choose a travel option that offers the maximum utility by comparing the available travel options. In contrast, habitual behaviour is a routine behaviour that perceives to block the deliberate process of decision making prior to behaviour. As a result, the same travel option is chosen irrespective of the changing circumstances. Pro–environmental behaviour can be defined as the action of an individual or group that advocates the sustainable or diminished use of natural resources (Sivek and Hungerford, 1989).

Stern (2000) proposed a framework highlighting the importance of four categories of factors to determine pro–environmental behaviour including, personal capabilities, external, contextual and attitudinal factors, and habit. First, personal capabilities include the individual's knowledge; availability of time and money; social status and power. Second, contextual factors include physical, social, economic, and political factors. Third, attitudinal factors include environmental and non-environmental attitudes, beliefs, values, and subjective norms. Pro–environmental behaviour is led by five important beliefs: the sense of obligation to take pro-environmental actions, altruistic values, beliefs about human and environment relations, awareness of adverse consequences and perceived ability to reduce these traits. Individuals with a positive attitude towards the environment are more likely to exhibit a higher level of self–reported or observed pro–environmental behaviour than those with a anthropocentric environmental attitudes (Corral-Verdugo et al., 2003; Schultz, 2000). Finally, habit represents a tendency to repeat the same actions over a period without employing the conscious decision making process (Verplanken et al., 1997). The key determinants of travel mode choice behaviour are discussed in the following sections.

4.3. Determinants of travel mode choice behaviour

The literature review has been carried out with a focus to the factors that may constrain or facilitate change in travel mode choice behaviour from car to walking within the scope of a travel plan. The key determinants of travel mode choice behaviour relevant to this study broadly fall under four groups(Chen and Chao, 2011; Collins and Chambers, 2005; Gardner, 2009; Gardner and Abraham, 2008; Hunecke et al., 2007). Factors under each of the four categories are presented below:

Socio-economic and demographic

Gender (Lois and Mercedes, 2009; Prillwitz and Barr, 2011), age (Lois and Mercedes, 2009; Prillwitz and Barr, 2011) education (Curtis and Headicar, 1997), job role (Curtis and Headicar, 1997), income (Lois and Mercedes, 2009; Prillwitz and Barr, 2011), no of children (Prillwitz and Barr, 2011), ethnicity (Cervero and Duncan, 2003), home ownership (Curtis and Headicar, 1997), household structure (Curtis and Headicar, 1997), physical fitness, access to cars (Dieleman et al., 2002; Klöckner and Friedrichsmeier, 2011), bodyweight (Schoeppe et al., 2013), driving licence (Stutts, 2007);

Modal attributes

Objective mobility

Travel distance (Cervero and Duncan, 2003; Zumkeller and Nakott, 1988), travel cost (Anable and Gatersleben, 2005; Collins and Chambers, 2005; Johansson et al., 2006), travel time(constraints) (Collins and Chambers, 2005; Mackett, 2003; Small, 2012; Johansson et al., 2006), car mileage (Steg and Vlek, 1996; Lois and Mercedes, 2009);

Subjective mobility

Comfort (Heinen et al., 2011; Johansson et al., 2006), convenience (Anable and Gatersleben, 2005; Mackett, 2003; Morency et al., 2014; Ortuzar and Willumsen, 1994), flexibility (Anable and Gatersleben, 2005; Heinen et al., 2011; Johansson et al., 2006), reliability (Ortuzar and Willumsen, 1994; Small et al., 2005), safety (Cauwenberg et al., 2012; Handy et al., 2006; Heinen et al., 2011; Morency et al., 2014), security (Nkurunziza et al., 2012), relaxing (Anable and Gatersleben, 2005), enjoyment

(Anable, 2002);

Psychological

Intentions (Abrahamse et al., 2009; Ajzen, 1991; Fishbein and Ajzen, 2010; Sigurdardottir et al., 2013), Intentions to use alternative modes (Gardner, 2008), Attitude/expected outcomes (Abrahamse et al., 2009; Ajzen, 1991; Fishbein and Ajzen, 2010; Sigurdardottir et al., 2013), Social norms (Ajzen, 1991; Schwartz, 1977; Fishbein and Ajzen, 2010), Personal norms (Ajzen, 1991; Abrahamse et al., 2009; Fishbein and Ajzen, 2010), perceived behavioural control (Abrahamse et al., 2009; Ajzen, 1991; Fishbein and Ajzen, 2010; Sigurdardottir et al., 2013), behavioural habit (Domarchi et al., 2008; Friedrichsmeier et al., 2013; Gardner, 2009; Ouellette and Wood, 1998; Verplanken and Aarts, 1999; Verplanken and Orbell, 2003; Verplanken et al., 2008), Self-motivation (Steg, 2005);

Situational

Accessibility (Handy et al., 2006), local transport conditions (Fosgerau et al., 2008), walking environment (Handy et al., 2006; Panter and Jones, 2010), pedestrian routes (Panter and Jones, 2010; Panter et al., 2014), land-use diversity/mixed use (Cervero and Duncan, 2003), personal commitments (Mackett, 2003), work commitments (Mackett, 2003), weather(bad weather) (Cervero and Duncan, 2003; INFAS and DIW, 2004; Klöckner and Friedrichsmeier, 2011; Mackett, 2003; Nkurunziza et al., 2012).

The following sections summarise past research on the complex interrelationships between the key determinants of travel mode choice.

4.3.1. Objective mobility and travel mode choice

The importance of both objective and subjective mobility attributes in determining travel mode choice for commuting trips is well documented in previous research (Ory and Mokhtarian, 2004; Wang and Chen, 2012). The travel behaviour attributes that can be directly measured are referred to as objective mobility, such as travel time, and travel distance. Conversely, the travel behaviour attributes that are usually measured based on the subjective perceptions of the travel mode users are referred as subjective mobility attributes.

4.3.1.1. Travel time and travel mode choice behaviour

Travel time to work is one of the most important explanatory variables of travel mode choice behaviour in terms of statistical significance (Collins and Chambers, 2005; Mackett, 2003; Small, 2012; Johansson et al., 2006). Commuting time may vary by socio–demographic characteristics (e.g. time and monetary constraints, travel pattern of the individuals), travel options, travel context of the individuals (e.g. time of the day, activity duration, relative locations of home and workplace, and travel conditions) (Axhausen et al., 2008). A study by Levinson (1998) suggested that travel time to workplace was not increasing at the same rate as the number of trips made and congestion, which reflected the dichotomy between social cost (e.g. congestion and pollution) and individual cost (e.g. commuting time). Recent data from the UK National Travel Survey 2013 show that all motor vehicle traffic has increased by 18.5% from 257.37 billion to 303.7 billion vehicle miles between 1993 and 2013 (DfT, 2014). If the present trend continues, road traffic is projected to rise by 46% by 2040 in comparison with the 2010 level of 303.7 billion vehicle miles. One of the key negative impacts of the projected rise in road traffic is 114% increase in congestion in lost time (DfT, 2013). In contrast, the duration of the average commuting trip has increased by five minutes between 1995/97 and 2013 (DfT, 2014). The time pressure imposed by the modern day life–style may explain why commuting time is not increasing at the same rate as traffic congestion.

Individuals tend to place a higher value for commuting time than that of discretionary activities (Anable and Gatersleben, 2005). The value of travel time whilst determining a travel option depends several factors, including individual circumstances (e.g. ability to use travel time productively, fatigue from travel, enjoyment of work, and tightness of work–hour constraints), trip purpose, travel option, time of day. A study by Daly et al. (2011) found that the value of travel time is positively correlated with the value of saving time, which in turn is associated with how time–constrained individuals are. Time constraints are imposed by the life cycle factors such as women may need to spend more time on carrying out family responsibilities. Small (2012) found that car users valued travel time by 25% to 55% higher under congested conditions than free flow conditions.

Moreover, the value of walking or waiting time on transit trip was found to be two to three times higher than that of in-vehicle time. However, previous studies suggest that employees, in particular women use the first 20 minutes of their time as a buffer between home and workplace (Blumen, 2000; Ben-Akiva and Lerman, 1985). Cross-sectional empirical evidence from all over the world shows that on average commuting trips mostly range from 25 to 35 minutes (Kenworthy and Laube, 1999). According to the National Travel Survey 2010, the average duration of commuting trips by walking was 18 minutes, which was shorter than by other modes of transport (e.g. cycling 22 minutes, car 24 minutes, bus 41 minutes, and surface rail 69 minutes) (DfT, 2011b). Therefore, despite the time constraints walking could be used as a viable travel option on its own or in conjunction with car journeys.

Moreover, an individual also attempts to derive a planned travel time by balancing off the travel time and activity duration (Dijst and Vidakovic, 2000; Raux et al., 2011). Dijst and Vidakovic (2000) suggest that underlying cognitive process of arriving at a perceived satisfactory travel time ratio by an individual depends on several factors, including time and space constraints; the degree of intention to maximise participation in activities; and willingness to travel further for attractive housing location. Schwanen and Dijst (2002) attempted to investigate the association between work duration and travel time based on a theoretical framework. The study used the 1998 Dutch National Travel Survey data and found that on average the participants spent 10.5% of the time of an eight–hour work day, which equals to 28 minutes per single trip for commuting. The ratio is defined as the total travel time (i.e. round trip) spent to visit an activity place divided by the sum of the total travel time to and activity duration at that destination. Bhat and Sardesai (2006) suggested that travel time ratio may vary from day to day for the same individual based on the variability of different aspects of the travel behaviour: trip–chaining propensity, travel route and travel mode choice.

Drawing upon the evidence found, it could be suggested that the relative significance of each of the above variables in explaining commuting durations remains unclear. However, based on the above discussion it could be suggested that if the travel time ratio is not satisfying over a period, the employees may consider several strategic decisions to change unfavourable commuting conditions: (a) changing travel mode; (b) travel duration; (c) arrival or departure timing; (d) residential location; and (e) incorporating non–work activities into commuting (Mokhtarian and Salomon, 1997). Individuals, who place a higher value for travel time and are time constrained are less likely to change travel mode choice unless flexible working arrangements are available to suit their travel needs. Hospitals that are located in congested areas may benefit from introducing measures such as off-site car park to reduce the pressure of traffic on local roads.

4.3.1.2. Travel distance and choice of residential location

Travel distance is an important factor for understanding and predicting travel mode choice behaviour (Scheiner, 2010). According to Jansen (1993), commuting distance is a basic characteristic of the spatial pattern of commuting, which may vary depending on the travel context. The travel trends data from the UK National Travel Survey suggest that individuals living in more rural areas are more likely to commute further than those in urban areas (DfT, 2014).

Distance is also perceived as a major barrier to promote the wider use of active modes of transport for commuting trips (Nelson et al., 2008). However, the perceptions towards distance as a barrier to walking may vary with respect to the socio–economic characteristics and travel context of the individuals. The use of human-powered transport such as walking and cycling to work is only viable if the travel distance criteria are met (Dickinson et al., 2003; Hamed and Olaywah, 2000; García-Palomares, 2010; Scheiner, 2010). According to a German study by Zumkeller and Nakott

(1988), walking, cycling, and car are considered as the fastest travel mode for distances under one kilometre, one to six kilometres, and over six kilometres respectively.

Commuting distance is closely associated with commuting time and, therefore, individuals with time constraints are more likely to have either a shorter distance or choose to use a faster travel mode, such as car. According to the UK National Travel Survey 2013, on average, the duration of commuting trips and commuting distance for women is shorter than men (DfT, 2014). Women with children or at certain stage in their career may need to make chained trips and spend additional time for commuting and choose to travel shorter distances. Goudie (2002) conducted a study among 408 households in Townsville and found that there was a positive association between the level of income and distance travelled.

Unlike car users, the active travel mode users estimate their travel distances based on mental or cognitive maps acquired through the travel experience, which is referred to as cognitive distance (Gärling and Loukopoulos, 2007). Cognitive distances are based on actual distances. However, several factors including, physical fitness of the individuals, the complexity of the routes, the quality of the travel environment may distort the cognitive distance (Stigell and Schantz, 2011). The distorted cognitive assessment of distance becomes a barrier to walking or cycling when the distance appears longer than the actual distance. For example, the cognitive distance may appear longer if the journey involves climbing hilly routes or walking within an unpleasant travel environment.

However, Gärling and Loukopoulos (2007) argued that due to the recurring nature the perceived complexity and cognitive demand associated with walking to work decrease and the cognitive distance appears smaller. The employers may organise trial walking trips around the workplace for the staff to help reduce the impact of cognitive distance by walking. Morency et al. (2014) investigated the potential of switching from short motorised trips to walking based on a sample of 65,000. The study relied on data collected Origin-destination Survey 2008 carried out in Greater Montreal Area, Canada. The study suggested that there was a need to improve the safety, convenience, and attractiveness of the walking environment to reduce the impact of cognitive distance to facilitate walking.

The importance of reducing commuting distance of the employees to increase the potential of using active travel modes for commuting trips is well documented in previous research (Schneider, 2013). An understanding of what factors may determine the choice of residential location of the staff is fundamental to design measures to encourage staff to move closer to work. A choice of residential location is driven by several considerations related to life–situation, work, housing, finance, environmental concerns, and travel (e.g. access to workplace, school and shops) (Curtis, 1996; Salomon and Ben-Akiva, 1983). Previous research explored the association between residential location choice and travel behaviour from different dimensions (Kitamura et al., 1997; Scheiner and Holz-Rau, 2007).

Curtis (1996) carried out a study based on an Oxfordshire case study. The key findings of the study was based on a survey response from 1,168 adults. The study found that although *proximity to work* was reported as a significant reason for selecting residential locations a large of amount of travel is generated from areas outside the county. It was suggested that the financial factors received a higher importance while determining the final housing locations. The households outweighed cheaper housing against long commuting distance.

A later study Scheiner and Holz-Rau (2007) proposed six theoretical models to depict the complex interrelationships between life situation [1], lifestyle, choice of residential location, and travel behaviour. The cross-sectional data were collected through a household survey in ten areas across Cologne, Germany between 2002 and 2003. Structural equation modelling was performed based on a sample size of 2,692. Lifestyle was found to have a significant effect on location attitudes [2] and location decisions, which in turn resulted in an indirect effect on travel mode choice. The study findings suggest that life situation had a direct effect on determining travel mode choice. Individuals with a preference for access to public transport, retail and good services were more likely to use public transport and non–motorised transport instead of cars. As a result, they were likely to hold a relatively lower annual average vehicle kilometres. In contrast, individuals with a high socio–economic status and families with young children exhibited no preference for urbanity, and were more likely to travel by cars. Individuals with access to a car were more likely to live in places with low density and less mixed land–use. The reason being having access to a car provides an overall larger activity radius and a higher flexibility to choose the residential location in comparison with those with no access to cars.

Choocharukul et al. (2008) investigated the effects of individual travel mode choice behaviour for commuting trips on residential location choice. Hundred and seventy–six responses were collected through a survey among the engineering students studying at Chulalongkorn University, Bangkok, and Ubon Ratchathani University, Ubon Ratchathani in Thailand. Data analysis based on structural equation modelling revealed that behavioural intention to car use had a significant impact on determining preference for residential location. Respondents with a preference for frequent car use were less likely to live in areas with easy access to public transport.

The influence of accessibility considerations behind the choice of residential location is less evi-

[1]Life situation refers to the socio–structural conditions that can not be altered by individuals.

[2]Location attitudes refer to the subjective evaluation of the importance of the attributes in relation to residence, location, and neighbourhood characteristics.

dent among the car users. The motivations behind the choice of residential location was explored and compared with the findings from the previous literature. The association between the residential location and life situation has not been explored as part of the study. However, a growing evidence suggests that the behaviour change interventions are more effective following a change in life situation, such as moving house, starting–up a new job, and becoming a parent (Stanbridge et al., 2004).

4.3.2. Subjective mobility attributes

The subjective mobility attributes are widely examined under the motivations behind travel mode use. This section, therefore, broadly covers the literature related to the motivations behind car use and walking. Motivation to use a travel mode is a non–unitary phenomenon, which is used to represent the reasons for our actions. Pardee (1990) defined *a motive is as a construct that prompts a person to act in a certain way or at least develop an inclination for specific behaviour.* According to Ryan and Deci (2000), *to be motivated means to be moved to do something.* A person who feels no impetus or inspiration to act is thus characterised as unmotivated, whereas someone who is energised or activated towards the end is considered motivated.

The level (i.e. how much) and orientation (i.e. type) of motivation may vary between individuals. Orientation of motivation correlates with the underlying attitudes and goals associated with an action. Attitude towards a travel mode is a relatively stable construct in comparison with motivation. Therefore, changing attitude involves a complex and lengthy process. In contrast, designing interventions to increase motivation to walking to work can have a relatively immediate impact on increasing walking to work. Fleury (1991) found that increasing motivation to physical activity could contribute to an increased level of physical activity.

The following section outlines the motivations behind car use and walking. A study by Steg (2005) classified the motivations behind car use into three groups, namely instrumental, symbolic (social), and affective motivations, which are defined below:

- *instrumental motives* refer to the objective consequences of car use, which in the short-term include travel cost, travel time, flexibility, convenience, speed, safety, predictability, and protection against the weather; and in the long term include health, fitness, environmental problems resulting from car use, feelings of freedom, independence, being in control, and self-confidence;
- *affective motives* refer to the emotions and feelings evoked by using a car, which may potentially alter people's mood, such as stress, excitement, pleasure, boredom, and control; and

- *symbolic or social motives* refer to the fact that people can express themselves by using a car, and people can compare themselves with others. The symbolic motive can be classified into two groups: (a) the person's position or social status; and (b) the expression of personal identity and values (Dittmar, 1992).

Anable and Gatersleben (2005) examined the relative importance people attach to various instrumental and affective journey attributes by comparing the findings from two studies. The first study involved a survey with a sample of 235, comprising university students and employees from the local councils. The study findings show that the respondents tend to attach greater importance to instrumental attributes, especially to convenience for work journeys than affective factors particularly for a sense of control, freedom, and lack of stress. The second study was based on a survey of 666 leisure facilities users of National Trust properties. The leisure facilities users' were found to have attached almost equal importance to instrumental and affective attributes for leisure journeys. The slightly different findings between the working and leisure trips could be attributed to the distinct values individuals attach to different activities. The significance of instrumental motives behind commuting by car has emerged from the literature. In contrast, a few studies attempted to measure the effects of affective motives on travel behaviour and argue that both instrumental and affective functions of the car use have significant impacts in determining the underlying attractiveness of car use (Mokhtarian and Salomon, 2001; Steg et al., 2001; Steg, 2005).

Besides, symbolic motives can provoke the perception of using cars as a symbol of status, social identity, and self–concept, thereby can increase the use of cars (Gatersleben, 2007). Mann and Abraham (2006) suggested that the type of car(s) driven by individuals can be used as an indicator to characterise individual identities based on their values. For example, individuals may choose to drive big and expensive cars to express their status-related values in contrast individuals with opposing values may choose not to use cars as a symbol of their status. However, it could be argued that the use of big and expensive cars may not always reflect the symbolic motives, but rather driven by individual needs and circumstances.

The relative comparison between the perceived advantages and disadvantages of car use and walking shows that the car users rate car journeys highly on personal benefits, such as quicker, convenient, comfortable, flexible, individual freedom, and social status. Gardner (2008) suggested that the car users often underestimate the actual cost of driving. Car users' evaluation of the negative impacts of car use such as cause environmental pollution, cause traffic congestion, lack of physical activity, costly, and lack of social interactions are often outweighed by the personal benefits of car use (Van Vugt et al., 1995).

Mackett (2003) conducted a study with a focus to identify the reasons for using cars for short trips under one mile. The data were collected by Steer Davies Gleave (SDG) through in-depth interviews over a five–year period among 377 participants residing in five areas across the UK, including London, Leeds, Ipswich, Hereford, and Dorset. According to the study, the highly reasons for not walking to work were dark out, bad weather, short of time, lift for family, needed at work, convenience, further trip or trip chain, and carrying heavy goods. The physical, mental, social, and wider benefits of walking are well documented in previous research (Wardman et al., 2001). Key benefits of walking can be summarised as, flexible, relaxing, environmentally friendly, cheapest (no direct cost involved), healthy, social benefits to the community. Therefore, the challenge of designing travel plan measures lies in addressing the wider benefits of walking that will motivate the staff to walk to work.

Current literature appears to validate the view that travel mode choice is better explained if both instrumental and affective motives are included. However, a few studies attempted to measure the affective motives behind car use that could be attributed to two key reasons: (a) the research methods used were based on instrumental motives; and (b) the car use behaviour is examined based on self-reported data and in order to justify their behaviour the car users tend to provide socially desirable answers. For example, it is very unlikely that the NHS hospital staff will admit that they commute by car because of enjoyment, excitement, and pleasure; when there is a high emphasis on reducing car use by the NHS Acute Trusts.

4.3.3. Psychological factors, situational factors and travel mode choice

The significance of psychological factors emerges with the growing realisation that the standard rational economic paradigm is insufficient to provide a complete picture of the travel mode choice behaviour (Bamberg et al., 2011; Bamberg and Schmidt, 2001; Bamberg and Möser, 2007; Gärling and Axhausen, 2003; Gardner and Abraham, 2008; Small, 2012; Steg and Vlek, 2009). In previous research mixed findings have been reported on the relative importance of socio–demographic, psychological, and situational factors on travel behaviour (Hunecke et al., 2007; Collins and Chambers, 2005). In travel behaviour research, there is a tendency to focus on the issues associated with volitions and constraints of travel mode choice. However, there is also a growing support for the claim that the relationship between the psychological and situational factors in determining travel mode choice for commuting trips is likely to be interactional in nature (Collins and Chambers, 2005; Corraliza and Berenguer, 2000; Thøgersen, 2006; Steg et al., 2001). As a result, the underlying knowledge behind the mechanisms behind travel mode choice remains fragmented.

The relative impacts of psychological and situational factors in determining pro–environmental behaviour vary with respect to the behaviours (Corraliza and Berenguer, 2000). Kitamura et al. (1997) investigated the impacts of socio-economic, land–use, and attitudinal variables on travel behaviour and suggested that the highest proportion of the variation in behaviour can be explained by attitudinal variables. A study by Collins and Chambers (2005) investigated the impacts of psychological and situational factors on commuter travel mode choice based on a sample of 205 Australian students. The study concluded that to achieve a transport–mode shift to public transport, public policy strategies should focus on individuals' transport–related environmental beliefs (e.g. personal control and environmental effects of cars) and situations (e.g. access to public transport at reduced cost).

A later study by Schuitema et al. (2007) examined the impact of two transport pricing policies on intention to change travel among 274 Dutch car users. The study found that most of the respondents had no intention to change car use for commuting trips. However, a different conclusion was drawn by a study by Ryley (2008), which investigated the motorists' propensity to walk for short trips based on a sample of 997 (i.e. 33% response rate). The data were collected through the West Edinburgh Household Survey in 2003. The relative importance three attributes, namely journey time, petrol cost and parking charge were assessed. The study found that motorists were more likely to for short trips with an increase in parking charge. Public acceptance of increasing parking cost is generally low (Steg and Schuitema, 2007). It was suggested that ring–fencing the income generated from car parking charges to fund measures to improve the quality of alternatives may increase the public acceptance.

4.3.4. Built environment and travel mode choice

A growing number of studies has examined the association between the built environment and travel mode choice. The aspects of the built environment include land–use patterns, transport system, and urban design features that provide opportunities for travelling from origin to destination. The significance of urban design characteristics at the neighbourhood scale to promote walking, cycling, and public transport has been well documented in recent research. Evidence consistently shows that people living in mixed-use and dense urban structure are more likely to walk for short trips than those living in sprawl urban structure (Cervero and Kockelman, 1997; Holtzclaw et al., 2002; Saelens and Handy, 2008). Kitamura et al. (1997) investigated the impacts of attitudes and land use characteristics on travel behaviour. The study concluded that travel behaviour were more strongly and directly associated with attitudes than land use characteristics.

Cervero (2002) investigated the impacts of compact, mixed–use and pedestrian–friendly developments on travel mode choice behaviour. A normative model was used to assess the impacts of three core dimensions of the built environment: (a) density, (b) diversity, and (c) design on travel mode choice. The study findings show that workplaces that were situated in high density and mixed–use areas facilitated the use of a higher level of public transport. The travel context of urban areas such as lack of car parking spaces, car parking charges, high traffic density, and low speed is likely to override the apparent unattractiveness of using other modes of transport. Areas with well–developed sidewalks/pavements were also found to have a positive impact on promoting the use of bus. Frank et al. (2007) conducted a cross-sectional study by using data collected through an Atlanta–based SMARTRAQ travel survey involving 10,848 participants. The study found that the frequency of walking was higher in the mixed–use areas of the Atlanta region, which is consistent with previous studies.

In contrast, a study by Næss and Jensen (2004) found that individuals living on the outskirts of large cities are more inclined to use cars. Dargay and Hanly (2007) investigated the key determining factors of commuting by car based on data obtained from the British Household Panel Survey (BHPS) between 1991 and 2001. The study found that commuting by car is negatively correlated with the population density of the area. It was suggested that several factors including, high cost of driving, and good access by public transport may have contributed to the lower use of car in the highly dense areas. A later study by Zhang et al. (2012) compared the relative impacts of built environment factors on vehicle miles travelled in five urban areas in the USA using Bayesian multilevel regression models. The factors studied include residential density, employment density, land use mix, block size, and distance from CBD. The effectiveness of the land use policies varies across the case study area and within the same case study area. Several factors are found to have mediating effects on the relationship between built environment and changes in vehicle miles travelled, including: (a) urban area size; (b) existing built environment status; (c) transit service coverage and quality; and (d) land–use decision–making process. Previous literature suggests that the built–environment characteristics that facilitates walking converges with reduced car use. However, collecting data to support such investigation was beyond the scope of this study.

4.4. Changing travel mode choice behaviour

Travel mode choice is a complex phenomenon and often subject to perceived or actual situational and personal constraints. Therefore, when developing travel plan measures it is important to identify groups of individuals, who are susceptible to change their travel mode choice behaviour. Susceptibility to change travel mode change behaviour may vary from the most susceptible to change to the least susceptible depending on the socio–economic, psychological and situational circumstances. The concept of susceptibility to change is closely associated with the nature and sources of car–dependent attributes and behaviour. The importance of understanding the difference between *car–dependent people* and *car–dependent trips* has been highlighted by RAC (1995). First, there is no universal definition of *car–dependent trips*, however, a trip can be termed as a car–dependent trip if there is no alternatives available (e.g. walking, cycle, bus, rail) other than a car. Several factors may contribute to individuals' car dependency, such as journey time (i.e. early mornings, late nights), physical inability to use other modes of transport, personal commitment(s), work commitment(s), trip chain(s), and bad weather.

British Social Attitudes Survey (1993) illustrated what types of people were likely to be car–dependent. Curtis (1996) investigated the commitment towards car–use among people with respect to location, age, and distance. The study findings show that commitment to car use was high among those, who resided in villages and the countryside than those living in big cities. Within different age–groups commitment to car use was highest amongst the youngest groups (18 to 24 years old). Curtis and Headicar (1997) conducted a study based on a sample size of 838 commuters residing in five housing estates in Oxfordshire. More than half of the respondents (56%) were not susceptible to change, and a further 17% were willing to change but cited practical reasons for not being able to change. Only over one-fifth of the respondents (22%) said they both considered changing from car use, and it was practical to do so. Male aged 30+ working full–time with no children and income ranging from £23,000 to £29,000 were found to be the most susceptible to change from car use to alternatives.

The study by Curtis and Headicar (1997) also found that the individuals with a commuting distance under five miles were more susceptible to change. According to the study, around 11% of the respondents of the most susceptible group considered to change from car to walking. Interestingly, a high proportion of the respondents, who could switch from car to alternatives but chose not to, cited increased time, convenience, laziness, and lack of access to alternative travel modes. Furthermore, car users, who are highly aware of the problems of using cars and already have a car mileage lower than the average are more likely to reduce car use (Steg and Vlek, 1996). The study findings echo with previous studies that the familiarity with alternatives to car significantly diminishes the perceived dependence on car use, thereby, increases the susceptibility to change (Stokes, 1996). A later study by Ryley (2006) found that the propensity of using cars was higher among the high earners with children population segment *(n = 2,910)*.

According to the National Travel Survey 2009, a higher proportion of the participants (38%) reported to have experienced difficulties in getting to work by car or motorcycle than those travelling by alternatives (31%) (DfT, 2011b). More than one–third of the individuals commute to work by car or motorcycle cited traffic congestion or road works as the main difficulty associated with car use. The negative impacts of traffic congestion on the individuals include longer and unpredictable journey time, lower desirable journey speed and waste of fuel. Evidence suggests that commuters experiencing high traffic congestion are more likely to suffer from higher level of stress (Hennessy and Wiesenthal, 1997).

Strategies to change travel mode choice need to have a combination of positive and restrictive measures to motivate different groups of people and discourage the use of cars (Cairns et al., 2002; Enoch and Ison, 2007; Newson, 1997; Roby, 2010; Rye and Ison, 2005; Rye et al., 2011). Cao and Mokhtarian (2005) investigated the effects of objective and subjective variables on individuals' response to 16 strategies to reduce travel demand. Binary logit models were performed based on 1,283 responses collected through a survey among the commuters from the San Francisco Bay Area in 1998. The effects of objective mobility, subjective assessments, desires, and affinities with respect to travel were found to have affected individuals' consideration to travel strategies. Besides, individuals with short travel distance, mobility constraints, and environmental concerns are more likely to consider adopting travel–related strategies with an attempt to reduce commuting distance. It should be noted that the presence of anyone in the household needing special care was positively associated with strategies that provided flexibility.

In some cases, there may not be any viable alternatives other than the car. Therefore, the strategies to restrict the use of cars need to be informed by a comprehensive understanding of staff travel needs and constraints to change travel behaviour to avoid the detrimental effects of unexpected commuting stress associated with change of travel mode (Schaeffer et al., 1988). Effective, persuasive campaigns and interventions need to be underpinned by the underlying modifiable situational and psychological constructs behind car use (Bartholomew et al., 2006). As discussed in Chapter 3, the psychological factors of the individuals are often overlooked in practice although they are the most important factors in perpetuating changes in travel behaviour. Despite a growing body of research on the psychological correlates of car use, it remains unclear how to address the modifiable antecedents while designing interventions to reduce car use.

In order to contribute to the knowledge gap, Gardner and Abraham (2008) conducted a systematic review to identify potentially modifiable constructs associated with car use intentions and/or behaviour and evaluate associations between each of these constructs and car use. The author concluded that there was a lack of reliable evidence base to design interventions to reduce the use of cars. Attempts to unravel the complex interrelationships between the determining factors of travel behaviour is a key area of interest in travel behaviour research. Researchers use different approaches to disentangle the key determinants for changing travel behaviour. A growing concern is evident in literature that questions the causality of these factors in changing travel behaviour.

The psychological factors are shaped by socio–demographic characteristics that are embedded in a context that stretch beyond the local travel and organisational circumstances. This study draws attention to the psychological factors by investigating the variation in psychological factors with respect to the socio–demographic and situational factors, and by capturing the psychological perceptions on the modal attributes and situational factors.

4.5. Literature gaps on determinants of travel mode choice behaviour

The literature reviewed has contributed to the body of knowledge regarding the factors influencing travel mode choice behaviour. However, the following research gaps have been identified based on the literature review. First, travel plan measures are designed with a high emphasis to influencing the socio–psychological process that is embedded within a context. There is a lack of widely acknowledged single framework to study the impacts of socio–economic, psychological and situational factors on changing travel mode choice behaviour, which contributed to a fragmented understanding of the phenomenon. It also remains unclear how to address the modifiable antecedents while designing interventions to reduce car use.

Second, the psychological constructs have a higher stability and difficult to change. Therefore, it is essential to have a deeper understanding of the psychological factors to design effective travel plan measures. The scope of altering the situational factors is limited within the travel planning process. As the factors are often interrelated, it is important to acquire an understanding of the impacts of the situational factors (e.g. location of the hospital, land–use characteristics, access to the hospital site) on shaping up the psychological perceptions towards travel mode choice and vice versa. Previous studies tended to focus on exploring the factors that may facilitate and constrain change in travel mode choice from the car to public transport (Collins and Chambers, 2005).

Further research is required to better understand the interrelationships between psychological and situational factors and their impacts on changing mode choice behaviour. Third, the potential of walking as a viable alternative to car use has yet to receive a high emphasis in travel behaviour research. There is a lack of comprehensive knowledge–base on the key constraints of changing travel mode from cars to walking. To address the above knowledge gaps this study study aims to investigate the key socio–economic, psychological and situational determinants for intention to change travel mode choice behaviour of hospital staff within the scope of a travel plan.

4.6. Summary

A comprehensive review of the literature about the key determining factors of travel mode choice was performed drawing attention to the factors that need to be considered within the scope of a travel plan. The key determining factors of travel mode choice are broadly classified into four groups: *(1) socio–economic, (2) psychological, (3) situational*, and *(4) modal attributes*. However, in travel behaviour research, the effects of different factors from each category are generally examined alongside factors from other categories. As there is a lack of travel behaviour research in the context of healthcare, previous research in other contexts has been reviewed.

The impacts of situational factors (e.g. built environment) on determining travel mode choice behaviour are found to be mixed in nature. Collecting actual situational data related to the staff working for various hospitals was beyond the scope of the study. However, data on the hospital staff's perceptions on situational factors were collected as part of this study. As this study examines the changing travel mode choice behaviour from car to walking a higher emphasis was placed on factors that may constrain change in travel mode choice, such as travel time, travel distance, and psychological factors. A limited number of studies examined the impacts of psychological factors on changing travel mode choice behaviour especially from car to walking. This identified knowledge gap is further explored in Chapter 5.

Chapter **5**

Theoretical framework

5.1. Introduction

This chapter illustrates the justification behind the theoretical underpinning of the study and the theoretical framework in light of the knowledge gaps identified in Chapter 4 and Chapter 5. The purpose is to investigate the impacts of socio-economic, situational, and psychological determinants on intention to change travel mode choice behaviour based on the Theory of Planned Behaviour to fulfil Objective Two as discussed in Section 1.6.

The structure of the chapter is outlined below. Section 5.2 provides an introduction to the theories that are widely used in travel behaviour research. Section 5.3 outlines the key determinants for intention to change travel mode choice based on the Theory of Planned Behaviour. Section 5.4 discusses the development of a theoretical framework based on the review of generic and theoretical literature and proposes the hypothesised relationships between the determinants of intention to travel mode choice behaviour. Section 5.5 delineates the operationalisation of the model constructs, whilst Section 5.6 summarises the chapter.

5.2. Theories in travel behaviour research

The word theory comes from the Greek word called *theoria*, which means beholding or speculation (Wikipedia, 2015). Theories refer to speculations that are used to describe, predict, explain, and control phenomena. A theory is based on a concept or an idea that is presented through a set of hypotheses. The hypotheses are tested by evidence. It should be noted that theories are not universally proven statements. The applications of theories may vary across different disciplines. In Science, a theory is referred to as a fact–based framework for describing a phenomenon. According to Goodwin (2009), in Psychology, a theory is a set of logically consistent statements about some phenomenon that:

- best summarises existing empirical knowledge of the phenomenon;
- organises this knowledge in the form of precise statements of relationships among variables (i.e. laws);
- provides a tentative explanation for the phenomenon; and
- serves as the basis for making predictions about behaviour.

In Social Science, a theory attempts to answer the *why* questions are referred to as theories. According to Van Ryn and Heaney (1992), a theory is systematically organised knowledge applicable in a relatively wide variety of circumstances devised to analyse, predict or otherwise explain the nature or behaviour of a specified set of phenomena that could be used as the basis of actions. The most commonly used (prevalent) theories of changing travel behaviour are the Norm–activation Model (Schwartz, 1977), the Theory of Interpersonal Behaviour (Triandis, 1977), Social Cognitive Theory Bandura (1986), Theory of Planned Behaviour (Ajzen and Fishbein, 1980), and Trans–theoretical (stages of change) model (Prochaska and DiClemente, 1984). The Social Cognitive Theory was introduced by (Bandura, 1986) that individual functioning is led by the interaction between behaviour, personal, and environmental factors, which is called reciprocal determinism. The environmental factors represent influence of situational factors within the context the behaviour is being performed. The personal factors include instincts, drives, traits and other individual motivational factors. The other factors that may have impacts on the underlying process of individual learning and changing behaviour include self–efficacy, outcome expectations, reinforcements, emotional coping, and observational learning.

The Trans–theoretical model (Prochaska and DiClemente, 1984) is widely used to understand the process of changing behaviour. The key concept behind the model is that behaviour change is a dynamic process and an individual moves through a set of sequential stages while changing behaviour. Figure 5.1 illustrates the stages of changing behaviour: (a) *pre–contemplation – not ready to change*; (b) *contemplation – thinking of changing*; (c) *preparation – ready to change; (d) action – making changes*; (e) *maintenance – maintaining the healthy behaviour*; and (f) *relapse – fail to maintain the healthy behaviour*. Maintaining the desired behaviour is considered as the most challenging stage. Many people remain in the maintenance stage throughout their life. Interventions need to be designed targeting at specific stages of changing behaviour, so that individuals can successfully move through and complete the process of changing behaviour. For example, interventions need to be designed with a focus to raising awareness towards the negative impacts of car use and benefits of walking to contempt individuals being at the pre–contemplation stage to change travel behaviour. The following interventions are widely applied to influence the move through the different stages of changing behaviour (Rose and Ampt, 2001).

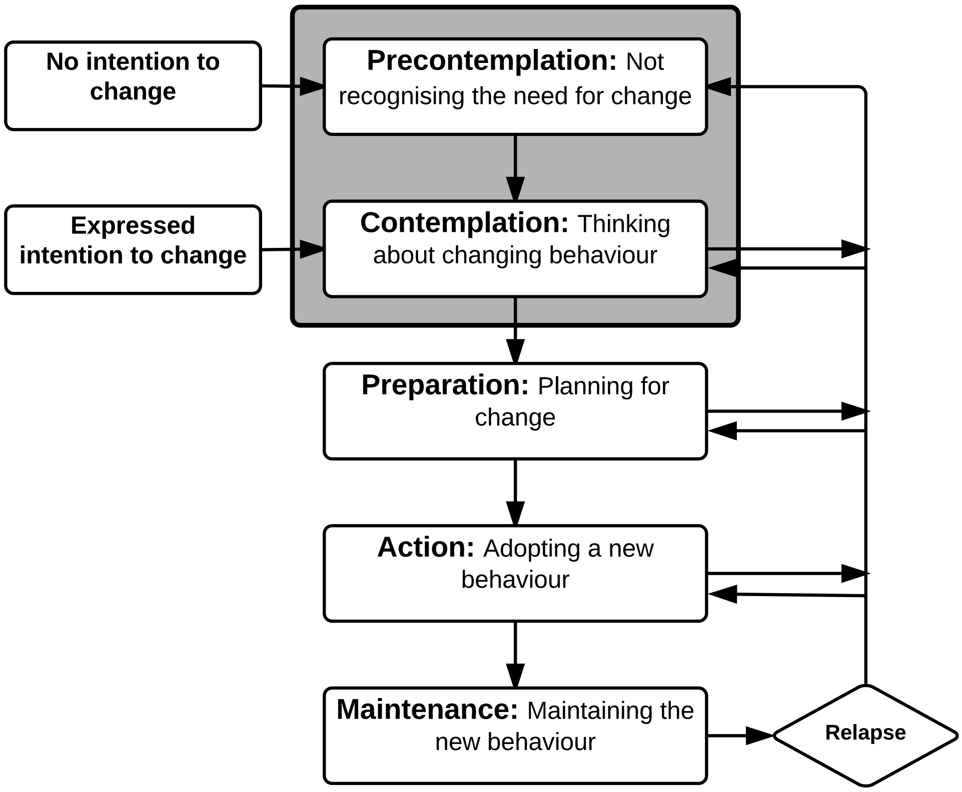

Figure 5.1: The Trans–theoretical model (Prochaska and DiClemente, 1984).

- *Consciousness–raising* involves increasing awareness towards the impacts of car use through educational materials, confrontation, media campaigns, and feedback.
- *Dramatic relief* involves producing an emotional experience of the impacts of car use followed by the anticipated reduced affect if appropriate actions are taken to reduce the use of cars through personal testimonials, media campaigns, and drama.
- *Self–reevaluation* involves inviting individuals to make cognitive and emotional assessments of their self–image by clarifying values, providing healthy models, and using imagery.
- *Environmental re–evaluation* involves assessing the presence or absence of car use or walking on the social environment by broadcasting documentaries and promoting personal stories.

Evaluating the impacts of travel plans on changing travel behaviour was beyond the scope of the study, therefore, the issues related to different stages of changing behaviour have not been explored as part of the study. In this study, data were collected to identify the car users intention to change mode choice behaviour. Intention to change and not to change travel mode choice behaviour represent being at the contemplation and pre–contemplation stages respectively.

In transport research, investigating the determinants of car use has primarily been guided by two theories: Utility Maximisation Theory (Aleskerov et al., 2007); and Theory of Reasoned Action or its successor the Theory of Planned Behaviour (TPB) (Fishbein and Ajzen, 1975), which are discussed in the following sections.

5.2.1. Utility Maximisation Theory

The Utility Maximisation (UM) Theory has been widely used to understand the underlying mechanisms behind the deliberate or rational travel mode choice behaviour (Aleskerov et al., 2007). The Utility Maximisation Theory assumes that travel choices are made by comparing the utility of different travel options, and people choose the travel mode that offers the highest utility among the alternatives. The utility of each travel option is measured based on a non–psychological perspective by considering observed features of the alternative travel options (e.g. travel time, travel cost) and socio–economic characteristics of the decision maker (e.g. age, gender, household income) (Ben-Akiva et al., 1999). Discrete choice models are frequently employed to analyse travel mode choice behaviour based on the Utility Maximisation Theory. The conventional discrete choice models assume that the independence of irrelevance alternatives (IIA) property are limited to capturing individuals random taste variations (Train, 2003).

The influence of psychological factors in influencing the preference for different travel options is now widely acknowledged (Aarts et al., 1997; Ben-Akiva et al., 2002; Chen and Chao, 2011; Johansson et al., 2006). The key criticism of the Utility Maximisation Theory is that it fails to interpret the differences in preference for travel options caused due to the influence of unobserved psychological factors, such as attitude, habits, and lifestyle preferences (Temme et al., 2008). It means, despite having identical socio–economic characteristics, two individuals may choose two different travel options due to the difference in their psychological constructs. In addition, Frank et al. (1990) argued that as the theory relies on rationality of human choices, it fails to capture the biased decisions made under the influence of passion. For example, the disutilities of using cars include monetary cost, mental cost; and inconvenience associated with driving and finding a parking a place (Gärling et al., 2002). Despite having the availability of alternatives offering an overall higher utility than car, individuals may continue to commute by car. Another limitation of the theory is that due to an exclusively individual approach, the influence of social laws on individual decision–making is not considered as part of the theory (Green, 2008).

The use of integrated choice and latent variable (ICLV) models is becoming popular to address the limitations of using discrete choice model as discussed above. The ICLV model incorporate discrete choice models with latent variable model to examine the influence of the underlying psychological factors associated with travel mode choice and provides a deeper understanding of the underlying decision–making process behind travel mode choice (Ben-Akiva et al., 1999). Structural equation modelling are used in transport research to study travel mode choice behaviour based on the principles of TPB (Ajzen, 1991), which is discussed in detail in the following sections. Despite the conceptual appeal, the applications of ICLV in travel behaviour research have been limited as the full estimation of information required by the model was considered as a rather complex and lengthy process. Recent advances in software such as Mplus has enabled a more flexible approach for estimating ICLV models. However, ICLV has not been used as part of this study due to time and resource constraints.

5.2.2. Theory of Planned Behaviour

The theories of Reasoned Action and Planned Behaviour are social cognitive models that are widely used to predict travel mode choice behaviour (Ajzen and Fishbein, 1980). The theories assume that human behaviour is a rational decision–making process that is led by the information or beliefs people possess about the given behaviour. The TPB is an extension of the TRA (Armitage and Conner, 2001). The use of the TRA is limited to circumstances under volitional control (i.e. straightforward circumstances), which is almost impossible to achieve in real–life circumstances. Perceived behavioural control was incorporated into the Theory of Planned Behaviour to enable the wider applications of the theory into complex real–life circumstances such as the psychological phenomenon behind travel mode choice behaviour. In comparison with the Utility Maximisation Theory, the TPB provides an insight into the underlying psychological constructs behind travel mode choice within a given context (Anable, 2005; Gärling and Axhausen, 2003; Hensher, 1998; Hunecke et al., 2007; Klöckner and Friedrichsmeier, 2011). Another advantage of the TPB is that it allows the examination of the disaggregate characteristics of travel behaviour by distinguishing the impact of habits from the rational determinants of performing behaviour (e.g. attitude, subjective norm, perceived behavioural control, intention) (Verplanken et al., 1994).

The TPB is underpinned by the assumption that individuals are more likely to perform a behaviour if they intend to do so (Fishbein and Ajzen, 2010). Intention is considered as the immediate antecedent of behaviour that *refers to the subjective probability of performing a behaviour*. Individuals may intend to engage in a behaviour if: (a) they can justify the likely consequences; (b) others support it; (c) they have the prerequisite skills and abilities; and (d) there are no environmental constraints to prevent them from carrying out their intentions (i.e. they have favourable intentions and actual behavioural control). If measured correctly, behavioural intention accounts for a significant proportion of actual behaviour. Once the behaviour is performed, individuals may encounter unanticipated positive and negative consequences, or favourable or unfavourable reactions from others or unanticipated constraining or facilitating factors. This feedback is likely to have impacts on individual's behavioural, normative, and control beliefs (see Figure 5.2). Changes in the beliefs in response to the feedback may vary with respect to behaviour and contextual factors.

The TPB is widely acknowledged as a reliable tool to predict car use behaviour (Bamberg and Schmidt, 2003). The underlying mechanism behind change in travel mode choice is a complex phenomenon, which is often embedded within the context (Klöckner and Friedrichsmeier, 2011). Contextual or situational factors (e.g. working patterns, personal circumstances, weather) that may affect travel behaviour are constantly changing. However, in comparison with situational factors, the psychological variables such as intentions, habits, attitude, perceived behavioural control, and norms have a high stability (Anable and Gatersleben, 2005). According to Klöckner and Friedrichsmeier (2011), if the variation in situational factors is rather low the impact of psychological variables can be estimated by using aggregates that consider the change in situational variation as error variation. For example, the situational factors that may vary over time and have impacts on travel mode choice behaviour for commuting trips include, work commitments (e.g. early or late night shift, site visits), personal commitments, and weather conditions. In case of deliberate behaviour travel mode choice should vary with respect to changing situational circumstances. In contrast, under the influence of strong habit the choice of travel mode may remain the same despite experiencing changing situational factors. Therefore, this study is designed based on the principles of Theory of Planned Behaviour.

Ajzen (1991) acknowledged the limitations of the theory and encouraged further research to improve the predictive utility of the theory on the following areas (Bamberg and Schmidt, 2003; Heath and Gifford, 2002).

- How salient beliefs held by drivers can be modelled as potential antecedents of attitudes, PBC, and distal predictors of car use? and
- How theoretical constructs that are not captured by the TPB cognitions can be incorporated to improve the utility of the model?

A revised version of the model that incorporates a measure of descriptive norm (i.e. perceptions of the extent to which significant others engage in the focal behaviour) was introduced by Ajzen and Fishbein (2005). Inclusion of a measure of descriptive norm to the TPB cognitions reported to have increased unique variance in both intentions to use buses and bus use behaviour (Heath and Gifford, 2002).

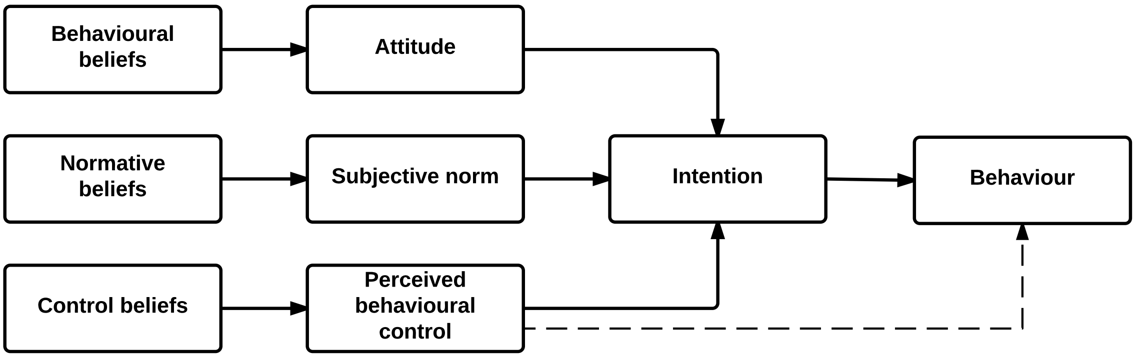

Figure 5.2: The Theory of Planned Behaviour (Ajzen, 1991).

5.3. Determinants of behavioural intentions

Intention can also be defined as the cognitive representation of an individual's readiness to perform a behaviour. The reason–based antecedents of the Theory of Planned Behaviour are attitude, subjective norms, and perceived behavioural control (Ajzen and Fishbein, 1980). Attitude represents a combination of perceptions of the consequences of an action, subjective norms refers to the perceived social approval for the action and perceived behavioural control refers to the perceived control over performing a behaviour (Ajzen, 1991). The effects of attitudes, subjective norms, and perceived behavioural control on behaviour are assumed to be indirect, and mediated by intentions. Perceived behavioural control can moderate the effects of attitudes and subjective norms on intentions in turn influence behaviour. The effects of attitudes and subjective norms on behaviour are mediated by intention. However, perceived behavioural control can have both mediated and direct effects on behaviour.

The effects of behavioural beliefs, normative beliefs, and control beliefs on intentions are mediated by their corresponding constructs. The relative contributions of attitude, subjective norms, and perceived behavioural control in determining intentions to engage in a behaviour are likely to vary across behaviours and circumstances (Fishbein and Ajzen, 2010). For example, Armitage and Conner (2001) conducted meta–analyses of the empirical literature for a wide variety of behaviours, and found that the mean correlations between attitude and intention range from .45 to .6; and perceived behavioural control accounts for .35 to .46 variance in explaining intention. However, many of the studies examined as part of the meta–analyses have not tested the reliability and validity of the constructs. Thereby, the findings raise concerns over the measurement scales used to measure the theoretical constructs and limit their wider acceptability (Fishbein and Ajzen, 2010). In this study, the reliability and validity of the constructs have been examined in Chapter 8.

Previous research suggest that attitudes towards a behaviour, subjective norms with respect to the behaviour, and perceived control over the behaviour can predict a significant amount of variance in intentions to car use and car use behaviour (Gardner, 2008). For example, a study by Bamberg and Schmidt (1999) found that attitudes, subjective norms, and perceived behavioural control accounted for 68% variance in car use. Latimer and Martin (2005) show that attitudes, injunctive norms, and perceptions of behavioural control simultaneously accounted for 61% variance in explaining intentions to engage in leisure–physical activity.

The association between intention to perform a behaviour and behaviour also varies across studies. Intention accounts for a considerable proportion of variance in predicting self–reported behaviour (Armitage and Conner, 2001) and is generally more consistent with past behaviour than future behaviour. Intention to engage in a behaviour reflects the past experience about the behaviour. Therefore, intention is considered as a better measure of past behaviour than future behaviour. However, intention to change travel mode choice behaviour is more likely to predict future behaviour (Albarracin and Wyer, 2000). However, failing to meet the criteria may result in literal inconsistency between intentions and behaviour is briefly explained below.

First, the assumption that *individuals who have intentions to change travel behaviour are more likely to change travel behaviour* may not be applicable for those who lack the necessary skills and resources; and/or experience constraints to perform the behaviour. In other words, despite having intention to change travel behaviour individual may not change their behaviour due to lack of volitional control. Volitional control refers to the cognitive ability of an individual that enables him/her to use their own free will to decide on and commit to a particular course of action. An individual with volitional control has the cognitive ability to act consciously with an understanding of the consequences. Conversely, under the influence of habits, the cognitive ability of an individual to act may become automatic resulting in a lack of volitional control. For example, an individual may have intentions to walk but may not have the cognitive ability to walk for commuting purposes.

Second, intention to change a behaviour may only be applicable for a specific context and behaviour. For example, due to restrictions on car parking permits individuals living within a close proximity to their workplace may start walking, but the same individuals may use cars for other short trips, such as using a car to access the local shops. Third, intentions expressed in a hypothetical situation whilst completing a questionnaire may differ from acting upon intentions to perform a new behaviour in real–life circumstances. Moreover, Verplanken et al. (1994) introduced the construct *habit* into the Theory of Planned Behaviour to predict intention to perform a behaviour. Habit refers to learned acts that become automatic responses to varied situations (William, 1980).

Previous research found that the habit has a moderating effect on the association between intention and behaviour (Gardner, 2009; Verplanken et al., 1994). The association between intention and behaviour weakens with strong habits (Ouellette and Wood, 1998).

The use of the Theory of Planned Behaviour in examining intention to use a travel mode or travel mode choice behaviour is widely acknowledged (Bamberg and Schmidt, 2003). However, only a few studies examined intention to change travel mode choice behaviour, especially from car to walking or walking as a link with car use. Heinen et al. (2011) proposed a conceptual framework according to the Theory of Planned Behaviour to measure the effects of attitudes, subjective norm, perceived behavioural control, and habit on cycling to work. Three constructs in relation to attitudes were proposed, which were attitudes towards direct benefits of cycling, long–term awareness and safety. The association between distance and cycling to work was also measured. A questionnaire was distributed among 25,500 people aged between 18 to 65 either working or residing in four cities of the Netherlands (Delft, Zwolle, Midden–Delfland, and Pijnacker–Nootdorp) through e–mails, intranet and mail. Around 4,310 responses were received. The findings based on factor analysis show that attitudes towards the direct benefits associated with time, comfort and flexibility had a high impact; and the long–term effects of cycling' and safety had a moderate impact on determining cycling to work. Moreover, the respondents with a longer commuting distance exhibited a more positive attitude towards cycling than those with a relatively shorter commuting distance.

Cycling is a relatively safe travel mode in the Netherlands in comparison with other countries (CEoGB, 2014; NL Cycling, 2014; Sustrans, 2013). Attitude towards safety issues is closely associated with the conditions of cycling infrastructure. Therefore, in countries with a lack of safe cycling infrastructure attitudes towards safety issues are likely to play a key role in determining cycle commutes. Another limitation of the study was subjective norm and perceived behavioural control were measured using one item. Especially, subjective norm is a complex construct, which is comprised of personal and social norms. A set of carefully designed questioned are required to ensure the accurate measure of subjective norm to avoid self–reported bias.

5.3.1. Attitudes

The importance of attitudes in determining human behaviour is widely acknowledged. In psychology, there is no globally acceptable definition of attitudes (Pratkanis et al., 2014). An earlier version of the definition by Allport (1935) received a wider acceptance, which states that:

> *"Attitude is a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individuals response to all objects and situa-*

> *tions with which it is related".*

More recently, Aiken (2002) defined attitude as:

> *"learned cognitive, affective, and behavioural predispositions to respond positively or negatively to certain objects, situations, institutions, concepts or persons".*

Ajzen and Fishbein (2005) defined attitude as:

> *"a disposition to respond favourably or unfavourably to an object, person, institution or an event".*

The key characteristics of attitudes from the above definitions can be summarised as: attitude is a multidimensional construct that involves individuals disposition to favourably or unfavourably evaluate certain objects or situations. Attitude is formed through learning based on the preconceived perceptions and practical experience (Ajzen and Fishbein, 1980). By processing information, individuals participate in a synthesis or learning which subsequently contributes to the formation of attitude. Attitude towards a behaviour reflects the individual's global positive or negative evaluations of performing a particular behaviour.

The antecedents of attitude are behavioural beliefs. Attitudes are formed spontaneously and inevitably as we form beliefs about the likely consequences of a behaviour. Formation of attitude relies on Expectancy–value Models, which assumes that people participate in activities they assign more value to (Fishbein and Ajzen, 1975). Attitudes are considered more stable in comparison with concepts, such as motives. However, it could be changed through learning and experience. Individual response to the same learning process may vary and each may inevitably develop different attitudes to a given stimuli.

Rosengren (1981) introduced a multi–component view of attitude that includes cognitive, affective and behavioural components, which are as follows:

- *the cognitive component* refers to the beliefs, thoughts, and attributes we associate with an object;
- *the affective component* refers to our feelings with respect to the object, such as satisfaction, fear, liking, and anger; and
- *the behavioural or action tendency component* refers to the disposition to take action with respect to the object.

However, beliefs associated with a travel mode choice can be broadly classified into two core beliefs, namely utility–based beliefs and affect–based beliefs, which are the antecedents of cognitive and affective attitudes respectively. Utility–based or cognitive–based beliefs refer to the beliefs concerning maximising personal and goal–directed utility, whereas affect–based beliefs refer to the beliefs concerning maximising positive and minimise negative affects of the journey outcomes (Steg et al., 2001; Wardman et al., 2001).

5.3.2. Perceived behavioural control

Perceived behavioural control (PBC) refers to as *individual's perceived control over performing a behaviour, which facilitates the implementation of behavioural intentions into actions.* The concept of perceived behavioural control is similar to the construct, self–efficacy expectation, which is introduced by psychologist Bandura (1997). Self–efficacy is defined as *individual's belief in their ability to succeed in certain situations by reflecting on the internal and external constraints that may affect the performance of the behaviour.* However, these two constructs are often operationalised differently in empirical research. People are more likely to engage in behaviours over which they believe to have a greater control over (Bandura, 1997).

5.3.3. Subjective norm

According to Ajzen (1991) subjective norm is: *"the perceived social pressure to perform or not to perform the behaviour"* in question. Subjective norm is considered to be a function of salient normative beliefs. Therefore, more specifically subjective norm is referred to as *an individual's belief about whether people, who are important to them think he or she should engage in a behaviour in a specific situation* (Finlay et al., 1999). Generally, individuals are likely to engage in behaviours that are perceived to have an approval by the significant others and vice versa.

Subjective norm is operationalised by exploring the influence of social norms (i.e. Social norms refer to the customary codes of behaviour in a group or people or larger cultural context) on personal norms (i.e. according to Schwartz and Fleishman (1978) personal norms refer to self-expectations for behaviour backed by the anticipation of self-enhancement or self-depreciation). The key difference between the two types of norms is, personal norms refer to internalised self-expectations, whereas social norms refer to external perceptions about the appropriateness of engaging in a behaviour. According to the Norm Activation Model, social norms could only be activated via personal norms (Schwartz, 1977). Individuals internalise the normative expectations of the social environment before they act on them. A study by Klöckner and Friedrichsmeier (2011) found that social norm failed to predict intentions to use travel modes directly. Therefore, the term subjective norm can be operationalised by exploring the influence of social norms on personal norms.

According to Klöckner and Blöbaum (2010), the effects of personal norms in maintaining the stability of a behaviour is higher than the other factors. Personal norms are significant predictors of pro–environmental behaviour, such as walking. Alongside personal norms, the importance of detangling the impacts of social norms in understanding environmentally behaviour such as walking is well documented in recent research. According to Schwartz (1977), social norms are reinforced and established by the social group. Two types of social norms are especially prevalent in the context of travel behaviour, namely descriptive social norms and prescriptive social norms (Cialdini et al., 1991). For example, descriptive social norms involve the perceptions of what type of travel modes are used by others for their trips and prescriptive social norms refer to the perceptions of what type of travel modes are expected to be used by individuals.

The NHS staff predominantly use cars to commute to work. Therefore, it could be assumed that the impact of descriptive norms in changing travel behaviour is rather low. However, in response to the higher policy emphasis on reducing the use of cars among the NHS hospital staff, nearly two third of the NHS Acute Trusts implemented travel plans (IC, 2011). Hence, it could be suggested that in this research context, the impacts of prescriptive social norms are likely to be relatively higher than descriptive social norms. As discussed earlier, the organisational commitments to reduce the use of cars is positively correlated with the effectiveness of a travel plan. Therefore, it could be suggested that the impacts of prescriptive social norms in changing travel behaviour is closely associated with the effectiveness of travel plans. The effectiveness of hospital travel plans has not been examined in this study. However, it is assumed that intention to change travel behaviour will be higher among the hospital staff with an effective travel plan.

A growing number of studies suggest that individuals with a relatively high personal norm and/or subjective norm are more likely to have intention change travel mode choice behaviour (Abrahamse et al., 2009; Chen and Lai, 2011; Eriksson and Forward, 2011; Klöckner, 2013; Nordfjærna et al., 2014). However, collecting data to capture the subjective norm of employees is also affected by several research and practical issues, which are outlined below.

- a set of carefully designed questions built around social and personal norms were required to capture the overall subjective norms towards car use and walking. As discussed above, social norms are classified as descriptive social norms and prescriptive social norms (Cialdini et al., 1991). Previous studies (e.g. Bamberg and Schmidt (2003); Heinen et al. (2011)) attempted to measure subjective norm based on less than three items, which approach certainly does not comply with the criteria used for measuring the reliability and validity of a construct in structural equation modelling. For example, Bamberg and Schmidt (2003) used two items for measuring subjective norm: *When I use the car for university routes next time, most people* *who are important to me would support this, Most people who are important to me think that I should use the car for university next time.* The items used by Bamberg and Schmidt (2003) cover social norm alone rather than personal norm towards car use and walking. Thereby, the construct measured based on this two items does not reflect the overall subjective norm of an individual;

- moreover, evidence suggests that a bias is usually prevalent with questions regarding people's social norms towards environmentally friendly behaviour since their responses are often induced by socially desirable answers (Collins and Chambers, 2005); and
- besides, Ajzen (1991) argued that subjective norm is generally a weak predictor of intention to perform behaviour. Findings from previous studies suggest that the impacts of personal norms to reduce car use on predicting behaviour is low in the presence of strong habits (Klöckner et al., 2003; Klöckner and Matthies, 2004).

Based on the evidence found from previous studies, it could be suggested that *the influence of subjective norm is more likely to be higher among those with an intention to change travel mode choice behaviour* (Abrahamse et al., 2009; Chen and Lai, 2011; Eriksson and Forward, 2011; Klöckner, 2013; Nordfjærna et al., 2014). Considering the above issues, collecting a volume of data related to subjective norm was beyond the scope of the study. Therefore, subjective norm was not included in the theoretical model. It was a conscious research design choice to reduce the burden on the respondents.

5.3.4. Habits

Habit is referred to as the automatic association between a goal (i.e. intention to act) and behaviour or behavioural script stored in memory. The original Theory of Planned Behaviour does not include the impact of habits on intention to perform a behaviour (Ajzen, 1985). Verplanken et al. (1994) introduced the construct *habit* into the TPB to predict intention to perform a behaviour alongside the reason–based constructs. Several other empirical studies (e.g. Domarchi et al. (2008); Friman et al. (2013); Gardner (2009); Ouellette and Wood (1998); Verplanken and Aarts (1999)) also found that habits had a significant impact on determining intention to perform behaviour or perform a behaviour. The Theory of Interpersonal Behaviour assumes that *habit* moderates the association between intention and behaviour.

According to Verplanken and Aarts (1999), the key characteristics of habit include automaticity (e.g. efficiency and lack of awareness), functionality, and situational constancy. Habits are related to the more stable proximal determinants of past behaviour. The association between the past and future behaviour depends on whether the context is favourable for sustaining the past behaviour. In an unfamiliar situation, people engage in deliberation over the advantages and disadvantages of the available travel options and make a conscious decision (i.e. from an intention) about which travel mode(s) to use. However, if the same travel option is repeatedly used in a stable context, initiation of the behaviour is said to come under the direct control of external and internal stimulus. Stimulus is a detectable change in the internal or external environment. Behaviour becomes a routine and habitual behaviour is formed. Habitual behaviour requires a small amount of attention and perceives to block the deliberate process of decision making prior to a behaviour (Eriksson et al., 2008; Klöckner and Friedrichsmeier, 2011). As a result, individual control over behavioural intention as well as the behaviour itself becomes minor. Intentions become increasingly irrelevant as behaviour habituates (Gardner and Abraham, 2008). The strength of habit may vary from weak to strong habit with respect to the psychological characteristics and situational circumstances of individuals. A strong habit is perceived to block the deliberate decision–making process prior to a behaviour. As a result, an individual acts in accordance to their habit instead of their motivation.

Generally, the propensity of forming habitual behaviour is higher among commuters, who solely rely on cars within a stable context (Abou-Zeid et al., 2012; Friedrichsmeier et al., 2013; Gardner, 2009). Travel plan measures aim to activate the deliberate decision–making process by interrupting habitual behaviour. A choice that is non–deliberate may, in fact, be difficult to influence with rational arguments (e.g. increased costs). Due to the force of habit, decisions may be repeated even though important conditions have changed and made a non–chosen alternative more preferable. For example, a study by Schuitema et al. (2007) found that despite an increase in driving cost the car users had no intention to change travel mode choice.

The concept of habit is widely discussed in the literature following two different approaches, which are the connectionist or associationist approach, and schema or script–based approach. The associationist approach was proposed by Wood et al. (2002), which assumes that an association between the situational context and the behavioural response is formed if a behaviour is frequently performed in a stable context. According to the associationist approach, a behaviour is connected to the stable aspects of the situational context.

A script based approach was introduced by Verplanken et al. (1994). A schema or script represents the knowledge of the likelihood of behavioural sequences in situations and provides a blueprint for subsequent behaviour (Friedrichsmeier et al., 2013). The script–based approach seeks to connect to a behavioural goal and applies generalised scripts that can be used to a wider range of situations. The key difference between the associationist and script–based approaches is the former approach focuses on the characterisation of the specific behaviour and stable context whereas the latter focuses on generalised behaviour. The two approaches are not mutually exclusive. However, Neal et al. (2006) suggested that the script–based approach can be reframed into the associationist approach if the situational context is conceptualised to include representations of goals, motivations and general behavioural knowledge.

The script–based instruments for measuring habit include, response frequency measure (RFM) (Verplanken et al., 1994) and self–report habit index (SRHI) (Verplanken and Orbell, 2003). However, the response frequency measure requires a controlled research environment, which is almost impossible to achieve in real–life environment (Norman and Conner, 2005). Conner and Sparks (2005) referred habit as a four–dimensional mental construct involving a lack of awareness, difficulty to control, mental efficiency, and repetition. Verplanken and Orbell (2003) developed a 12 item scale called self–report habit index (SRHI) to measure habit based on these four dimensions mentioned above. SRHI does not require a highly controlled environment. However, it requires an extensive amount of information to measure habit.

Friedrichsmeier et al. (2013) compared the moderating effect of two approaches of habits on: (a) the association between intention and behaviour; and (b) the stabilisation of behaviour in the prediction of changing travel behaviour based on a cross–sectional study. The data were collected through an online survey among the students of Ruhr–University, Bochum, Germany; and 1,048 valid responses were received. The study findings suggest that the combination of context stability and the behavioural frequency constitutes the key elements of habits. According to the associationist approach, the habit strength (HS) was measured by multiplying the past behaviour and context stability measures as proposed by Wood et al. (2005). The habit strength measure found to have a moderating effect on both intention and behaviour link and predicting behavioural stabilisation in the analysis of change in travel behaviour. However, habits measured according to the script–based (RFM) approach failed to show a significant moderating effect on both accounts. The authors acknowledged the limitation of the RFM measure to capture issues linked with a specific situational context. The findings suggest that the presence of habits is linked with the specific situational context rather than the individuals themselves. For example, the presence of habitual behaviour could be limited to commuting trips only.

Interventions designed to reduce car use reported to have failed to meet the targeted outcome due to the influence of strong car use habits. Hence, measuring the impacts of habits in existing travel behaviour is essential to design effective travel plan measures. Ouellette and Wood (1998) suggested two conditions that need to be met to break a habitual behaviour: (a) change to the situational context; and (b) the behaviour becoming more conscious and deliberate. Recent research suggests that key life events (e.g. residential relocation, new job) can have a significant impact on changing travel behaviour. For example, Bamberg et al. (2003) examined travel mode choice after a house move, and a substantial change was observed.

Habit has not been directly measured in this study, the reasons for which are discussed below. Correctly measuring habit requires extensive information about the past behaviour. Attempt to collect such information is possible if the data collection effort is supported by the senior management. However, securing approval from the senior management to support a data collection effort is a difficult and lengthy process. The possible reasons include, not wanting to disclose the information for research purposes and fearing that asking the staff to participate in lengthy surveys may upset them. The alternate solution was to carry out a follow–up survey among the staff, who took part in the survey, which was not possible due to time constraints. Moreover, the staff are either less likely to participate in the survey or provide socially desirable answers if they are assume that the data are to be used to inform the existing transport policies (Steg et al., 2001).

Moreover, Friedrichsmeier et al. (2013) argued that *"measuring habits is inherently difficult"*, the reason being because associationist and script–based approaches assume habits as unconscious processes that is often difficult to capture based on self–reported data. Past behaviour is an antecedent of habit; therefore, the frequency of performing past behaviour is viewed as a valid measure of habit that is predictive of future behaviour by both approaches (Ouellette and Wood, 1998). Chen and Chao (2011) measured habit using the frequency of using car use within a week and found that habit had a significant negative impact on intention to change travel mode choice. Considering the issues discussed above it was assumed that the hospital staff, who commute by car alone are more likely to adopt habitual behaviour.

In the presence of habit, the car users are more likely to exhibit the following characteristics: (a) the use of a single mode in a stable context (Chen and Chao, 2011; Gardner, 2009; Friedrichsmeier et al., 2013; Ouellette and Wood, 1998); (b) a weaker intention to change travel mode choice behaviour (Ajzen, 1991; Friedrichsmeier et al., 2013; Klöckner, 2013); (c) a positive attitude towards car use and situational factors related to car use (Gardner, 2008; Klöckner and Friedrichsmeier, 2011); (d) a negative attitude towards walking and the situational factors related to walking (Handy et al., 2006; Panter and Jones, 2010; Panter et al., 2014); (e) a lack of normative or moral considerations (Matthies et al., 2006; Ouellette and Wood, 1998); (f) a lack of perceived behavioural control towards walking to work (Klöckner and Friedrichsmeier, 2011); and (g) a negative impact of existing behaviour on intention to change travel mode behaviour (Gardner, 2009). The assumption will be considered true only if supported by the evidence collected as part of the study. The logic behind the assumption is that if the staff were exhibiting deliberate behaviour they were more likely to use a combination of modes to commute to work.

5.4. Theoretical framework

A theoretical framework is a structure that describes a theory being used as part of a research study. It demonstrates an understanding of theories and concepts that are relevant to the research topic being studied and establishes a link with the relevant broader fields of knowledge being studied. Based on a review of literature and analytic models pertinent to the research problem being investigated, the following research gaps were identified.

First, there is a lack of empirical studies with a lack of focus on changing intention to change travel behaviour. Sanko et al. (2013) evaluated the model fit of two sub–types of objective and latent models, which are compensatory and non–compensatory models to measure intention to change travel behaviour from car to public transport based on stated preference data. The study was based on a sample size of around 6,000 commuters, who took part in the *Transport Questionnaire Survey in Commuting to Work* and small–scale household travel survey in 1997 in Japan. The data included topics related to travel cost, travel, parking, petrol price, and the subjective evaluation of the level–of–service (e.g. satisfaction with travel and travel cost) for both car and public transport. Latent, non–compensatory, fitted, 20% model was found to be the best performing model. Sanko et al. (2013) highlighted the need for further research to operationalise intention to change travel behaviour.

Second, there is a lack of theoretical studies with a focus on changing travel mode choice behaviour from car to walking and also little evidence was found on how the situational factors shape up the perceptions of varying utility among the individuals (Collins and Chambers, 2005). Historically transport policy about changing travel behaviour tended to focus on the modal shift from car to public transport. As a result, the viability of promoting walking as alternative to car use for commuting purposes has also been little explored. Previous research aimed at investigating the intention to use a travel mode mostly used constructs related to that specific travel mode. Many argue that the inclusion of alternative travel modes would provide a more comprehensive picture of the psychological antecedents of a specific travel mode (Gardner, 2008). The antecedents of behavioural intention are discussed below. Third, the Theory of Planned Behaviour studies used to support the design of interventions to change behaviour are often strongly grounded on the cognitive beliefs of the individuals Conner et al. (2011). However, Ajzen and Fishbein (2005) suggested that models underpinned by the Theory of Planned Behaviour should incorporate both affective and cognitive (i.e. instrumental) attitudes.

A study by Fabrigar and Petty (1999) found that promotional materials are more effective in promoting a behaviour if they were designed to address both cognitive and affective attitudes. More specifically, previous studies demonstrated that the variation in the effectiveness of the promotional materials to change behaviour is a function of individual differences in NFC (i.e. NFC refers to the propensity of an individual to participate and enjoy an effortful cognitive activity) and NFA (i.e. NFA refers to the individual beliefs that judgements and behaviours are led by the emotions and the need to pursue them).

A study by Haddock et al. (2008) found that individuals with a high level of NFA were likely to be more receptive to messages containing affective information. The use of images to promote healthy behaviour is also becoming popular. Mixed findings have been reported in the literature on the impact of affective attitudes. Some studies reported having failed to take into account the impact of affective attitudes in the decision–making process. However, a larger effect of affective attitudes on intentions and various behaviours in comparison with cognitive attitudes has also been reported by previous research (Conner et al., 2011).

Conner et al. (2011) investigated the impacts of cognitive and affective messages on changing exercise behaviour based on two longitudinal independent studies. For each study, two surveys at three weeks interval were conducted among the students of the University of Leeds, UK. The data analysis was performed based on a sample size of 383 for study 1 and 197 for study 2. For both studies, all participants were subject to one of the three conditions: received either affective or cognitive messages to promote exercise; or no message or control group. Findings from both studies suggest that an affective message was more effective in increasing self–reported exercise behaviour than cognitive message or no message control. The study suggests that simple persuasive messages can have an impact on changing affective attitudes, which in turn can change behaviour.

Travel plan measures are designed to maximise the utility of alternative modes of transport by reducing the constraints encountered while using the travel modes and introducing incentives to increase the value of the travel modes. Based on the above discussion, a theoretical framework underpinned by the Theory of Planned Behaviour has been proposed to demonstrate the key determinants for intention to change travel mode choice behaviour.

According to the Theory of Planned Behaviour, an individual with a positive attitude towards walking and perceived ability to walk for commuting trips are more likely to have intentions to walk (Donald et al., 2014). Intention to change travel mode choice behaviour is, therefore, the outcome of several intervening processes to the individual's beliefs that can be represented by a series of hypotheses. As this study focuses on identifying the impacts of attitude, PBC and objective mobility on intention to change travel mode choice from car to walking and walking as a link with car use. Therefore, the impacts of attitude towards both car use and walking on intention to change were included in the theoretical model.

Figure 5.3 shows the schematic representation of the relationships between the latent constructs and intention to change travel mode choice. Behavioural, normative and control beliefs are considered as distinct categories of beliefs associated with the corresponding constructs. Fishbein and Ajzen (2010) suggested that the indicators of the constructs may overlap between each other. For example, some individuals may hold behavioural beliefs that walking to work is time–consuming. At the same time, they may have control belief that they are unable to walk to work due to time constraints. Moreover, two well–known experts in the Theory of Planned Behaviour - Armitage and Conner (2001) stated that:

> *"In the prediction of social behaviours, there are no absolutes."*

According to McDonald (1996), a variable is observable if and only if its value can be obtained using a real–world sampling experiment (p. 239). Observable variables are also commonly called as items or manifest variables or observed measures. There are two types of indicators, namely reflective indicators and formative indicators (Bollen and Lennox, 1991). Reflective indicators are caused by latent constructs, whereas, formative indicators cause or change latent constructs. The psychological constructs in the theoretical framework were assessed by reflective indicators. In contrast, a variable that does not correspond to anything observable is considered as unobservable (Dijkstra, 1983).

According to Bagozzi and Phillips (1982), a theory may contain the following types of concepts:

- *theoretical concept*s, which are abstract and have unobservable properties or attributes of a social unit of entity (p. 465);
- *empirical concepts*, which may have properties or relations under suitable circumstances. The presence or absence of the properties in a given case can be inter–subjectively ascertained by using direct observations; and
- *derived concepts*, which are unobservable but unlike theoretical concepts must be tied directly to empirical concepts.

Moreover, there are three types of relationship that are commonly used to link these concepts: *(a) non–observational hypotheses, (b) theoretical definitions,* and *(c) correspondence rules* (Bagozzi, 1984). The association between two theoretical concepts is represented by a non–observational hypothesis. The link between theoretical and derived concepts are represented by a theoretical definition. Empirical concepts are linked with theoretical or derived concepts through correspondence rules, which provide empirical significance to theoretical terms. The theoretical and derived concepts are converted into unobserved variables and empirical concepts converted into indicators. Figure 5.3 illustrates the interrelationships between the variables within the theoretical framework.

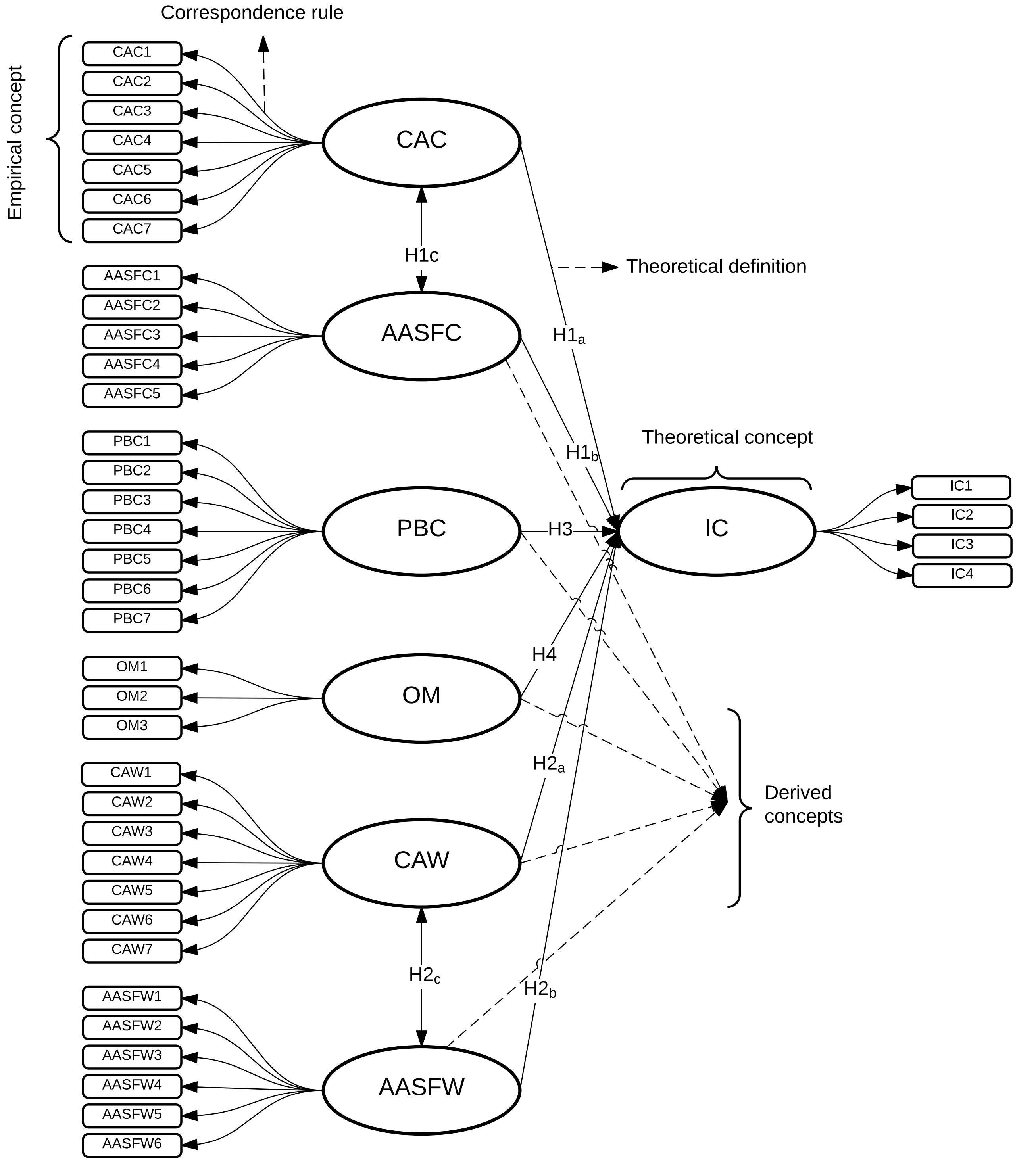

Figure 5.3: Theoretical framework based on the Theory of Planned Behaviour, where CAC: Cognitive attitude towards car use, CAC1: Time, CAC2: Security, CAC3: Reliability, CAC4: Flexibility, CAC5: Convenience, CAC6: Comfort, CAC7: Cost; CAW: Cognitive attitude towards walking, CAW1: Time, CAW2: Security, CAW3: Convenience, CAW4: Flexibility, CAW5: Reliability, CAW6: Comfort, CAW7: Cost; AASFC: Affective attitude towards situational factors related to car use, AASFC1: Time, AASFC2: Parking charge, AASFC3: Availability of parking space, AASFC4: Traffic flow, AASFC5: Road quality; AASFW: Affective attitude towards situational factors related to walking, AASFW1: Security, AASFW2: Pedestrian route, AASFW3: Pedestrian crossing, AASFW4: Pavement quality, AASFW5: Street light, AASFW6: On–site walking environment; PBC: Perceived behavioural control, PBC1: Time constraints, PBC2: Long distance, PBC3: Inconvenience, PBC4: Lack of alternatives, PBC5: Security concerns, PBC6: Work commitments; PBC7: Personal commitments; OM: Objective mobility, OM1: Commuting time, OM2: Commuting distance, OM3: Annual average car mileage; IC: intention to change travel mode choice, IC1: Intention to walk, IC2: Intention to reduce CO_2 emissions, IC3: Intention to improve health, IC4: Intention to reduce car use.

5.4.1. Cognitive and affective attitudes

The strength of the attitude determines its ability to predict behaviour. The likelihood of predicting behaviour increases with the strength of the attitude. Fishbein and Ajzen (1975) proposed the Expectancy–value Theory to postulate the relationships between behavioural, control, and normative beliefs and the corresponding constructs within the Theory of Planned Behaviour. Each belief associated with a construct is valued either positively or negatively and links the behaviour to a certain outcome. For example, an individual with a negative attitude towards walking may not have intentions to change travel mode choice behaviour.

Cognitive attitude towards a travel mode represents an individual's beliefs or knowledge towards the overall utility of a travel mode. Cognitive attitude towards a travel mode is measured by comparing the difference between the relative importance attached and real–life/perceived performance of the salient attributes of a travel mode. The utility of a travel mode is negatively associated with travel time and travel cost, and positively associated with comfort, convenience, relaxing, flexibility, and security. Therefore, with an increase in travel time or travel cost the perceived utility of a travel mode decreases and vice versa. Walking is a cost–effective travel option in comparison with car. Therefore, the overall perceived utility difference between the remaining modal attributes between car and walking is likely to have an impact on determining travel mode choice (Chen, 2008).

Abrahamse et al. (2009) found a negative relationship (γ = -.3) between attitude towards car use and intention to reduce car use based on a sample size of 241 Canadian commuters. Chen and Lai (2011) studied the impacts of TPB constructs on intention to use public transit among 220 commuters from Kaohsiung City, Taiwan. The data were collected through a self–administered survey among commuters from Kaohsiung City, Taiwan in 2009 using convenience sampling. The study findings based on structural equation modelling show that attitude towards public transit (γ = .32) was positively related to commuters' intention to use public transit. However, discrepancies between stated attitude towards the behaviour and willingness to perform the behaviour have also been reported in previous studies (Kollmuss and Agyeman, 2002).

A study by Eriksson and Forward (2011) based on a sample population of 620, who were residents of the Falun Municipality of Sweden also found that attitudes towards using public transport and cycling were positively correlated with the intention to use the corresponding travel mode. Klöckner (2013) proposed a model depicting the relationships between the socio–psychological determinants of environmentally friendly behaviour based on three theories: (a) Theory of Planned Behaviour, (b) Norm–Activation–Theory, and (c) Value–Belief–Norm Theory. Meta–analytical structural equation modelling was applied on 56 behavioural datasets to test the model. According to the study findings, attitude was a significant predictor of intention to engage in a behaviour. A recent study by Nordfjærna et al. (2014) administered a survey among the randomly selected population residing in six largest areas in Norway and performed structural equation modelling on 1,039 usable responses (18% response rate). According to the study findings, attitude towards public transport was a weak determinant (γ = .00) of intention to use public transport. Therefore, it could be suggested that positive attitude towards a travel mode may not always lead to positive intention to use the travel mode.

Affective response to a travel mode refers to the discrepancy between the prior expectation and perceived performance of the travel mode after consumption (Oliver, 1980). A few of studies attempted to measure the impacts of affective response to a travel mode on intention to change travel mode choice, especially from car to walking. In literature, affective response such as satisfaction, and service quality are often used interchangeably (Lai and Chen, 2011). However, several studies examined the impact of service quality of public transport on preference for using public transport among the car or motorcycle users. Perceived service quality refers to the difference between individuals' expectations and the actual performance of a travel mode. Lai and Chen (2011) examined the impact of satisfaction with the overall service quality on intention to use public transit based on a sample of 763.

Collins and Chambers (2005) conducted a study among 205 students from two Australian universities: University of Melbourne, and Deakin University, found that the relative cost, relative time and access were significant predictors of preference for public transport. Analysis of the qualitative responses of the survey also suggests that increased services, improved facilities, and better connection between services were more likely to encourage car commuters to consider using public transport. Around 70% of the car commuters indicated that they would consider using public transport for commuting trips if public transport were faster than car travel. Besides, 50% of the public transport users indicated that they would consider driving if the cost of driving were equivalent to public transport.

A similar claim was made by Van Vugt et al. (1996) that the average travel time by public transport was shorter than car (i.e. the presumed noncooperative option) and journeys by public transport was as reliable as car journeys (i.e. an equal or lower variability in travel compared to car) resulted in an increase in the preference for using public transport. A later study by Chen and Lai (2011) among the motorcycle users from two cities of Taiwan show that the intention to use public transport was higher in the presence of good public transport services *(n = 231)*.

Similarly, in case of car journeys, traffic congestion, poor quality road networks, and lack of available car parking spaces are more likely to increase the level of stress and anxiety and decrease the autonomy associated with driving (Fosgerau et al., 2008). Traffic flow is closely associated with the duration of congestion. The two immediate consequences of congestion are: (a) increase in average travel time; and (b) travel time becomes increasingly variable and unpredictable. Travel time is often minimum during free traffic flow with no congestion. Conversely, travel time is likely to be higher during morning and afternoon peak hours on congested roads with a high density of traffic. The affective experience of *congestion* includes coping with delays and the effects of longer journeys. The time spent in a car looking for a parking space could be frustrating, therefore, may have a higher implicit cost than ordinary driving (Fosgerau et al., 2008). Moreover, people may value walking time differently than in–vehicle time. A poorly designed network can add additional generalised cost and time to the commuter. Therefore, satisfaction with the situational factors related to car use are more likely to have an impact on intention to change travel mode choice behaviour. The above discussion also suggests that individual's attitudes towards the utility of car use are closely associated with the situational factors related to car journeys (Anable and Gatersleben, 2005; Gardner, 2009; Steg, 2005).

Rodrguez et al. (2008) measured the impact of car parking availability, road traffic, walkways, trails (pedestrian routes), and sidewalks (pavements) on self–reported walking behaviour. The study found that perceived difficulty with parking was positively associated with higher levels of walking for transport. Based on a sample of 413 Troped et al. (2003) found that the presence of sidewalk (+) and heavy traffic (-) were associated with walking for transport. Previous research suggests that satisfaction with car journeys are negatively associated with susceptibility to change travel mode (Jakobsson, 2007). Satisfaction with situational factors play a role in determining the overall satisfaction with car journeys, which in turn is likely have a key role in intention to change.

Individuals with positive perceptions towards walking environments are more likely to walk (Doescher et al., 2014; Handy et al., 2006; Panter and Jones, 2010; Panter et al., 2014). Panter et al. (2013) conducted a study among 419 commuters over the age of 16 residing within 30km distance of the city of Cambridge. The study found that around one–third of the commuters (31%) incorporated walking or cycling with car journeys. The study suggests that those without having access to a parking permit reported to have a supportive environment for walking or cycling were more likely to walk or cycle. Doescher et al. (2014) examined the role of built environment on walking behaviour among 2,152 individuals residing in nine small towns, USA. Mixed–effects logistic regression modelling was performed on the dataset collected through telephone survey. The study found that self–reported presence of crosswalks and pedestrian signals had a significant impact on walking for utilitarian purposes.

These findings led to the presumption that cognitive attitudes towards car use and walking; and affective attitudes towards situational factors related to car use and walking are likely to have a significant impact on intention to change travel mode choice behaviour. In the study context, the following hypotheses were proposed to demonstrate the relationships between cognitive attitudes towards car use and walking; affective attitudes towards situational factors related to car use and walking; and intention to change travel mode choice behaviour.

Hypothesis 1_a: Cognitive attitude towards car use has a significant impact on intention to change travel mode choice behaviour.
Hypothesis 1_b: Affective attitude towards the situational factors related to car use has a significant impact on intention to change travel mode choice behaviour.
Hypothesis 1_c: Cognitive attitude towards car use is associated with affective attitude towards the situational factors related to car use.
Hypothesis 2_a: Cognitive attitude towards walking has a significant impact on intention to change travel mode choice behaviour.
Hypothesis 2_b: Affective attitude towards the situational factors related to walking has a significant impact on intention to change travel mode choice behaviour.
Hypothesis 2_c: Cognitive attitude towards walking is associated with affective attitude towards the situational factors related to walking.

5.4.2. Perceived behavioural control

The association between perceived behavioural control and intention vary with respect to the behaviour and context (Ajzen, 1991). In the presence of strong attitudes and normative influences, the ability of perceived behavioural control to predict intentions could be weakened. Besides, positive attitude towards a behaviour does not always correspond to the behavioural actions. Salient beliefs regarding the presence of factors that may constrain walking may lower individual's perceived behavioural control towards walking. Therefore, despite holding a positive attitude towards walking individuals with a lack of perceived behavioural control towards walking may not have an intention to change travel mode choice behaviour. For example, no significant impact of perceived behavioural control on determining intention to change travel mode was found by Chen and Lai (2011) and Nordfjærna et al. (2014).

Volitional control facilitates the implementation of intention to perform a behaviour. If there is a lack of volitional control, the association between intention and behaviour becomes weaker. As a result, in the presence of low volitional control, behavioural intentions may account for a small amount of variance in behaviour (Ajzen, 1991). Under such circumstances perceived behavioural control may independently predict the behaviour. Individuals with high perceived behavioural control are likely to have increased feelings of control and willing to apply additional effort to perform a behaviour successfully.

In contrast, in conditions under complete volitional control (conscious choice), the association between intention and behaviour is likely to be optimal with no influence from perceived behavioural control. Therefore, if the individuals with high volitional control apply additional effort to engage in a behaviour that may not affect the actual performance of their behaviour. For example, Downs and Hausenblas (2005) performed a meta–analysis on physical activity behaviour studies based on the Theory of Planned Behaviour or Theory of Reasoned Action. The study found that perceived behavioural control was statistically significantly correlated with the intention to engage in physical activity behaviour and predicted physical activity behaviour. The predictive validity of the model, as measured by the average multiple correlation was .55.

Besides, Latimer and Martin (2005) conducted a study among individuals with spinal cord injury to examine their intentions to do at least 30 minutes of leisure physical activity every day. Multiple regression analysis on the data showed that the ability of perceived behavioural control (β = .46) in predicting intentions to engage in physical activity was higher than attitudes (β = .29) and injunctive norms (β = .27). Abrahamse et al. (2009) found a positive relationship (β = .32) between perceived possibilities and difficulties for reducing car use and intention to reduce car use. Moreover, a study by Eriksson and Forward (2011) show that perceived behavioural control towards using cycling was a significant predictor of intention to use cycling. This finding further suggests that the impact of perceived behavioural control varies with respect to the behaviour and context. The following hypothesis was also proposed to demonstrate an association between perceived behavioural control and intention to change travel mode choice.

Hypothesis 3: Perceived behavioural control has a significant impact on intention to change travel mode choice behaviour.

5.4.3. Objective mobility

Ajzen (1991) acknowledged the limitations of the theory and encouraged further research on how theoretical constructs that are not captured by the TPB cognitions can be incorporated to improve the explanatory power of the model. Previous studies suggest that incorporating the measures of habit or past behaviour into models underpinned by the Theory of Planned Behaviour improves the predictive utility of the model (Gardner and Abraham, 2008; Friedrichsmeier et al., 2013).

As discussed in Section 5.3.4, because of practical reasons measuring habit prospectively was beyond the scope of the study. Verplanken et al. (2008) suggested that the frequency of a past behaviour in a stable context reflects habit strength. Past behaviour is widely used as proxy measure for habit (Ouellette and Wood, 1998; Triandis, 1977; Wood et al., 2002). A growing number of studies examined the direct impact of objective mobility/past behaviour on intention to change travel mode choice behaviour, such as Chen and Lai (2011); Lo et al. (2014); Moons and De Pelsmacker (2015).

The logic of using past behaviour in predicting intention has been subject to debate. However, previous research suggests the a higher impact of past behaviour on predicting future behaviour in comparison with the reasoned constructs suggests the presence of habit (Gardner and Abraham, 2008; Ouellette and Wood, 1998). In the context of this study, a higher negative impact of past behaviour or objective mobility on intention to change mode choice behaviour would indicate the presence of habits. Previous research found that individuals with lower travel time, travel distance and annual average car mileage are more likely to change travel mode choice behaviour (Dickinson et al., 2003; Gardner, 2008; Mackett, 2003; Steg and Vlek, 1996). Based on the above the following hypothesis is proposed.

Hypothesis 4: Objective mobility has a significant impact on intention to change travel behaviour.

5.4.4. Socio–demographic and situational factors

The effects of socio–demographic and situational factors were not included in the originally proposed Theory of Planned Behaviour (Ajzen, 1991). The past research exhibited no consistent role of the socio–demographic and situational factors in explaining intention to change travel mode choice behaviour. Chen and Lai (2011) examined the impact of socio–economic factors on motorcycle use by comparing the results of four different probit models based on a sample of 231. According to the study, the model with the psychological constructs exhibited no significant effect of the socio–economic factors on motorcycle use. However, the model without the psychological constructs had a low negative effect of income on motorcycle use. The authors suggested that the presence of psychological factors may have suppressed the effects of socio–economic variables.

Hunecke et al. (2010) performed structural equation modelling on a sample 1,991 and found that the predictive power of the psychological constructs, such as attitudes, norms, and values was higher in determining the use of private motor vehicles than the socio–demographic and geographic factors. In contrast, the knowledge of socio–demographic and contextual factors in understanding behavioural responses to travel demand management measures have also been highlighted by previous research (Gärling et al., 2002). Four factors are consistently found to have a significant impact in determining travel mode choice, which are age, gender, number of cars, number of children, and household income.

There is a growing support for the claim that individuals living in mixed–use and high–density areas with good access by alternative modes of transport are more likely to reduce car use and use alternative modes of transport (Cervero, 2002; Dargay and Hanly, 2007; Frank et al., 2007; Zhang et al., 2012). Collins and Chambers (2005) investigated the association between psychological and situational factors in determining the preference for travel mode choice for commuting trips. The study found that the effects of psychological factors on behaviour were moderated by the situational factors, such as access to the site by different travel options.

Collecting situational data about the residential neighbourhood of the respondents was beyond the scope of the study. However, the respondents' workplace location data were collected and classified into five groups, namely near a city/town centre (i.e. if a hospital is located within a one mile proximity to the centre), on the outskirts of a city/town and other (i.e. middle of the city/town). Organisations located near the city centre generally have good access by alternative modes of transport (Curtis and Headicar, 1997).

High traffic congestion during peak hours are more evident in the city or town centres. The propensity of changing travel mode is likely to be higher among car users who experience travel constraints, such as congestion, lack of free parking spaces, and high parking charges. Based on the above evidence, it could be suggested that the hospitals that are located in the city or town centre provide favourable transport conditions to support walking and thereby, their staff are more likely to have an intention to change travel mode choice behaviour. Six socio—demographic and situational factors namely age, gender, number of children, household income, hospital location, and access to a travel plan were included as control variables in the theoretical framework.

5.5. Operationalisation of the model constructs

Operationalisation of intention to change travel mode choice behaviour underpinned by the Theory of Planned Behaviour is a relatively new area of research. There are no globally agreed on sets of indicators to measure the constructs of the Theory of Planned behaviour. The instruments used to measure the constructs of intention to use a travel mode or intention to change travel mode choice behaviour are not conclusive. The need for further research to operationalise intention to change travel behaviour has been reported in previous research (Sanko et al., 2013). In social science, researchers often develop their own instruments to measure the behavioural constructs to reflect the context of the study (e.g. Kuppam and R (2001); Klöckner and Friedrichsmeier (2011); Chen and Lai (2011); Ory and Mokhtarian (2004)). The initial selection of items to measure each of the latent constructs were guided by previous research and Survey 1: Hospital travel plan survey. Previous research suggests that the measurement scales used to assess the latent constructs should be modified to reflect the context being studied (Lai and Chen, 2011). The indicators used to measure the latent constructs were finalised in consultation with the Barking, Havering and Redbridge University Hospitals NHS Trust to reflect the healthcare context. It should be noted that the number of variables that can be used to measure the relative attractiveness of different modes is not limited by the model itself, it was guided by the information that could be conveniently obtained through the survey.

5.5.1. Intention to change travel mode

A study by Sanko et al. (2013) claimed that a few studies attempted to operationalise intention to change travel mode choice behaviour. *Intention to walk* and *intention to reduce car use* are more commonly used to measure intention to change travel mode choice behaviour (Gardner, 2008; Murtagh et al., 2012a). Gardner (2009) used four items to measure intention (n = 107), which were *I intend to use a car for most of my journeys to the university campus over the next week, I will try to use a car for most of my journeys to the university campus over the next week, I plan to use a car for most of my journeys to the university campus over the next week* and *I aim to use a car for most of my journeys to the university campus over the next week.* One of shortcomings of using similar items to measure intention is the respondents may fail to distinguish the differences between indicators unless each of them are clearly demonstrated in the questionnaire. The indicators were also designed to capture the respondents intention to use car for a short-term (i.e. a week).

Murtagh et al. (2012a) used *I intend to drive less in the future* as a key item alongside seven other distracted items, including *intending to get fitter* and *spending more time with family* to measure *baseline intention to change.* Lai and Chen (2011) used two indicators to measure behavioural intention: (a) *I am willing to recommend the KMRT (i.e. Kaohsiung Mass Rapid Transit) to others*; and (b) *I am willing to keep on taking the KMRT in the future.*

According to Sanko et al. (2013):

> "Data for intention to change travel behaviour can be obtained from SP (stated pref-

erence) surveys, which include hypothetical situations that might change travel behaviour."

The idea behind this approach is allowing the respondents to express their intentions without fearing to lose something they value highly (e.g. a car-parking permit). *Environmental concerns/reducing CO2 emissions* and *proexercise/improving health* have been widely reported as the key motivations behind walking or pro–environmental behaviour (Anable and Gatersleben, 2005; Anable, 2005; Collins and Chambers, 2005; Murtagh et al., 2012a). Taking into consideration of the above issues, alongside capturing data on the staff's intention to walk, carefully designed stated preference questions were asked to capture indicators for this construct (Moskowitz, 1986; Murtagh et al., 2012a; Sanko et al., 2013). The indicators were finalised in consultation with the Barking, Havering and Redbridge NHS Trusts to increase the staffs acceptance towards and participation in the survey. The indicators used to assess intention to change travel mode choice behaviour are presented in Table 5.1.

Table 5.1: Indicators used to measure intention to change travel mode choice behaviour.

Indicators	Description
IC1: Intention to walk	Refers to a respondents intention to walk on its own or with car journeys for up to 10 to 15 minutes for commuting trips. Individuals with intention to walk are more likely to intend to change travel mode choice (Gardner, 2008; Murtagh et al., 2012a).
IC2: Intention to reduce CO_2 emissions	Refers to a respondents intention to walk for commuting trips to reduce CO_2 from car use. Individuals with intention to reduce CO_2 emissions are more likely to intend to change travel mode choice (Anable and Gatersleben, 2005; Murtagh et al., 2012a; Prillwitz and Barr, 2011) Prillwitz and Barr, 2011).
IC3: Intention to improve health	Refers to a respondents intention to walk for commuting trips to improve health. Individuals with intention to improve physical fitness are more likely to intend to change travel mode choice (Anable, 2005; Anable and Gatersleben, 2005).
IC4: Intention to reduce car use	Refers to a respondents intention to reduce car use for commuting trips. Individuals with intention to reduce car use are more likely to intend to change travel mode choice (Gardner, 2008; Murtagh et al., 2012a).

5.5.2. Cognitive and affective attitudes

Attitude is a complex unobserved hypothetical construct, which is commonly represented by a single numerical index based on self–reported data (Ajzen and Fishbein, 2005). However, many argue that the use of single numerical index based scale is insufficient to capture the complexity of attitude (Fabrigar et al., 2005). According to the Expectancy–value Theory (Fishbein and Ajzen, 2010), the underlying cognitive structure of behaviour shows that attitude towards the behaviour is determined by two components, a set of salient beliefs and subjective evaluation of those beliefs that individuals hold about performing the behaviour. The beliefs concerning specific consequences of a behaviour that determine the attitude towards the given behaviour are called salient beliefs. The salient beliefs are identified by extracting the most frequently cited beliefs by a random sample from a research population (Fishbein and Ajzen, 2010). An Expectancy-value Index is obtained by summing up the product of the subjective probabilities of the occurrence and positive or negative evaluations of all expected consequences of the behaviour(*belief strength X is evaluation of the outcome score*). In other words, the theory assumes that an attitude towards a behaviour is formed. For example, an individual will expect the walking experience to be positive if he or she assigns a positive value to walking to work. However, walking to work is classified as a positive activity only if the real–life walking experience meets the expectations. Expectancy–value Theory has three basic components:

1. new information about an item or action is likely to develop a belief about the item or action or modify a belief already held by an individual;
2. a belief is formed based on several attributes and each of the attribute is assigned a value; and
3. an expectation is created or modified based on the psychological assessment of beliefs and values.

The theory has been validated by comparing the values obtained from the Expectancy–value Index with direct attitude measures.

5.5.2.1. Cognitive attitude

Cognitive attitude can be operationalised as the perceptions towards the utility of a travel mode. The perceived value or perceived utility of a travel mode refers to the difference between the perceived benefits and perceived costs associated with the travel mode (Lovelock, 2000). Cognitive attitude towards car use and walking were measured based on the concept of Expectancy–value Theory. Perceived utility of a travel mode is generally measured by travel cost, travel time, convenience, comfort, flexibility, reliability, and security (Anable, 2005; Bamberg and Schmidt, 2001;

Ben-Akiva et al., 2002; Levinson, 1998; Mackett, 2003; Raux et al., 2011; Ryley, 2008; Schwanen and Dijst, 2002). For example, Abou-Zeid et al. (2012) used *on–time arrival*, *flexibility*, *quick arrival*, *cost*, and *comfort* to measure the car users' perceptions or attitude towards car use. The indicators used to measure cognitive attitude towards car use and walking presented in Table 5.2.

Table 5.2: Indicators used to measure cognitive attitude towards car use/walking.

Indicators	**Description**
CAC1 & CAW1: Commuting time	Refers to a respondents overall evaluation of time when using a car or walking for commuting trips (Collins and Chambers, 2005; Johansson et al., 2006; Mackett, 2003; Small, 2012).
CAC2 & CAW2: Security	Refers to a respondents overall evaluation of security (i.e. the state of being free from danger, or feeling safe) when using a car or walking for commuting trips (Nkurunziza et al., 2012).
CAC3 & CAW3: Reliability	Refers to a respondents overall evaluation of reliability (i.e. the travel mode will work as intended during the travel) when using a car for commuting trips (Ortuzar and Willumsen, 1994; Small, 2012). According to Institute of Electrical and Electronics Engineers (1990), reliability is defined as the ability of a system or component to function under stated conditions for a specified period.
CAC4 & CAW4: Flexibility	Refers to a respondents overall evaluation of flexibility when using a car for commuting trips (Anable and Gatersleben, 2005; Heinen et al., 2011; Johansson et al., 2006). In the context of engineering design such as automobile or car flexibility is defined as the ability of a system to respond to potential internal or external changes affecting its value delivery, in a timely and cost–effective manner. In the presence of uncertainty, flexibility becomes a valuable travel mode attribute. Therefore, flexibility can also be referred to as the ability of a system to respond to uncertainty in a manner to sustain or increase its value delivery.
CAC5 & CAW5: Convenience	Refers to a respondents overall evaluation of convenience when using a car for commuting trips (Anable and Gatersleben, 2005; Mackett, 2003; Morency et al., 2014; Ortuzar and Willumsen, 1994; Prillwitz and Barr, 2011). Convenience an be defined as the attribute that increases ease in accessibility (e.g. door to door mobility), saves resources (e.g. time, cost, and energy), and decreases frustration. Convenience is closely associated with perceived physical and cognitive demands. Car journeys are often rated highly on convenience by drivers (Huey and Everett, 1996).
CAC6 & CAW6: Comfort	Refers to a respondents overall evaluation of comfort (i.e. is a sense of physical or psychological ease, often characterised as a lack of hardship) when using a car for commuting trips (Heinen et al., 2011; Johansson et al., 2006).
CAC7 & CAW7: Commuting cost	Refers to a respondents overall evaluation of cost when using a car for commuting trips (Anable and Gatersleben, 2005; Collins and Chambers, 2005; Johansson et al., 2006). Travel cost is widely recognised as a key determinant of travel mode choice (Bamberg and Schmidt, 1998). Walking is a relatively cost–effective travel option in comparison with car journeys.

5.5.2.2. Affective attitude towards situational factors

Affective attitudes towards the situational factors were operationalised by the satisfaction with the situational factors that may affect the utility considerations of a travel mode (Saelens and Handy, 2008). Affective attitude towards the situational factors related to car use and walking were also measured based on the concept of Expectancy–value Theory. However, to reduce burden on the respondents, the perceived power of each of the affect–based beliefs were assumed as equal to '1'.

Previous research provides no clear guidance on examining the relative importance of subjectively and objectively measured attributes of the built environment on walking (Lin and Moudon, 2010). The reason being the data collection methods are often inspired by the research design and the data that could be conveniently collected within the project timeframe.

Likewise, the selection of indicators to assess affective attitudes were limited to modifiable situational factors that could be addressed within the scope of a travel plan (Rodrguez et al., 2008). The situational attributes that reported to have a high impact on determining the overall car journey experience include, traffic flow (Fosgerau et al., 2008; Troped et al., 2003), travel time (Collins and Chambers, 2005), car parking charge (Ryley, 2008), availability of parking space (Fosgerau et al., 2008; Rodrguez et al., 2008), and road quality (Frank et al., 2008). The indicators used to assess affective attitude towards situational factors related to car use are presented in Table 5.3.

The attributes used to measure the quality of the walking environment including, street lighting, pedestrian crossing, pedestrian security, quality of the pavements, continuity and quality of the pedestrian routes, and overall quality of the on–site walking environment (Mackett, 2003; Saelens and Handy, 2008). The indicators used to assess affective attitude towards situational factors related to walking are presented in Table 5.4.

Table 5.3: Indicators used to measure affective attitude towards situational factors related to car use.

Indicators	Description
AASFC1: Time	Refers to a respondents satisfaction with time spent on looking for a car parking space when commuting by car (Collins and Chambers, 2005; Johansson et al., 2006; Mackett, 2003; Small, 2012).
AASFC2: Car parking charge	Refers to a respondents satisfaction with car parking charge (i.e. the policy of imposing a charge payable by the employees for using the parking facilities at work) when commuting by car. Individuals, who are not satisfied with the car parking charges are more likely to express intention to change travel mode choice behaviour (Ryley, 2008).
AASFC3: Availability of car parking spaces	Refers to a respondents satisfaction with availability of parking space when commuting by car. Difficulty with finding a parking space is likely to cause delay and stress (Fosgerau et al., 2008; Rodrguez et al., 2008). Individuals, who are not satisfied with finding a car parking space are more likely to have intention to change travel mode.
AASEC4: Traffic flow	Refers to a respondents satisfaction with traffic flow (i.e. the volume and speed of the traffic) when commuting by car (Fosgerau et al., 2008; Troped et al., 2003). Mean traffic volume within 1 km buffer (Lee and Moudon, 2006). Heavy traffic is likely to cause congestion and delays in journey time (Fosgerau et al., 2008). Individuals, who are dissatisfied with the traffic flow are more likely intend to change travel mode choice behaviour.
AASFC5: Road quality	Refers to a respondents satisfaction with road quality (i.e. the quality of the infra–structure and number of intersections) when commuting by car (Frank et al., 2008). The presence of higher number of intersections and traffic signals are more likely to increase journey time. A lower satisfaction with the road quality are more likely to be negatively associated with intention to change travel mode choice.

Table 5.4: Indicators used to measure affective attitude towards situational factors related to walking.

Indicators	Description
AASFW1: Pedestrian security	Refers to a respondents satisfaction with security when commuting by walking. Is closely associated with two types of security concerns: (a) fear of accidents; and (b) fear of crime (Hoehner et al., 2005).
AASFW2: Pedestrian routes	Refers to a respondents satisfaction with pedestrian route (i.e. the continuity and overall quality of the pedestrian routes) when commuting by walking (Panter and Jones, 2010; Panter et al., 2014; Troped et al., 2003).
AASFW3: Pedestrian crossing	Refers to a respondents satisfaction with pedestrian crossing when commuting by walking. The presence of safe pedestrian crossings is closely associated with walking behaviour (Doescher et al., 2014).
AASFW4: Pavement quality	Refers to a respondents satisfaction with pavement quality (i.e. the presence of wide, continuous and good quality pavements) when commuting by walking (Hoehner et al., 2005). Total length of sidewalks within two kilometres walking area surrounding the hospital site (Lee and Moudon, 2006). Perceptions of the presence of sidewalks was positively correlated with walking (Addy et al., 2004).
AASFW5: Street lighting	Refers to a respondents satisfaction with streetlight when commuting by walking. On a 30 mph road street lights are installed 185 metres apart. Satisfaction with the street lighting at night is likely to have an impact on intention to walk for commuting purposes (Mackett, 2003; Saelens and Handy, 2008)
AASFW6: On–site walking environment	Refers to a respondents satisfaction with on-site walking environment (i.e. the overall quality of the walking environment of the hospital site) of the hospital when commuting by walking. (Handy et al., 2006; Mackett, 2003; Panter and Jones, 2010; Saelens and Handy, 2008)

5.5.3. Perceived behavioural control

Perceived behavioural control provides an explanation on how the potential constraints and facilitators associated with an action are perceived by the actor and why intentions do not always predict behaviour. It is assumed that the measure of perceived control reflects the perception of actual constraints as well as motivational effects. Fishbein and Ajzen (2010) suggest that perceived behavioural control can be operationalised effectively by drawing out readily accessible beliefs about factors that may affect the performance of the behaviour under consideration. The assumption concerning the relationship between control beliefs and perceived behaviour control is valid under two conditions. First, if a given control factor is present which is termed as control belief strength and second, if it can facilitate or impede performance of the behaviour that is termed as power of the control factor. In this study, the perceived power of each of the control beliefs were assumed as equal to '1'.

Mackett (2003) conducted a study among 310 UK residents to identify the key perceived barriers behind not walking for short trips under one mile. The respondents suggested that out of the 1,642 short trips made by car 500 trips could be made by walking. The key perceived barriers to walking for 333 short trips were dark out, bad weather, short of time, lift for family, needed at work, convenience, further trip(s) or trip chain(s) and carrying heavy goods. A later study by Pooley et al. (2011a) among 798 UK residents found that the respondents perceived walking with too much physical effort, bad experience of using existing sidewalks and long distance. Subjective perception of the length of commuting distance may deviate from the actual travel distance (Stigell and Schantz, 2011), which has been discussed in Section 4.3.1.2. Therefore, the impact of perceived commuting distance on intention to change travel mode choice is likely to differ from the actual commuting distance. Therefore, commuting distance was included as an indicator to assess perceived behavioural control. The indicators used to measure perceived behavioural control are presented in Table 5.5.

Table 5.5: Indicators used to measure perceived behavioural control towards car use/walking.

Inidcators	Description
PBC1: Increased commuting time	Refers to a respondents belief about time constraints when switching from car to walking. Walking is a relatively slow travel option in comparison with car journeys, therefore, walking to work on its own or with car journeys increases the overall commuting time. Drivers may perceive journeys by alternatives as longer than car journeys (Collins and Chambers, 2005; Mackett, 2003; Wardman et al., 2001; Van Vugt et al., 1996).
PBC2: Long distance	Refers to a respondents belief about long distance when switching from car to walking. Walking on its own is considered as acceptable for commuting trips of up to two miles distance (DfT, 2014). Long commuting distance may be perceived as a barrier to walking (Dickinson et al., 2003; Hamed and Olaywah, 2000; Nelson et al., 2008; Scheiner, 2010).
PBC3: Inconvenience	Refers to a respondents belief about inconvenience (i.e. the state of being difficult concerning one's personal requirements or comfort) when switching from car to walking (Gardner, 2008).
PBC4: Lack of alternatives	Refers to a respondents belief about the lack of alternatives (i.e. walking or walking with car journeys not being a feasible travel option) when switching from car to walking (Watts and Stephenson, 2000).
PBC5: Security concerns	Refers to a respondents belief about security concerns (i.e. the subjective perceptions of threats, challenges, vulnerabilities, and risks that may be encountered) when switching from car to walking. Car users may have biased perceptions towards the security concerns associated with walking (Gardner, 2008).
PBC6: Work commitments	Refers to a respondents belief about work commitments (i.e. the duties that are carried out by the hospital staff as part of their jobs that may directly or indirectly increase the reliance on car use) when switching from car to walking. Refer to as (Mackett, 2003), Survey 1.
PBC7: Personal commitments	Refers to a respondents belief about personal commitments (i.e. the act of voluntarily taking on and fulfilling obligations related to the person or his/her family members that may directly and indirectly increase the reliance on car use) when switching from car to walking (Mackett, 2003), Survey 1.

5.5.4. Objective mobility

The frequency of using a travel mode is widely used to measure objective mobility (Murtagh et al., 2012a; Ory and Mokhtarian, 2004). In this study, the target group for changing travel mode choice behaviour was limited to those who commuted by car alone. Cao et al. (2006) several indicators including frequency of commuting, commuting time, commuting distance, and log total miles by personal vehicle to measure objective mobility. Ory and Mokhtarian (2009) used *the frequency of short trips* (i.e. 100 miles or less one way) and *weekly distance* (i.e. total distance travelled in a week by short trips) to measure objective mobility. The issue with the later indicator is the respondents may fail to keep record of the total distance travelled over a week. Similarly, Sanko et al. (2013) used travel time (i.e. total travel time) as one of the objective characteristics variables related to car use and public transport. Measures of objective mobility generally cover, travel duration, travel length/distance, and travel frequency (Ory and Mokhtarian, 2009). The indicators used to assess objective mobility is presented in Table 5.6.

Table 5.6: Indicators used to measure objective mobility.

Indicators	Description
OM1: Commuting time	Refers to the commuting time (i.e. amount of time spent) for a one-way trip (i.e. from home to main workplace) by car as reported by the respondents (Cao et al., 2006; Collins and Chambers, 2005; Johansson et al., 2006; Mackett, 2003; Small, 2012).
OM2: Commuting distance	Refers to the distance between the home and main workplace postcodes of the respondents (Anable and Gatersleben, 2005; Cao et al., 2006; Collins and Chambers, 2005; Johansson et al., 2006).
OM3: Annual average car mileage	Refers to the annual average car mileage as reported by the respondents (Lois and Mercedes, 2009; Scheiner and Holz-Rau, 2007; Steg and Vlek, 1996).

5.6. Summary

This chapter reported the development of the theoretical framework based on the concept of the Theory of Planned Behaviour to demonstrate the key determinants of intention to change travel mode choice behaviour in response to the identified research gaps. A theoretical framework was developed based on a review of existing literature on travel behaviour. It includes seven constructs: *(1) CAC: Cognitive attitude towards car use; (2) CAW: Cognitive attitude towards walking; (3) AASFC: Affective attitude towards situational factors related to car use; (4) AASFW: Affective attitude towards situational factors related to walking; (5) PBC: Perceived behavioural control; (6) OM: Objective mobility; and (7) IC: Intention to change travel mode choice behaviour.* Based on the literature review, eight research hypotheses were proposed to investigate the association between the latent constructs. The constructs were operationalised based on the synthesis of literature and survey instruments. Finally, measures used to operationalise the constructs are discussed.

Chapter 6

Methodology

6.1. Introduction

This chapter discusses the rationale behind using the methodological approaches for this study. The sequential actions used to conduct the research based on a methodological framework developed as part of the study. This study was designed drawing upon strategies that allowed the use of a combination of qualitative and quantitative methods to answer the central research question:

> *"what are the key determinants for intention to change travel mode choice behaviour?"*

The structure of the chapter is outlined below. Section 6.2 discusses the research design approach chosen for the study and details the sequential actions used to conduct the research during the three phases of the study: (1) Literature review phase: Identifying the research gaps and designing the PhD work–plan; (2) Phase 1: Defining the scope of the study; and (3) Phase 2: Investigating the travel behaviour of hospital staff. Section 6.3 provides a brief description on the Literature review phase. Section 6.4 explains the activities undertaken in Phase 1: Defining the scope of the study, which details the questionnaire development, sampling technique and data analysis techniques used to define the scope of the study. Section 6.5 successively elaborates on the Phase 2: Investigating the travel behaviour of hospital staff, which includes questionnaire development, sampling techniques, and data analyses techniques. Section 6.6 provides a summary of the chapter.

6.2. Research design

Research in social science is guided by two fundamental types of research questions namely, (a) what is going on? and (b) why is it going on? Research can be classified into two groups guided by the nature of the underlying research questions, namely descriptive and explanatory research. Descriptive research is conclusive in nature and is designed to answer the *what questions*. Good descriptive research is fundamental to the research enterprise and has made a significant contribution to the knowledge. Descriptive research can include either concrete or abstract description. An example of a concrete description is a socio–demographic profile of a sample population. In contrast, descriptive research may attempt to answer the abstract questions, such as *what proportion of the hospital staff solely relies on cars to commute to work?* Descriptive research provides the basis for performing explanatory research attempting to answer the why questions.

However, Mills (1959) argued that the use of inconsequential information may fail to provoke the why questions, which he refers to as *abstracted empiricism*. In contrast, explanatory research attempts to answer the why questions. For example, investigating the state–of–the–art of hospital travel plans, the travel behaviour characteristics and the determinants for intention to change travel mode choice behaviour of the hospital staff may provide an explanation to - *why have the impacts of travel plans on changing travel mode choice behaviour of the staff been low in practice?* Answering the why question involve exploring the underlying phenomenon behind travel mode choice behaviour.

Research has four major dimensions: *(1) ontology, (2) epistemology, (3) methodology, and (4) methods* (see Figure 6.1). The knowledge based on the interrelationships between ontological, epistemological, and methodological assumptions provides a philosophical and conceptual framework to systematically study a phenomenon. The selection of methods of this project is guided by the framework. A paradigm represents a researchers beliefs towards the world and their response to ontological, epistemological, methodological, and methods questions. A paradigm is underpinned by two philosophical assumptions: *(1) ontological; and (2) epistemological*. Ontological assumptions are concerned with a researchers believe towards what constitute reality. Blaikie (2000) refers to ontology as *"claims and assumptions that are made about the nature of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other"*.

A researchers ontological position represents their perceptions of how things really are and how things really work. The issues concerning social science are shaped by two ontological positions: realism, and idealism. Realism assumes that the meaning and interpretation of the external world

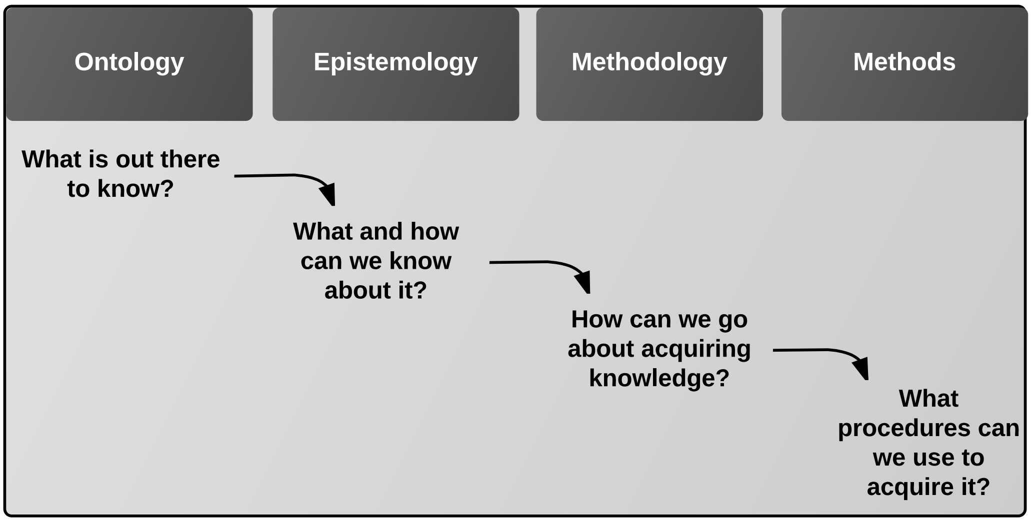

Figure 6.1: The philosophical underpinning behind the research.

held by individuals are varied. In other words, according to realism, different researchers could interpret the rationale behind a phenomenon differently. On the other hand, idealism assumes that the reality is only knowable through the human mind and socially constructed meanings. One of the key criticisms behind idealism is, it does not consider the influence of uncertain circumstances (e.g. weather) on travel mode choice behaviour. The philosophical standpoint of this research is therefore supported by idealism. Epistemology is concerned with the nature, origin and limits of human knowledge. According to Blaikie (2000), epistemology refers to as *the possible ways of gaining knowledge of social reality, whatever it is understood to be*. This philosophical approach can also be interpreted as how to create, acquire, and communicate knowledge about a phenomenon guided by what is already known regarding it.

Several key issues are closely associated with epistemological debates in social research, including the reasoning used to acquire knowledge. The process of drawing conclusions based on the principles of theories and evidence is referred to as reasoning (Leighton and Sternberg, 2003). Reasoning is often classified into two groups: *(a) deductive*, and *(b) inductive reasoning*. Deductive reasoning is a logical process in which a conclusion is drawn based on one or more statements that are generally assumed to be true (Sternberg, 2009). In contrast, inductive reasoning is a logical process in which one or more statements are combined to obtain a specific conclusion. The key difference between deductive and inductive reasoning is that a definite logical conclusion can not be drawn based on inductive reasoning.

Theories intend to provide an interpretation of renowned or established research regarding the complexities and changing nature of human behaviour and organisations. According to Blaikie (2009), research design is an integrated statement of and justification for the technical decisions involved in planning a research project. Research design is also referred to as a *blueprint* for empirical research that aims at answering specific research questions or testing specific hypotheses, and must specify at least three processes: *(a) the data collection; (b) the instrumental development (e.g. developing a theoretical framework, questionnaire, and structural equation model);* and *(c) the sampling*. Research designs can be broadly classified into two categories: *(a) positivist research design; and (b) interpretive research design* (Phillips and Burbules, 2000).

Positivist designs attempt to generalise the patterns of a phenomenon based on the objective view of reality. This research design employs a theory testing that begins with a theory to guide what observations should be made. A set of hypotheses are derived using a deductive reasoning (i.e. starting from general to specific) based on the assumption that if the theory is true certain things will follow in real–life. Observations are made to test if the hypotheses are true. If the hypotheses are not supported by the data the theory either needs to be rejected or modified. In contrast, interpretive designs attempt to provide subjective interpretations of social phenomena based on the perspectives of the subjects involved. Theory building or inductive reasoning approach is used as part of the interpretive designs, which starts with making observations about a phenomenon. This is followed by the derivation of a theory based on the evidence found. The theory building methods include action research and ethnography. There is one fundamental difference between the approaches. According to the positivist approach, sociology is viewed as a science that employs quantitative methods (e.g. questionnaires) involving a relatively large sample population. Whereas, the interpretive approach rejects sociology as science and seeks to understand a small–scale social actors based on qualitative methods (e.g. interviews). In transport, the positivist research design approach is widely used to study travel mode choice behaviour. The choice of research design in this study was guided by the following factors:

- *practical*: availability of resources (e.g. time and money), subject matter, prior research in the area, research interests of the researcher;
- *ethical*: ethical grounds of the methods, and confidentiality; and
- *theoretical*: validity, reliability, representativeness, and theoretical beliefs of the researcher.

Taking into account the above factors the study was underpinned by the positivist research design approach.

The research methodology is informed by a philosophical stance that explains the logical arguments behind selecting the research methods to achieve the research objectives. The selection of methods for this study was guided by the data required to investigate the research objectives and the appropriateness of the method to collect and analyse the selected data. Cross—sectional and longitudinal research methods are widely used to study travel mode choice behaviour (Davies, 1994). Cross-sectional studies aim to observe a population characteristics instead of determining the cause and effect relationship between the variables. In contrast, longitudinal studies are designed to measure changes in a sample population characteristics over time. The key difference between the two methods is that cross–sectional studies provide a snapshot of a sample population based on data collected at a single point in time, whereas longitudinal studies involve taking multiple measures at distinct points in time. Cross–sectional methods are confined to a single specific time period they are a relatively cost effective approach to gather preliminary data to support further research. The disadvantages of longitudinal methods are that they are expensive to complete and require multiple observations over an extended time period before conclusions can be drawn. The PhD project was to subject to time and resource constraints; therefore, cross–sectional methods were used in this study. However, future research into the area may employ longitudinal methods to provide a useful insight into the travel mode choice behaviour of the NHS hospital staff.

The research objectives and corresponding methods used to collect and analyse the data are presented in Table 6.1.

The timeline for the PhD project was divided into three different phases, as shown in Figure 6.2:

- **Literature review phase**: Identifying the research gaps and designing the PhD work–plan;
- **Phase 1**: Defining the scope of the study; and
- **Phase 2**: Investigating the travel behaviour of hospital staff.

6.3. Literature review phase

This research began with a review of the state-of-the-art and continued throughout the PhD study period in parallel with other activities. There is no consensus about how to assess the reliability of sources for literature review. Five criteria are widely used to evaluate the reliability of information sources (Polifko-Harris, 2009), which have also been used in this study:

- *accuracy* was determined by assessing if the information was based on reliable and proven facts; and could be verified against other reliable sources;
- *authority* was determined by assessing the relevant qualifications of the writer on the subject area;
- *objectivity* was assessed by evaluating whether the key findings of the literature were based on facts or biased opinions. Literature solely based on subjective opinions have been excluded

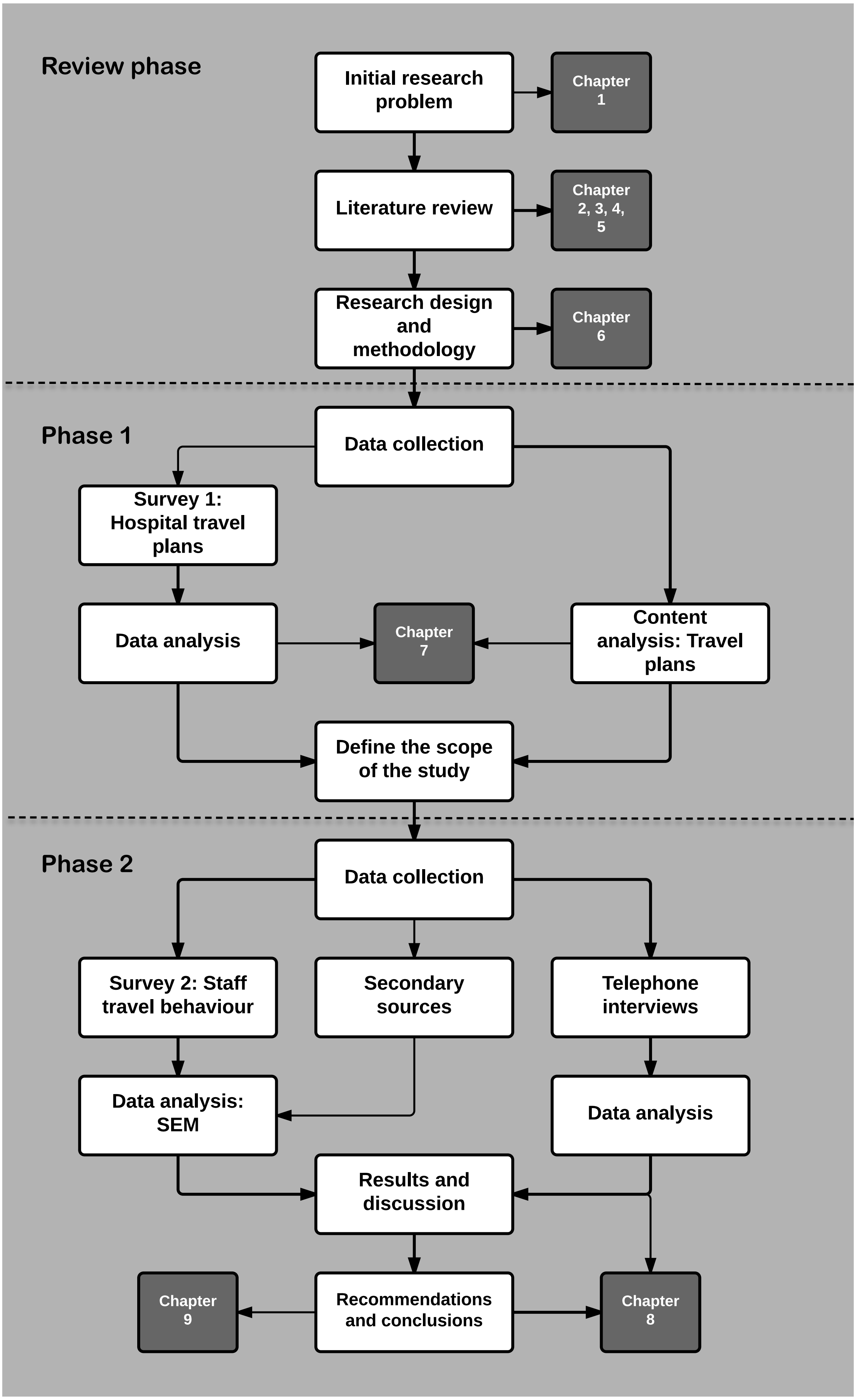

Figure 6.2: Research methodology used to achieve the research objectives.

Table 6.1: Research objectives and corresponding methods used to achieve the objectives.

Objective	Data source	Method
To examine workplace travel plans with a focus to the key determinants of a successful travel plan	• Secondary sources • Survey 1	• Literature review • Content analysis • Descriptive statistics • Spearman test
To develop a theoretical framework to demonstrate the impacts of socio–economic, situational and psychological determinants on intention to change travel mode choice behaviour based on the Theory of Planned Behaviour	• Secondary sources • Survey 1	• Literature review
To examine the travel behaviour of the NHS hospital staff within the context of travel plans	• Secondary sources • Survey 1 • Survey 2	• Descriptive statistics • Mann–Whitney U test
To identify the key determinants for intention to change travel mode choice behaviour of hospital staff within the scope of a travel plan	• Secondary sources • Survey 2 • Telephone interviews	• Structural equation modelling
To provide recommendations to inform the decision–making process of travel plan measures for hospital staff	• Secondary sources • Survey 1 • Survey 2 • Telephone interviews	

from the study;

- *currency* was assessed by evaluating if the information was current or out–of–date. Currency is relevant for the specific information; and
- *coverage* was assessed by evaluating if the information provided had met the basic or in–depth information needs of the project.

Despite having a high policy emphasis on reducing the use of cars by the NHS (Armitage et al., 2006; NHS SDU, 2013; Sir Derek Wanless et al., 2007), there is a lack of prior research with a focus on transport issues related to healthcare professionals (Melia, 2012). Therefore, the research topic for this study was broadly set within the theme *Travel plans for hospital staff* in the beginning and a deductive reasoning approach was used to narrow the focus of the PhD (see Figure 6.3).

First, a literature review on workplace travel plans was performed to identify the potential areas of research. Based on the initial literature review, *the key determinants of a successful travel plan* was identified as a potential area of research. There is no widely acknowledged systematic framework

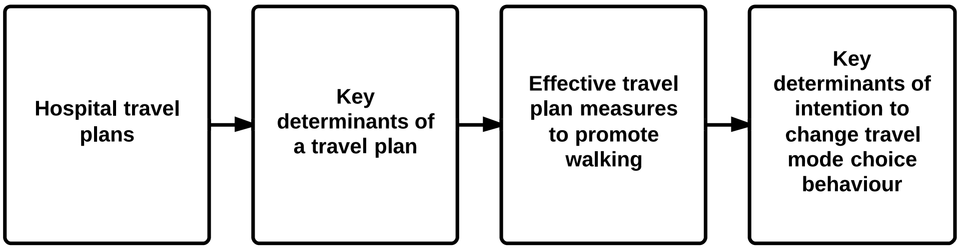

Figure 6.3: The deductive approach used to carry out the research.

in transport research or practice to design effective travel plan measures. By exploring literature from public health research it was found that the Model for Planned Promotion is widely used to develop effective interventions (Conner and Sparks, 2005). The key determinants of a successful travel plan have been reviewed following the six steps proposed by the Model for Planned Promotion and presented in Chapter 3. To better understand the key aspects is relation to the NHS hospital travel plans in practice a nationwide survey was conducted among the NHS hospital travel plan co–ordinators during Phase 1. A questionnaire was designed based on the literature review. Issues emerge from the Literature review Phase and Phase 1 related to designing travel plan measures were further explored to support the research design of Phase 2. The analysis of behavioural determinants is considered as one of the most important step for developing effective behavioural interventions based on the concept of the Model for Planned Promotion and evidence found from Survey 1: Hospital travel plan survey and the review of hospital travel plans.

Second, the general body of literature on travel behaviour was reviewed to identify the key determinants of travel mode choice behaviour within scope of a travel plan. Behavioural theories are widely used to study the psychological correlates of car use. However, it remains unclear how the modifiable antecedents are addressed while designing interventions to reduce car use and promote walking. Further empirical research supported by theoretical account is required to better understand the impacts of psychological constructs in changing travel mode choice behaviour alongside the socio–economic and situational factors. Moreover, there is thus a lack of comprehensive knowledge-base on the key constraints of changing travel mode from cars to walking. The evidence found during the Literature review phase and Phase 1 highlighted the significance of investigating the impacts of the socio–economic, situational, and psychological determinants on intention to change travel mode choice behaviour. Finally, once the research aim was finalised the research design was revised accordingly to achieve the research objectives.

6.4. Phase 1: Defining the scope of the study

The knowledge on how to secure the success of a travel plan remains fragmented, especially in a healthcare setting. A nation-wide survey was conducted to obtain an overview of hospital travel plans in England. The survey data were analysed using statistical techniques (e.g. Spearman ρ correlation tests). To further investigate the key issues related to developing travel plan measures, 12 hospital travel plans were reviewed using a coding framework. The scope of the study was determined based on the findings from this phase. A theoretical framework was designed based on the principle of Theory of Planned Behaviour to examine the underlying principles behind changing travel behaviour. The methods used to analyse the survey data were also identified based on existing literature on research methods in this research area. The methodology used in Phase 1 is discussed in the following sections.

6.4.1. Survey 1: Hospital travel plan survey

A survey was designed to capture the views of the NHS Acute Trusts' representatives [1] responsible for designing and implementing hospital travel plans.

6.4.1.1. Questionnaire development and pilot survey

The survey questions were devised based on a comprehensive review of a combination of academic literature, best–practice guidance and reports on workplace travel plans to reflect the key aspects of a successful workplace travel plan. The design of the questionnaire is described below:

- first, the respondents with or without a travel plan were asked to identify the key transport issues experienced by their hospital site(s) from a list of transport issues pertinent to hospitals;
- second, the respondents were asked a set of general questions relating to their travel plans;
- third, two similar five–item Likert–type questions (i.e. 'very unimportant = 1 to 'very important' = 5) were asked on used to identify the motivations behind introducing the existing travel plan; and motivations to the future development of the travel plan respectively (Likert, 1932);
- fourth, a set of questions related to travel plan measures were asked, which were a multiple–choice question to identify the methods used to collect the data required to design travel plan measures; a question to assess the relative importance of several factors while designing travel plan measures; and the relative effectiveness of travel plan measures. An open–ended question was asked on the key barriers to changing travel behaviour of the staff, enabling the

[1] NHS Acute Trusts provides services on behalf of the English NHS.

respondents to express their views on any issues experienced while implementing the travel plan; and

- finally, there were two questions on the frequency of monitoring the travel plan and the indicators used to evaluate the impacts of the travel plan.

Prior to the main survey a pilot survey was administered in two steps among eight people. Participants were contacted by email with instructions on how to provide feedback and a covering letter explaining the aim of the survey and an online link to the questionnaire.

6.4.1.2. Sampling technique

A sample is a subgroup of a statistical population whose characteristics are studied to gain an understanding of the characteristics of some units within the population (Frey et al., 2000; Sharon, 1999). Sampling is referred to as the process of selecting a subset of a population for inclusion in a study. Two types of sampling techniques are widely used in social science research: *(a) probability;* and *(b) non–probability* (Paul, 2008). Probability sampling is a technique, in which every individual in the population has a known and nonzero probability of being selected in the sample (Henry, 1990). Conversely, non–probability is a technique, in which every individual in the population does not hold the equal chance of being selected in the sample.

The selection of sampling techniques depends on the goal of the research. The fundamental difference between the two sampling techniques lies within their ability to confidently represent the survey population (Frey et al., 2000). The key advantage of a well–designed probability sample is, it allows a rigorous estimation of the selection bias [2] and error (Henry, 1990). Four types of probability sampling techniques are commonly used across different disciplines, which are simple, systematic random, stratified random, and cluster sampling. However, Paul (2008) argue that in real–life circumstances it may not always be feasible to carry out probability sampling because of time and resource constraints.

Non–probability sampling techniques are frequently used in market research and public opinion surveys that attempted to target a large population. Several non–probability sampling techniques are introduced by different authors, including convenience, purposive, and snowball sampling (Frey et al., 2000; Henry, 1990). First, convenience sampling is a type of non–probability sampling in which the sample is drawn because of their convenient accessibility. Second, purposive sampling involves selecting a sample based on the researcher's knowledge of the population to meet the research objectives (Babbie, 1990). Finally, snowball sampling technique is used on rare oc-

[2] The tendency of a sample statistics to exclude a target group(s) from the sample resulting in an inaccurate representation of the population group.

casions when the survey population is unknown (MacNealy, 1999). Snowball sampling relies on previously identified individuals to identify a population group with similar characteristics (Henry, 1990). In this study, although the survey population are defined, there is a lack of readily available information on transport issues in the context of healthcare. Hence, the use of convenience sampling was more suitable in the research context.

The key advantage of the convenience sampling is that it is easy to employ and cost–effective. However, the sample collected through this technique can be subject to selection bias. Selection bias may cause systematic bias [3]. Another limitation of the technique is, the sample population may not be representative of the target population as the data are collected based on a self–participatory approach or from those who volunteer to take part in the survey. In other words, the results based on convenience sampling may not represent the characteristics of the survey population. However, the use of sampling technique can provide accurate results when existing theoretical propositions are tested by examining the relationships between variables. So, the mode of generalisation in such cases is analytical generalisation.

Survey 1: Hospital travel plan survey was designed to elicit the views of hospital travel plan co–ordinators on the key aspects of a travel plan managed by them. There are 397 NHS hospitals in England, managed by 170 NHS Acute Trusts (i.e. healthcare authorities). As the survey population is limited to the NHS hospital travel plan co–ordinators, it was decided to employ convenience expert sampling to circulate the questionnaire to all hospital travel plan co–ordinators. The following steps have been followed to identify the contact information for the hospital travel plan co–ordinators.

First, the names and contact information for 397 NHS hospitals were collected from the NHS official website. In order to identify the specific contact information for the people responsible for managing hospital travel plans, online searches were made in Google using the following the words, *travel plan* + *hospital*; *travel plan* + *NHS*; *transport plan* + *hospital*; *transport plan* + *NHS*; *hospital* + *travel plan co–ordinators* and *NHS* + *travel plan co–ordinators.*

Around fifteen contact information for various hospitals were collected through the online searches. Telephone enquiries were made to the first 34 hospitals (in alphabetical order). Around six contact information were found from the telephone enquiries. The following issues were commonly experienced during the telephone enquiries:

- the operator and representative from the Estates Department not being familiar with the word 'travel plan'/'transport plan' or not aware of the people responsible for managing the

[3] Systematic bias refers to the constant difference between the results from the sample and the entire population.

travel plan; and

- in many cases, the staff responsible for managing the travel plan were out of office.

Many NHS Acute Trusts have only one travel plan co–ordinator responsible for managing their hospital travel plan(s), especially if the hospitals are located in the same geographical area. Given the issues experienced, it was decided to collect contact information for at least one representative (responsible for managing a travel plan) from each of the Trust with a travel plan. Telephone enquiries were made to the remaining Trusts. Contact information was collected for around forty people. Apart from the online search and telephone enquiries, contact information were found for another forty people through the ActTravelWise and LinkedIn website. Contact information for at least one representative from the London Travel Plan Network (LTPN) and Yorkshire Travel Plan Network (YTPN) were also collected.

A cross–referencing of records collected by directly contacting the Acute Trusts and data published by the Information Centre for Health and Social Care showed that 115 NHS Acute Trusts (68% of the NHS Acute Trusts) had a travel plan in place in 2011 (IC, 2011). In the end, contact information was collected for 130 representatives from 110 NHS Acute Trusts. The participants were contacted individually by email with a cover letter describing the aims of the survey and a link to the web–based questionnaire in September 2011. Hundred and ten emails were sent successfully. Some of the contact information were found to be either out–of–date or the recipients no longer worked for the respective NHS Acute Trusts.

Besides, the survey information was circulated via London TPN, Yorkshire TPN, and NHS Sustainable Development Unit (NHS SDU). Fifty–six valid responses were received, out of which 47 responses (i.e. representatives from 47 hospitals) were from 39 Acute Trusts with a travel plan; the remainder was from Trusts with travel initiatives only. The key focus of the study is limited to hospital travel plans, therefore, responses received from Acute Trusts with a travel plan are only included for the main part of the data analysis, which represents an overall 34% of the total number of Acute Trusts with a travel plan in 2011.

6.4.1.3. Survey data analysis

The internal reliability of the questionnaire was tested using Cronbach's α coefficient (Cronbach, 1951). Testing the significance of hypotheses H1 and H2 involved assessing the relationship between two ordinal variables. The strength of association between two variables is identified by computing the correlation coefficient. The Pearson and Spearman's ρ correlation methods are widely used to measure the association between ordinal variables. The key difference between these two methods is that Pearson correlation method measures the strength of the linear relationship between normally distributed variables. In contrast, Spearman's correlation tests ρ correlation coefficient is used to measure the association between variables that are either not normally distributed or have non–linear relationships.

Therefore, the Spearman's ρ correlation coefficient was used to measure the strength of the association between travel plan measures to promote walking and restrictive measures to reduce the use of cars. This test is valid based on the assumptions that the variables are measured on at least an ordinal scale and the relationship between two variables can be described using a monotonic function [4]. The successive values of a monotonic function is either increasing, decreasing or constant. If there are no repeated data values, a perfect Spearman's correlation of +1 (denotes a strong positive correlation) or -1 (denotes a strong negative correlation) occurs when each of the variables is a perfect monotone function of the other.

6.4.2. Content analysis of hospital travel plans

Since the 18^{th} century, content analysis is used as a popular research method to interpret the content of text data through a systematic classification process of coding and identifying themes or patterns (Rosengren, 1981). According to Downe-Wamboldt (1992), the goal of content analysis is to provide knowledge and understanding of the phenomenon under study. Generally, a content analysis includes seven steps: *(a) formulating the research questions to be answered; (b) selecting the sample to be analysed; (c) defining the categories to be applied; (d) outlining the coding process; (e) implementing the coding process; (f) determining trustworthiness; and (g) analysing the results of the coding process* (Kaid, 1989).

However, the process of the content analysis may vary depending on approaches used in a study. Three approaches are commonly used to perform a content analysis depending on the research design of the study: *(a) conventional, (b) directed,* and *(c) summative (see Table 6.2). In a conventional content analysis,* categories are derived during data analysis whereas with a directed content analysis, an initial coding scheme is developed prior to the data analysis based on existing theories or prior evidence (Kyngas and Vanhanen, 1999). The initial coding scheme is refined and revised as the analysis progresses. The summative approach to content analysis is fundamentally different from the other two approaches and the text is analysed about single words or particular content.

Hospital travel plan is not a confidential document. However, many hospital authorities are re-

[4]The term 'monotonic' refers to 'maintaining order' or 'no change'. A monotonic function refers to a function between ordered sets that preserves the given order.

Table 6.2: Major coding differences among three approaches to content analysis.

Type	Research design	Codes or keywords	Source
Conventional content analysis	Observation	Codes are defined during data analysis	Codes are derived from data
Directed content analysis	Theory	Codes are defined before and during data analysis	Codes are derived from theory or relevant research findings
Summative content analysis	Keywords	Keywords are identified before and during data analysis	Keywords are derived to answer research questions or review of literature

Source: (Hsieh and Shannon, 2005)

luctant to share their travel plan documents with the public. Obtaining hospital travel plans for research purposes under the formal freedom of information enquiry involves a lengthy process. Therefore, at the first instance, it was decided to review the travel plans that were available in the public domain. Twenty travel plans were accessible via the NHS Acute Trusts' website. Out of the 20, four travel plans were proposed for new hospitals and with no prior evidence on the staff travel patterns; and subsequently excluded from the analysis. Another four travel plans were designed to address more than one hospitals managed by the same NHS Acute Trust. As issues specific to each of the hospital were not clearly stated in the travel plans, the joint travel plans were excluded from the study. Finally, 12 travel plans were selected and reviewed using a coding framework as discussed in Chapter 3. The identities of the hospitals were kept anonymous.

The hospital travel plans were reviewed to assess if they were designed as recommend by the best–practice guidance. Therefore, the hospital travel plans were reviewed following the concept of the directed content analysis. A coding framework as outlined in Section 3.2.1 was used to review the travel plans (DfT, 2002, 2006; Enoch and Ison, 2007; TfL, 2006).

6.5. Phase 2: Hospital staff travel behaviour

In Phase 2, the scope of the study was revised based on the findings from Literature Review Phase and Phase 1. Phase 2 was originally designed as an in–depth case study to capture the actual situational factors affecting the staff travel behaviour. At the end of the Survey 1 questionnaire, the respondents were asked if they were interesting in taking part in a follow–up case study. Representatives from 15 NHS Acute Trusts had initially expressed their interest to take part in the case study, out of which seven NHS Trusts did not have any plans to carry out a staff travel survey in the near future. The remaining eight representatives were contacted detailing the commitments required from the NHS Trusts and four of them agreed to take part in the case study. The main data collection effort as part of the case study involved conducting a staff travel survey across the NHS Trust and collecting in–depth information on the local transport conditions. A proposal was produced detailing the action plan to carry out the case study.

Out of the four NHS Trusts, Barking, Havering and Redbridge University Hospitals NHS Trust was chosen as a case study for agreeing to provide the following support:

- to allow the researcher to collect data, as required by the research project;
- to provide the maximum support to carry out a staff travel survey within the next three months; and
- to provide support with accessing the data and other resources as required by the research project.

The Barking, Havering and Redbridge University Hospitals NHS Trust is responsible for managing two hospitals, namely Queen's Hospital and King George Hospital. The two hospital sites were going to be used as two individual case studies. A survey, site–assessment and face–to–face interviews were originally proposed as the key methods for data collection. A questionnaire for the staff travel survey was designed in consultation with the Estates and Facilities Department, Barking, Havering and Redbridge University Hospitals NHS Trust; and Havering Council in order to improve the clarity and comprehension of the questionnaire at a level the general NHS hospital staff could understand.

The communication team at the Trust was responsible for circulating the questionnaire among the hospital staff. The questionnaire was finalised and sent to the Director of Communication at the Trust for the final approval before circulation. The Director of Communication had agreed to circulate the questionnaire through the channels of the Communication Team subject to one condition - shortening the questionnaire. This questionnaire was designed to collect the data required to answer the research questions. Therefore, it was decided to terminate the case study agreement with the Barking, Havering and Redbridge University Hospitals NHS Trust. It posed a new challenge for data collection. Due to time constraints, it was decided to carry out a nation–wide survey instead of carrying out a hospital case study. A combination of methods used during this phase to collect and analyse the data are discussed in the following sections.

6.5.1. NHS hospital staff travel behaviour survey

A self–administered online survey was conducted among the NHS hospital staff to identify the key determinants for intention to change travel mode choice behaviour.

6.5.1.1. Questionnaire development

The questions were devised based on a comprehensive review of a combination of literature; findings from Survey 1: Hospital travel plan survey. The relevance of the factors in measuring the latent constructs were finalised in consultation with the representatives from the Barking, Havering and Redbridge University Hospitals NHS Trusts; and Havering Council.

The questionnaire includes six sections, which are outlined below.

- *Section A: Journey to work* - Contains eight common questions in relation to journey to work for all travel mode users; eleven questions in relation to car use for only those who commute by car and five questions about walking for only those who walk to work;
- *Section B: Travel plans* - Includes two questions on travel plans;
- *Section C: About yourself* - contains Sixteen questions socio–demographic factors for all travel mode users; and
- *Section D: Additional comments* - contains one open–ended question on travel experience to and fromm work.

The questionnaire comprised of a set of questions including five–item Likert–type scale questions (i.e. ranging from *very unimportant* = 1 to *very important* = 5) in relation to the key latent variables of the theoretical model and socio–economic characteristics of the staff. The respondents were asked to indicate how many days a week do you use the following travel modes to get to and from work? They were given six options to choose from: (a) car, (b) car–share, (c) walking on its own, (d) walking for more than 10 minutes with car journeys, (e) cycling, (f) bus, and (g) other. Other modes include train, underground, tram, taxi, and motorcycle. The respondents had the option to choose as many travel modes as they usually use and indicate the number of days commuted by each corresponding travel mode. The questionnaire is provided in Appendix 2 for details.

6.5.1.2. Pilot survey

A pilot survey was conducted during September to October 2012 to identify the potential issues that might occur during the main survey data collection process. Fifteen professionals with or without any knowledge about hospital staff travel behaviour and were asked to provide feedback on the clarity of the contents and design of the questionnaire; and as well as record the time taken to complete the questionnaire. The participants were asked to hypothetically think of themselves as an NHS hospital staff and choose a travel mode(s) depending on their travel needs. Depending on the type of travel mode and answers chosen it took the participants 7 to 12 minutes to complete the questionnaire. The questionnaire was revised based on their feedback.

6.5.1.3. Ethical approval

Loughborough University requires every study involving human participants to comply with the ethical issues as stated within the Loughborough University Ethical Policy Framework (University, 2013). Prior to the data collection, an ethical approval checklist was completed and approved by one of the members of the Ethics Committee. A copy of the ethical approval form is attached in Appendix C. The identity of the respondents was kept anonymous to protect the confidentiality of the respondents in accordance with the Data Protection Act 1998 (Great Britain, 1998).

6.5.1.4. Self–reported data

Car use behaviour research generally depends on self–reported data. The use of self–reported data in the case of socially undesirable behaviour is generally subject to bias due to self–presentation concerns and tendencies to justify behaviour (Lajunen and Summala, 2003). Therefore, the extent to which self-reported data can be considered as accurate and reliable in case of car use remains a matter of debate. Self–presentation concerns could be minimised by carefully choosing the wording and response scale types of a questionnaire (Moskowitz, 1986). For example, the use of a forced–choice format, where the respondent chooses between alternatives of equal social acceptability (Heilbrun, 1964); and subtle items on which where the acceptability of the responses is not apparent. However, this practice raises questions about the face validity. Face validity is the extent to which a test is subjectively viewed as covering the concept it intends to measure.

Strategies used to improve the reliability of the self–reported data is discussed below. First, the respondents were made aware that their identity would be kept confidential to ensure the anonymity of the responses. Second, the wording of the questionnaire was carefully chosen to avoid self–presentation biases [5].

6.5.1.5. Sampling technique

Data collected based on probability sampling allow statistical generalisation, therefore, considered more robust. However, probability sampling requires having access to a list of the NHS staff working for NHS Acute Trusts. Due to time constraints, securing senior management support to have access to such information was not possible. Therefore, convenience sampling was used collect

[5] For example, the respondents were asked to select three options out of five that would reduce congestion on local roads around their main workplace, the given options were *improving the quality of bus services*; *improving pedestrian routes*; *improving cycling routes*; *reducing the use of cars* and *providing flexible working hours*. An indirect approach to collect information on people's intention to reduce car use appeared more effective to avoid self–presentation biases. Around 35.79% of the respondents of the car user group cited *reduce car use* as an option in comparison with *improving the quality of public transport* by 76.84% of the respondents. Moreover, only over a quarter of the respondents of the car user group (27.08%) expressed their intention to walk, which suggest that the self–reported data is less likely to be affected by self–presentation biases.

the hospital staff travel behaviour data. A message detailing the purpose of the study and a link to the online questionnaire was circulated among more than 100 NHS hospitals. Some of the NHS Acute Trusts circulated the survey information around via intranet sites.

6.5.1.6. Sample size

In structural equation modelling (SEM), appropriate sample size is important to produce reliable results (Hair et al., 1995). There is no strict rule of thumb about the sample size but having at least 10 observations per indicator or observed variables is widely considered as adequate to perform a SEM analysis as a basis for testing research hypothesis (Nunnally, 1967). Yuan et al. (2010) evaluated different models with various number of respondents and suggested that a sample size of between 300 and 400 is appropriate for performing structural equation modelling using ordinal data. However, Hair et al. (1995) pointed out that when the sample size is more than 400 the SEM analysis may become too sensitive and, as a result, show a poor goodness of fit measure. Large sample size enhances the precision of model parameter estimation; however, chi–square value (χ^2) is found to be sensitive to sample size. With an increase in the sample size, χ^2 value increases and the corresponding *p–value* decreases. As a result, with a large sample size, the χ^2 values are likely to be inflated and thereby statistically significant, indicating a poor model fit despite being a good fit. Therefore, in case of a model with a relatively large sample size the model fit is measured by the χ^2 value divided by its degrees of freedom (df) (Kline, 2004). If the χ^2/df value is less than 3 the model indicates a good fit. So, as part of this study χ^2/df value was used as a goodness–of–fit measure.

6.5.1.7. Data quality

The quality of online survey data depends on several factors, including survey length, variability of answers to questions in grids, item response rate, and length of answers to open–ended questions (Galesic and Bosnjak, 2009; Yan and Tourangeau, 2008). The length of the questionnaire is closely associated with other indicators and play a key role in determining the overall data quality of the survey. Previous studies suggest that response times, item response rates, differentiation of items in grids, and length of answers to open questions are likely to be smaller with the further away a question is from the beginning of the survey (Herzog and Jerald, 1981). Several experimental studies have found that the questionnaire length is negatively associated with response rates in online surveys (Deutskens et al., 2004; Galesic and Bosnjak, 2009; Marcus et al., 2007).

Galesic and Bosnjak (2009) conducted an experiment among 3,472 respondents to test the association between survey length and response rate. The respondents were divided into three groups;

each group was asked to complete an online questionnaire with length varying from 10, 20, and 30 minutes. Findings show that individual's willingness to participate and complete the questionnaire significantly decline for long surveys. Respondents, who take part in long surveys may answer questions without giving much consideration - this is called *satisfacing*. *Satisfacing* is a decision–making strategy, which is led by acceptable choices rather than the optimal choices that would best represent their views in this regard (Colman, 2006). For example, the respondent may select the first choice in every question resulting in straight lines in grid questions or randomly select choices without much consideration. As part of the same project the impact of survey length on data quality was examined using several indicators, including response time, item response rate, length of answers to open–ended questions, and variability of answers to questions in grids. The results showed that except for item response rate the quality measured by the remaining indicators showed a decline in data quality with the increase in survey length.

There is no strict rule of thumb about the length of a questionnaire. However, to achieve an optimum number of responses a 10 to 15 minutes long survey among the non–specialist respondents is generally regarded as acceptable (Long, 2007). However, baring in mind that the response rates and the quality of the data may vary depending on the research topic; contents and the design of the questionnaire; and the characteristics of the total population. A wider range of services are provided by the NHS hospital staff including healthcare, nursing, administration, IT, laboratory, dietary, supply, housekeeping, and maintenance. Therefore, a high proportion of the staff need to work out of their desk with limited access to internet or computer as part of their job. Considering the above issues an up to 15 minutes long questionnaire was designed to maintain the data quality of the survey. Several NHS authorities and other stakeholders provided positive feedback on the quality of the survey and expressed their interests to receive further information on the outcomes of this study. Around 80% of the respondents provided their contact information, which validates the identity of the majority of the respondents as the NHS hospital staff. Besides, SurveyMonkey allows just one response from one IP address to avoid receiving multiple responses from the same user, which verifies the uniqueness of each response.

6.5.2. Missing data analysis

All statistical data analyses were performed in STATA 13. Nine hundred and forty–four responses were received at the first instance, out of which 863 responses were valid. The total number of missing values for each of the cases was estimated. The number of the questions answered by the respondents varied depending on their travel mode choice. Eighty–one cases with a high number of missing values were deleted based on judgements using listwise case–deletion method. Listwise case–deletion method involves deleting all data for a case that has missing value.

The missing value rate was higher for the demographic variables, ranging from 7.76% to 11.59% with a mean value of 7.53% except for age. Generally, the further away the questions are from the beginning of the survey the less time the respondents spend on answering them. From the telephone interviews with the respondents, it became apparent that some of the respondents deliberately chose not to disclose personal information, such as age, income level, and number of adults in the household. As a good practice, the missing values of the demographic variables were not estimated.

The data are assumed to be missing at random (MAR) (Rubin, 1976). MAR assumes that the actual variables where data are missing are not the cause of the incomplete data - instead, the cause of the missing data is due to some other factors that are also measured. Existing literature suggests that data analysis using the complete cases alone can lead to biased and/or inefficient estimates of the parameters (White et al., 2011). There is no robust method available to draw a clear conclusion about the missing data patterns. However, data analysis using multiply imputed data results in coefficient with less bias when compared with complete case analysis. There are two major approaches to creating multiply imputed datasets. The first approach assumes that all variables in the imputation model have a multivariate joint normal distribution. The other approach is called Multiple Imputation by Chained Equations (MICE), which is based on each conditional density of a variable given other variables.

The theoretical ground of the multivariate normal approach is considered stronger than the imputation by chained equations approach. However, the use of MICE to estimate missing values has been increasing because of the following reasons: (1) the assumption of the variables to have a multivariate joint distribution is not required; and (2) allows the estimation of different types of weights of the variables if permitted by the regression model. Therefore, MICE method was applied here to impute the missing data. The individual variables with around 3% missing data were imputed using predictive mean matching (pmm) approach.

6.5.3. Data processing

The socio–economic and situational variables such as age, gender, household income, number of children, hospital location, and access to a travel plan were included as control variables. The variables were dummy coded to test the effect for being female (male = 0), middle–aged (below 45 = 0), with children (no children = 0), high income (income below 45,000 = 0), city centre (other = 0) and access to a travel plan (no access to a travel plan = 0).

To avoid bias responses related questions on self–reported behavioural intention to change two indirect questions were asked to capture the respondents' intention to reduce car use, improve health, and reduce CO_2 emissions (Murtagh et al., 2012a). The variables were coded as yes = 1 and no = 0. The car user group were also given several options and asked: "if solutions or incentives are provided to address the travel needs of the staff, how often do you think you will be able to walk for all or part of your journey to and from work". Interestingly, more than two third of the respondents from the car user group cited either *Not at all* or *Do not know* about their ability to change their travel mode to walking on its own or for up to 10 to 15 minutes in conjunction with their car journeys either on a regular or occasional basis. For this variable, the *Not at all* and *Do not know* options were coded as 0 and the other options were coded as 1 to maintain consistency with the other variables used to measure intention to change travel mode choice behaviour.

Each respondent was asked to provide their home postcode and the name of the main workplace. The postcodes for the main workplaces of the 863 respondents were collected from the corresponding official NHS hospital website. Shortest travel distance between home and the main workplace for each respondent was retrieved in miles by using the Google map website (https://maps.google.co.uk/). The travel distance data were collected based on the assumption that respondents were already familiar with the possible travel routes and likely to choose the shortest path between home and workplace. However, if the journey involves trip chains, the travel distance is likely to be longer than the shortest paths. The respondents were asked whether their journey was comprised of trip chains, however, collecting data related to change in travel distance due to trip chains was beyond the scope of the study.

Based on the concept of Expectancy–value Theory attitude towards a travel mode is operationalised using a two–scale measure. To assess whether or not the respondent holds the belief about the behaviour in question. For example, how different journeys are experienced or are perceived. How the car is deemed to perform on various attributes. The items for cognitive attitude for both car use and walking were estimated based on the concept of Expectancy–value Theory (Fishbein and Ajzen, 2010). The respondents were given six items as discussed in Chapter 5, and asked to rate each of them on a five-point Likert–type scale of its importance (i.e. *very unimportant* = 1, *very important* = 5) while determining travel options and evaluation of the items based on their experience (i.e. *strongly disagree* = 1, *strongly agree* = 5). The two scores for each of the items were multiplied to derive each item to measure cognitive attitudes. The overall cognitive attitude towards each of the travel mode is represented by the following equation (Fishbein and Ajzen, 2010).

$$A = \sum_{i=1}^{n} b_i e_i \tag{6.1}$$

where, A is attitude towards (evaluation of) car use or walking; b_i is strength of belief about the ith attribute of car use or walking; e_i is evaluation of the ith attribute of car use or walking; and n is number of salient beliefs.

The items to measure affective attitude towards situational factors related to car use and walking were obtained by providing the respondents with five and six items respectively and asked to rate how satisfied they were on a five–point Likert–type scale (i.e. *very dissatisfied* = 1, *very satisfied* = 5). However, in case affective attitude the evaluation of each of the items was assumed to be equal to one. Similarly, the respondents were asked to rank the top five barriers to walking out of seven options. The non–selected options were coded as the '5th barrier'.

6.5.4. Data analysis

The data analysis in Phase 2 includes three major sections. First, the sample profile was analysed using descriptive statistics. Second, the characteristics of the two travel mode(s) user groups: *(a) car users*, and (b) *other mode users*, was examined using Mann–Whitney U tests. The correlation between the individual's beliefs towards the importance of the modal attributes are measured using Spearman's ρ correlation tests. Finally, structural equation modelling was performed to identify the key determinants for intention to change travel mode choice behaviour. The justification behind using and the steps followed to perform structural equation modelling are discussed in the following sections.

6.5.4.1. Structural equation modelling

First–generation techniques such as regression–based approaches (e.g. multiple regression analysis, discriminant analysis, logistic regression, analysis of variance), and factor or cluster analysis are commonly used to either identify or confirm theoretical hypothesis based on the analysis of empirical data. However, the fundamental assumptions of the methods are subject to several limitations namely, postulate a simple model structure; and all variables can be considered as observable. Concerning the first limitation, Jacoby (1978) argued that we live in a complex and multivariate world and studying variables in isolation is inadequate to represent the real–life phenomena. It is not practical to include all the aspects associated with a phenomena while building a model (Shugan, 2002). However, regression–based approaches are considered as too limiting to represent complex real–life situations. The impacts of both observable and unobservable factors in changing travel behaviour is widely acknowledged. Therefore, the use of methods that are solely based on the observable factors fail to provide an explanation behind the changes an behaviour due to the unobserved factors.

Finally, estimation of a real–life phenomena results in a measurement error, which is comprised of two parts Bagozzi et al. (1991) namely, random error, and systematic error. Random error is caused by the order of questions or respondent fatigue (Heeler and Ray, 1972) and system error (i.e. the difference between the actual value of what is being measured and the value found) is caused by any factors that systematically affect measurement of the variable across the sample (Churchill, 1979). So, first generation methods should only be used in circumstances without concerning either random or measurement error component, which is difficult to achieve in real–life circumstances.

Structural equation modelling (SEM) is a second–generation advanced multivariate statistical analysis that allows the simultaneous analysis of multiple unobserved and observed variables nested within a theoretical framework to test the consistency of the data with the initial hypotheses (Byrne, 2010). SEM offers a range of supports that help to overcome the limitations of first–generation techniques has broadened up the use of SEM to analyse the theoretical hypotheses behind travel mode choice. The relative comparison between SEM and multiple regression analysis is presented in Table 6.3.

Table 6.3: Relative comparison between SEM and multiple regression analysis.

Criteria	SEM	Multiple regression
Carry out the simultaneous analysis of the whole system variables	Yes	No
Use confirmatory data analysis approach	Yes	No
Use exploratory data analysis approach	Yes	Yes
Provide explicit estimates for measurement errors	Yes	No

Moreover, the structural relations between the variables of the SEM can be presented pictorially (i.e. with diagrams) to enable a clearer conceptualisation of the theoretical constructs and hypotheses under consideration. The pattern of inter–variable relationships can also be specified a priori by a series of structural equations against the empirical data (e.g. structural model and measurement model). SEM allows to distinguish the specific nature of the effects between the variables and to measure the effects of observed variables (i.e. also called *items, indicators, and manifest variables*) on latent variables (Chin, 1998). A variable is called a latent variable, if it is unobserved or no data is collected against the variable. Finally, SEM is a useful analytical technique in situations where either independent variables or dependent variables or both contain measurement errors. SEM provides explicit estimates of the variables by adjusting the measurement errors and thereby provides a more flexible approach to test the validity of the hypotheses. Therefore, SEM was used to explore the impacts of socio–economic, psychological and situational factors in determining intention to change travel mode choice behaviour of the NHS hospital staff.

However, the limitations of SEM include:

- does not establish causal orders among variables if the temporal order of these variables is unknown;
- missing data and outliers influence the covariance and correlation matrices analysed;
- a large sample size produces stable estimates of the covariance or correlation among variables, but it make the model easier to be rejected;
- there may be multiple equivalent models that fit data equally well; and
- the number of parameters to be estimated cannot exceed the number of known values.

According to Wright (1921) the method of path analysis (SEMs) is not intended to accomplish the impossible task of deriving causal relations from the values of correlation coefficients.

6.5.4.2. The steps of structural equation modelling

A structural equation model was developed to test the research hypotheses based on the theoretical framework proposed in Chapter 5. Structural equation modelling is performed following five key iterative steps (see Figure 6.4): *(1) model specification; (2) model identification; (3) model estimation; (4) model assessment and model fit; and (5) model modification and final estimation.* The fundamental concepts of the SEM are discussed in the following sections alongside the key methods used to perform the SEM. However, details of the methods used to perform SEM has been discussed in Chapter 8 alongside the results.

Model specification - In this section, different terminologies used to specify structural equation model are discussed first followed by the model specification. Based on the theoretical causal model, the variables can be classified as observed and unobserved variables. There are three types of unobserved variables: *(a) latent construct; (b) an error associated with the measurement of each observed variables*; and *(c) an error associated with the prediction of each factor.* Errors associated with the measurement of the observed and unobserved variables indicate the influence of unknown factors that have not been observed. Error in prediction is also called disturbance. In a SEM model, observed or manifest variables are presented in rectangular–shaped boxes and latent variables are enclosed in the oval shaped (see Table 6.4). One–way arrows represent structural correlation coefficients and thus indicate the impact of one variable on another. The curved lines

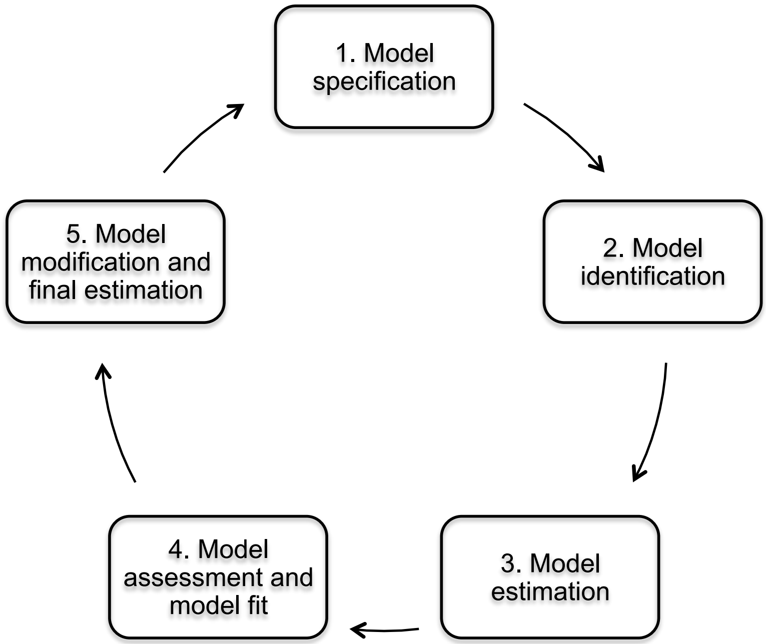

Figure 6.4: The key steps of performing a SEM analysis. Structural equation modelling was performed following an iterative process. The process stops once a statistically valid good model fit is obtained.

without arrowhead attached represent the variances of the independent variables. The source–less one–way arrows pointing from the small circles to observed variables indicate the impact of random measurement errors on the observed variables and errors in the prediction of latent variables. Curved two–way arrows represent covariance or correlations between pairs of variables.

Based on the origin of the variables the SEM variables are classified into two groups: (a) exogenous, and (b) endogenous variables. The word *exogenous* comes from the Greek words *exo* meaning *outside* and *gignomai* meaning *to produce*. Exogenous refers to an action or object that comes from outside of a system. An exogenous variable refers to the variable that is not influenced by other variables in the model. In contrast, endogenous refers to something generated from within the system. An endogenous variable refers to a variable that is influenced by other variables in a model.

In a structural equation modelling diagram, a variable is exogenous if only arrows pointing out from it with no arrows pointing to it. A variable is endogenous if arrows are pointing in and out from it. The factors of SEM can also be classified into two groups based on the casual dependency of the variables, which are dependent and independent variables. A variable with a unidirectional arrow aiming at it represents a dependent variable. A dependent variable can be expressed as a structural regression function of other variables. For every dependent variable, the regression function can be summarised by the following equation (Haenlein and Kaplan, 2004).

Table 6.4: Symbols used to represent a structural equation model.

Symbol	**Description**
▭	Observed variable or indicator
⬭	Theoretical construct or latent variable
○	Error or a variable
$\longrightarrow$	Causal relationship from a causal variable to an effect
$\longleftrightarrow$	Non-causal relationship between two variable or a covariance between two residual

$$Y = aX + \epsilon \tag{6.2}$$

where, Y = dependent variable, X = independent variable and a = weighting coefficient ϵ = error On the other hand, a variable with no unidirectional arrow pointing at it is called an independent or exploratory variable.

The relationships between the different parameters of the SEM can be described by three types of equations. First, the relationship between indicators of the exogenous latent variables to their associated measurement error and the latent exogenous variables is represented by the following equation.

$$x = \lambda\xi + \delta \tag{6.3}$$

where, x = manifest variable or indicator of an exogenous latent variable, λ = factor loading, ξ = exogenous construct, δ = error term of measurement variable of exogenous latent variable.

Second, the relationship between the indicators of the endogenous latent variables to their associated measurement error and the latent endogenous variables is described as:

$$y = \lambda\eta + \varepsilon \tag{6.4}$$

where, y = manifest variable or indicator associated with endogenous latent variable, λ = factor loading, η = endogenous latent variable, ε = error term for measurement variable of endogenous latent variable.

Finally, the relationship between the latent endogenous and latent exogenous variable is described as:

$$\eta = \gamma\xi + \zeta \tag{6.5}$$

where, η = endogenous latent variable, γ = regression of an endogenous latent variable on exogenous latent variable, ξ = exogenous construct, ζ = structural error term.

In other words, reflective indicators should be used if something observed is either increasing or decreasing due to an unobserved variable. Due to the influence of the same unobserved variable, reflective indicators are likely to be highly correlated with each other. In contrast, formative indicators are perceived as combination of explanatory indicators that explain the formation of a latent variable (Fornell and Bookstein, 1982). Formative indicators of the same construct may not be correlated with each other, which means a change in one indicator does not necessarily reinforce a change in other indicators (Chin, 1998). The indicators used to measure the latent constructs in this study are reflective indicators.

The structural model includes two parts: (a) measurement model; and (b) structural model (Byrne, 2010). The measurement model specifies the relationships between the latent and observed variables. It is employed to assess the measurement properties of the latent constructs. The structural model specifies the causal or hypothesised relationships among the latent constructs (Mohamed, 2003). It explains the causal effects of the latent constructs and the amount of corresponding unexplained variance (Anderson and Gerbing, 1982).

The initial model specification included all the variables as proposed in the theoretical framework (please see Figure 6.5). Structural model was used to test the hypothesised relationships between the constructs proposed in the theoretical model. The structural model included six exogenous and one endogenous latent variables. The exogenous latent variables were CAC: Cognitive attitude towards car use, AASFC: Affective attitude towards the situational factors related to car use; CAW: Cognitive attitude towards walking, AASFW: Affective attitude towards the situational factors related to walking, PBC: Perceived behavioural control and OM: Objective mobility; and the endogenous latent variable was IC: Intention to change travel mode choice behaviour. The indicators are also referred to as the key characteristics of the latent constructs (Deepen, 2007).

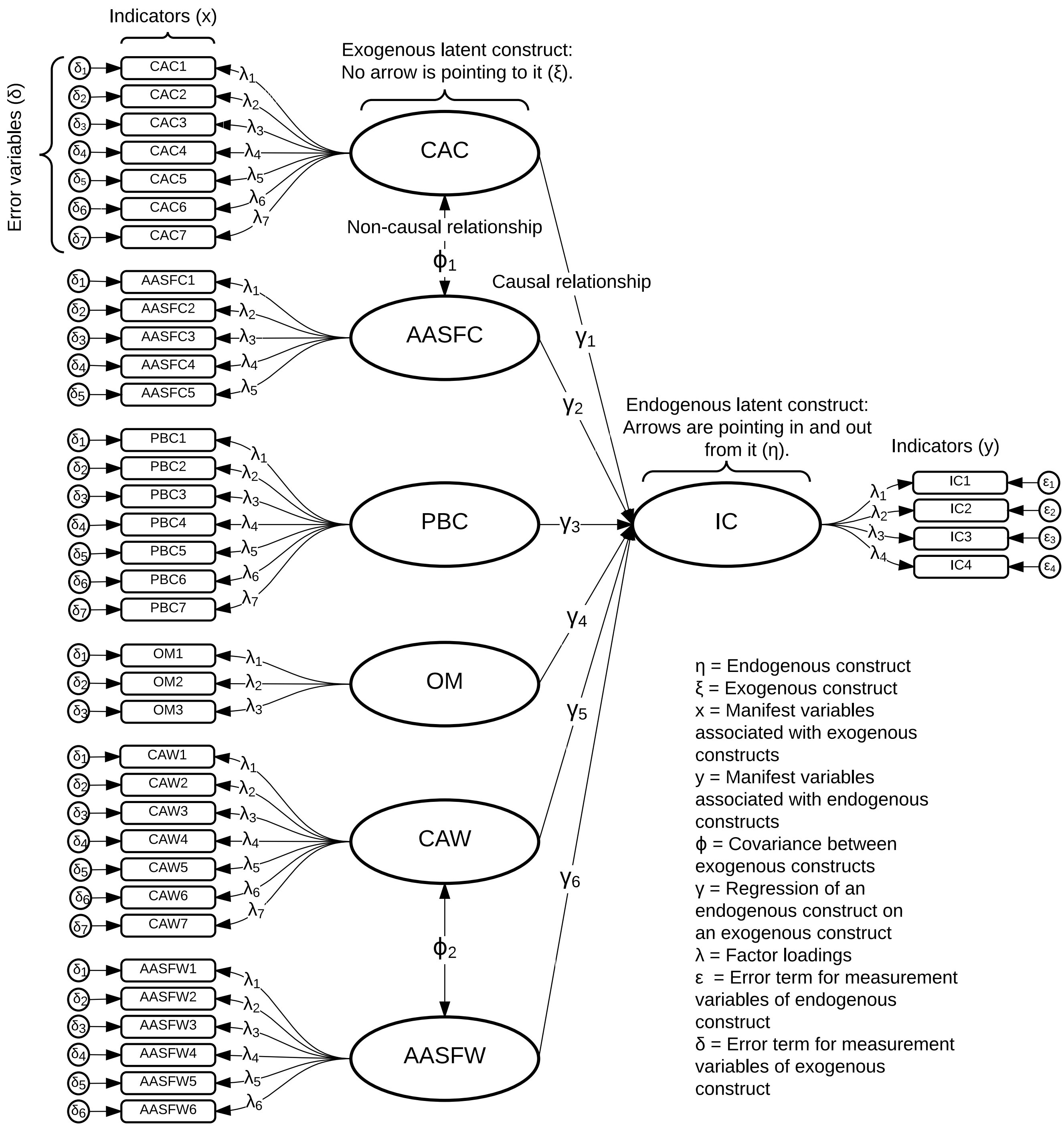

Figure 6.5: Structural equation model of the key determinants for the intention to change travel mode choice, where CAC: Cognitive attitude towards car use, CAC1: Commuting time, CAC2: Security, CAC3: Reliability, CAC4: Flexibility, CAC5: Convenience, CAC6: Comfort, CAC7: Cost; CAW: Cognitive attitude towards walking, CAW1: Commuting time, CAW2: Security, CAW3: Convenience, CAW4: Flexibility, CAW5: Reliability, CAW6: Comfort, CAW7: Cost; AASFC: Affective attitude towards situational factors related to car use, AASFC1: Time, AASFC2: Parking charge, AASFC3: Availability of parking space, AASFC4: Road Traffic, AASFC5: Road quality; AASFW: Affective attitude towards situational factors related to walking, AASFW1: Security, AASFW2: Pedestrian route, AASFW3: Pedestrian crossing, AASFW4: Pavement quality, AASFW5: Street light, AASFW6: On–site walking environment; PBC: Perceived behavioural control, PBC1: Time constraints, PBC2: Long distance, PBC3: Inconvenience, PBC4: Lack of alternatives, PBC5: Security concerns, PBC6: Work commitments, PBC7: Personal commitments; OM: Objective mobility, OM1: Commuting time, OM2: Commuting distance, OM3: Annual average car mileage; IC: intention to change travel mode choice, IC1: Intention to walk, IC2: Intention to reduce CO_2 emissions, IC3: Intention to improve health, IC4: Intention to reduce car use.

Table 6.5: Criteria used to identify structural equation model.

Identification type	Criteria	Outcome
Just identified or saturated model	Number of data points = number of parameters	The model will perfectly fit the data. Can be used to estimate the values of the path coefficient.
Over identified model	Number of data points $<$ number of parameters	The parameters cannot be estimated. Some parameters need to be deleted to estimate the model.
Under identified model	Number of data points $>$ number of parameters	The analysis can proceed.

Model identification - Prior to model estimation the ability of the SEM to obtain unique estimates of the structural parameters needs to be determined, which is referred to as model identification. Several rules are used to check whether a model is identified or not. The widely used criteria to assess model identification are presented in Table 6.5. First of all, the model identification can be determined by comparing the number of data points and number of parameters to be estimated. The input data set is the sample variance/covariance matrix and the number of data points equal to the number of variances or covariances in the matrix.

$$\textit{No of data points} = \frac{m(m+1)}{2} \tag{6.6}$$

where, m = the number of measured variables.

The scale of each independent variable is generally set to a constant value 1 (as in Z scores). The scale of the dependent latent variables is set to same as measured variables. The scale of the independent latent variables can be set to 1 or same as the variance of the measured variable. The scale of a measured variable can be set by fixing the path from the latent construct to the measured variable to 1. Most often the scale of dependent or independent latent variables is set to 1 or the variance of a measured variable. The measurement model is likely to be identified if there is one or more latent variables. Each latent construct is determined by at least three indicators and the errors of the indicators are not correlated with each other. Each indicator loads on only one latent factor and the factors are allowed to covary. None of the variances and covariances between factors is zero.

The structural model is identified if the latent dependent variables do not predict each other. If one latent construct predicts the other, in that case, the model is identified if the relationship is recursive and the disturbance are not correlated. A relationship is recursive if the causal relationship is unidirectional. The identification problem can be resolved by setting the value of selected endogenous, exogenous or error variables to zero. However, previous research suggests that restricting the values of the parameters need to be clearly assessed and underpinned by theoretical knowledge of the phenomenon under investigation (Golob, 2003).

Model estimation - Doloi et al. (2010) suggested that the initial consistency of the measurement model should be tested by performing Cronbach's α reliability test. A good score for construct reliability does not always verify that the test is valid. Construct validity is generally difficult to ascertain. Securing a good score for construct validity also represents a good predictive, concurrent and content validity. If a test has a high estimate of validity, reliability estimates will be less important. Therefore, a higher emphasis was placed on testing the construct validity. The construct validity was measured by examining the convergent validity and discriminant validity of the constructs. Convergent validity refers to the extent to which the measured variables of a specific construct share a high proportion of variance. The discriminant validity refers to the extent to which a construct is truly distinct from other constructs (Hair et al., 2006). As recommended by Kline (2005), the correlation coefficients between each pair of variables is used as a measure of discriminant validity. A higher correlation coefficient ($>$ .85) suggests that the variables should be treated as a single variable.

Exploratory factor analysis (EFA) is recommended as a preliminary analysis in the absence of a set of established measurement scales or instruments to assess the theoretical constructs (Gerbing and Anderson, 1988). The variables used to assess the constructs were extracted from an extensive review of previous literature. However, the same set of variables have not been used to operationalise the latent constructs, especially in the healthcare sector. Therefore, following the assessment of internal consistency, exploratory factor analyses were performed to identify a set of items for each model construct. EFA analyses the interrelationships between a large number of variables and identify the variables that statistically define the underlying dimensions of the construct (Hair et al., 2006). Convergent validity was assessed by examining the magnitude of the standardised factor loadings and their significance levels. According to Bollen (1989), a factor loading over .5 indicates good convergent validity. However, Koufteros (1999) argued that a significant t–value alone could indicate convergent validity.

Confirmatory factor analysis (CFA) is a subset of structural equation modelling that provides a robust measure of construct validity and unidimensionality in comparison with the EFA. Confirmatory factor analysis (CFA) is a multivariate statistical technique that is used to verify the factor structure of a set of observed variables or whether measures of a construct are consistent with the theoretical representation of the construct (Hair et al., 2006). The CFA was performed to refine and support the preliminary results found from the EFA.

The plausibility of the hypothesised model was tested based on the estimation of the observed data in the model. The following equation shows a typical structural equation model with 'G' number of endogenous variables (Kuppam and R, 2001).

$$\begin{bmatrix} Y_1 \\ . \\ . \\ . \\ Y_G \end{bmatrix} = \begin{bmatrix} Y & X \end{bmatrix} \begin{bmatrix} B \\ \tau \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ . \\ . \\ . \\ \varepsilon_G \end{bmatrix} \tag{6.7}$$

The equation can be rewritten as:

$$Y = BY + \tau X + \varepsilon \tag{6.8}$$

where, Y is a column vector of endogenous variables; B is a matrix of parameters associated with right-hand-side endogenous variables; X is column vector of exogenous variables; τ is a matrix of parameters associated with exogenous variables; and ε is a column vector of error terms associated with the endogenous variables.

Structural equation modelling was estimated based on covariances–based structural analysis, which is also called method of moments. In this method, a sample covariance matrix is estimated based on the observed data. The model is estimated to minimise the difference between the sample covariance and the implied model covariance matrices (Bollen and Lennox, 1991). The fundamental hypothesis for the covariance–based estimation procedures is that the covariance matrix of the observed variables is a function of a set of parameters (see the equation below).

$$\sum = \sum (\theta) \tag{6.9}$$

where, $\sum$ is the population covariance matrix of observed variables, θ is a vector that contains the model parameters, and $\sum (\theta)$ is the covariance matrix written as a function of θ. The relationship between $\sum$ and $\sum (\theta)$ conveys a fundamental understanding of identification, estimation and assessments of model fits. The matrix $\sum (\theta)$ has three components namely the covariance matrix of Y, the covariance matrix of X with Y and the covariance matrix of X. If ϕ = covariance matrix of X and ψ = covariance matrix of ε. Then covariance matrix written as a function of θ can be shown as (Bollen, 1989):

$$\sum(\theta) = \begin{bmatrix} (1-B)^1(\tau\phi\tau' + \psi)(1-B)^1 & (1-B)^1\tau\phi \\ \phi\tau'(1-B)^{1'} & \phi \end{bmatrix} \tag{6.10}$$

The parameters , τ, ϕ and ψ are estimated so that the implied model covariance matrix is as close as the sample covariance matrix.

STATA allows the estimation of SEM based on both asymptotic distribution free (ADF), and maximum likelihood (ML) methods. Browne (1984) introduced ADF to estimate binary or ordinal–level variables that are not normally distributed. However, according to simulation studies, the maximum likelihood method is robust enough to accurately estimate data that violate the assumption of joint normality (Golob, 2003). ML was used to estimate the structural equation model. ML tends to overestimate the test statistics for non–normal data (Curran et al., 1996). Therefore, the normality of the variables were assessed based on the skewness and kurtosis of the individual variables. A variable is considered to have a non–normal distribution if skewness is $>$ 2 and/or kurtosis is $>$ 3 (West et al., 1995). The scores for skewness and kurtosis, some of the variables were found to be above the cut–off value for normal distribution. During the measurement model estimation, the bootstrapping resampling method was used to resample the data. The bootstrapping resampling method provides accurate Type I error rates and power than single sample method that assumes a normal distribution and thereby it becomes valid to use maximum likelihood method to estimate the resampled non–normal data.

The likelihood function is the density function regarded as a function of θ:

$$L(\theta|x) = f(x|\theta), \theta \, \epsilon \, \Theta \tag{6.11}$$

$$\hat{\theta}(x) = arg\ maxL(\theta|x) \tag{6.12}$$

$\hat{\theta}(x)$ is the maximum likelihood estimator for θ. A fitting function $F(S, \sum(\theta))$ is used to minimise the difference between the sample and implied model covariance matrices. The fitting function has the properties of a scalar.

$$F(S, \sum(\theta)) \geq 0 \tag{6.13}$$

$$F(S, \sum(\theta)) = 0,\ if\ \sum(\theta) = S \tag{6.14}$$

There are two types of core parameters in SEM, which are regression coefficients for paths between the variables and variances and co–variances of the independent variables. Parameters can be either be fixed to a certain value or estimated. The value of the parameters can be set to '1' or '0'. One important aspect is every latent construct needs a path to their predicted manifest variable with a fixed or seed value to solve the estimation of equations. Other path values are estimated relative to the seed value.

Model assessment and model fit - Model fitting is one of the most important steps of structural equation modelling (Yuan, 2005). Structural equation modelling assumes that the variables underpinning the theoretical constructs are interrelated through a set of linear relationships. The plausibility of the relationships between the variables are examined by testing the variances and covariances of the variables. SEM allows to test whether a set of variances and covariances in a covariance matrix fits within a specified structure. The fit indices were used as a measure to determine how well the specified factor model represented the observed data. A model fit that shows an approximate representation of the reality is generally acceptable. However, it is assumed that the data will fit if the causal model is true. The discrepancy between the models is termed as residual.

Therefore, the model–fitting process can be summarised as:

$$Data = Model + Residual \tag{6.15}$$

A quote by Albert Einstein also supports the argument:

> *"As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality".*

The fit indices are generally classified absolute fit indices and incremental fit indices (Hoyle, 1995).

(a) **Absolute fit indices** determine to what extent the hypothesised model reproduces the sample data (Shah and Goldstein, 2006). The commonly used indices include, the relative Chi–square (χ^2/df), Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR), which are discussed below. χ^2 is one of the traditional measures of absolute fit indices. It assesses the degree to which the sample matrix differs from the covariance matrix (Hu and Bentler, 1999). In other words, χ^2 reports the magnitude of discrepancy between the sample and fitted covariances matrices ($\sum(\theta)$ - $\sum$) (STATA, 2013). The saturated model is the model with a zero degrees of freedom that fits the covariances perfectly. A non–significant χ^2 value generally represents a good model fit and, therefore, regarded as acceptable. Therefore, the chi–square is also referred to as *badness of fit* (Kline, 2005) or *lack of fit* (Mulaik et al., 1989) measure. In contrast, a model is considered as a poor fit if χ^2/df is significant at p $<$ .05 level and should be rejected. However, as discussed in Section 6.5.1.6, one of the key limitations of the chi–square is, it is sensitive to sample size (Kline, 2005). The relative/normed chi–square is used as an alternative chi–square to minimise the effect of sample size on the model as recommended by Wheaton et al. (1977). The recommended acceptable value of χ^2/df ranges from 2 (Tabachnick et al., 2000) to 5 (Wheaton et al., 1977).

RMSEA was introduced by Steiger and Lind (1980) (Steiger, 1990). The RMSEA evaluates how well the model would fit the population covariance matrix (Byrne, 2010). One of the key advantages of RMSEA is it allows the precise estimation of the null hypothesis (poor fit) (McQuitty, 2004). However, RMSEA is sensitive to the number of parameter estimated in the model (Diamantopoulos and Siguaw, 2000). The RMSEA tends to select the model with a fewer number of parameters. A cut–off value of .05 is widely acknowledged as an acceptable limit for RMSEA (Steiger, 1990).

SRMR is the square root of the difference between the residuals of the sample covariance matrix and hypothesised covariance model. An SRMR value ranges from .5 to (Byrne, 2010) to .8 (Hu and Bentler, 1999) deemed acceptable. An SRMR value of 0 represents the perfect model fit. However, the SRMR value is sensitive to the number of parameters and sample size. A model with a high number of parameters or large sample size tends to lower the SRMR value.

(2) **Incremental fit indices** assesses how well the model fitted by comparing the chi–square value of a base or null model. The null model assumes that all the latent variables are uncorrelated (Mcdonald and Ho, 2002). Incremental indices are also known as comparative (Miles and Shevlin, 2007) or relative fit indices (Mcdonald and Ho, 2002). Comparative fit index (CFI) was introduced by Bentler (1990). The CFI compares the sample covariance matrix with the null hypothesis. The CFI performs well when the sample size is small (Tabachnick et al., 2000). A cut–off criterion of CFI $>$ .9 is considered as acceptable.

The complex and saturated models tend to produce better-fit indices (Mulaik et al., 1989). To address this issue, Mulaik et al. (1989) introduced two parsimony of fit indices, the Parsimony Goodness–of–Fit Index (PGFI) and the Parsimonious Normed Fit Index (PNFI). Both indices defuse the effects of the model complexity, thereby, lowers the parsimony fit index values in comparison with the goodness–of–fit–indices. However, the interpretation of the results based on the parsimony indices is difficult as they dont have any recommended threshold levels.

The other type of parsimony fit index is called *information criteria* indices. The commonly used *information criteria* index is the Akaike Information Criterion (AIC) (Akaike, 1974). This index is commonly used to compare the results of the non–nested or non–hierarchical models estimated based on the same data, and identify the most parsimonious model. There is no recommended cut–off value for AIC. The model with a smaller AIC value indicates a good model fit. These statistics need a sample size of 200 to make their use reliable (Diamantopoulos and Siguaw, 2000).

Bagozzi and Yi (2012) suggested that a reliable model fit can be secured based on five model fit indices including χ^2, Root Mean Square Error of Approximation (RMSEA), Non–normed Fit Index, such as Non–Normed Fit Index (NNFI), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), and Standardized Root Mean Square Residual (SRMR). The cut–off values of the model fit indices vary with respect to the area of research. The model fit indices are also influenced by the sample size, type of data and number of variables. The default fit indices as provided by STATA were used to measure the model fit in this study (see Table 6.6).

Table 6.6: Fit–Indices used to assess the model fit.

Index	**Details**	**Value***	**Source**
χ^2/df	Likelihood ratio test statistics	< 2	Tabachnick et al. (2000)
		< 5	Wheaton et al. (1977)
RMSEA	Root Mean Square Error of Approximation	.05	Steiger (1990)
		$< .08$	Browne et al. (1993)
CFI	Comparative Fit Index	$> .09$	Fan et al. (1999)
TLI	Tucker Lewis Index	$> .09$	Marsh et al. (1988)
AIC	Akaike information criterion	Lower value	Raftery (1995)
BIC	Bayesian Information Criterion	Lower value	Raftery (1995)

*Acceptable value.

6.5.4.3. Structured telephone interviews

Large–scale survey instruments with close–ended or fixed alternative questions allow hypothesis testing with a high degree of generalisability and confidence (Floyd J. Fowler, 2013). However, one of the limitations of this method is correlation between the factors does not represent causation. Interview–based approach allows to amplify and complement data derived from quantitative methods (e.g. surveys), and reconstruct a coherent representation of how and why particular phenomena took place (Schoenberger, 1991).

Research interviews are conducted to explore the views, experiences, beliefs and/or motivations of individuals on issues related to specific matters (Gill et al., 2008). Interviews are used to collect data through interactive verbal communications with subjects, generally on a one to one basis. Interviewing is a time–consuming process, however, it is considered as a more detail, flexible, and adaptable approach than surveys. Interviews are widely used to support exploratory research and enrich the findings from quantitative methods. The widely used techniques to conduct interviews include: *(a) structured interviews, (b) non–structured interviews,* and *(c) unstructured interviews* (Gill et al., 2008). Following the hospital staff travel survey, structured telephone interviews were conducted for the following reasons:

- to clarify the underlying reasons for the survey responses; and
- to collect data on general issues that can be applied to a wider group of the staff to complement the survey data. For example, shift working patterns, car parking charges, park and ride service by hospitals.

Following the survey, the car users, who took part in the prize draw were contacted by emails and asked if they were interested in taking part in a short follow–up telephone interview. Initially, 13 staff expressed their interests in taking part in a telephone interview. However, finally four staff were available and took part in a structured 15 to 30 minutes telephone interview. The participants were contacted in the beginning of December 2013. The availability of only four participants to take part in a telephone interview can be attributed to either many staff being on leave or holding a busy schedule before the Christmas period.

The interviewees were open to express any ideas or thoughts that sit outside the set questions. Several methods are commonly used to analyse interview data, including content analysis, discourse analysis, and relational analysis. The common feature related to these approaches is direct quotes are used to draw a conclusion. The three basic procedures used to analyse the interview data include: *(a) identify the concepts, (b) collect examples,* and *(c) analyse the concepts*. However, two fundamental approaches are used to analyse qualitative data, namely the deductive approach, and inductive approach (Burnard et al., 2008). Deductive approaches begin with a predefined structure or coding framework and the data are analysed according to a structure. Analysing interview data following this approach is relatively quick and easy to do. However, the key criticism behind the approach is the use of the inflexible structure limit the scope of developing new themes or theories. Conversely, the inductive approaches involve deriving a structure based on the analysis of the unstructured data. As the telephone interviews were conducted to complement Survey 2 rather than introducing new themes into the research, the deductive approach was used to analyse the telephone interviews.

The interview questions were broadly classified into three themes: (1) local travel context, (2) organisational context, and (3) personal circumstances. Prior to the interview the participants were informed of the purpose and ethical principle (i.e. the identity of the participants to be kept anonymous) of the study. The following questions were asked related to each of the themes.

1. Questions related to local travel context.
   a) In your view how good is the access to the hospital site by car?
   b) In your view how good is the access to the hospital site by walking?
   c) What is your overall view about the walking environment of surrounding areas of the hospital site?
   d) How do you think the walking environment (e.g. pedestrian security) in and around the hospital site can be improved?
   e) In your view how good is the access to the hospital site by public transport?
2. Questions related to organisational context.
   a) Do you have any issues with car parking spaces?
   b) Do you pay car parking charges?
   c) How familiar are you with the travel plan for the hospital?
3. Questions related to personal circumstances.
   a) What are the key reasons for using cars for travelling to work?
   b) What does your job role involve?
   c) Are you satisfied with your current travel arrangements?
   d) If you could change anything, what would have liked to change?

6.6. Summary

This chapter illustrates the research methodology used to achieve the research objectives during the study. The timeline of the study was divided into three different phases. First, a literature review was performed on workplace travel plans to identify the potential areas of research. Following the literature review the areas of research gaps were identified and the scope of the research was defined. A research plan was produced to outline research objectives and the research methods employed to achieve the objectives. Based on the initial literature review 'the key determinants of a successful travel plan' was identified as a potential area of research. In Phase 1, a questionnaire was designed to acquire a better understanding of issues about hospital travel plans. A nation–wide survey was conducted among the NHS Acute Trusts representatives (e.g. travel plan co–ordinators) responsible for managing hospital travel plans to capture their views on the key aspects a travel plan. The survey findings showed that measures to promote walking were the least effective. Analysis of behavioural determinants is considered as one of the most important step for developing effective behavioural interventions based on the concept of the Model for Planned Promotion and evidence found from Survey 1: Hospital travel plan survey and review of hospital travel plans.

The analysis of hospital staff travel behaviour was performed in three steps. First, the sample profile was analysed using descriptive statistics. Second, the difference between the demographics and travel behaviour characteristics of the two travel mode(s) user groups (e.g. car users and other mode users) was examined using Mann–Whitney U tests. The correlation between the individual's beliefs towards the importance of the modal attributes are measured using Spearman rho correlation tests. In the second section, all latent constructs were assessed individually and finally an overall measurement model was estimated using confirmatory factor analysis to verify the unidimensionality between the measures. Finally, the structural model was estimated and compared with the measurement model to verify the overall fit to the data, which is followed by a description on construct validity and reliability.

Chapter 7

Analysis of hospital travel plans

7.1. Introduction

There is a lack of research on hospital travel plans, especially in terms of what factors may have affected their success (Cairns et al., 2010; Melia, 2012). This chapter discusses the findings from Phase 1, which includes analysis of Survey 1: Hospital travel plans data and the content analysis of hospital travel plans.

The structure of the chapter is outlined below. Survey 1: Hospital travel plan survey was designed to capture the views of the NHS Acute Trust representatives on the key aspects of a travel plan and findings are discussed in Section 7.2. The key issues identified in Section 7.2 are further explored in Section 7.3 based on a content analysis on hospital travel plans. The findings from both studies are discussed in Section 7.4 and finally Section 7.5 summarises the chapter.

7.2. Results from the1 hospital staff travel survey

The α coefficient value for the overall questionnaire and for the three Likert–type questions was found to be .764 and .932 respectively indicating good internal consistency of the measurement scale of the questions. The Survey 1: Hospital travel plan survey data analysis results are discussed in Sections 7.2.1 to 7.2.10.

7.2.1. Summary of the sample

The distribution of the sample by the three key regions of England (i.e. South, Midlands, and North) and the staff size of the NHS Acute Trusts (i.e. up to 3,000; 3,001 to 6,000, and more than 6,000) in

Table 7.1: Sample distribution of the by NHS Acute Trust size and standard regions.

	n	%	N	%
Trust size				
Up to 3,000	11	28.2	45	39.1
3,001 to 6,000	17	43.6	49	42.6
More than 6,000	11	28.2	21	18.3
Total	39	100	115	100
Standard region				
South	24	61.5	59	51.3
Midlands	5	12.8	30	26
North	10	25.6	26	22.6
Total	39	100	115	100

comparison with the target population of the study is shown in Table 7.1. The sample distribution for both types is broadly similar to the population distribution. First, the classification of the sample by the regions of England shows that there was an over–representation of respondents from the South region (61.5%) and an under–representation of respondents from the Midlands region (12.8%). The classification of the sample by the size of the Trust shows that there was an under–estimation of respondents from the small Trusts with up to 3,000 staff and an over–representation of respondents from the large Trusts with more than 6,000 staff.

7.2.2. Transport issues

The respondents were given 13 options and asked to select as many options that applied to their organisation. The results are presented in Figure 7.1. Transport issues experienced by most of the hospitals can be characterised as high car use and associated externalities. Most of the respondents (84%) cited a lack of car parking spaces and high car use as the key transport issues experienced by their hospital site(s).

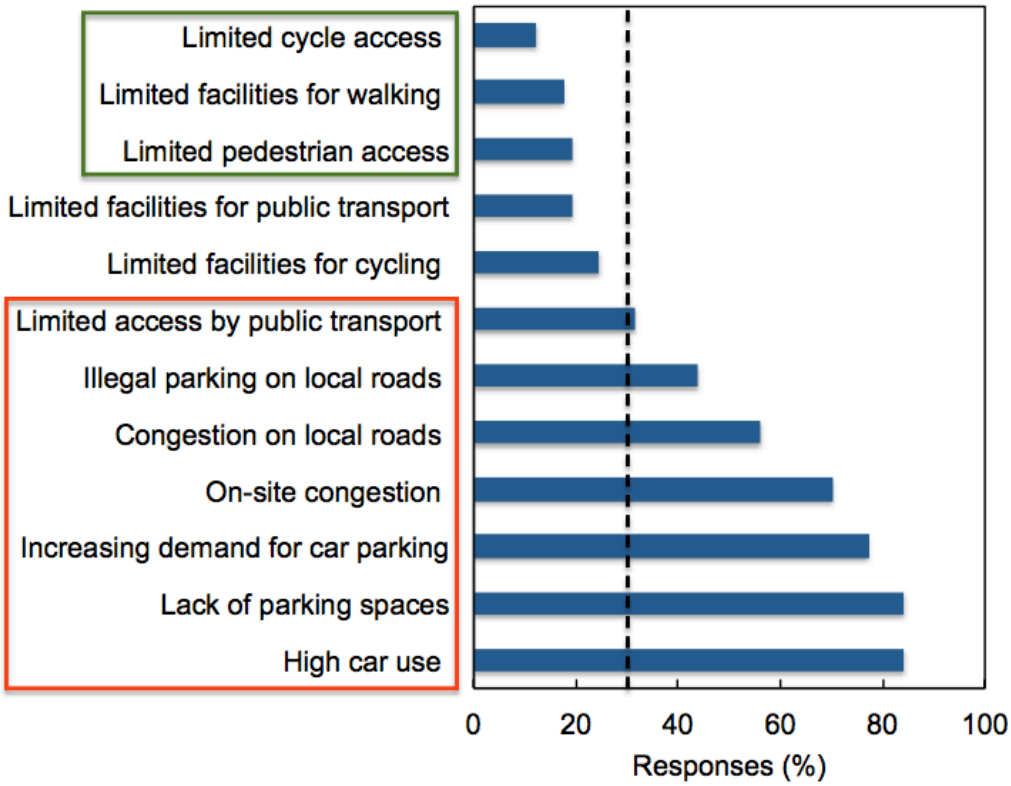

Figure 7.1: Key transport issues experienced by the hospitals. The highly and less cited transport issues are shown in a red and green rectangle respectively.

The evidence found reinforces claims made by other studies of a high car–dependency among hospital staff in England (NHS SDU, 2007). High car–dependency among hospital staff is often linked with the provision of free or low–cost car parking spaces, shift–working patterns, lack of access to the hospital sites, and the organisational culture to car use (Curtis and Headicar, 1997; Rye, 1999; Stokes, 1996).

A significant proportion of the respondents (77%) also cited the *increasing demand for car parking spaces* as a transport issue. More than half of the respondents acknowledged the impact of high car use by citing *on–site congestion* (70%) and *congestion on local roads* (56%). Congestion is likely to cause delay in accessing hospital sites and thereby significantly affect the delivery of services. Therefore, in comparison with other services ensuring easy access to the hospitals sites for staff, patients, and visitors is of relatively higher importance. Moreover, nearly one–third of the respondents (32%) reported that their hospital sites had *limited access by public transport.* A small proportion of the respondents reported to have limited facilities for walking (18%) or limited access by walking (19%). The results provide confirmatory evidence that most of the hospitals were facilitated by pedestrian access and facilities to support walking behaviour among their staff.

7.2.3. General information on travel plans

The type of human–resources employed to produce and implement a travel plan is presented in Figure 7.2. More than half of the respondents (56%) reported that the in–house team of the hospital was responsible for producing the travel plan. This was followed by more than one–third (40%), who said the travel plan was produced by the in–house team jointly with external consultants. Only a small proportion (5%) stated that external consultants alone were responsible for producing the travel plan. There is no clear view about whether a travel plan prepared by the in–house team in collaboration with external consultants was preferable to a travel plan prepared by the in–house team alone.

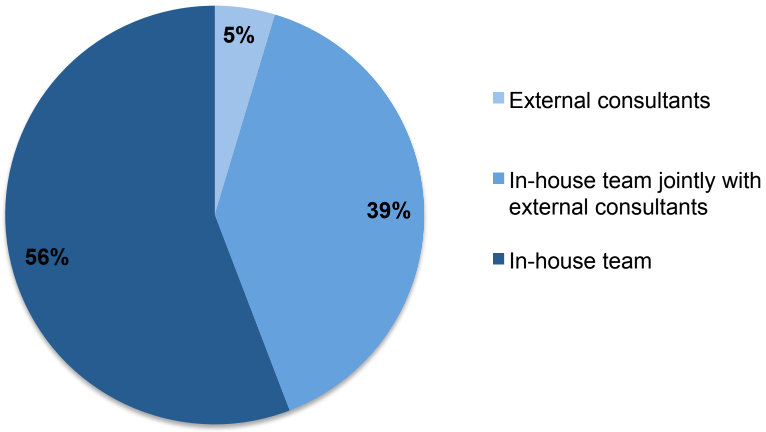

Figure 7.2: Expertise used to produce travel plans.

The Survey 1: Hospital travel plan survey findings reveal that the take–up of travel plans has increased since 2006, reflecting the increasing environmental awareness of the use of sustainable modes of transport among the hospital authorities (see Figure 7.3). The highest proportion of the respondents (40%) reported to have introduced a travel plan between 2009 and 2011. It suggests that a policy requirement to have a travel plan may have accelerated the take–up of travel plans among the hospitals in England in recent years.

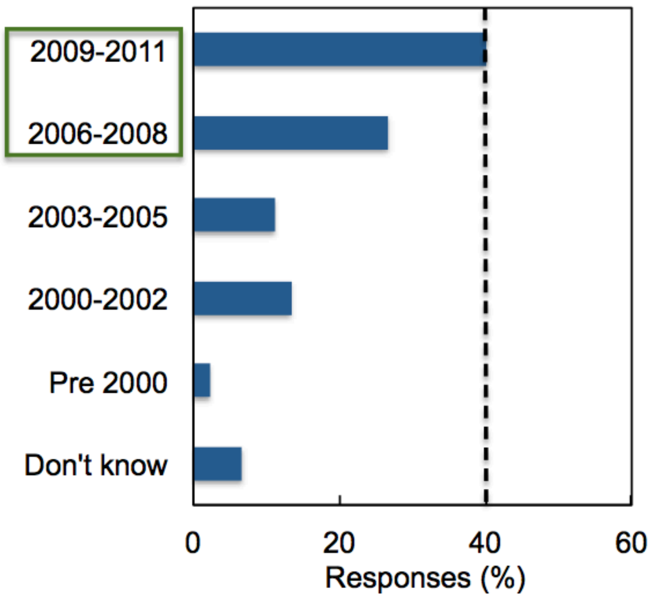

Figure 7.3: Travel plans by the year introduced. Most of the NHS Trusts reported to have introduced travel plans during 2006 to 2011.

More than half of the respondents (60%) reported to have a travel plan target in place to limit the use of cars or promote the use of sustainable modes of transport. Setting out specific, measurable, achievable, realistic, and time–based (SMART) targets and associated actions to achieve the targets within the given timeframe was considered to be an important part of the travel plan decision–making process (Doran, 1981).

7.2.4. Motivations behind developing travel plans

The Survey 1: Hospital travel plan survey results (see Table 7.2) show that almost all of the respondents (98%) cited meeting regulatory requirements as either a *very important* or *important* reason for introducing their travel plans ($\mu = 4.45$, $SD = 0.55$). The role of hospitals in taking a lead to promote the use of sustainable modes of transport through the adoption of travel plans was highlighted in the Transport White Paper by the Department of Environment, Transport and Regions (DETR, 1998). This result aligns with the previous research findings showing that national and organisational policy interests acted as the key driving forces behind introducing travel plans for hospitals in England (Roby, 2010; Rye et al., 2011).

Next, around 93% cited *reducing carbon emissions* as either a *very important* or *important* reason for introducing the travel plan ($\mu = 4.33$, $SD = 0.687$). Promoting health and well–being and *a lack of car parking spaces* were also cited as either *very important* or *important* reasons for introducing the travel plan by a significant proportion of the respondents, 88% and 83% respectively. Despite the high level of car use, the NHS staff have adopted a more positive attitude towards the use of sustainable modes of transport in recent years. Interestingly, *the changing attitudes of staff towards the use of sustainable modes travel* scored the second highest mean value of 4.38 with a standard deviation (SD) of 0.7 indicating the role of hospital staff in initiating travel plans in their organisation. Moreover, site–specific issues such as *improved accessibility*, and *expansion or redevelopment of the hospital sites* were cited as either *very important* or *important* by nearly three–quarters of the respondents. Nearly half of the respondents (45%) said saving money was *neither important nor unimportant* factor behind introducing a travel plan.

Table 7.2: Original and future motivations to introducing or developing the travel plans.

	1		2		3		n		μ		SD	
	OM	(FM)	OM	FM	OM	FM	OM	FM	OM	FM	OM	FM
	%	%	%	%	%	%	–	–	–	–	–	–
Planning regulations												
Reduce carbon emissions	2.4	0	4.8	0	92.9	100	42	42	4.33	4.6	0.69	0.5
Promote health and well–being	0	0	11.9	0	88.1	100	42	42	4.24	4.43	0.66	0.5
Meet regulatory requirements	0	0	2.5	2.5	97.5	97.5	40	40	4.45	4.45	0.55	0.55
Organisational values												
Meet corporate social responsibility targets	4.9	0	12.2	4.9	82.9	95.1	41	41	4.02	4.37	0.76	0.58
Save money	7.5	2.4	45	16.7	47.5	81.0	40	42	3.68	4.07	0.97	0.75
Increase staff retention	7.3	4.9	36.6	26.8	56.1	68.3	41	41	3.63	3.85	0.92	0.82
Changing attitudes of staff towards travel	0	0	11.9	4.8	88.1	95.2	42	42	4.38	4.57	0.7	0.59
Site–specific issues												
Improve accessibility	7.1	4.8	16.7	9.5	76.2	85.7	42	42	4.07	4.21	0.92	0.81
Reduce illegal parking on local roads	19.5	4.9	19.5	29.3	61.0	65.9	41	41	3.61	3.83	1.09	0.83
Lack of staff parking spaces	4.9	4.8	12.2	9.5	82.9	85.7	41	42	4.15	4.26	0.82	0.83
Expansion of hospital site(s)	7.9	2.6	18.4	15.4	73.7	82.1	38	39	4.03	4.26	1.03	0.8

*1 = very unimportant or unimportant; 2 = neither important nor unimportant; 3 = important or very important.
OM: Original motivations, FM: Future motivations, n: Total responses, μ: Mean, SD: Standard deviation.

Future motivations behind developing the travel plan were broadly similar to the results of the original motivations for introducing the travel plan, where all of the respondents (100%) stated that *reducing carbon emissions* and *meeting the regulatory requirements* (98%) as *very important* or *important* reasons for the future development of the travel plan. The relative comparison between the mean values of original and future motivations shows that except for meeting regulatory requirements, on average a higher importance was placed on all of the factors for future motivations. The highest increase in mean value was for *saving money* ($\mu = 4.07$, $SD = 0.75$). This suggests that regulatory requirements will continue to play an important role behind sustaining travel plans in the future. For many NHS organisations, there is a growing concern over the high expenditure associated with staff travel (NHS Employers, 2010). The added dimension of reducing the overall expenditure associated with the staff travel is likely to pose further pressure on the hospital authorities to significantly reduce the use of cars.

7.2.5. Data collection methods

The design of travel plan measures underpinned by a comprehensive knowledge of the staff travel patterns within the given context can significantly increase the effectiveness of travel plan measures. The Survey 1: Hospital travel plan survey results show that most of the respondents (88%) reported to have conducted a staff travel survey to collect the information required to produce the travel plan (see Figure 7.4).

More than three–quarters of the respondents also reported that they use a site assessment and a car parking audit as a means of collecting the required information. Nearly half of the respondents (49%) stated that they collect the required information through a travel audit, staff forum(s) (51%) or informal staff feedback (46%). Only a small proportion of the respondents (5%) reported not to use any of the listed activities to collect the information required to inform the travel planning decision–making process.

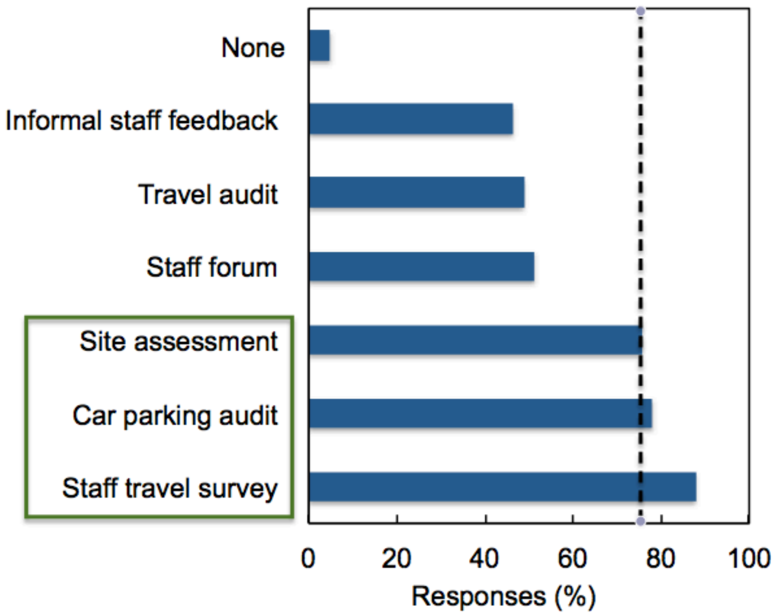

Figure 7.4: Key methods used to collect the data required to develop the travel plan. Most of the NHS Trusts reported to have collected data through a staff travel survey, car parking audit, and site assessment.

7.2.6. Factors related to travel plan measures

The key factors considered while designing a travel plan is presented in Figure 7.5. A relatively higher importance was placed on the organisational factors by most of the respondents in comparison with other factors while designing travel plan measures. In case of factors in relation to individual travel needs of staff, a relatively lower proportion of the respondents (68%) cited personal commitments of staff as either *very important* or *important* in comparison to staff working patterns (85%) and staff health and fitness (85%).

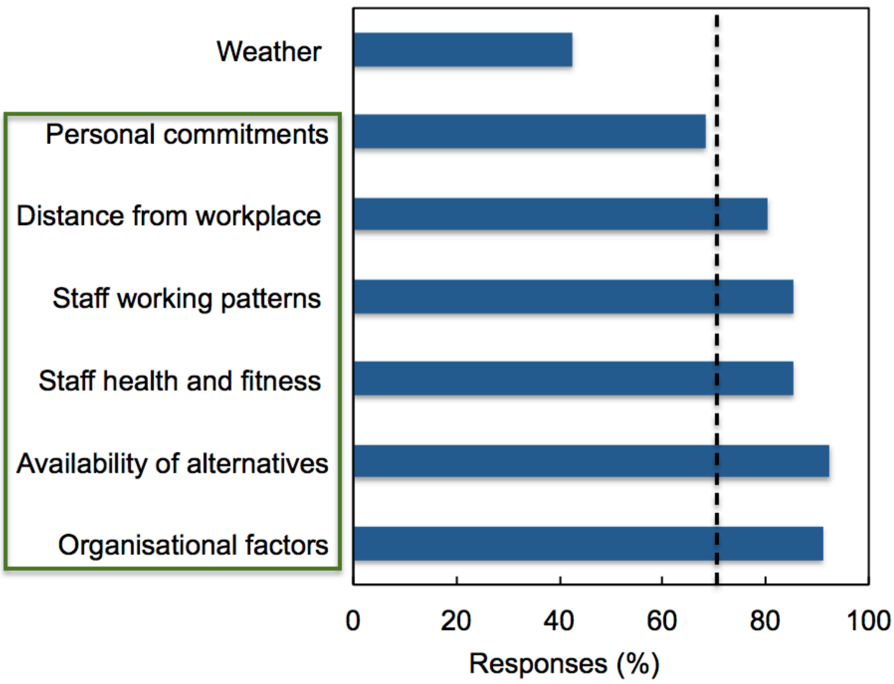

Figure 7.5: The key factors considered during travel planning process. The most highly cited factors are shown within a green rectangle.

Most of the respondents rated organisational commitment to reduce car use ($\mu = 4.58$, $SD = 0.5$) and organisational culture to car use ($\mu = 4.44$, $SD = 0.55$) and as either *very important* or *important* factors while designing travel measures. Next, the factors associated with the alternative modes of transport such as cycle access to and from the hospital site, facilities for cycling, access by public transport, facilities for public transport and staff perceptions of the quality of the public transport while designing travel plan measures were also cited as either *very important* or *important* by a high proportions of the respondents. In case of factors related to the personal circumstances of the staff, relatively lower proportion of the respondents (68%) cited personal commitments of staff as either *very important* or *important* in comparison to staff working pattern (85%) and staff health and fitness (85%). Weather was cited as *neither important nor unimportant* by nearly half of the respondents (47%) scoring the lowest mean value of 3.35 (SD = *0.7)* amongst all of the factors.

7.2.7. Effectiveness of travel plan measures

The survey results show that more than three–quarters of the respondents (78%) rated measures to promote cycling (e.g. incentives for cycling, improved access by cycling, improved facilities by cycling, and promotional materials and activities to encourage cycling) as either *very effective* or *effective* in comparison to measures to promote or reduce other modes of transport especially walking (see Figure 7.6). Moreover, measures to promote public transport were also cited as *very* *effective* or *effective* by a high proportion of the respondents (70%). In the case of travel plan measures aimed at reducing the use of cars, restrictions on car parking permits was rated as either a *very effective* or *effective* measure by a higher proportion of the respondents than imposing car parking charges.

Travel plan measures to promote walking were cited as *ineffective* or *neither effective nor ineffective* by nearly three–quarters of the respondents (75%). The dissimilarity between the performance of travel plan measures to promote cycling and walking suggests that although there is a potential to promote walking on its own or in conjunction with car use for hospital staff, designing travel plan measures to promote walking still remains a challenging task in practice. The reasons why the potential of promoting walking is higher than cycling and public transport is discussed in Chapter 1 in detail. Findings from Survey 2 that include data on the proportion of hospital staff living within the walking distance is discussed in Chapter 8. However, the key idea is if there is no environmental constraints present to prohibit walking within the areas adjacent to the hospital site (two miles radius) any individual without any physical disability should be able to walk to work either on its own or in conjunction with car use. Walking is a relatively safe travel option that does not require any special skills or and any major improvement to the existing infra–structure.

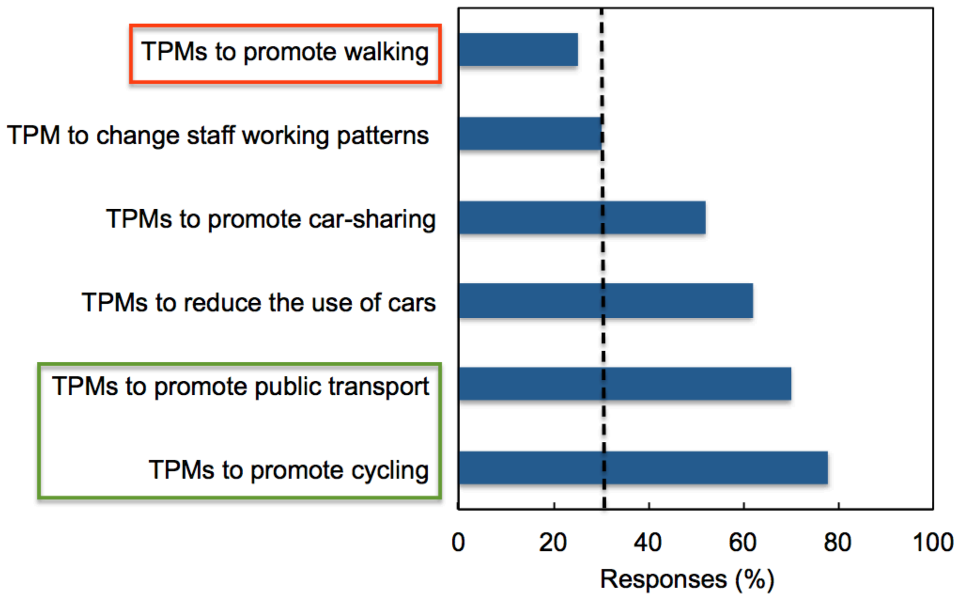

Figure 7.6: The relative effectiveness of travel plan measures. Travel plan measures to promote cycling and public transport were cited as *very effective* or *effective* by a higher proportion of the NHS Trusts. In contrast, travel plan measures to promote walking were cited as *very effective* or *effective* by the lowest proportion of the NHS Trusts.

The Spearman's ρ correlation coefficient scores (Spearman, 1904) between measures to promote walking and discourage the use of cars are presented in Table 7.3. The results show that the effectiveness of measures to promote walking, such as promotional materials and activities to promote

Table 7.3: Spearman's ρ test: Correlation between measures to promote walking and reduce the use of cars.

	Travel plan measures	1	2	3	4	5	6
1	Incentives for walking		.93**	.89**	.88**	.15	.35*
2	Improved facilities for walking			.91**	.75**	.002	0.32
3	Improved pedestrian access				.76**	.16	.51**
4	Promotional activities to encourage walking					.04	.28
5	Restrictions on parking permits						.45*
6	Car parking charges						

** Correlation is significant at the .001 level (2–tailed).

* Correlation is significant at the .05 level (2–tailed).

walking was positively associated with measures designed to change the situational context, such as incentives for walking *(ρ = .88**)*, improved pedestrian facilities *(ρ = .75**)*, and improved pedestrian access *(ρ = .76**)*. Promotional materials are designed to reinforce positive attitude towards walking (Anable, 2005) and changing the situational context within the scope of travel plan often involves providing incentives to encourage walking and/or improving the situational constraints to facilitate walking. The effectiveness of measures to restrict car parking permits was only positively correlated with the effectiveness of measures to introduce car parking charges *(ρ = .45*)*. However, the effectiveness of measures to introduce car parking charges was positively correlated with the effectiveness of measures to promote walking, such as incentives for walking *(ρ = .35*)* and improved pedestrian access *(ρ = .51*)*. The results found in this study are consistent with prior research findings by several studies that a combination of hard and soft measures are more effective in reducing the use of cars or promote walking (Cairns et al., 2002, 2004, 2010; Enoch and Ison, 2008; Enoch and Zhang, 2008; Taylor and Newson, 2008). The results found validate the research hypotheses, which are:

- **Hypothesis 1 (H1)**: The effectiveness of measures to promote walking is positively correlated with the effectiveness of measures to discourage the use of cars.
- **Hypothesis 2 (H2)**: The effectiveness of soft measures to promote walking is positively correlated with measures to change situational context of the walking environment.

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7.2.8. Monitoring the travel plan

The Survey 1: Hospital travel plan survey findings show that nearly half of the respondents (49%) reported that they monitor the travel plan at least once a year (see Figure 7.7). Moreover, nearly one–fifth (20%) of the respondents reported that they monitor the travel plan at least once every two years. Only a small proportion of the respondents reported to monitor the travel plan at least once every three years or at least once every five years. The remaining respondents (around 20%) reported that they do not have any fixed time period to monitor their travel plans. The respondents were also asked to identify key indicators they use to monitor the impacts of the travel plan.

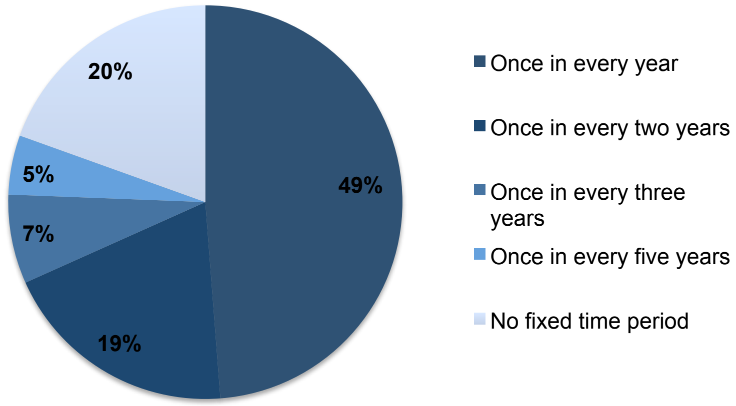


Figure 7.7: The frequency of monitoring the travel plans.

The highest proportions of the respondents said the performance of the travel plan was monitored by *a change in modal share* (62%); and *car parking space and employee ratio* (60%) (see Figure 7.8). Moreover, nearly one–third of the respondents reported to have used *employee satisfaction* and *average vehicle occupancy status* to monitor their travel plans. Monitoring the impacts of a travel plan is a complex process. Several methods and tools have been introduced by different organisations to–date including the "Workplace travel plan evaluation tool" by the Department for Transport (DfT, 2008). However, the travel plan monitoring process is largely dominated by a checklist approach guided by organisational expertise and motivations.

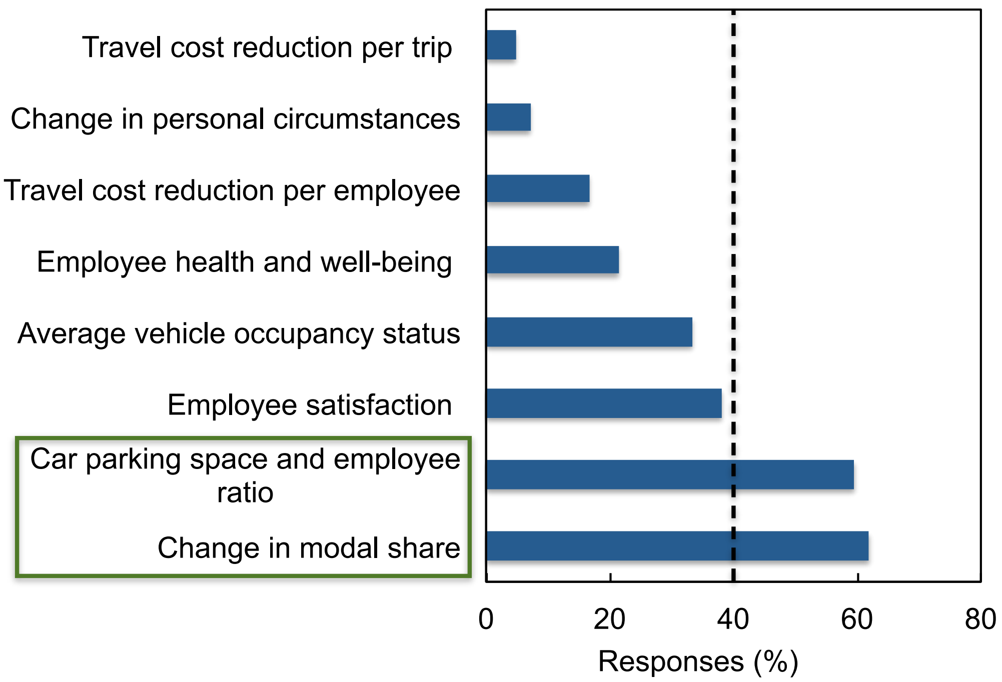


Figure 7.8: The key indicators used to monitor travel plans. More than half of the NHS Trusts reported to have monitored the travel plans by a *change in modal share* and *car parking space and employee ratio*.

7.2.9. Challenging step of a travel plan

The respondents were asked to identify the most challenging step of the travel planning decision–making process. The Survey 1: Hospital travel plan survey findings show (see Figure 7.9) that the highest proportion of the respondents (34%) cited implementing the travel plan as the most challenging part of the travel planning process, which supports the claims made by other studies (Cairns et al., 2002; Roby, 2010; Newson, 1997; Rye and Ison, 2005; Rye et al., 2011) (see Figure 7.9). As discussed earlier, the implementation of a travel plan largely depends on several organisational and situational aspects, which need to be taken into account during the design phase of the travel plan. For example, introducing car–parking charges may lead to unintended consequences such as illegal parking on local roads, and resentment among the staff towards the hospital authority. The staff may still continue to use cars despite imposing car parking charges for several reasons:

- if the car parking charges are perceived as cheap in comparison with other modes of transport;
- if there are no feasible alternatives to car use;
- if there is a provision of free car parking spaces in the surrounding areas;
- if the socio–economic and environmental implications of reducing car use is not realised; and
- if car parking charges are viewed as a means of generating income.

Therefore, the issues associated with car parking charges need to be resolved through adequate consultation and by determining car parking charges with respect to individual circumstances of the staff (Ison and Rye, 2003). Previous research suggested that ring–fencing the income generated from car parking charges to improve the infrastructure for alternatives can help increase the acceptance of such measures (Ryley, 2005).

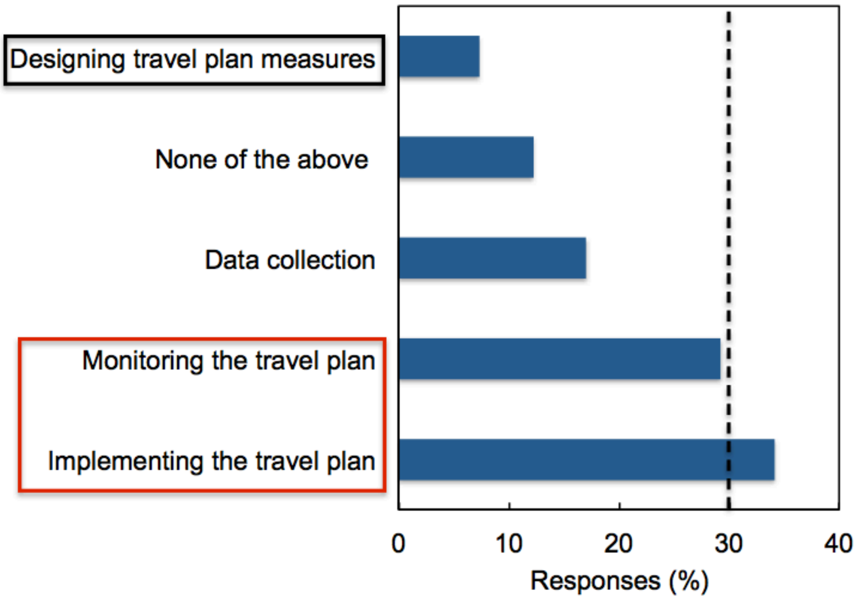


Figure 7.9: The most challenging step of the travel planning process. Monitoring and implementing the travel plans were cited as the most challenging by a higher proportion of the NHS Trusts. Designing travel plan measures was viewed as a challenging step by the lowest proportion of the NHS Trusts.

7.2.10. Barriers to change in travel mode choice

The respondents were asked to express their views on the key barriers to change in travel mode choice. From their responses, the factors cited as barriers to change in travel mode choice were identified and classified into four groups in accordance with the general classification of factors associated with travel mode choice. The factors were also classified into three groups according to the frequency of the responses (i.e. 0 to 5, 6 to 10 and 11 to 15) and presented in Table 7.4. The results show that the barriers (to change in travel mode choice) with the highest frequency of responses were shift working patterns (15) and lack of access by public transport (14). Other factors that were cited a key barrier by a relatively high number of respondents include personal circumstances (10), car dependency/high car use/culture of car use (9), staff attitude towards travel (7), and lack of resources (7).

Table 7.4: Barriers to change in travel mode choice.

Category	Socio–economic	Pychological	Situational	Modal attributes
0 to 5		Travel habit (2) Resistance to change (4) Negative perceptions towards alternative modes of transport (3) Safety concerns (2) Lack of environmental awareness (1)	Site visits (5) Free or low car parking charges (5) Lack of communication (1) Lack of management support (3) Location of hospital sites (1) Distance between workplace and home (2) Weather (2) Lack of facilities for cyclists (1) Lack of facilities for pedestrian (1) Lack of access by cycle (e.g. lack of cycle lanes) (1) Designing effective travel plan measures (1)	Convenience (3) Time efficiency (3) Flexibility (2) Poor quality of public transport (3) High cost of public transport (4)
6 to 10	Personal circumstances (10)	Car dependency/high car use/culture of car use (9) Staff attitude towards travel (7)	Lack of resources (7)	
11 to 15			Shift working patterns (15) Lack of access by public transport (14)	

7.3. Results on hospital travel plans review

Twelve hospital travel plans were reviewed following the concept of directed content analysis using a coding framework. The key purpose of the review was to examine if the travel plans were produced following the recommendations made by the best–practice guidance. The key findings from the hospital travel plan review are presented in Table 7.5, Table 7.6 and Table 7.7.

The review of hospital travel plans shows that only two hospitals reported to have a target for both reducing car use and increasing walking within a defined time–frame Table 7.5. The target to reduce car use and increase walking within a five–year period ranged from 10% to 20% *($n = 3$)* and 8% *($n = 10$)*. Three–quarters of the hospitals *($n = 9$)* reported to have conducted a staff travel survey. Seven hospitals collected information on the modal share for both car use and walking. Most of the hospitals *($n = 8$)* reported to have more than 70% staff, who commuted by car. Only one hospital had a relatively lower modal share for car use (55%). The proportion of the staff walked to work across the eight the eight hospitals ranged from 4% to 14%.

The recommended commuting distance by walking is two miles (DfT, 2007). Time require to travel two miles distance by walking may vary with respect to age, gender and health–conditions. The proportion of people living within a two–mile radius from the hospital site is generally used as a key criteria to identify the staff, who can walk to work. Only one hospital travel plan collected information on the proportion of staff living within a walking distance, which was only 16% of the staff Table 7.6. Therefore, the proportion of the staff living within walking distance for the remaining hospitals is unknown. This information is important for setting up realistic targets for a travel plan. Therefore, a question arises, based on what information the travel plan targets were determined. The scope of combining walking as a link with other travel modes should be considered if a high proportion of the staff live outside two miles catchment area. Only two hospitals collected information on the time spent on commuting by the staff. However, a staff travel survey was conducted by a high number of the hospitals. The use of important information, such as commuting distance, and time to inform the travel planning process was not evident from the review of travel plans.

Carrying out a walking audit is recommended as a key action to assess the provision of pedestrian facilities and pedestrian access to and from the site. However, only small proportion of the hospital travel plans reported to have collected information on pedestrian access to and from the site *($n = 4$)*; and on-site provision for walking *($n = 2$)*. Hospitals are considered as one of the least accessible services by walking. Collecting information on the existing pedestrian access and provision of pedestrian facilities is vital measures to support walking. Information on the current

Table 7.5: Travel plan targets and information collected on staff travel patterns.

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	n	%
Travel plan target														
Travel plan target (years)	5	-	2-3	5	5	-	-	-	-	-	-	-	4	33
Reduce single occupancy car use (%)	14	-	10	10	10	10-20	-	-	-	7	5	-	5	42
Increase walking (%)	8	-	4	-	-	-	-	-	-	2	-	-	3	25
Travel mode used														
Car use (%)	74	-	55	-	82	83	88	76	-	71	87	55-88	9	75
Walking (%)	8	-	8	-	12	7	-	4	14	-	6	4-14	8	67
Staff living within walking distance														
Staff live within 2 miles (%)	-	-	-	-	16	-	-	-	-	-	-	-	1	8
Commuting time by staff (%)														
0 to 15 minutes	-	-	-	-	26	-	-	-	29	-	-	-	2	17
16 to 30 minutes	-	-	-	-	43	-	-	-	38	-	-	-	2	17
31 to 60 minutes	-	-	-	-	-	-	-	-	30	-	-	-	1	8

n: Frequency

Table 7.6: Methods used to collect data to develop a travel plan.

Criteria	1	2	3	4	5	6	7	8	9	10	11	12	n	%
Data collection method														
Conducted a site assessment	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	2	17
Conducted a staff travel survey	✓	✗	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓	9	75
Data collected														
Pedestrian access	✓	✗	✗	✗	✓	✗	✓	✗	✗	✗	✓	✗	4	33
On-site provision for walking	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	2	17
Vehicular access	✗	✗	✓	✓	✓	✗	✗	✗	✗	✗	✗	✓	4	33
Onsite congestion	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	1	8
Congestion on local roads	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	2	17
Car park availability	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓	✗	✗	7	58
Car park use	✗	✗	✓	✗	✓	✗	✗	✗	✓	✓	✓	✗	5	42
Road side parking	✗	✗	✓	✗	✓	✗	✗	✗	✓	✗	✓	✗	4	33

n: Frequency

provision of car parking and the uses of car parking spaces throughout the day were recorded by seven and five hospital travel plans respectively. An excess demand for car parking spaces during peak hours was reported by all of the travel plans. A small proportion of the travel plans also collected information on vehicular access *($n = 4$)*, roadside parking *($n = 4$)*, congestion on local roads *($n = 2$)*, and on–site congestion *($n = 1$)*.

Identifying issues related to the staff travel behaviour is key to design effective travel plan measures (Table 7.7). None of the hospitals considered the all three issues as recommended by the Transport for London (TfL, 2006). Identifying the key barriers to change travel mode choice is, in particular, important to determine the viability of walking as a commuting travel option (Macmillan et al., 2013). However, only a quarter *(n = 3)* of the travel plans had identified the key barriers to change travel mode choice.

Seven travel plans had a combination of travel plan measures to promote walking and discourage

Table 7.7: Issues considered while designing travel plan measures.

Criteria	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	n	%
Key issues considered while developing travel plan measures and travel plan measures used														
Identified the reasons for the present travel pattern	✓	✓	✓	✗	✓	✗	✗	✓	✓	✗	✘	✗	6	50
Identified the barriers to changing travel behaviour	✓	✗	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	3	25
Addressed the changing travel needs of the staff	✗	✓	✗	✓	✗	✗	✓	✗	✗	✗	✓	✓	5	42
Measures to manage car use														
Car parking management policy	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	8	67
Restrictions on parking permits	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	8	67
Car parking charges	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	10	83
Measures to promote walking														
Incentives for walking	✗	✗	✓	✗	✓	✗	✗	✗	✓	✓	✗	✗	4	33
Improved facilities for walking	✗	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	9	75
Improved access by walking	✗	✓	✓	✗	✗	✗	✓	✗	✓	✓	✓	✓	7	58
Promotional materials and activities to encourage walking	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	11	92

n: Frequency

the use of cars. Most of the travel plans ($n = 10$) had introduced both car parking charges; and promotional materials and activities to promote walking. Restrictions on car parking permits ($n = 8$) and the provision of improved facilities ($n = 9$) were also found to be popular. However, only a quarter of the travel plans ($n = 4$) introduced incentives to promote walking.

7.4. Discussion on hospital travel plans

Securing the success of a travel plan has become a real challenge for the most of the healthcare authorities. A few studies have attempted to investigate the key determinants of a travel plan. However, the knowledge of how to secure the success of a travel plan remains fragmented especially in a healthcare setting. This study attempted to contribute to the knowledge gap by providing an overview of hospital travel plans in England. This study has shown that transport issues experienced by most of the hospitals can be characterised as high car use and associated externalities, such as congestion on local roads, on–site congestion, and high demand for car parking spaces. The travel context of hospitals is often linked with the provision of free or low cost car parking spaces, shift–working patterns, a lack of access to the hospital sites by public transport and the organisational culture to car use (Rye, 1999).

The study shows that the adoption of hospital travel plans is dominated by organisational and policy interests and these will continue to play a key role in sustaining hospital travel plans in the future. The use of travel plans to address the organisational values and site–specific needs were evident among the healthcare authorities. Many healthcare authorities have attempted to link the objectives of a travel plan with the socio–economic, health and transport objectives of the organisation, reflecting a more pro–active approach to utilise the full potential of travel plans. Introducing travel plans in response to a wide range of motivations help to sustain travel plans for longer (Roby, 2010). For example, introducing a travel plan with a motivation to improve access by alternative modes of transport help to broaden–up the scope of engaging with the local authorities, public transport providers, and other organisations for support and may reduce the overall cost of maintaining a travel plan over a longer term. Moreover, a travel plan with a wide range of issues can maximise the overall benefits gained to the organisation, which helps to secure senior management approval to provide financial support to continue the travel plan in the long–term.

According to the survey, most of the respondents considered factors related to organisational and situational context; work commitments and personal circumstances during the travel planning process. Consideration of these factors is in particular important for determining realistic modal shift targets and effective implementation strategies to achieve higher public acceptance. These factors were also viewed as the key constraints to changing travel mode choice behaviour. However, there was insufficient evidence to suggest what methods may have been used to utilise the evidence to inform the travel planning process. Moreover, the use of information about the psychological constructs of the staff was not evident from the review of travel plans. It confirms that the travel plan measures were designed with a lack of focus on influencing the psychological constructs of the staff.

As recommended by the best–practice guidance on travel plans, the use of a combination of positive and restrictive measures was evident in most of the travel plans. A variation in the effectiveness of travel plan measures was evident; measures to promote walking were cited as the least effective. What factors may have had a higher impact on determining the effectiveness of travel plan measures remain unclear. However, the evidence found suggests that despite following an effective strategic approach, the quality of evidence and methods used to inform the travel planning process may have affected the effectiveness of the travel plan measures. An Australian study by (De Gruyter et al., 2014) suggests that the council staff's lack of expertise to assess the quality of travel plans for new developments may have affected their success. The evidence discussed above calls for the importance of collecting reliable information and methods to synthesise the information to support the travel planning process in practice. Training the staff involved in travel planning process with the right skilss and expertise is therfore vital to ensure the overall success of the travel plan (Associates, 2008; De Gruyter et al., 2014).

Providing better access by public transport may involve allocation of additional resources, improving the existing transport infrastructure, negotiation with local public transport providers, and regular liaison with the local authorities. In many cases, the necessary actions required to provide better access by public transport is either beyond the scope of a travel plan or require long–term planning (Watts and Stephenson, 2000). Therefore, for hospitals with limited access by public transport promoting alternative modes of transport, such as walking and cycling is vital to reduce the use of cars.

The issues experienced by the NHS hospitals further emphasise the significance of promoting walking among the hospital staff. The review of hospital travel plans shows that a proportion of the hospital staff were already walking to work. Further initiatives to promote walking among the staff will improve the overall walking environment, which in turn will help a higher proportion of the staff to walk to work. Most of the NHS Trusts reported that their on–site parking facilities were insufficient to meet the peak hour parking demand. Many hospitals already have the provision of off–site car parking facilities to accommodate the demand for additional car parking, such as Glenfield Hospital, and Leicester Royal Infirmary Hospital. In case of hospitals with limited car parking spaces, the patients and visitors receive a higher priority to park on–site. For example, at Southampton General Hospital the main car park is allocated for the patients and visitors (University Hospital Southampton NHS Foundation Trust, 2015). Moreover, congestion on local roads is likely to cause delay in accessing hospital sites, which is likely to have serious implications on the delivery of healthcare services. The provision of off–site car that is 10 to 15 walking distance away from the hospital site will be proven to be beneficial to address the transport issues experienced by hospitals.

There are essentially two pre–requisites to adopting walking as a travel option: an individuals' physical ability to walk as a travel option; and there are no constraints that could hinder walking. People with a permanent physical inability to walk should, therefore, be excluded from the target group to change travel behaviour. The overall success of the travel plan lies on the effective implementation of travel plan measures to address the situational changes required to facilitate the walking behaviour of the staff (Möser and Bamberg, 2008; Macmillan et al., 2013). Situational changes may involve providing pedestrian facilities to improve pedestrian access. However, major situational changes such as improving pedestrian infrastructure are resource intensive and time–consuming tasks that could be beyond the scope of travel plans (Watts and Stephenson, 2000). These issues need to be considered while determining the target to increase the modal share for walking and design measures to promote walking.

The staff, who use cars on a regular basis for commuting purposes may eventually adopt habitual behaviour towards car use and no longer practice the deliberate process of decision–making (Gardner, 2008; Verplanken et al., 2008). It means despite having walking as a viable travel option for some trips; people continue to use cars for non–car dependent trips. Breaking habitual behaviour towards car use often requires changing the context related to the behaviour (Ouellette and Wood, 1998; Verplanken et al., 2008). The strength of the habitual behaviour may vary from weak to strong (Wood et al., 2005). Measures to influence the psychological constructs of habitual behaviour include promotional materials and activities, incentives, and car parking charges. Promotional materials and activities are designed to change people's perceptions of the walking environment and reinforce positive attitude held towards walking (Gärling and Fujii, 2009; Anable and Gatersleben, 2005). Effective, persuasive campaigns, and interventions need to be underpinned by the underlying modifiable psychological constructs behind car use (Fujii and Taniguchi, 2005).

In many cases, the staff who hardly walk for commuting purposes may remain unaware of the changes made to the physical environment to facilitate walking, therefore, may hold a relatively negative or biased perception of the walking environment (Verplanken et al., 1997). There is a growing support for the claim that persuasive campaigns and incentives alone have not been successful in encouraging the use of sustainable modes of transport (Domarchi et al., 2008; McClintock and Shacklock, 1996).

Subjective expected utility accounts of travel mode choice is proven to be useful. However, individuals may still not change mode choice behaviour in response to new information and new circumstances. Strong habits may provide a plausible explanation behind why interventions tend to have small to moderate impacts on changing travel behaviour (Hardeman et al., 2002). Individuals with strong habits tend to use heuristic and low effect strategies that have limited and selective information processing power irrespective of the level of knowledge and previous experience. In the presence of strong habit among the target population, interventions may need to focus on altering the travel context.

Strong habitual behaviour is hard to break and often require introducing measures to alter the travel context, such as car parking charges, and restrictions on parking permits. The significance of a robust car parking strategy in reducing the use of cars has been highlighted in many studies (Cairns et al., 2010; DfT, 2009a; Ryley, 2008). In line with previous studies, the evidence produced by this study also suggests that in the context of healthcare a combination of positive and restrictive measures are more effective in reducing the use of cars and promote walking. However, introducing measures to restrict the use of cars often causes strong emotions and negative reactions among the staff and may result in unintended consequences, such as illegal parking on local roads (Anable, 2005). Evidence suggests that issues associated with car parking charges could be resolved through adequate consultation and by determining car parking charges in accordance with the individual circumstances of the staff. Many suggested that ring–fencing the income generated from car parking charges to improve the provision of alternatives help to increase the public acceptance of such measures (Ryley, 2010; Watts and Stephenson, 2000).

In some cases, solutions to situational problems (e.g. introducing bus lanes, cycle routes, negotiating with public transport operators for improved services and provide/use funds to subsidise bus routes) may be beyond the employer's immediate influence and require assistance from other organisations (Watts and Stephenson, 2000). Therefore, the effectiveness of travel plan measures draws upon the successful adoption of innovative organisational practices and strategies in the dynamic situational and individual travel context. However, in case of new hospitals the challenges experienced while implementing a travel plan could be minimised by the careful selection of hospital sites with access to quality alternatives and residential accommodations.

Most of the healthcare authorities reported to have a system in place to monitor their travel plans. However, the effectiveness of the monitoring processes used to capture the wider direct and indirect impacts of a travel plan predominantly depends on the organisation's commitment to the travel plan (Cairns et al., 2010). There is no legal binding from local government or standardised protocols from the NHS to monitor the impacts of the hospital travel plans (Rye et al., 2011). As suggested by other studies, a legally binding monitoring of travel plans is likely to lead to the adoption of a more robust travel plan monitoring among the healthcare authorities (Enoch and Potter, 2003; Rye et al., 2011). Future strategies and policy actions targeted to secure the success of hospital travel plans need to place a higher emphasis on designing effective travel plan measures and following a systematic approach to monitor the travel plan. Previous studies on designing interventions to change travel behaviour mostly focussed on issues in relation to car–use, public transport, car–sharing, and cycling; therefore, further research is required to explore the issues in relation to designing interventions to promote walking.

Macmillan et al. (2013) suggested that a travel plan needed to be monitored on a regular basis over a period to evaluate the true effects of travel plans on changing travel behaviour. Most studies on hospital travel plans have not been published in peer–reviewed publications. The reliability of methods used to develop and monitor the travel plans have been questioned by academics, such as Macmillan et al. (2013). Therefore, there is a lack of reliable evidence–base to draw a conclusion on the overall effectiveness of travel plans in practice.

In conclusion, drawing upon the evidence found, it could be suggested that the NHS Acute Trusts need to employ robust methods to develop innovative and flexible measures to increase the potential of walking among the staff. The healthcare organisations can resolve the issues associated with the lack of expertise and resources by working in collaboration with other organisations (e.g.

NHS Trusts, Universities, and other charity organisations) and foster a mutually beneficial learning environment (Horton, 2000; Kaseje et al., 2015; Wartman et al., 2009). The findings from this phase further validate the need for further research into the impacts of socio–economic, situational, and psychological factors on changing the travel mode choice behaviour of the hospital staff (Gärling et al., 2002). However, they should take initiatives to encourage the staff to reside within proximity from the hospital site in the long term.

7.5. Summary

To acquire a better understanding of the key issues in relation to the effectiveness of hospital travel plans in practice, a nationwide survey was conducted among the NHS hospital travel plan co–ordinators during the first phase of the thesis and the results have been presented in this chapter. There were 47 responses received from 39 NHS Acute Trusts, representing 34% of the 115 NHS Acute Trusts with a travel plan. The survey shows that transport issues experienced by most of the hospitals could be characterised as high car use and associated externalities, such as congestion on local roads, on–site congestion and high demand for car parking spaces. Despite having a high potential to promote walking as a key travel option among the hospital staff, the measures to promote walking were regarded as the least effective.

Spearman's ρ correlation tests were used to measure the travel plan co–ordinators perception towards the effectiveness between travel plan measures to promote walking and discourage the use of cars. The results showed that the effectiveness of measures to promote walking such as promotional materials and activities to promote walking were positively associated with measures designed to change the situational context by offering objective benefits or improving the situational constraints. Besides, the effectiveness of measures to introduce car parking charges is positively correlated with the effectiveness of measures to promote walking, such as incentives for walking, and improved pedestrian access. The results are consistent with prior research findings by several studies that a combination of hard and soft measures are more effective in reducing the use of cars or promote walking (Cairns et al., 2002, 2004, 2010; Enoch and Ison, 2008; Enoch and Zhang, 2008; Taylor and Newson, 2008).

To further explore the issues associated with designing travel plan measures. Twelve hospital travel plans were reviewed based on a coding framework developed in this study based on existing policy guidance and literature. Most of the hospitals reported to have a combination of travel plan measures to promote walking and discourage the use of cars. Therefore, it can be suggested that despite employing of a combination of positive and restrictive travel plan measures to promote walking and discourage the use of cars, the lack of consideration to identify the key constraints to change travel mode choice may have contributed to the lack of success in promoting walking among the NHS hospital staff.

Chapter **8**

Analysis of hospital staff travel behaviour

8.1. Introduction

This chapter discusses the results of the findings from Phase 2, which was designed to investigate the travel mode choice characteristics and key determinants for intention to change travel mode choice behaviour of the NHS hospital staff. The primary data collection effort part of the phase included a nation–wide survey among the NHS hospital staff. The survey data were analysed alongside other data collected from secondary sources, for example, Digimap, HSCIC. Following the survey, structured telephone interviews were conducted to better understand the survey findings.

The structure of the chapter is outlined below. The analysis of the descriptive data was discussed in Sections 8.2 to 8.5. Mann–Whitney U tests were used to compare the characteristics of two travel mode user groups and discussed in Section 8.6. Prior to the structural equation modelling, a combination of preliminary analyses were performed, and the findings are discussed in Sections 8.7 to 8.9. Section 8.10 presents the results from the structural equation modelling followed by the findings from the structured telephone interview analysis discussed in Section 8.11. The NHS hospital staff's responses to travel plan measures are outlined in Section 8.12. The key findings found from Phase 2 are discussed in Section 8.13. Finally, Section 8.14 summarises the chapter.

8.2. Sample characteristics

The sample population characteristics are described in the following sections.

8.2.1. Socio–economic and demographic characteristics

Eight hundred and sixty three valid responses were received from Survey 2: Hospital staff travel behaviour survey. The sample population was classified into two groups based on their travel mode choice behaviour, namely (1) the car user group, who only commuted by car; and (2) other mode(s) user group, who commuted by alternative travel modes on its own or alongside cars. The comparison between the sample characteristics of the two travel mode user groups is presented in Table 8.1.

The key demographic characteristics of the respondents show that 79.6% of the respondents were female, which is slightly higher than the proportion of the national average female workforce (77.7%) working for the NHS (HSCIC, 2014b, c). The highest proportion of the respondents (41.19%) belonged to 45 to 59 age group followed by 37.58% of the 30 to 44 age group. Only 3.93% of the respondents were aged 60 to 64 or older. Around 35.37% of the respondents reported to have an annual household income of more than £60,000, which was followed by around 31.6% of the respondents with a £30,000 to £45,000 income level. Around two thirds (64.29%) of the respondents had no children. Around one fifth of respondents (18.11%) had two or more children. Around two third (65.47%) of the respondents worked on a full–time basis.

The sample distribution of the car user group was broadly similar to the other mode(s) user group. However, the car user group had a higher proportion of female (84.21%), middle aged (44.72%), with high household income over £60,000, with two or more children (20.87%), and part–time (40.09%) staff in comparison with the other mode(s) user group. The differences in frequency distribution does not indicate a statistically significant impact of the above socio–demographic groups in determining mode choice behaviour. Previous research exhibited no consistent role of the socio–demographic factors in explaining mode choice behaviour. However, several studies reported to have found that the propensity of using cars was associated with being female or with high income or working part–time (Curtis, 1996; Goudie, 2002). The effect of being female (male = 0), middle–aged (below 45 = 0), with children (no children = 0), with high income (income below £60,000 = 0), and working part–time (full–time = 0) on intention to change mode choice behaviour was examined in this study.

The comparison between the NHS staff and sample population by job role is presented in Table 8.2. The sample distribution was broadly similar to the NHS staff distribution. However, there was an over–representation from qualified scientific, therapeutic, and technical staff (22.84%); and support to clinical staff (38.19%). Conversely, doctors (4.39%); qualified nursing, midwifery and health visiting staff (23.09%); qualified ambulance staff (0.13%); and NHS infrastructure staff (8.39%) were

Table 8.1: The comparison between the socio–economic and demographic characteristics of the car and other mode(s) user groups.

Socio–demographic characteristics	Sample population (%)	Car user group (%)	Other mode user group (%)
Gender			
n	794	399	395
μ	1.2	1.16	1.25
SD	0.4	0.37	0.43
Skewness	1.5	1.88	1.15
Kurtosis	3.16	4.5	2.3
Female	79.6	84.21	74.94
Male	20.4	15.79	25.06
Age			
n	636	322	314
μ	3.31	3.37	3.26
SD	0.82	0.75	0.89
Skewness	-0.18	-0.31	-0.044
Kurtosis	2.67	2.4	2.7
16–19	0.63	—	1.27
20–29	16.67	13.35	20.06
30–44	37.58	39.13	35.99
45–59	41.19	44.72	37.58
60–64	3.62	2.80	4.46
65 and over	0.31	—	0.64
Income			
n	769	384	385
μ	3.96	4.1	3.82
SD	1.19	0.37	0.43
Skewness	-0.38	-0.55	-0.23
Kurtosis	3.11	3.36	3.03
Below £15,000	5.33	4.95	5.71
£30,001–£45,000	31.60	24.74	38.44
£45,001–£60,000	27.70	30.47	24.94
£60,001–£75,000	26.66	29.43	23.90
Over £75,000	8.71	10.42	7.01
No of children			
n	784	393	391
μ	0.54	0.6	0.48
SD	0.78	0.81	0.75
Skewness	1.86	1.18	
Kurtosis	2.38	2.05	2.81
No children	64.29	61.07	67.52
1 child	17.60	18.07	17.14
Two or more children	18.11	20.87	15.35
No of adults			
n	788	393	395
μ	2	2.04	2
SD	0.61	0.61	0.62
Skewness	-0.1	-.02	0
Kurtosis	2.67	2.71	2.63
1 adult	17.64	16.28	18.99
2 adults	62.56	63.10	62.03

Continued on next page

Table 8.1 – *Continued from previous page*

Socio–demographic characteristics	**Sample population (%)**	**Car user group (%)**	**Other mode user group (%)**
3 or more adults	19.8	20.61	18.99
Job type			
n	863	459	404
μ	1.65	1.6	1.71
SD	0.48	0.49	0.45
Skewness	-0.65	-0.4	-0.97
Kurtosis	1.42	1.16	1.94
Part-time	34.53	40.09	28.22
Full-time	65.47	59.91	71.78

n = Sample size, μ = Mean, SD = Standard deviation.

under–represented. The highest proportion of the responses (38.19%) was received from the support to clinical staff. The administrative staff provide vital support to the core healthcare professionals to facilitate the delivery of a diverse range of healthcare services. They are more likely to have desk–based job roles with regular internet access, it explains why there was a high response rate from the administrative staff. Around one fifth of the responses (20.26%) were received from the clinical qualified nurse, which is followed by around 14.45% from the allied health professionals (AHPs). Apart from working in hospitals, the allied health professionals provide services at different settings including patients home, clinics, schools, and colleges. Therefore, the travel mode choice of the allied professionals are likely to be influenced by their travel requirements during working hours.

Moreover, less than one third of the respondents (27.48%) were categorised as core healthcare staff, who were more likely to do shift hours (i.e. early mornings or late night starts), work on multiple sites, visit sites, and carry heavy instruments. However, working patterns and travel needs of the NHS staff may vary with respect to their job roles. One of the staff (Participant three), who took part in the telephone interviews worked as a clinical nurse once a week was asked to provide further information on the job roles of the core healthcare staff. According to the interviewee, the core healthcare staff such as doctors, specialists, and nurses are more likely to do shift patterns. The core healthcare or clinical staff have more rigid shift patterns. The working shifts of the clinical staff are designed to suit the needs of the patients to ensure that there are staff available at the ward to provide care at all times. In most of the hospitals there are two working shifts: (1) day shift from 7.00am till 7.30pm; and (2) night shift from 7.00pm till 7.30am. Most of the clinical staff are bound to do shift hours except for exceptional circumstances (e.g. family issues). The core healthcare staff therefore require more flexible travel arrangements irrespective of the length of their commuting trips.

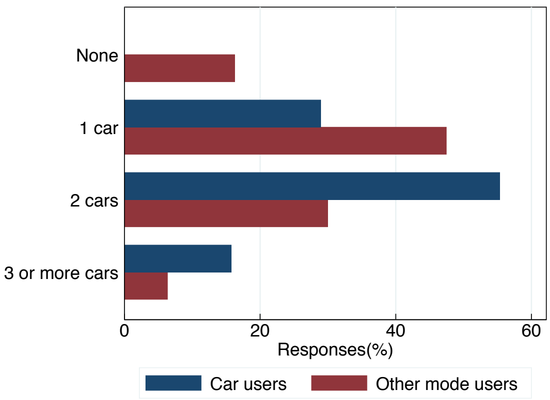
Table 8.2: The comparison between the NHS staff and sample population by job role.

Job roles	NHS staff (%)	Sample (%)
All doctors	9.37	4.39
Total qualified scientific, therapeutic & technical staff	13.03	22.84
Allied Health Professional (AHP)	-	14.45
Scientist	-	4.26
Technician	-	4.13
Qualified nursing, midwifery & health visiting staff	29.07	23.09
Qualified Nurse (Clinical)	-	20.26
Qualified Nurse (Non-clinical)	-	2.06
Midwife	-	0.77
Qualified ambulance staff	1.52	0.13
Support to clinical staff	29.64	38.19
NHS infrastructure support	17.38	8.39
Total	100% (1,234,123)	100% (775)

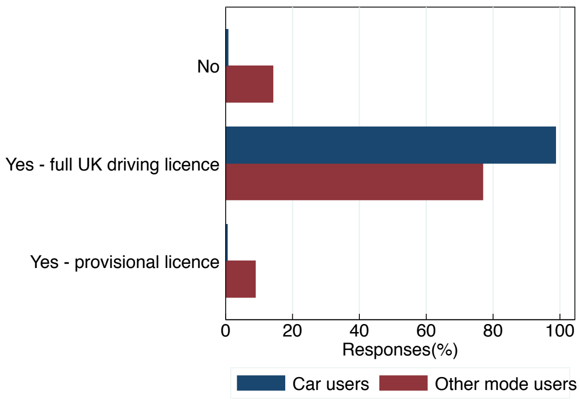
8.2.2. Mobility constraints

Access to car(s) is considered as a mediating factor between socio-economic factors and travel mode choice behaviour. Figure 8.1a shows that the respondents of the car user group were with a higher access to cars. Around two thirds of the respondents of the car user group (71.07%) were with access to two or more cars in comparison with 36.3% of the other mode user group. As reported in other research, the evidence found in this study suggests that the use of public transport, walking, and cycling was higher among the respondents (63,7%) without or limited access to a car (Kamruzzaman et al., 2013). These findings were further validated by comparing the number of car(s) and adult(s) ratio for each respondent, which also shows that most of the respondents (92.85%) of the car user group were with access to at least one car per adult in the household.

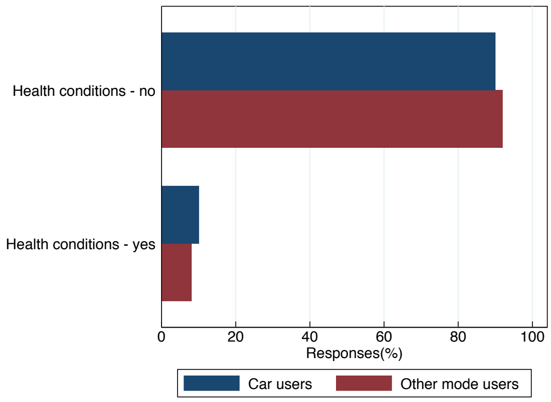
The study findings also shows that the use of a combination of travel modes was higher among those without a driving licence or with a provisional licence. Around one quarter of the respondents (23.04%) of the other mode user group were without a driving licence or with a provisional licence, as shown in Figure 8.1b. Around 10.5% of the car users only reported to have conditions that affect their ability to walk for up to 15 to 30 minutes, as shown in Figure 8.1c.



(a) Access to car(s).



(b) Driving license.



(c) Physical ability to walk.

Figure 8.1: Comparison between the car and other mode(s) user groups by: (a) Access to car(s), (b) Driving license , and (c) Physical ability to walk for commuting purposes.

Most of the respondents (83.88%), who used cars alone held an NHS authorised car parking permit (see Table 8.3). The provision of free or low cost car parking permit reported to have contributed to the high use of cars (Rye, 1999). For example, the provision of car parking permit is free of charge for the NHS staff working in the Derbyshire region. However, a monthly charge depending on the salary scale of the staff applies to the NHS staff working in the Nottinghamshire region.

Table 8.3: Access to an NHS car parking permit and parking methods.

Car parking	Frequency	Percentage
NHS car parking permit		
Yes	385	83.88
No – but I have applied	13	2.83
No – applied but a permit denied	7	1.53
No – no intention to apply	54	11.76
Total	459	100
Parking methods		
On-site hospital car park	352	75.37
Off–site NHS car park	53	11.35
On local roads	42	8.99
Other off–site car park(s)	20	4.28
Total	467	100

8.2.3. Situational factors

The sample distribution by the geographical location of the hospitals is shown in Figure 8.2. Responses were received from 68 hospitals across all of the English regions. However, most of the responses were received from the East Midlands (55.76%), East of England (22.7%), and South West (12.57%) regions. A higher proportion of the responses were received from 11 hospitals due to the active support received from the corresponding NHS Trust representatives with circulating the questionnaire via either their intranet sites or other mediums. More than 100 responses were received from Leicester Royal Infirmary (141), Nottingham University Hospitals NHS Trust - Queen's Medical Centre Campus (114) and West Suffolk Hospital (101). More than half of the respondents (53.4%) were from hospitals managed by the Acute Teaching Trusts, which is followed by nearly one third (30.9%) by the small Acute Trusts. The NHS Acute Teaching Trusts provide patient–care with a higher emphasis to trials, audits, and research projects (Khan, 2012). Therefore, the staff working for the Teaching Trusts are more familiar with academic research projects and more willing to take part in surveys conducted as part of research projects.

The relative comparison between the two travel mode user groups by workplace location is presented in Figure 8.3. The highest proportion of the respondents from hospitals located near the city centre (64.67%) commuted by alternative travel modes. The use of alternative travel modes by a relatively higher proportion of the respondents could be attributed two reasons: (a) around 60.67% of the respondents from hospitals located near the city centre lived within up to five miles distance; and (b) hospitals located near the city centre are likely to have good access by alternative modes of transport. In contrast, the modal share for commuting by car alone was the highest among the respondents from hospitals located near the edge of town (64.25%). City centres are generally better facilitated by easy access to alternative modes of transport, which is likely to have

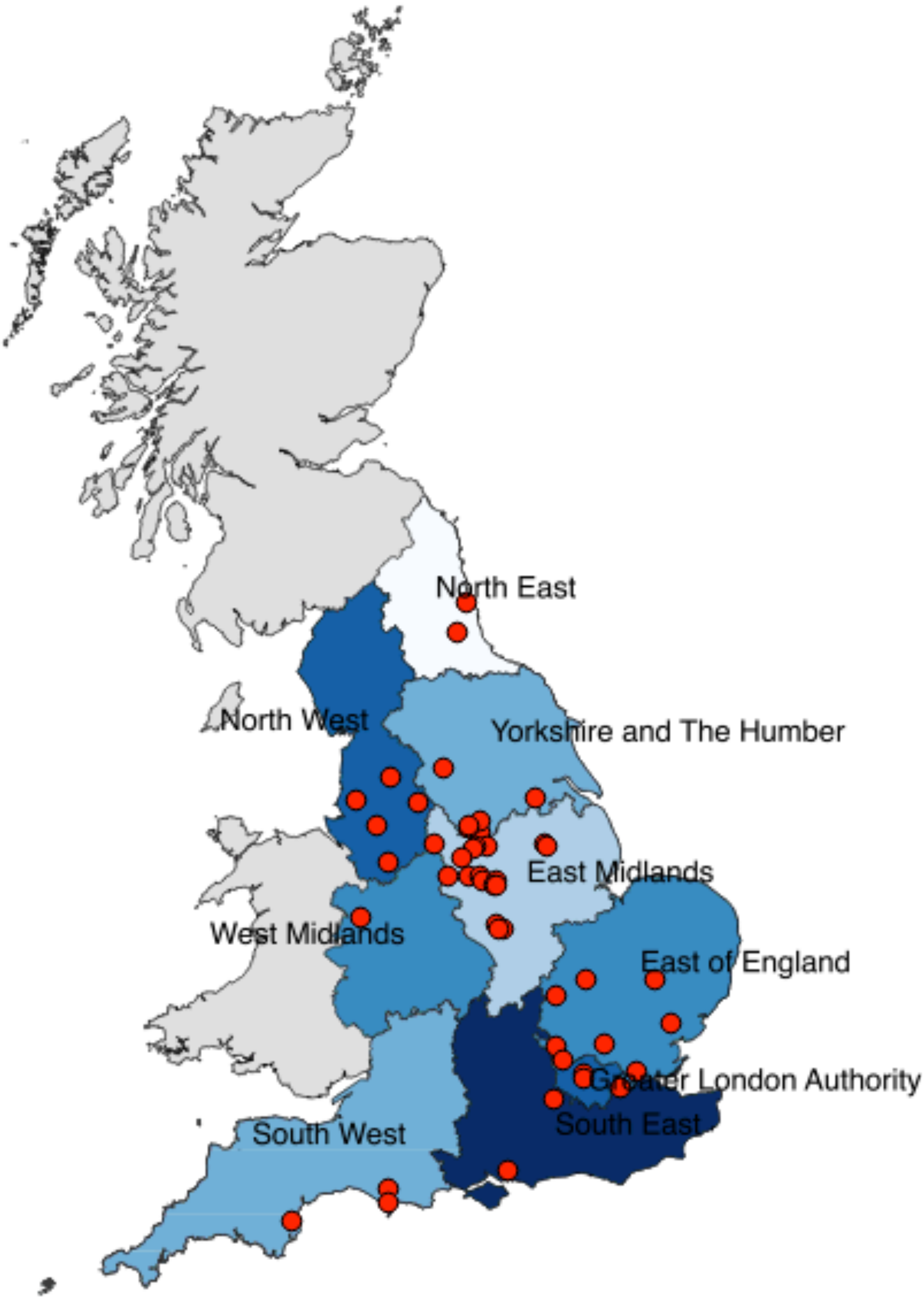


Figure 8.2: Sample distribution by the geographical location of the hospitals.

an impact on the travel behaviour of the NHS hospital staff. Most of the respondents (91.3%) were from General Acute Hospitals. Therefore, it could be assumed that the work responsibilities for each job role for most of the respondents were similar.

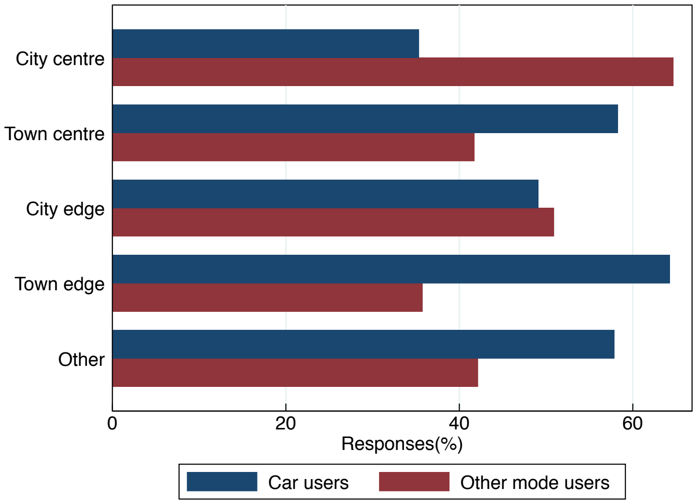


Figure 8.3: The comparison between the car and other mode(s) user groups by their main workplace location.

Figure 8.4 shows that the distributions of the mode user group(s) by access to a travel plan were broadly similar. More than half of the respondents (54.29%) from hospitals with an access to a travel plan commuted by car alone. The impacts of travel plans on changing travel behaviour are likely to vary with respect to situational factors, such as historic car use, access by alternative modes of transport, proportion of staff living within five miles distance, and organisational parking policy (Cairns et al., 2010; Enoch, 2012; Macmillan et al., 2013). The data collected in this study were insufficient to indicate the potential impact of travel plans on the existing staff travel patterns.

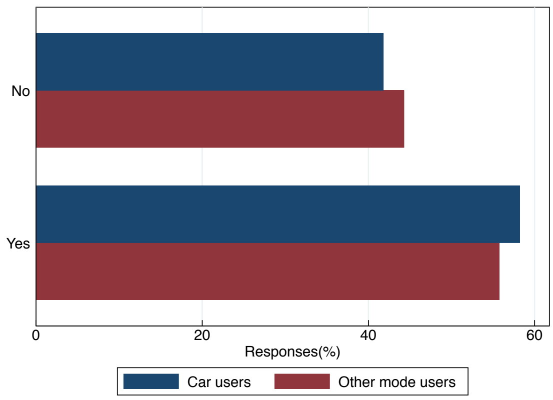


Figure 8.4: The comparison between the car and other mode(s) user groups by access to a travel plan.

8.3. Existing staff travel patterns

The frequency of using different travel modes by the sample population is presented in Figure 8.5. Car was the predominant travel mode among the NHS staff, around two third of the respondents (65.5%) reported to have commuted by car, occasionally or on a regular basis. The modal share for the remaining travel modes were 17.38% by bus, 16% walking, 9.84% cycling, 7.88% car sharing,

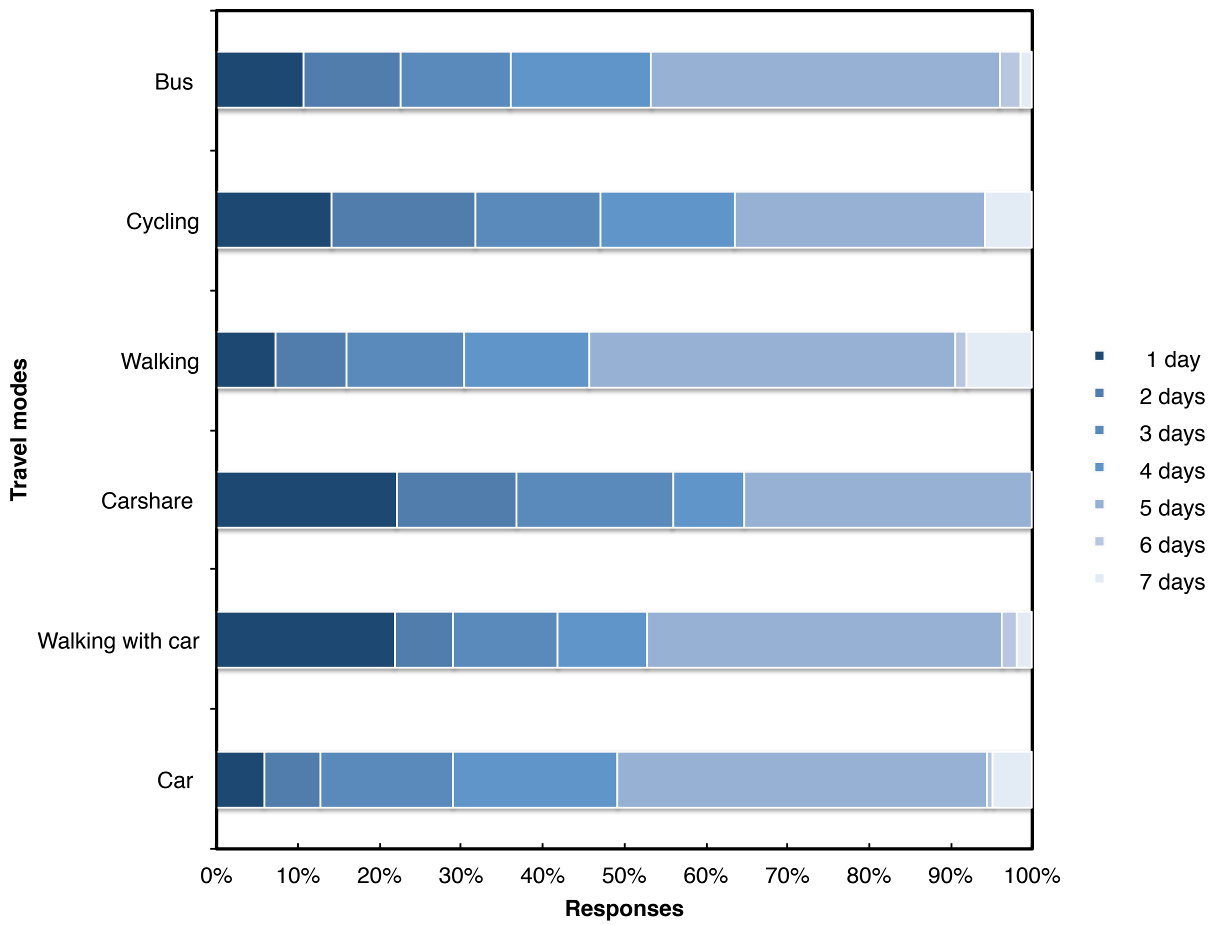


Figure 8.5: The frequency of using different travel modes by the sample population.

and 6.37% walking with car use.

The travel mode choice behaviour of the NHS staff was broadly classified into two groups based on the assumption that the prevalence of habit is higher among the staff, who commute by car only. More than half of the respondents (53.19%) reported to have commuted by car and/or car–sharing alone, and were selected as a target population for changing behaviour as part of this study. Therefore, the structural equation modelling was performed to test the research hypotheses based on the 459 responses from the car user group.

8.3.1. Objective mobility

All respondents were asked to select the time spent on either getting to or from work by their main travel mode. More than half of the respondents (60.45%) reported to have over 30 minutes of commuting time each way (see Figure 8.6a). As evident in other studies, the average commuting time for the car user group (31 to 60 minutes) was higher than the other mode user group (16 to 45 minutes) (DfT, 2014). Figure 8.6b shows that a high proportion of the respondents of the car user group (81.27%) were with a commuting time of more than 30 minutes in comparison with those of the other mode user group (36.13%).

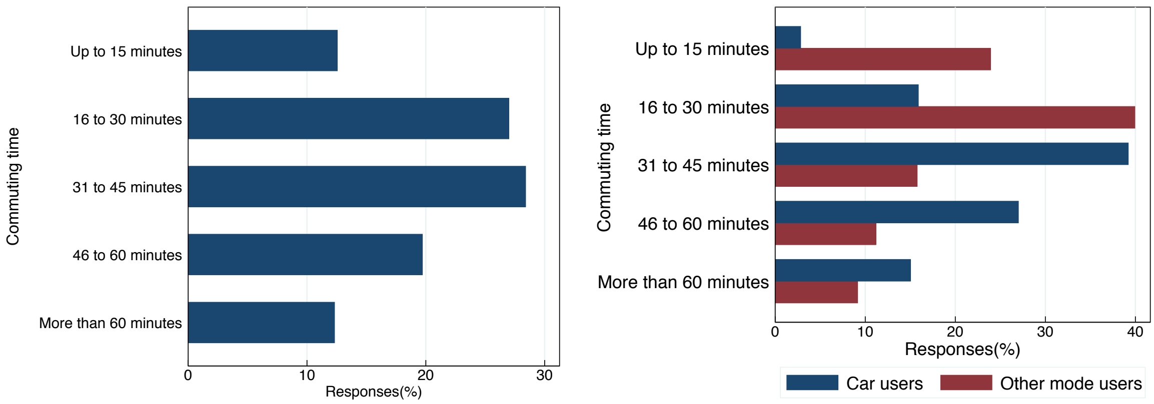
Figure 8.7a shows that respondents living within a two and five miles distance accounted for 18.77% and 43.68% of the total sample population respectively. The average commuting distance for the sample population was 11.45 miles (each way), which was longer than the average UK commuting distance of 8.8 miles in 2013 (DfT, 2014).

The comparison between the two groups by commuting distance also shows a similar pattern as commuting time (see Figure 8.7b). The average commuting distance (each way) of the car user group was 13.93 miles, which was considerably longer than the other mode user group (8.64 miles). Only 5.88% respondents of the car user group were with a commuting distance of up to two miles in comparison with around one third (33.42%) of those of the other mode user group. Around two–thirds of the respondents of the other mode user group (64.61%) lived within five miles distance from their workplace in comparison with only a quarter of those of the car user group. The potential of walking and cycling is generally higher when the distance criteria is met and the travel environment is perceived as satisfactory by the individuals (Dickinson et al., 2003; García-Palomares, 2010). Therefore, it can be assumed that long commuting distance may have limited the use of walking and other alternative modes of transport among a high proportion of the NHS hospital staff.

The average annual car mileage of the sample population is presented in Figure 8.8a. According to the results 23.48% of the respondents were with an average annual car mileage of over 9,000 miles. Figure 8.8b shows that a high proportion of the respondents of the car user group (60.93%) were also with a high annual average car mileage of over 9,000 miles in comparison with those of the other mode user group (29.41%). The data suggest that the average commuting time, commuting distance and annual average car mileage of the car user group were relatively higher when compared with the other mode user group.

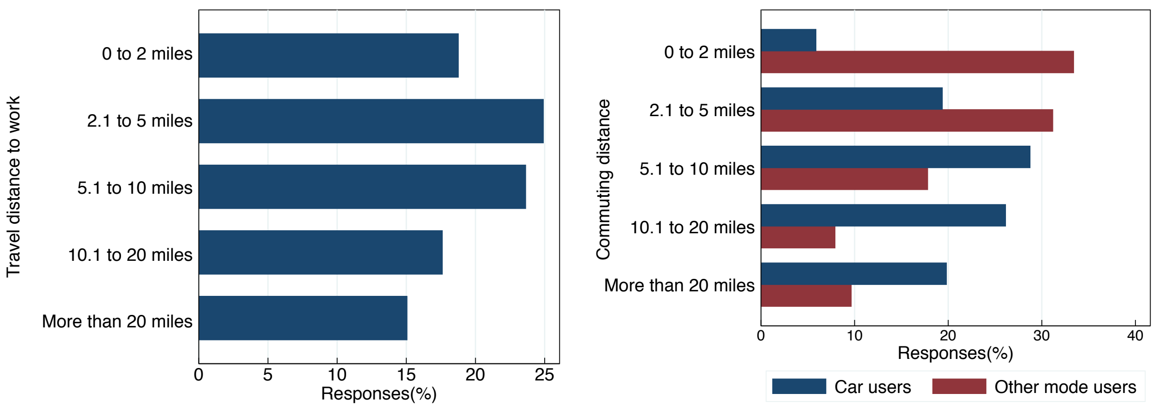
Figure 8.9 shows that a relatively higher proportion of the respondents (61.57%) worked at their present workplace for more than five years in comparison with those of the other mode user group (49.38%). The data suggest that the frequency of commuting by car was lower among the relatively new staff (work duration < five years).

The comparison between the two travel mode user groups by job role shows that around two–third of the qualified clinical nurses (65.61%) commuted by car alone. In contrast, more than half of the administrative staff (59.72%) commuted by alternatives. The job responsibilities and working hours between the clinical and administrative staff are different, which is likely to influence their travel mode choice behaviour.



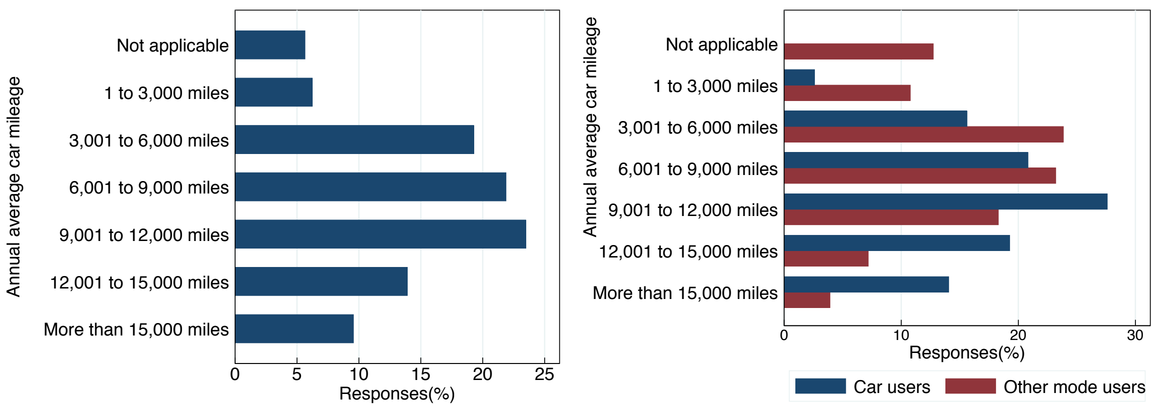
(a) Sample. **(b)** Comparison.

Figure 8.6: Analysis of commuting times. (a) Sample population, and (b) Comparison between the car and other mode(s) user groups.



(a) Sample. **(b)** Comparison.

Figure 8.7: Analysis of commuting distance. (a) Sample population, and (b) Comparison between the car and other mode(s) user groups.



(a) Sample. **(b)** Comparison.

Figure 8.8: Analysis of annual average car mileage. (a) Sample population, and (b) Comparison between the car and other mode(s) user groups.

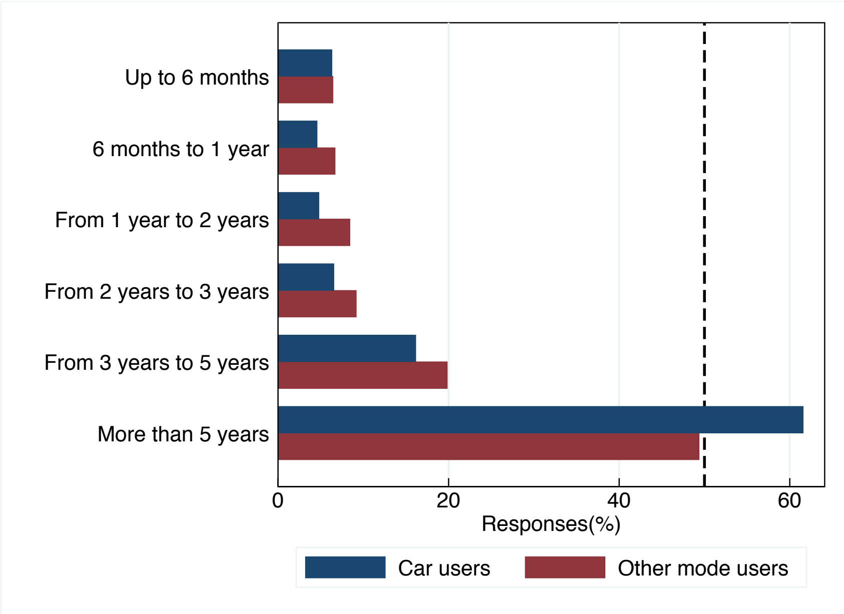


Figure 8.9: The relative comparison between work duration at present workplace by travel mode user groups.

As discussed earlier, except for exceptional cases the qualified clinical nurses are more likely to do early morning or late night shifts on a regular basis, whereas the administrative staff are more likely to do normal office hours (i.e. 8.30am - 4.30pm). For example, following a late night shift the staff may not commute by walking or other modes of transport for several reasons, including security concerns, exhaustion, and limited access to public transport late at night.

More than 100 responses were received from the East Midlands (479), East of England (195), and South West (108) Strategic health authorities. Commuting by car alone was more evident among the staff from the South West Strategic Health Authority (SHA) accounting for two third of the total respondents (66.67%) from this region. However, in case of respondents from the East Midlands SHA the proportion of respondents (50.94%) commuted by car alone was almost equal to those commuted by alternative modes (49.06%).

Most of the responses (84%) were received form the Acute Teaching and small Acute Trusts. Interestingly, a lower proportion of the respondents from hospitals managed by the Acute Teaching Trusts commuted by car alone (50.87%) in comparison with those from hospitals managed by the small Acute Trusts (57.79%).

8.4. Housing information

Table 8.4 shows that relatively a higher proportions of the respondents from the car user group were home owners (82.1%), residing in detached houses (40.2%) and with the duration at current residence for more than five years (61.9%) than those of the other mode user group. In contrast, a higher proportion of the respondents of the other mode user group were tenants (28.8%) and residing in terraced properties (26.8%). The findings are in line with previous research that the propensity of using cars for commuting is lower among people, who have recently moved to a new area and are environmentally concerned (Thøgersen, 2006; Verplanken et al., 2008).

Table 8.4: The comparison between the car user and other mode(s) user groups by housing information

Housing information	Car user group	Other mode(s) user group
Housing tenure		
Lodger	1	1.3
Owner	82.1	67
Shared/joint ownership	3.1	2.9
Tenant	13.8	28.8
Total	385 (100%)	382 (100%)
Housetype		
Detached	40.2	19.7
Semi–detached	37.3	40
Terraced	16.8	26.8
Flat/apartment	5.7	12.5
Hospital accommodation	0	1.3
Total	386 (100%)	385 (100%)
Duration at current residence		
Up to 6 months	6.4	7.6
6 months–1 year	3.6	7.9
From 1 year–2 years	7.9	9.1
From 2 years–3 years	9.4	9.3
From 3 years–5 years	11.5	13.2
More than 5 years	61.9	53.1
Total	319 (100%)	394 (100%)

8.4.1. Motivations behind choice of residential location

Exploring the reasons for choosing residential location reflects if there is any association between travel mode choice behaviour and choice of residential location. Figure 8.10 shows that more than half of the respondents from both travel mode user groups cited the preference for *reasonable house price* and *good quality housing* as two of the key reasons behind the selection of residential location. However, a clear distinction was also observed between the two travel mode user groups. More than half of the respondents of the car user group (51.09%) cited *preference for countryside* as one of the key reasons for their choice of residential location. In contrast, a relatively high proportion of the respondents from the other travel mode(s) user group cited *proximity to workplace* (54.52%), *proximity to town/city centre* (45.74%) and *access to public transport* (44.95%) as the key reasons for their choice of residential location. The findings suggest that the other travel mode user group may have placed a higher emphasis on the consideration of travel issues whilst determining residential location decisions.

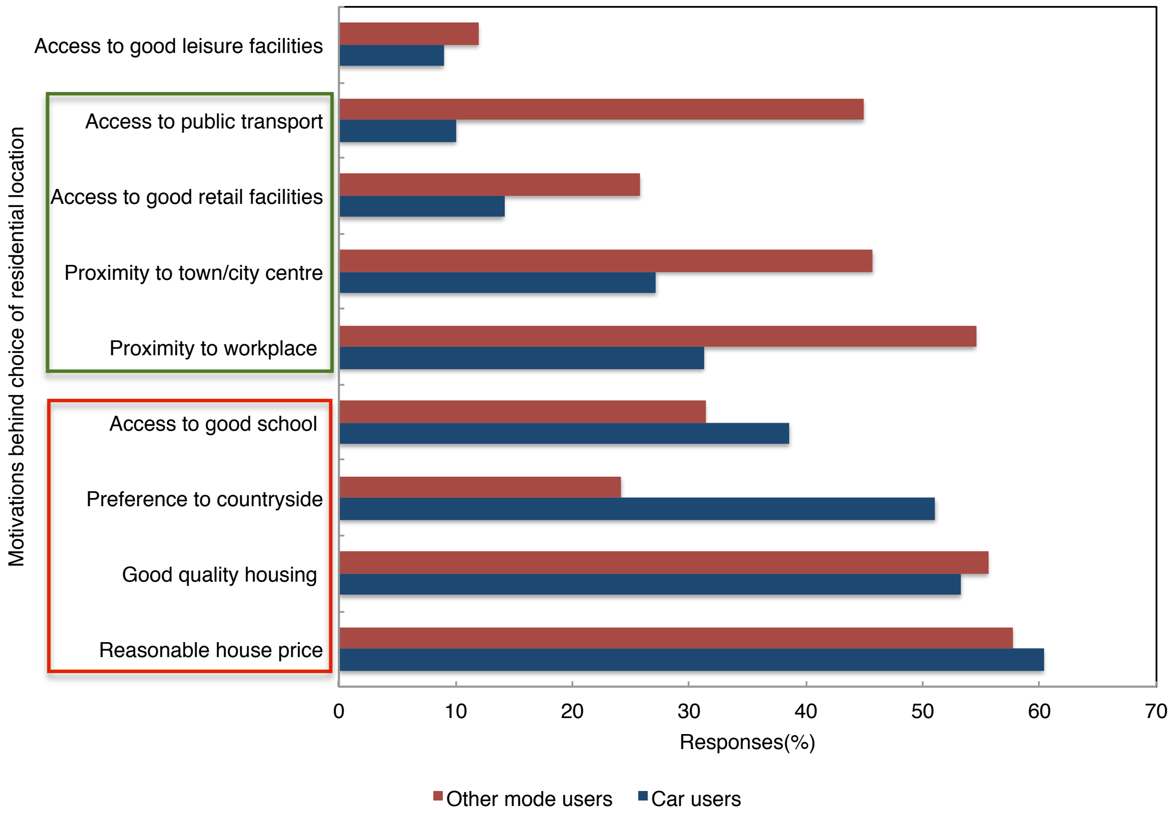


Figure 8.10: Motivations behind the choice of residential location by travel mode user groups. The highly cited reasons behind the choice of residential location by car user and other mode(s) user groups are shown within a red and green box respectively.

There is a close association between trip distance and household income (Mackett, 2003). The commuting distance for individuals with a higher income household was 11.7 miles, which is nearly twice as much as for those with a lower household income (5.7 miles). Generally, the females especially with children undertake more complex journeys, which may involve dropping off and picking up children at school or nursery, visiting the gym or shopping centres or grocery stores in comparison with the males (McGuckin and Murakami, 1999; Pooley and Turnbull, 2000; Root and Schintler, 1999). Therefore, they are more likely to choose one travel mode for the whole journey on a regular basis.

8.5. Travel mode users characteristics

The Mann-Whitney U tests were performed to see if there was a significant difference between the socio–economic and demographic characteristics between the two travel mode user groups. In case of large sample size over 20, *z score* is generally used instead of U score. Unlike t–test, Mann-Whitney U test does not require the dependent variable to be a normally distributed interval variable. If the observed *z value* exceeds the critical *z value* of -1.96 or +1.96 then it is assumed that the null hypothesis should be rejected and there is a significant difference between the two travel mode user groups for different variables. Table 8.5, Table 8.6, Table 8.7 and Table 8.8 present the results from the Mann–Whitney U tests.

The comparison between the socio–economic and demographic characteristics by the travel mode user groups using Mann–Whitney U tests is presented in Table 8.5. There was no significant difference between the two travel mode user groups for age and number of adults in the household. The mean–rank scores for the car user group were significantly higher on income *(z = 3.72, $p < .0002$, Mean–rank = 413.73)*, number of children *(z = 2.07, $p < .0387$, Mean–rank = 424.52)* and number of cars *(z = 10.63, $p < .000$, Mean–rank = 474.63)*. The Mann–Whitney U tests indicated that the average level of household income, number of children and number of cars among the car user group were significantly higher than the other mode(s) user group. The key socio–demographic characteristics of the car users are similar to the evidence found in other studies (Curtis, 1996; García-Palomares, 2010; Goudie, 2002). Commitment towards car use was higher among women with a relatively higher income, access to cars and children (Curtis, 1996; Goudie, 2002; Klöckner and Friedrichsmeier, 2011).

Table 8.5: The comparison between the socio–economic and demographic characteristics of the car user and other mode(s) user groups using Mann–Whitney U tests.

Variable	**Mode**†	$n > \widetilde{x}$ ‡	**Mean rank**	z	p§	n	**Direction**¶
Age	Car	153	329.97	1.71	0.09	322	NS
	Other	134	306.73			314	
Income	Car	153	413.73	3.72	0.0002	384	C→O
	Other	119	356.34			385	
No. of children	Car	153	424.52	2.07	0.04	393	C→O
	Other	127	390.52			391	
No. of adults	Car	81	401.42	1	0.32	393	NS
	Other	75	387.61			395	
No. of cars	Car	62	474.63	10.63	0.000	394	C→O
	Other	25	314.37			394	

†Travel mode user group.
‡Responses (n) greater than median ($\widetilde{x}$).
§p value is significant at a .05 level.
¶C, O and NS represent car user group, other mode(s) user group and non–significant, respectively.

The comparison between the objective mobility characteristics by the travel mode user groups using Mann–Whitney U tests is presented in Table 8.6. The mean–rank score for the car user group was significantly higher for travel time *(z = 11.83, p < .000, Mean–rank = 522.81)*, travel distance *(z = 11.99, p < .000, Mean–rank = 525.25)*, annual average car mileage *(z = 10.08, p < .000, Mean–rank = 234)* and duration at present workplace *(z = 3.377, p < .0007, Mean–rank = 455.29)*. However, the mean–rank score for the other travel mode(s) user was significantly higher on number of commuting days *(z = -3.66, p < .0003, Mean–rank = 408.02)*. The Mann–Whitney U tests indicated that the average commuting time, commuting distance, and annual average car mileage were significantly higher among the car user group. The finding that the number of commuting days for the car user group was significantly lower than the other travel mode(s) group is in–line with the previous research that women, who work part–time or fewer number of days are more likely to use cars alone (Curtis and Headicar, 1997).

The importance of the attitude refers to how significant the attitude is to the person. The comparison between the perceived importance of the modal attributes by the travel mode user groups using Mann–Whitney U tests is presented in Table 8.7. The mean-rank score for the car user group was significantly higher on all of the modal attributes, which include travel time *(z = 2.66, p < .008, Mean–rank = 442.62)*, travel cost *(z = -4.84, p < .000, Mean–rank = 402.08)*, comfort *(z = 5.61, p < .000, Mean–rank = 469.55)*, convenience *(z=4.74,* $p < .000$*, Mean–rank = 452.52)*, flexibility *(z = 7.35, p < .000, Mean–rank = 485.25)*, reliability *(z = 4.15, p < .000, Mean–rank = 448.54)* and security *(z = 5.5, p < .000, Mean–rank = 453.3)*. The results from the Mann–whitney U tests suggest that the importance of all the modal attributes were much higher among the car user group. It could be argued that the cost of walking to work is cheaper than travelling by car if the distance criteria (i.e.

Table 8.6: The comparison between the objective mobility characteristics of the car user and other mode(s) user groups using Mann–Whitney U tests.

Variable	**Mode**[†]	$n > \widetilde{x}$ [‡]	**Mean rank**	z	p[§]	n	**Direction**[¶]
No. of commuting days	Car	-	408.02	−3.66	0.0003	459	C←O
	Other	-	459.24			404	
Travel time	Car	193	459	11.83	0.000	485	C→O
	Other	80	321.7			393	
Travel distance	Car	211	525.25	11.98	0.000	459	C→O
	Other	71	326.06			404	
Car mileage	Car	234	427.04	10.08	0.000	384	C→O
	Other	90	272.98			306	
Work duration	Car	29	455.29	3.38	0.0007	458	C→O
	Other	26	403.39			403	

[†] Travel mode user group.
[‡] Responses (n) greater than median ($\widetilde{x}$).
[§] p value is significant at a .05 level.
[¶] C, O and NS represent car user group, other mode(s) user group and non-significant, respectively.

two miles walking distance) is met. However, the car user's evaluation of the perceived benefits of the other modal attributes could be higher for car use than the cost of travelling by car. If individuals overall perceived utility of using car is much higher than walking or other alternative modes of transport then they are more likely to travel by car.

The comparison between the satisfaction with the walking environment by the travel mode user groups based on the Mann–Whitney U tests is presented in Table 8.8. There was no significant difference between the two groups for pavement quality. The mean–rank for the remaining aspects of the walking environment was significantly lower for the car user group on street light *(z = -3.19, p $<$ .0014 , Mean–rank = 424.6)*, pedestrian security *(z = -2.89, p $<$ .0039, Mean–rank = 403.39)*, pedestrian route *(z = -5.22, p $<$ .000, Mean–rank = 385.35)*, pedestrian–crossing *(z = -3.68, p $<$ .0002, Mean–rank = 397.98)*, and on–site walking environment *(z = -3.42, p $<$ .0006, Mean–rank = 421.04)*. The results from the Mann–Whitney U tests suggest that the car users' satisfaction towards the walking environment was much lower than the other mode(s) user group. As discussed in Chapter 5, the satisfaction towards the walking environment is closely associated with the individual's evaluation of the utility of the travel mode. Therefore it can be suggested that the overall utility of walking is more likely to be lower among the car users in comparison with those who walk to work on its own or with other modes of transport.

All respondents were asked to rate the importance of several modal attributes, which are travel cost, travel time, convenience, comfort, security, flexibility, and reliability on a five–point Likert–type scale whilst choosing their travel options. The interrelationships between the respondents' beliefs towards the importance of the modal attributes based on Spearman's $/rho$ correlation tests are presented in Table 8.9. The relationships between all of the modal attributes were found to be

Table 8.7: The comparison between the perceptions of the modal attributes by the travel mode user groups using Mann–Whitney U tests.

Variable	**Mode**†	$n > \widetilde{x}$ ‡	**Mean rank**	z	p§	n	**Direction**¶
Comfort	Car	129	453.3	5.61	0.000	445	C→O
	Other	59	364.59			379	
Convenience	Car	-	452.52	4.57	0.000	456	C→O
	Other	-	388.4			389	
Cost	Car	-	402.08	−4.84	0.000	440	C→O
	Other	-	385.01			399	
Flexibility	Car	207	469.63	7.35	0.000	450	C→O
	Other	82	352.65			381	
Reliability	Car	-	448.54	4.15	0.000	449	C→O
	Other	-	391.76			394	
Security	Car	217	453.3	5.5	0.000	442	C→O
	Other	117	366.49			383	
Time	Car	-	442.62	2.66	0.008	455	C→O
	Other	-	404.65			394	

†Travel mode user group.
‡Responses (n) greater than median ($\widetilde{x}$).
§p value is significant at a .05 level.
¶C, O and NS represent car user group, other mode(s) user group and non–significant, respectively.

Table 8.8: The comparison between the perceptions of the walking environment by the travel mode user groups using Mann–Whitney U tests.

Variable	**Mode**†	$n > \widetilde{x}$ ‡	**Mean rank**	z	p§	n	**Direction**¶
Street light	Car	50	403.39	−3.19	0.0014	458	C←O
	Other	59	456.75			402	
Security	Car	194	405.33	−3.16	0.002	457	C←O
	Other	212	456.05			400	
Pedestrian route	Car	165	385.35	−5.22	0.0000	450	C←O
	Other	234	467.81			397	
Pedestrian crossing	Car	36	397.98	−3.68	0.0002	450	C←O
	Other	49	455.47			399	
Pavement quality	Car	170	439.47	−0.16	0.87	454	NS
	Other	176	447.18			400	
On–site WE‖	Car	43	421.04	−3.42	0.0006	458	C←O
	Other	55	473.63			400	

†Travel mode user group.
‡Responses (n) greater than median ($\widetilde{x}$).
§p value is significant at a .05 level.
¶C, O and NS represent car user group, other mode(s) user group and non–significant, respectively.
‖WE represents walking environment.

significant at $p < .05$ level. However, the strength of the relationships between the variables varied from *weak* to *moderate*. The respondents' beliefs towards the importance of security concerns was moderately correlated with comfort (0.45), flexibility *(ρ = .43)*, and reliability *(ρ = 0.41)*. A higher emphasis on security concerns could be attributed to the most of the respondents being females, who may required to do early morning or late night shifts (Loukaitou-Sideris; Mackett, 2003). There was also a moderate relationship between the respondents' belief towards time and convenience.

The significance of commuting time as a key determining factor behind travel mode use is well documented in previous research (Bérubé et al., 2006).

Table 8.9: Spearman's ρ test: Correlation between the importance of modal attributes.

	Modal attributes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Comfort	1						
2	Convenience	0.35 *	1					
3	Cost	0.13*	0.11 *	1				
4	Flexibility	0.4*	0.34*	0.11 *	1			
5	Reliability	0.25 *	0.33 *	0.23*	0.34 *	1		
6	Pedestrian security	0.45 *	0.23*	0.23*	0.43 *	0.41 *	1	
7	Time	0.27 *	0.42*	0.32 *	0.26*	0.33*	0.26 *	1

* p value significant at .00 level.

The respondents were asked to rate how satisfied they were with the key elements of the walking environment on their way to and from work and the overall on–site walking environment of their workplace. More than half of the respondents were either *very satisfied* or *satisfied* or *neither satisfied nor dissatisfied* with the quality of the pavements (59.3%), pedestrian routes (52.5%), and pedestrian security (52.1%). Employers are likely to promote the use of alternative modes of transport only if they believe that these other modes are capable of providing an alternative. Most UK respondents felt that these alternatives could provide an adequate alternative only with major improvements. The Spearman's ρ correlation coefficients between respondents' satisfaction towards the aspects of walking environment is presented in Table 8.10. The aspects of the walking environment were positively correlated with each other. As reported in other research satisfaction with pedestrian security was moderately correlated with the satisfaction with street light *(ρ = .54).* Satisfaction towards the overall on–site walking environment were also moderately correlated with pedestrian routes *(ρ = .52)* and pavement quality *(ρ = .43).*

Table 8.10: Spearman's ρ test: Correlation between the aspects of walking environment.

	Aspects	1	2	3	4	5	6
1	Street light	1					
2	Pedestrian crossing	0.49 *	1				
3	Pedestrian security	0.53 *	0.37 *	1			
4	Pavement quality	0.4 *	0.34 *	0.48 *	1		
5	Pedestrian route	0.39 *	0.46 *	0.4 *	0.54 *	1	
6	On–site WE	0.37 *	0.34 *	0.38 *	0.44 *	0.52 *	1

* p value significant at .00 level.

8.6. Motivations behind car use and walking

The motivations behind car use and walking of the hospital staff are discussed in the following sections.

8.6.1. Motivations behind car use

The respondents, who reported to have used cars as part of their journey were given 12 options and asked to select five key reasons for commuting by car. The findings are presented in Table 8.11. *Convenience* was cited as one of the key motivations behind car use by the highest proportion of the respondents (73.18%). This is followed by around two third of the respondents (66.09%), who reported to have commuted by walking *to save time*. The findings are in–line with the previous research that *convenience* and *time constraints* play an important role in influencing travel mode choice behaviour (Anable and Gatersleben, 2005; Curtis and Headicar, 1997; Gardner, 2009; Steg, 2005). The other reasons cited by more than a quarter of the respondents were *the only viable option* (38.8%), *work commitments* (33.8%), *comfort* (26.82%) and *personal commitments* (25.4%). The findings are consistent with previous research and results found in Survey 1: Hospital travel plan survey. As discussed in Section 7.2.10, a relatively high number of the NHS Trust representatives cited *personal commitments* (10), *lack of access by public transport* (14), and *work commitments* (15) as the key barriers to change mode choice behaviour.

The impacts of informational campaigns in promoting walking is a matter of debate. Several studies suggested that information campaigns are unlikely to have a significant impact on promoting walking unless the individuals already have a high intention to engage in such behaviour (Ogilvie et al., 2007; Kahn et al., 2002).

Table 8.11: Motivations behind car use.

Motivations	Frequency	Percentage
Instrumental		
Convenience	341	73.18
To save time	308	66.09
Only viable option	257	55.15
Work commitments	206	44.2
Comfort	125	26.82
Personal commitments	137	25.4
Bad weather	108	23.18
Security concerns	92	19.74
To save money	91	19.5
To carry heavy staff	46	9.87
Physical inability to walk	8	1.71

8.6.2. Motivations behind walking

The respondents were given 15 options and asked to select five key reasons for walking for more than 10 minutes as part of their journey to and from work. Table 8.12 shows that a high proportion of the respondents perceived both instrumental and affective factors as the key motivations behind walking to work. The highest proportion of the respondents (57.59%) cited improving physical fitness as the key motivation behind walking. Around half of the respondents (46.15%) reported to have walked to work to save money, which reflects the importance of financial cost in their travel decision making process. Alongside the above motivations *difficulties with car parking* (36.29%), *most practical option* (27.61%) and *live close to work* (27.02%) were also cited as the key motivations behind walking by a high proportion of the respondents.

The above finding suggests that the car users, who experience difficulties with car parking to and from work are more susceptible to change travel behaviour. Besides, affective factors such as *like to walk* and *stress free* were cited as the key motivations behind walking by a 46.75% and 22.68% of the respondents respectively. This finding is in–line with the previous research that affective motivations play an important role in influencing travel mode choice behaviour (Anable and Gatersleben, 2005; Gardner, 2009; Steg, 2005). Conversely, the alternative mode users may switch to car if they are not satisfied with their current travel arrangements. Therefore, strategies to promote walking need to place a high emphasis introducing measures to increase the utility of alternative travel modes to influence those who are satisfied with their present travel modes.

Table 8.12: Motivations behind walking.

Motivations	Frequency	Percentage
Affective motivations		
Like to walk	237	46.75
Stress free	115	22.68
Do not like driving	15	2.96
Instrumental motivations		
To improve physical fitness	292	57.59
To save money	234	46.15
Difficulties with car parking	184	36.29
Most practical option	140	27.61
Live close to work	137	27.02
Acceptable journey time	112	22.09
Convenient	97	19.13
Do not hold a car parking permit	97	19.13
To avoid congestion delays	91	17.94
Environmental concerns	70	13.8
No car available	60	11.83
Do not have a driving licence	42	8.28

8.7. Descriptive statistics of the constructs

The descriptive statistics of the seven latent constructs are presented in Table 8.13. The data analysis is performed based on a sample size of 459. The mean values of the *Cognitive attitude towards car use* variables were above the medium value of 13.00 ranging from 4.67 to 21.48. The finding suggests that overall the car users exhibited a strong positive attitude towards car use. More specifically, the respondents overall beliefs towards utility of CAC5: Convenience ($\mu = 21.48$, $SD = 4.39$), CAC3: Reliability ($\mu = 20.89$, $SD = 4.56$) and CAC1: Commuting time ($\mu = 20.07$, $SD = 4.6$) were higher for car use. An envisaged, the overall perceived utility of cost scored the lowest for car use.

The mean values of the variables related to *Affective attitude towards the situational factors related to car use* were ranged from 2.39 to 3.67. More specifically, the respondents overall satisfaction with AASFC5: Road quality ($\mu = 3.67$, $SD = .88$) was higher than the other situational factors related to car use. In contrast, the overall mean score for AASFC4: Traffic flow ($\mu = 21.48$, $SD = 4.39$) and AASFC2: Parking charge ($\mu = 2.69$, $SD = 1.21$) were below the medium value of 3.00 (i.e. neither satisfied nor dissatisfied). According to the survey result the respondents were not satisfied with the road traffic flow and car parking charge. The finding is consistent with the evidence found from Phase 1 and previous research. More than half of the respondents from Survey 1: Hospital travel plan survey reported to have experienced on-site congestion and congestion on local roads. As discussed in Section 7.3, 10 out of 12 hospital travel plans reported to have introduced car–parking charges. Previous research suggests that traffic congestion on roads are more likely to increase the level of stress and anxiety and decrease the autonomy associated with driving (Fosgerau et al., 2008). Interestingly, despite the staff's strong positive attitude towards car use, the dissatisfaction with the situational factors presents an opportunity to design travel plan measures to reduce the use of cars.

The overall *Cognitive attitude towards walking* among the car user group was relatively low. Except for CAW7: Cost *(*$\mu = 13.77$*,* $SD = 6.81$*)* the mean values of the variables within the scale were below the average value of 13. Interestingly, although walking is a relatively cheaper travel option than car journeys, overall the car users' beliefs towards the perceived utility of cost for walking was slightly lower than car trips. The finding suggests that the car users evaluation of cost for car trips did not resemble the actual cost of travelling by car. In comparison with the other variables the mean score of CAW2: Security *(*$\mu = 8.08$*,* $SD = 4.88$*)*, CAW1: Time *(*$\mu = 8.19$*,* $SD = 4.88$*)* and CAW6: Comfort *(*$\mu = 8.42$*,* $SD = 4.94$*)* were lower. The high share of female respondents within the car user group (84.21%) might explain why security had the lowest mean score for walking. Walking is a relatively slow and human powered travel option, which may have contributed to the low mean score for travel time and comfort. However, previous research suggests that the car users evaluate the modal attributes of car journeys such as comfort, convenience, flexibility, reliability, safety, and time efficiency highly in comparison with other modes (Steg and Vlek, 1996).

Except for gender, the skewness and kurtosis value of the socio–economic variables such as age, income, number of children, and number of adults of both mode user groups were lower than 2 and 3 respectively indicating that the variables were normally distributed (West et al., 1995). However, the kurtosis value of the gender variable for the car user group was greater than 3 suggesting the non–normal distribution of the variable.

Interestingly, the car users exhibited a relatively positive affective attitude towards the situational factors related to walking in comparison with cognitive attitude towards walking. The mean values of the *Affective attitude towards the situational factors related to walking* variables were above the average value of 3.00, ranging from 3.11 to 3.58. The car users overall satisfaction with AASFW4: Pavement quality *(*$\mu = 3.11$*,* $SD = .98$*)* was the lowest. According to the above findings, despite holding a relatively positive affective attitude towards the situational factors related to walking, the car users evaluation of the utility of walking was relatively low. The relative difference between the cognitive attitude towards car use and walking calls for introducing measures with a focus to improve the cognitive attitude towards walking among the car users.

The mean values of the *Perceived constraints towards walking* variables ranged from 2.51 to 3.35.

Table 8.13: The descriptive statistics of the latent constructs.

Variables	Mean	SD	Skewness	Kurtosis
CAC				
CAC1: Commuting time	20.07	4.6	.73	3.3
CAC2: Security	17.7	5.81	-0.38	2.32
CAC3: Reliability	20.89	4.56	-1.11	4.34
CAC4: Flexibility	4.67	2.18	3.71	25.22
CAC5: Convenience	21.48	4.39	-1.34	5.07
CAC6: Comfort	17.43	5.33	-.188	2.46
CAC7: Cost	15	5.26	-0.004	2.35
CAW				
CAW1: Commuting time	8.19	4.97	1.3	4.6
CAW2: Security	8.08	4.88	1.3	4.6
CAW3: Convenience	10.46	6.33	0.64	2.25
CAW4: Flexibility	9.23	5.38	0.74	2.79
CAW5: Reliability	11.23	6.21	0.45	2.18
CAW6: Comfort	8.42	4.94	1	4.02
CAW7: Cost	13.77	6.81	0.03	2
AASFC				
AASFC1: Time	3.14	1.22	- 0.29	2.01
AASFC2: Parking charge	2.69	1.21	0.17	1.9
AASFC3: Availability of parking space	3.07	1.26	-0.33	1.9
AASFC4: Traffic flow	2.39	1.36	0.29	1.68
AASFC5: Road quality	3.67	0.88	-0.77	3.34
AASFW				
AASFW1: Pedestrian security	3.23	0.85	-0.16	3.04
AASFW2: Pedestrian routes	3.23	0.85	-0.16	3.04
AASFW3: Pedestrian crossing	3.49	0.8	-0.2	2.8
AASFW4: Pavement quality	3.11	0.98	-0.16	2.46
AASFW5: Street light	3.58	0.89	-0.53	2.86
AASFW6: On-site walking environment	3.46	0.95	-0.58	2.8
PBC				
PBC1: Time constraints	2.43	1.44	0.3	2.1
PBC2: Long distance	2.05	1.66	0.51	2.04
PBC3: Inconvenience	2.25	1.71	0.32	1.74
PBC4: Lack of alternatives	2.67	1.53	0.28	1.57
PBC5: Security concerns	2.15	2	0.22	1.43
PBC6: Work commitments	2.37	1.83	0.1	1.6
PBC7: Personal commitments	1.89	1.92	0.51	1.69
OM				
OM1: Commuting time	3.36	1	-0.04	2.47
OM2: Commuting distance	3.3	1.15	-0.15	2.17
OM3: Annual average car mileage	3.73	1.15	0.49	2.14
IC				
IC1: Intention to walk	.26	0.44	1.1	2.23
IC2: Intention to reduce CO_2 emissions	0.19	.39	1.58	3.51

Continued on next page

Table 8.13 – *Continued from previous page*

Variables	**Mean**	**SD**	**Skewness**	**Kurtosis**
IC3: Intention to improve health	0.32	0.47	0.78	1.6
IC4: Intention to reduce car use	0.3	0.46	0.89	1.8

Sample size $n = 459$,
SD = Standard deviation,
CAC = Cognitive attitude towards car use,
CAW = Cognitive attitude towards walking,
AASFC = Affective attitude towards situational factors related to car use,
AASFW = Affective attitude towards situational factors related to walking,
PBC = Perceived behavioural control,
OM = Objective mobility,
IC = Intention to change travel mode choice.

More specifically, the overall mean score for PBC1: Time constraints *($\mu = 2.58$, $SD = 1.35$)*, PBC2: Long distance ($\mu = 2.51$, $SD = 1.48$), and PBC3: Inconvenience *($\mu = 2.96$, $SD = 1.37$)* were higher in comparison with the other constraints. The findings are in–line with the evidence found in other studies (Gärling and Axhausen, 2003; Hillman, 1998; Loukopoulos et al., 2004; Mackett, 2003; Nordlund, 2002). Alongside the length of trip and inconvenience, time constraints are often cited as the key reason for using car for short trips or not switching travel mode for commuting trips (Mackett, 2003; Nordlund, 2002). Individuals tend to place higher value for time for commuting trips due to several reasons, such as activity duration, activity time, the maximum time willing to spend on commuting, and personal commitments planned around the commuting time, which in turn place a time–pressure for commuting trips (Buliung and Kanaroglou, 2007; Roodra and Miller, 2005; Schwanen and Dijst, 2002).

The overall *Objective mobility* of the car users was relatively higher than the medium value of 3.00. The mean values of the variables ranged between 3.3 and 3.73, suggesting that the average commuting time, commuting distance, and annual average car mileage of the car user group were above 45 minutes, 10 miles, and 9,000 miles respectively. The objective mobility data validate that the actual length of the trip may have acted as a key constrain to walking on its own for commuting trips for a high proportion of the respondents (Dickinson et al., 2003; Hamed and Olaywah, 2000; Nelson et al., 2008; Scheiner, 2010). Individuals intention to walk for long commuting trips may vary with respects to their personal circumstances. Future research may explore the factors that may constrain walking as a link for long commuting trips.

8.8. Internal consistency

There were seven independent scales used in the questionnaire to measure the constructs proposed in the theoretical framework: (a) CAC: Cognitive attitude towards car use, (b) CAW: Cognitive attitude towards car use walking, (c) AASFC: Affective attitude towards the situational factors related to car use, (d) AASFW: Affective attitude towards the situational factors related to walking, (e) PBC: Perceived behavioural control, (f) OM: Objective mobility, and (g) IC: Intention to change travel mode choice behaviour. An assessment of internal consistency was performed to ensure that the measurement scales used consistently and accurately capture the meaning of the constructs. Cronbach's α coefficient has been used as a measure of internal consistency, which estimates how closely correlated a set of items of a construct (Cronbach, 1951). A low Cronbach's α coefficient indicates a poor representation of the construct (Kline, 2005). Hair et al. (2006) suggests that Cronbach's α coefficient score between .6 to .7 is acceptable. Except for IC, the Cronbach's α scores of the measurement scales of the constructs ranged from .62 to .87, which are considered acceptable. The Cronbach's α coefficient for IC was .54. As IC is the most important construct for this study, therefore, retained in the model. However, future studies consider exploring indicators to measure intention to change travel mode choice behaviour to improve the reliability of the measurement scale. Therefore, it could be suggested that the measurement of the constructs were consist of a set of variables that consistently captured the meaning of the constructs.

8.9. Exploratory factor analysis

Following the assessment of the internal consistency, an Exploratory factor analysis was performed. EFA was performed for each of the construct and discussed in the following sections.

8.9.1. Factorability of data

Factorability refers to the assumption that the variables are correlated with each other to a degree to allow the identification of coherent factors. A correlation matrix classifies the variables according to the correlations between the variables and exhibits if the selected variables measure the same underlying construct (Field, 2005). Correlation matrix has been used instead of covariance matrix as the variables were measured using different scales. Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) is generally used to determine the factorability of the correlation matrix (Coakes et al., 2006). Kaiser–Meyer–Olkin (KMO) values above .6 indicate sampling adequacy (Coakes et al., 2006).

8.9.2. Factor extraction and rotation

Exploratory factor analysis is generally performed following two steps: (1) factor extraction: identify the number of factors based on a method and criterion; and (2) factor rotation and interpretation: attempts to improve the interpretation of the selected factor solution (Field, 2005). Principal component analysis is widely used to convert a dataset with correlated variables into a set of values of linearly uncorrelated variables called principal components. The criteria used to extract the principal components are outlined below.

1. *Latent root (eigenvalue) criterion*: considers that a component with value higher than 1 is considered as significant and vice versa;
2. *Catell's scree test*: assesses which components explain most of the variability in the data by displaying the eigenvalues associated with a component in descending order against the number of the components; and
3. *Percentage of variance criterion*: assesses the significance of the derived components based on the amount of variance explained by them. By nature, the information used in behavioural science is less precise, therefore, a solution accounting for 60% or less of the total variance is considered as acceptable.

The initial component solutions are with high loadings in comparison with the other components, therefore, does not provide an adequate interpretation of the degree to which the variables load onto the components (Field, 2005). A factor rotation provides a simpler and more meaningful solution by maximising the variance of the squared loadings of a component (column) on all the variables (rows) in a correlation matrix. The Varimax orthogonal rotation is widely used as a rotation technique because of its simplicity (Tabachnick and Fidell, 2012). Following the component extraction the Varimax orthogonal rotation was employed to rotate the components. As recommended by Hair et al. (2006), a cut–off point of .5 has been used to ensure the significance of the variables in each component. The results of the EFA are presented in the following sections.

8.9.3. Exploratory factor analysis results

EFA was performed for each of the seven constructs individually following the method discussed above in STATA and results are presented in Table 8.14. The scree test identified one component for each of the construct, suggesting that the variables selected to assess each of the construct represented the same underlying construct. As most of the variables fall under the same component the pattern of the rotated component(s) (if there were more than one components) did not provide any meaningful results. All the variables were significant at $p < .05$ level with a component loading greater than .5. The retained components accounted for 42.79% to 57.92% of the total variance of the each corresponding constructs. CAC4: Flexibility (.92), AASFC4: Road Traffic (.85), AASFC5: Road quality (-.56) and PBC7: Personal commitments (.81) fell under *Component 2* and were above the cut–off loading value of .5. *Component 2* of the constructs was consist of less than three variables and thereby failed to meet the criteria of being considered as an independent part of the constructs and subsequently excluded from the constructs.

The Cronbach's α coefficients of the six constructs ranged from .62 to .88, which were above the acceptable value of .6 and demonstrated internal consistency. The Cronbach's α coefficient for IC including IC4: Intention to reduce car use was .54. The factor loading for IC4: Intention to reduce car use was .46, which was the cut–off loading value of .5, therefore, subsequently removed from the IC construct. The Cronbach's α coefficient for IC with the remaining three variables was .58, slightly below .6. As IC is the most important construct for this study, therefore, retained in the model. The above findings suggest that the measurement scale of the theoretical model comprised of reliable and valid items, and represented the same underlying construct. Kaiser–Meyer–Olkin (KMO) values of the constructs ranged from .6 to .87, which were above the minimum acceptable value of .6 (Coakes et al., 2006). Therefore, the data indicated sampling adequacy.

Table 8.14: Principal component analysis.

Variables	**Component 1**	**Component 2**
CAC		
Variance explained	44.45%	
Cronbachs α	.8	
Eigen value	3.112	
KMO	.78	
CAC1: Commuting time	.74	
CAC2: Security	.73	
CAC3: Reliability	.84	
CAC4: Flexibility		.92
CAC5: Convenience	.76	
CAC6: Comfort	.73	
CAC7: Cost	**.46**	
CAW		
Variance explained	56.27%	
Cronbachs α	.88	
Eigen value	3.939	
KMO	.87	
CAW1: Commuting time	.8	
CAW2: Security	.78	
CAW3: Convenience	.77	
CAW4: Flexibility	.78	
CAW5: Reliability	.79	
CAW6: Comfort	.8	
CAW7: Cost	**.48**	
AASFW		
Variance explained	53.77%	
Cronbachs α	.83	
Eigen value	3.226	
KMO	.82	
AASFW1: Security	.75	
AASFW2: Pedestrian route	.77	
AASFW3: Pedestrian crossing	.66	

Continued on next page

Table 8.14– *Continued from previous page*

Variables	**Component 1**	**Component 2**
AASFW4: Pavement quality	.78	
AASFW5: Street light	.72	
AASFW6: On–site walking environment	.72	
AASFC		
Variance explained	56.02%	
Cronbachs α	.83	
Eigen value	2.2407	
KMO	.66	
AASFC1: Time	.91	
AASFC2: Parking charge	.76	
AASFC3: Availability of parking space	.91	
AASFC4: Road Traffic		.85
AASFC5: Road quality		.56
PBC		
Variance explained	57.92%	
Cronbachs α	.62	
Eigen value	3.475	
KMO	.87	
PBC1: Time constraints	.81	
PBC2: Long distance	.67	
PBC3: Inconvenience	.81	
PBC4: Lack of alternatives	.85	
PBC5: Security concerns	.66	
PBC6: Work commitments	.76	
PBC7: Personal commitments		.81
OM		
Variance explained	59.78%	
Cronbachs α	.62	
Eigen value	1.793	
KMO	.66	
OM1: Commuting time	.73	
OM2: Commuting distance	.86	
OM3: Car mileage	.72	
IC		
Variance explained	42.79%	
Cronbachs α	.54 (.57)	
Eigen value	1.712	
KMO	.6	
IC1: Intention to walk	.60	
IC2: Intention to reduce CO2 emissions	.76	
IC3: Intention to improve health	.75	
IC4: Intention to reduce car use	**.46**	

CAC = Cognitive attitude towards car use, CAW = Cognitive attitude towards walking, AASFC = Affective attitude towards situational factors related to car use,
AASFW = Affective attitude towards situational factors related to walking,
PBC = Perceived behavioural control, OM = Objective mobility,
IC = intention to change travel mode choice.

Following the extraction of the individual components a principal component analysis (PCA) was performed on all the extracted components. Seven independent components as found from the individual principal component analyses were extracted from the overall principal component analysis. Varimax orthogonal rotation was employed to rotate the components. The pattern matrix produced based on the overall PCA analysis is presented in Table 8.15. As the measurement scales of the latent constructs remained unchanged, the internal consistency and sampling adequacy as established and discussed above is also applicable for the overall PCA analysis.

Table 8.15: The pattern matrix.

Variables	**CAC**	**CAW**	**AASFC**	**AASFW**	**PBC**	**OM**	**IC**
CAC1: Commuting time	.6						
CAC2: Security	.78						
CAC3: Reliability	.86						
CAC5: Convenience	.71						
CAC6: Comfort	.73						
CAW1: Commuting time		.87					
CAW2: Security		.82					
CAW3: Convenience		.82					
CAW4: Flexibility		.82					
CAW5: Reliability		.78					
CAW6: Comfort		.82					
AASFC1: Time			.86				
AASFC2: Parking charge			.77				
AASFC3: Availability of parking space			.8				
AASFW1: Security concerns				.84			
AASFW2: Pedestrian route				.88			
AASFW3: Pedestrian crossing				.76			
AASFW4: Pavement quality				.86			
AASFW5: On–site walking environment				.79			
PBC1: Time constraints					.81		
PBC2: Long distance					.58		
PBC3: Inconvenience					.67		
PBC4: Lack of alternatives					.82		
PBC5: Security concerns					.76		
PBC6: Work commitments					.78		
OM1: Commuting time						.66	
OM2: Commuting distance						.82	
OM3: Annual average car mileage						.74	
IC1: Intention to walk							.51
IC2: Intention to reduce CO_2 emissions							.77
IC3: Intention to improve health							.79

Sample size $n = 459$,
CAC = Cognitive attitude towards car use, CAW = Cognitive attitude towards walking, AASFC = Affective attitude towards situational factors related to car use,
AASFW = Affective attitude towards situational factors related to walking,
PBC = Perceived behavioural control, OM = Objective mobility,
IC = intention to change travel mode choice.

8.10. SEM estimation results

The structural equation modelling was performed following a two–step approach: (a) measurement model, and (b) structural model. First, the measurement model was specified to secure validity and unidimensionality. Second, the structural model was examined to assess the relationships between the constructs. The fit indices and model parameters were individually assessed for both models.

8.10.1. Measurement model specification and assessment criteria

The EFA analysis in the previous section identified seven components and confirms the reliability of the measurement scales as proposed in the theoretical framework. However, the EFA does not provide a comprehensive assessment of construct validity and unidimensionality, which are essential elements of the measurement theory (Gerbing and Anderson, 1988; Hair et al., 2006). Construct validity refers to the degree to which a set of measurement variables measures a theoretical construct. Unidimensionality refers to the measure of whether all the items in the measurement scale are measuring the same underlying construct (Gerbing and Anderson, 1988). A confirmatory factor analysis (CFA) model is treated as a factor structure that exhibits a set of relationships between the observed variables and a latent construct. The key difference between the CFA and EFA is the number of factors, and the relationship between the factors and the variables are set prior to the analysis. The CFA involved assessing how well the factor structure fitted with the data, which was followed by assessing the unidimensionality and construct validity. The details of the analysis is discussed below.

Exploratory factor analysis (EFA) is a preliminary analysis that does not provide an explicit test of unidimensionality (Gerbing and Anderson, 1988). Previous research suggests that a valid and reliable measurement model should be finalised before estimating the structural model (Gerbing and Anderson, 1988; Fornell and Larcker, 1981). The measurement model allows the assessment of unidimensionality of all the constructs in the same context as recommended by Anderson et al. (1987). The measurement model was developed by integrating the components retrieved from the pattern matrix into one CFA model.

The model included two layers: (1) indicators or measurement variables; and (2) first order components or latent variables. The indicators of the constructs were standardised to enable the comparison between the constructs, which is called *scale invariant* (Long, 1983). The concept of reliability and validity differ between exploratory and confirmatory analyses. The correlation coefficient and their corresponding *t–values* are regarded as a reliable measure that the measurement variables represent the underlying constructs (Bollen, 1989). There is no universally accepted cut–off value for correlation coefficients and their respective standard errors. However, *t–values* greater than 2 at .05 and 2.576 at .001 significance level represent acceptable convergent validity. *t–value* is the ratio of an estimated parameter to its standard error (Marsh and Hocevar, 1985).

8.10.1.1. Discriminant validity

The discriminant validity was measured by comparing the average variance extracted (AVE) and squared correlation between constructs. Fornell and Larcker (1981) suggested that in the presence of discriminant validity the common variance shared between the items and respective construct is higher than the squared correlation coefficients between the construct and other constructs.

8.10.1.2. Modification indices

The modification index for a parameter represents the amount of decrease in χ^2 if the model is re–estimated with the parameter being free whilst the other parameters are held fixed at the same estimated values (Joreskog and Sorbom, 1989). For example, a high modification index for x item suggests that x may share a significant amount of variance with construct 2, therefore not being unidimensional. To improve the model fit, a path between the respective indicator and construct can be estimated. The estimated path reduce the χ^2 by the amount of the modification index. Standardised expected change in the loading with the other latent variables were recorded alongside the modification index statistics. Change in more than .3 indicates a lack of unidimensionality. Small modification indices below 4 *($p < .05$)* provide insignificant improvement in fit relative to the loss of 1 df from estimating the additional paramount (Kaplan, 1990). Items exhibiting changes greater than .3 were investigated for their lack of unidimensionality. Freeing substantially implausible parameters may lead to misleading results (Medsker et al., 1994). Therefore, Bentler (1980) suggested that a parameter should only be relaxed if supported by a systematic point of view.

8.10.1.3. Measurement model results

The measurement model was assessed according to the criteria discussed above, and the results are presented in Figure 8.11, Figure 8.12, Table 8.16, Table 8.17 and Table 8.18. First, confirmatory factor analysis (CFA) was performed allowing all the latent constructs to covary with each other to test the internal consistency between the variables based on the covariance structure. An examination of the results revealed that AASFC4, PBC1, PBC2 and PBC4 did not meet the correlation coefficient value above .5 criterion at .05 significant level, which were subsequently removed following the first iteration. Several iterations have been performed to secure a better model fit of the data. The overall fit indices of the estimated measurement model after retaining all the constructs were: $\chi^2 = 830.4, df = 329, \chi^2/df = 2.49, RMSEA = .058, CFI = .88, TLI = .86, AIC = 44646.117, BIC = 45079.668$, where the value of CFI and TLI were slightly below the acceptable value of .9.

All indicators had significant loadings above .5 with their respective constructs verifying the posited relationship except for indicators IC1 and PBC3. These two indicators were significant at .05 level with a correlation coefficient value lower than .5, suggesting the potential for elimination. IC1: Intention to walk is one of the most important indicators of the model with a reasonable loading and it was possible to obtain convergence of the model by retaining PBC3, therefore, both items were retained in the measurement model. The *t–value* associated with each of the correlation coefficient exceeded the critical values at .05 significant level. The composite reliability of the constructs were above the acceptable value of .6 except for PBC. Moreover, the average variance extracted by PBC was also well below .5 (Bagozzi et al., 1991). Therefore, the construct PBC was finally excluded from the measurement model and the model was run again.

The reason why PBC was non–significant in determining intention to change travel mode choice behaviour can be explained several ways. With regard to the non–significant variables Fishbein and Ajzen (2010) stated that:

> *"In some instances, one or two of the three basic determinants of intention may not carry a statistically significant weight in the intentions. Far from posing a problem for the theory, even such extreme variations in the contributions of the three components are to be expected".*

The ability of perceived behavioural control in predicting intention to change travel behaviour can be weaken in the presence of strong attitude or powerful normative belief (Fishbein and Ajzen, 2010). In this regard, Ajzen and Fishbein (2004) also suggested that a behaviour can be guided by attitudinal considerations with no effect from subjective norm and perceived behavioural control.

After the initial estimation model modification is performed to improve the model fit, it changes the analysis from confirmatory to exploratory. A better identified model provides a better model fit. As discussed in Chapter 6 model identification refers to the conceptual constraints on parameters of a model so that a unique numerical estimation for each of the parameters in the model can be obtained. There are two types of constraints namely, substantive constraints, and normalisation constraints. STATA automatically provides normalisation constraints.

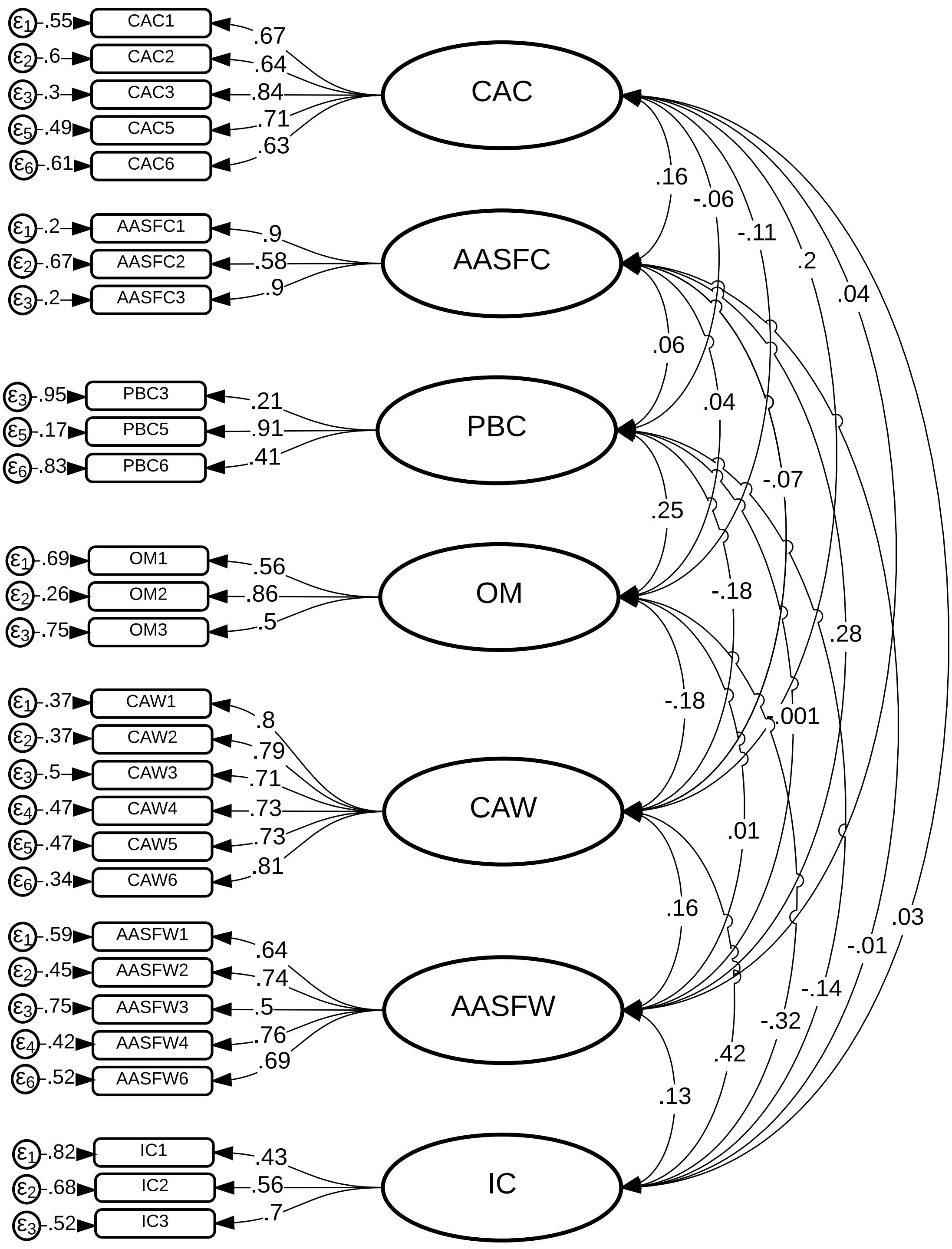


Figure 8.11: Initial measurement model before modification. Sample size $n = 459$

The modification indices above the value of 4 and their corresponding expected parameter change values are presented in Table 8.16. The paths between indicators with no theoretical justifications have not been considered for model modification. Connecting paths between indicators with theoretical justifications may also result in ambiguous results, and, therefore, the paths were connected only if an improved model fit was achieved. The value of modification indices between indicator CAC2 and CAC5; and CAC2 and CAC6 were relatively higher. However, it was found that connecting these two paths decreased correlation coefficient of CAC2 to .43. As a retaining indicator, CAC2 without modification decreased the overall model fit, therefore, the indicator was excluded from the measurement model. Finally, after several iterations four paths between indicator CAW2 and CAW6; CAW3 and CAW4; CAW3 and CAW5; and AASFW1 and AASFW2 were kept. Following the modification, the measurement model was finalised, and the results are presented in Figure 8.12 and Table 8.18.

Table 8.16: The modification indices.

Paths	MI	EPC
cov(e.IC2, e.IC3)	4.6	.35
cov(e.CAC1, e.CAC2)	27.95	-.3
cov(e.CAC1, e.CAC3)	4.1	.17
cov(e.CAC1, e.CAC5)	13.28	.23
cov(e.CAC2, e.CAC5)	21.1	-.27
cov(e.CAC2, e.CAC6)	46.35	.38
cov(e.CAC3, e.CAC6)	24.4	-.39
cov(e.CAW1, e.CAW4)	10.69	.21
cov(e.CAW2, e.CAW3)	22	-.3
cov(e.CAW2, e.CAW5)	5.1	-.14
cov(e.CAW2, e.CAW6)	21.1	.33
cov(e.CAW3, e.CAW4)	14.9	.23
cov(e.CAW3, e.CAW5)	14.37	.23
cov(e.CAW3, e.CAW6)	5.78	-.16
cov(e.CAW5, e.CAW6)	15	.26
cov(e.AASFW1, e.AASFW2)	28.17	-.36
cov(e.AASFW1, e.AASFW3)	6	.13
cov(e.AASFW1, e.AASFW4)	6.1	.17
cov(e.AASFW2, e.AASFW3)	8.67	.18
cov(e.AASFW2, e.AASFW4)	5.86	.21
cov(e.AASFW3, e.AASFW4)	6.74	-.16
cov(e.AASFW3, e.AASFW5)	5	-.13

MI = Modification indices, EPC = Standardised expected parameter change, All modification indices are significant at $p < .05$.

In the final measurement model, the correlation coefficient of the indicators were significant and above the acceptable value of .5, except for IC1 (λ = .43). The reason for retaining IC1 has already been discussed above. IC3: Intention to improve health (.7), OM2: Distance, CAC3: Reliability (.8), CAW1: Time (.81), AASFC3: Availability of parking space (.9) and AASFW2: Pedestrian route (.81) appear to had the largest effects on IC, OM, CAC, CAW, AASFC, and AASFW respectively. After retaining all the constructs, the fit indices of the estimated measurement model were acceptable ($\chi^2 = 515.5, df = 233, \chi^2/df = 2.21, RMSEA = .05, CFI = .93, TLI = .91, AIC = 38209.78, BIC = 38585.53$) indicating a good model fit. The Cronbach's α scores of the measurement scales of the final measurement model ranged from .6 to .88, which indicated internal consistency (Hair et al., 2006). As shown in Table 8.17, the shared average variance extracted between two constructs was higher than their respective squared correlation coefficient for all the constructs demonstrating discriminant validity (Fornell and Larcker, 1981).

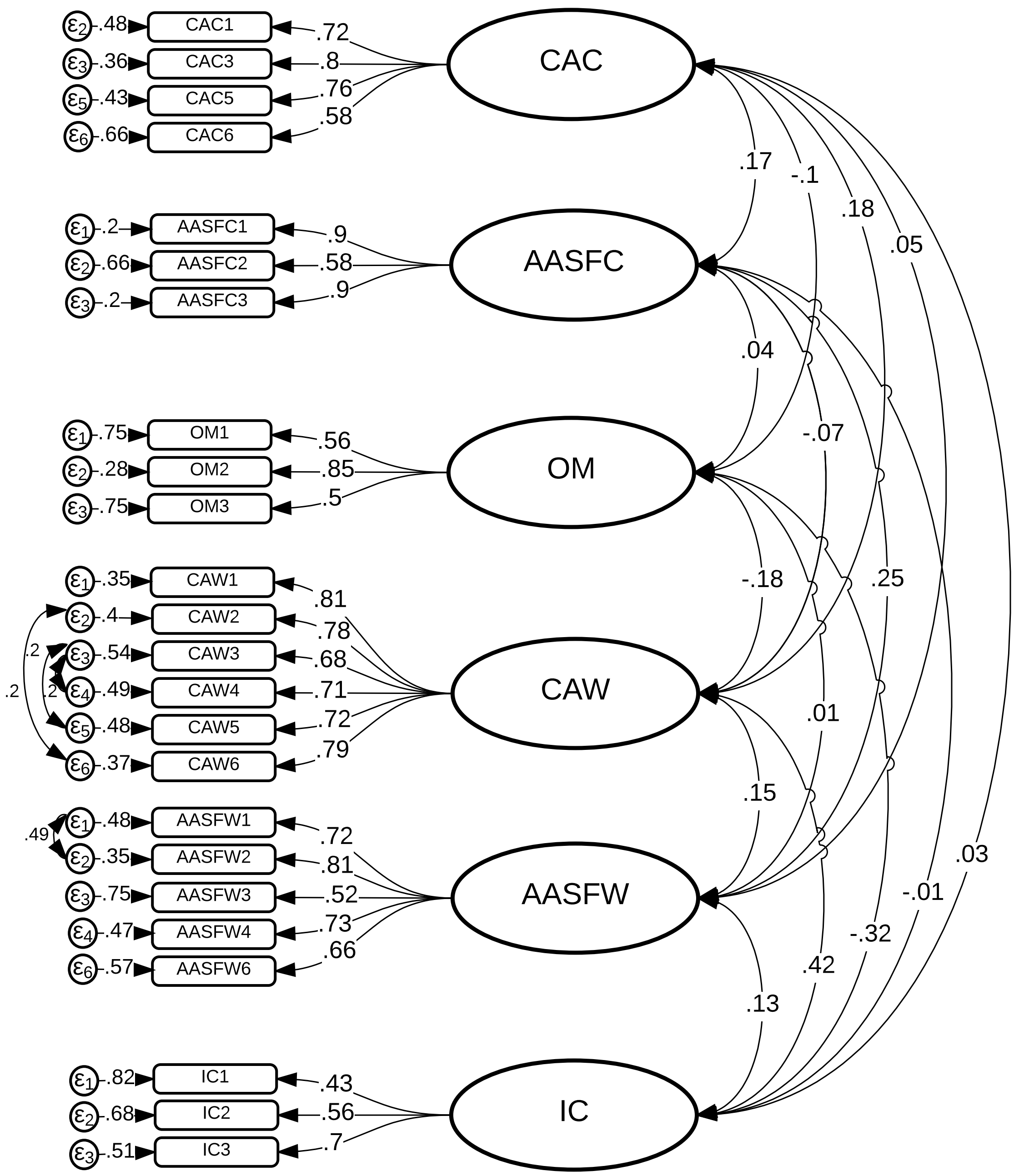


Figure 8.12: .

The final measurement model after modification. Sample size $n = 459$

Table 8.17: Discriminant validity results of the final measurement model.

Constructs		**CAC**	**AASFC**	**CAW**	**AASFW**	**OM**	**IC**
CAC	R^2	1	.03**	.03**	.003	.01	.0009
	AVE		.57	.54	.49	.57	.4
AASFC	R^2		1	.005	.06**	.002	.0001
	AVE			.59	.55	.63	.45
CAW	R^2			1	.02*	.03*	.18**
	AVE				.52	.6	.42
AASFW	R^2				1	.0001	.02*
	AVE					.55	.46
OM	R^2					1	.10**
	AVE						.46
IC	R^2						1

R^2 = Squared correlation coefficient, AVE = Average variance extracted, ** = Correlation is significant at the .001 level, * = Correlation is significant at the .05 level.

IC: Intention to change travel mode choice behaviour had three statistically significant exogenous variables (AVE = 28%) - IC3: Intention to improve health (λ = .7) being the most influential variable. The findings suggest the car users with a higher awareness towards the environment and benefits of walking were more likely to walk. Measures to encourage walking should, therefore, highlight the instrumental and environmental benefits towards walking.

All three initially selected exogenous variables - OM1: Commuting time, OM2: Commuting distance, and OM3: Car mileage were also found to be statistically significant in determining OM: Objective mobility (AVE = 41%). OM2: Commuting distance (λ = .85) had the largest effect on OM: Objective mobility suggesting the importance of reducing commuting distance to increase the car users intention to change travel mode choice behaviour.

Six exogenous variables - CAW1: Commuting time, CAW2: Security, CAW3: Convenience, CAW4: Flexibility, CAW5: Reliability and CAW6: Comfort were found to be statistically significant in determining CAW: Cognitive attitude towards walking. 56% variance was explained by the variables. The finding echoes with previous studies that individuals with a positive attitude towards walking are more likely to intend to walk (Donald et al., 2014). CAW7: Cost was found to be the statistically non–significant suggesting that cost was not salient to the staff. In other words, the result indicates that an increase in cost may not have any significant impact on intention to change. CAW1: Commuting time (λ = .81) was the most influential exogenous variable for CAW: Cognitive attitude towards walking. The finding suggest the importance of commuting time whilst consider walking among the car users. The other exogenous variables with a higher factor loadings were CAW2: Security and CAW6: Comfort.

Table 8.18: Measurement model results.

Variables	Loading	t-value
CAC		
AVE	.52	
Cronbach's α	.8	
CAC1: Commuting time	.72	24.62
CAC3: Reliability	.8	30.85
CAC5: Convenience	.76	27.28
CAC6: Comfort	.58	16.1
AASFC		
AVE	.63	
Cronbach's α	.83	
AASFC1: Time	.9	41.48
AASFC2: Parking charge	.58	17.07
AASFC3: Availability of parking space	.9	41.62
CAW		
AVE	.56	
Cronbach's α	.88	
CAW1: Commuting time	.81	35.27
CA2W: Security	.78	29.05
CA3W: Convenience	.68	20.53
CAW4: Flexibility	.71	24.18
CAW5: Reliability	.72	23.55
CAW6: Comfort	.79	31.45
AASFW		
AVE	.48	
Cronbach's α	.8	
AASFW1: Security	.72	21.64
AASFW2: Pedestrian route	.81	28.37
AASFW3: Pedestrian crossing	.52	13.93
AASFW4: Pavement quality	.73	26.43
AASFW6: On-site walking environment	.66	20.48
IC		
AVE	.28	
Cronbach's α	.57	
IC1: Intention to walk	.43	7.97
IC2: Intention to reduce CO_2 emissions	.56	13.29
IC3: Intention to improve health	.7	11.19
OM		
AVE	.41	
Cronbach's α	.62	
OM1: Commuting time	.56	11.94
OM2: Commuting distance	.85	15.69
OM3: Car mileage	.5	10.07

Sample size $n = 459$,
Model fit indices: $\chi^2/df = 515.5/233 = 2.21$, RMSEA = .05, CFI = .93, TLI = .91, AIC = 38209.78, BIC = 38585.53;
t-values are significant at 95% significant level.

AASFW: Affective attitude towards situational factors related to walking had five statistically significant exogenous variables, which explained 48% variance of the construct. Exogenous variable AASFW2: Pedestrian route (λ = .81) was the most influential variable for AASFW: Affective attitude towards situational factors related to walking. The study findings suggest that the car users with a higher satisfaction with pedestrian routes, pavement quality, and pedestrian security are more likely to have a positive attitude towards walking.

Moreover, CAC: Cognitive attitude towards car use *AVE = 52%)* and AASFC: Affective attitude towards situational factors related to car use *AVE = 63%)* had four and three statistically significant exogenous variables respectively. In case of, CAC: Cognitive attitude towards car use, CAC2: Security was non–significant. The structures two cognitive constructs for car use and walking of the same sample population were remarkably different from each other. This study findings thereby suggest that a car user is more likely to walk if they positively evaluate time, security, and comfort associated with walking for commuting trips. CAC1: Commuting time (λ = .72), CAC3: Reliability (λ = .8)and CAC5: Convenience (λ = .76) were the most influential exogenous variables for CAC: Cognitive attitude towards car use. Commuting is an obligatory activity, which is subject to time constraints. The results indicate why did the car users may have rated car highly on commuting time and reliability. Convenience is highly associated with individuals perceived physical and cognitive demands associated with using travel mode (Gardner and Abraham, 2007). The findings also echo with previous research that the car users rate driving highly on convenience (Anable and Gatersleben, 2005; Mackett, 2003; Morency et al., 2014; Ortuzar and Willumsen, 1994).

Interestingly, the most influential exogenous variables for AASFC: Affective attitude towards situational factors related to car use were AASFC1: Time (λ = .9) and AASFC3: Availability of parking space (λ = .9). The findings thereby suggest that the car users were satisfied with the availability of parking spaces and the amount of time spent on looking for car parking spaces. The higher satisfaction with the availability of parking spaces may act as a facilitator for frequent car use as reported by previous studies (Curtis and Headicar, 1997; Rye, 1999; Stokes, 1996). In contrast, the factor loading for AASFC2: Parking charges (λ = .58) was slightly lower suggesting that satisfaction with commuting time and findings a car parking space was more important to the car users. Previous studies demonstrated how car users hold biased attitude towards the actual cost of driving and an increase in driving cost resulted no significant changes in travel mode choice behaviour (Gardner, 2008).

8.10.2. Structural model

Following the estimation of the unidimensionality and validity of the measurement model, the structural model was measured. The structural model was estimated based on the maximum likelihood method to test the hypothesised relationship between the latent constructs. The structural model was assessed based on two criteria, which are: (1) model fit indices, and (2) standardised path coefficients. The criteria for assessing the model fit indices is similar to those used in the measurement model. A standardised path coefficient above .3 is considered acceptable (Byrne, 2010).

The results of the structural model are presented in Figure 8.13. The structural model included five exogenous latent variables: CAC, AASFC, CAW, AASFW and OM, and one endogenous latent variable: IC. The model also included six dummy–coded variables, namely age, gender, number of children, household income, hospital location and access to a travel plan. The effect of being female (male = 0), middle–aged (below 45 = 0), with children (no children = 0), high income (below £45,000 = 0), city centre (other = 0) and access to a travel plan (no access to a travel plan = 0). The error variance for dummy–coded variable was fixed to zero.

The model estimation showed that the effects of the socio–economic and situational variables failed to reach the statistical significance in determining intention to change travel mode choice and subsequently removed from the structural model. Previous research attempts to incorporate socio–economic variables within the TPB framework has been mixed in nature. Armitage et al. (2002) attempted to examine the mediating effects of age, gender, and multidimensional health locus of control (MHLC) on behavioural intentions and behaviour. The findings showed that although the psychological constructs accounted for significant proportions of the variance in health–related behavioural intentions and behaviour, they failed to mediate the effects of the demographic variables. According to the study, further research was needed to improve the predictive ability of the socio–economic factors within the setting of a theoretical framework.

The model was run again. The final structural model was achieved based on several iterations. The overall fit indices of the final estimated structural model were acceptable ($\chi^2 = 515.5, df = 233, \chi^2/df = 2.21, RMSEA = .5, CFI = .93, TLI = .91, AIC = 38209.784, BIC = 38585.528$), indicating a good model fit (Bollen, 1989). According to the results, out of the five structural paths two were found to be statistically significant *($p < .001$)* and with a meaningful path coefficient. CAW: Cognitive attitude towards walking had a positive effect *($\gamma = .38$, $p < .001$)* and OM: Objective mobility constructs had a negative effect *($\gamma = -.3$, $p < .001$)* on IC: Intention to change travel mode choice behaviour, thus there was enough evidence to support hypotheses $H2_a$ and H4 were found to be statistically significant.

The constructs CAC, CAW were positively associated with AASFC (ϕ = .18, p $<$ .001) and AASFW *(ϕ = .15, p $<$ .05)* respectively. For both paths, although the strength of the associations were relatively low, the corresponding *t–values* were above 2 exhibiting support for hypotheses $H1_c$ and $H2_c$. The *t–values* were significant at 95% confidence level. Previous research suggests that intentions towards performing a behaviour can be changed by changing certain beliefs associated with the antecedents of the intentions Ajzen (1991). Changes in beliefs with a low predictive power is likely to enable a small change in intentions to change behaviour. However, Fishbein and Ajzen (2010) argued that although a high regression coefficient score indicates the importance of the determinants in predicting intentions, a construct with a low score should not always be interpreted as an unimportant determinant. Therefore, hypotheses $H1_c$ and $H2_c$ were accepted. Three additional paths OM $\leftrightarrow$ CAW *(ϕ = -.18, p $<$ .05)*, CAC $\leftrightarrow$ CAW *(ϕ = .18, p $<$ .001)* and AASFC $\leftrightarrow$ AASFW *(ϕ = .25, p $<$ .001)* were also found significant. CAW and OM accounted for 13% and 9% variance in intention to change travel mode choice behaviour.

Drawing upon the above findings it could be suggested that the theoretical framework was partially supported by the data (see Figure 8.13, Table 8.19).

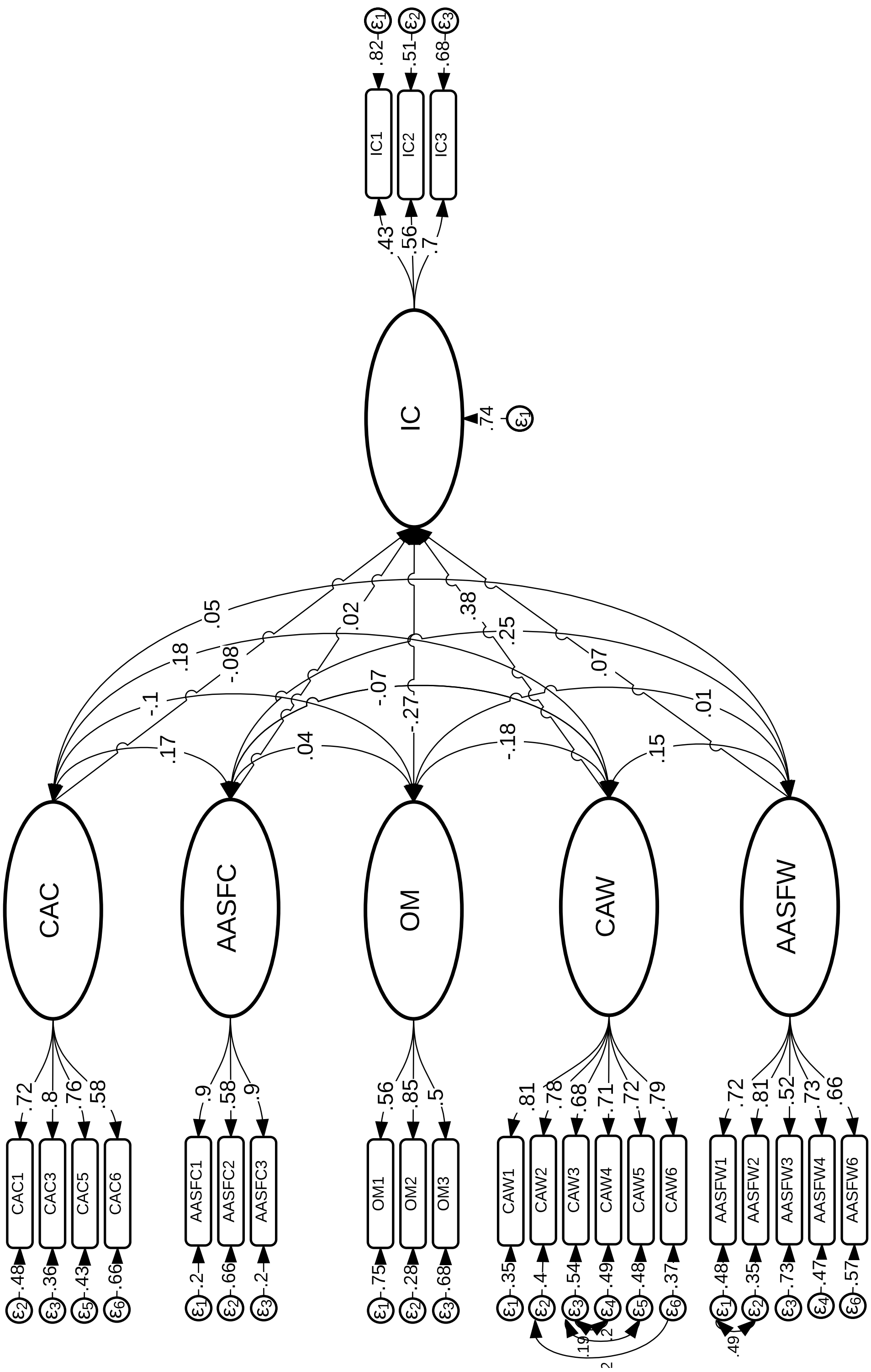


Figure 8.13: Structural model, sample size $n = 459$.

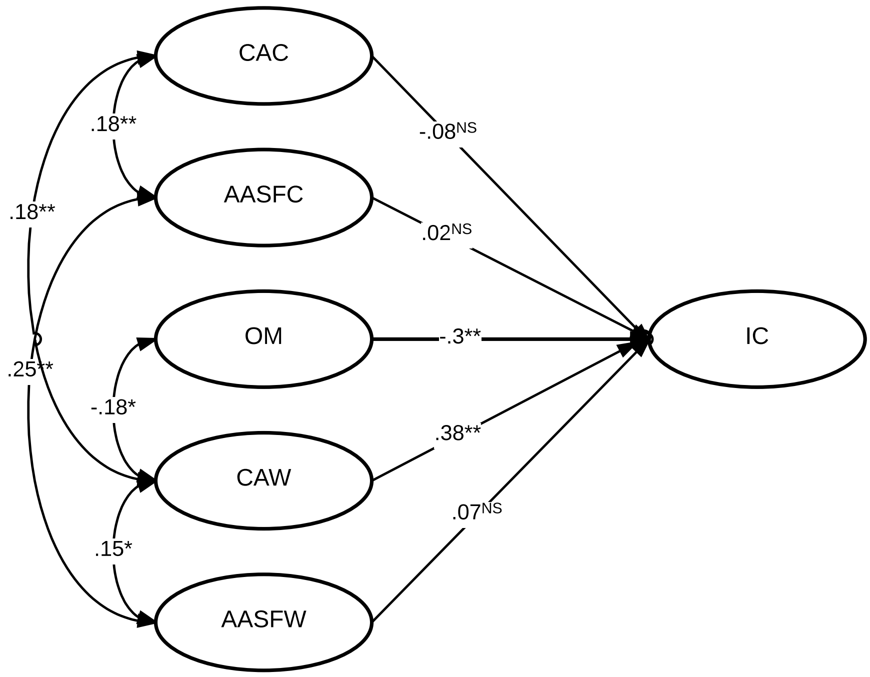


Figure 8.14: Structural model. Sample size n = 459.* = Significant at p $<$ .001, * = Significant at p $<$ .05, NS = Non–significant.

Table 8.19: Structural equation modelling for hypothesised path relationship.

Hypothesis		**Result**
Hypothesis 1_a:	Cognitive attitude towards car use has a significant impact on intention to change travel mode choice behaviour.	Rejected
Hypothesis 1_b:	Affective attitude towards the situational factors related to car use has a significant impact on intention to change travel mode choice behaviour.	Rejected
Hypothesis 1_c:	Cognitive attitude towards car use is associated with affective attitude towards the situational factors related to car use.	**Accepted**
Hypothesis 2_a:	Cognitive attitude towards walking has a significant impact on intention to change travel mode choice behaviour.	**Accepted**
Hypothesis 2_b:	Affective attitude towards the situational factors related to walking has a significant impact on intention to change travel mode choice behaviour.	Rejected
Hypothesis 2_c:	Cognitive attitude towards walking is associated with affective attitude towards the situational factors related to walking.	**Accepted**
Hypothesis 3:	Perceived behavioural control has a significant impact on intention to change travel mode choice behaviour.	Rejected
Hypothesis 4:	Objective mobility has a significant impact on intention to change travel behaviour.	**Accepted**

In the final model, the endogenous latent construct IC: Intention to change travel mode choice had three statistically significant exogenous variables, which accounted for 26% of the variance of the construct. A lower variance of IC: Intention to change usually suggests either the effect of unobserved variables or the strength of the construct being weak. Intention to change travel mode choice is likely to be low in the presence of strong car use habits (Ajzen, 1991; Friedrichsmeier et al., 2013; Klöckner, 2013).

The total effects of the variables were estimated by summing up direct and indirect effects. According to the structural model estimation, the total effects of both CAW: Cognitive attitude towards walking and OM: Objective mobility on IC: Intention to change travel mode choice behaviour were .02 and -.10 respectively. However, in the measurement model, the indirect effects of CAW: Cognitive attitude towards walking (.03) and OM: Objective mobility (-.15) were found to be slightly higher through IC3: Intention to improve health in comparison.

8.11. Analysis of telephone interviews

Four staff from two NHS Acute Trusts, who commute by car alone, took part in the telephone interviews and their brief profile is presented in Table 8.20. Participant one and three were females, aged between 20 to 59 and worked as a Non–clinical Qualified Nurse. However, Participant three worked as a Clinical Nurse once a week and provided information on her role as a clinical nurse. The remaining two participants were males, aged between 30 to 59 and held job roles as an IT Administrator and a General Manager.

Out of four participants, three were from the Nottingham University Hospital NHS Trust, Nottingham and one from Derbyshire Community Health Service NHS Trust. The participants were asked several questions in relation to their travel context. The participants from the Nottingham University Hospital NHS Trust reported to have worked on both City Hospital and Queen's Medical Centre on a regular basis or occasional basis. The City Hospital and Queen's Medical Centre both are located in Nottingham, and the Walton Hospital is located on the edge of Chesterfield town. The participants were asked several questions related to the access to the hospital sites, car parking and personal circumstances. All three participants from the Nottingham University Hospital NHS Trust expressed similar views about a number issues in relation to the local transport conditions and parking arrangements at the NHS Trust, which is significantly different from Participant four working at Walton Hospital. The key findings from the telephone interview are discussed in the following sections.

Table 8.20: Profile of the telephone interview participants.

Participant	Hospital	Gender	Age	Job role
P_1	City Hospital, Nottingham	Female	20-29	Qualified nurse (non–clinical)
P_2	Queen's Medical Centre, Nottingham	Male	30-44	IT Administrator
P_3	City Hospital, Nottingham	Female	45-59	Qualified nurse (non-clinical)
P_4	Walton Hospital, Chesterfield	Male	45-59	General Manager

Access by car - All four participants agreed that access to their corresponding workplace by car is good. However, Participant one, two and three reported to have an early start (7.00am to 8.00am) to avoid the peak hour traffic congestion and secure a car parking space at the main hospital site. They reported to have experienced delay and difficulty getting into the hospital site or finding a parking space at the main hospital site after 9.00am. Participant one was working at both City Hospital and Queen's Medical Centre from time–to–time, however, she reported to have car parking permit for just the City Hospital. At the Queen's Medical Centre, several car parking facilities were closed to carry out construction work during the survey, which would continue to run until 2015 and limited the number of available staff car parking spaces.

The NHS organisations generally set out several criteria in relation to work and personal circumstances (e.g. working out of normal hours) to determine the essential car users and allocate car parking permits to the staff with a higher necessity of using cars. There are two park and ride services within a close proximity to Queen's Medical Centre, where anyone can park free of charge. The Medi–link bus service runs between the two hospital sites; and the park and ride service. Despite having the free park and ride service Participant two cited that increased journey time by 10 to 15 minutes as the key reason for not using the park and ride service. In contrast, Participant four reported to have no parking issues and parking spaces are available at all times except for exceptional circumstances, such as during training events. The participants expressed the following statements related to car use, which suggest a positive attitude towards car use.

> P_1*: If I finish work by 5.00pm to 6.00pm, I can just get into my car and go home and it is quicker as well. I don't have to worry about catching a bus.*
>
> P_2*: I don't want to spend all my day travelling, I would rather go home.*
>
> P_3*: When I deal with patients at the end of the day, all I want to do is go home.*
>
> P_4*: Majority of the time I can drive in and find a car parking space.*

The only negative view with regard to car use was expressed by Participant one (P_1) that the car park appeared secluded at night.

Access by public transport - The participants were asked *"In your view how good is the access to the hospital site by public transport?"* Participant one, two, and three rated the bus services from the hospital sites to other areas of Nottingham as very good. All three participants were highly satisfied with the Medi–link service between the hospital sites, and park and ride. The satisfaction with the service was closely associated with several factors including journey cost (free), journey time (10 to 15 minutes), and frequency of the service (every 10 minutes).

Participant one reported that it was a lot easier to use the Medi–link service than driving. However, participants one and two reported that they lived outside Nottingham and it was not viable for them to use public transport to get to work due to increased journey time, long distance and high cost. Participant two reported that he lived in a remote area from where the nearest bus stop was two miles away from home, therefore, it was not viable for him to use public transport. Participant two, who used to commute by public transport for previous jobs, had mixed responses with regard to his travel arrangements.

> P_2*: I enjoy my work. It does not bother me that I spend an hour each way to get to work, I am very happy with this kind of commute.*

> P_2*: If I had lived in Nottingham or if I had access to good public transport I would have considered using public transport. I prefer to use public transport, I like riding on a bus and read a book for example. These types of things I miss when commuting to work. But I don't have any complaints to be honest. It costs me a quite a bit of money on fuel though.*

According to Participant two, although he preferred public transport to car because of environmental reasons commuting to work by car was the only viable option for him. On the other hand, he reported to have no intention to move close to the workplace because of his preference for living in the countryside. According to Participant four good residential accommodation and access to alternative modes of transport may not encourage the staff to reside in a close proximity to the hospital site because of their preference for the countryside. People living in the countryside have a completely different mind–set and they are likely to have access to cars. Participant four reported that access to the hospital site was poor by alternatives. Only one bus stop at the nearest bus–stop from the hospital that goes once every hour. The other bus–stop where more buses stop is 5 to 10 minutes further away from hospital site.

Access by walking - *In your view how good is the access to the hospital site by walking?* Participant one, two, and three rated access to their corresponding hospital sites by walking as good and were satisfied with the walking environment in and around the hospital site. However, Participant four reported that access to the hospital site by walking and cycling were not safe and convenient because of narrow lanes and hills.

Travel plan - The participants were asked: *How familiar are you with the travel plan for the hospital?* The Nottingham University Hospital NHS Trust has a travel plan. However all three participants from the Trust reported that they were not aware of a travel plan. Participant four was involved in the process of preparing the travel plan, however, it had never been implemented to encourage the use of alternatives.

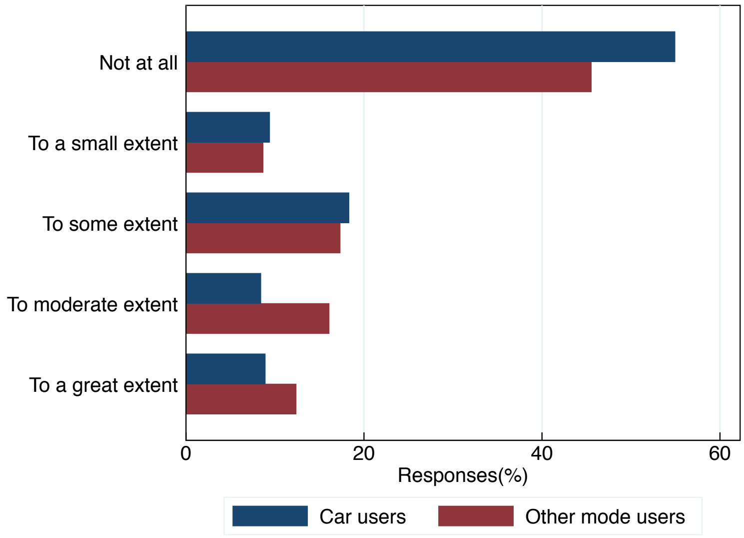


Figure 8.15: Incentives to encourage walking.

P_2: I am not aware of one. I don't know what is a travel plan either.

Reasons for using cars - The reasons for using a car to commute to work can be summarised as: convenience, distance, time constraints, site visits, lack of alternative travel options, to carry heavy stuff (e.g. laptop, trolley full of staff, files) and personal commitments. Generally, community nurses and training staff need to carry heavy files and laptops.

Satisfaction with current travel arrangements - The participants were asked: *How satisfied are you with your current travel arrangements?* and all four respondents reported to be highly satisfied with their current travel arrangements.

8.12. Travel plans

The sample population were asked *"To what extent they were aware of the benefits of a travel plan?"* and the result is presented in Figure 8.15. According to the finding, a high proportion of the respondents (more than 45.44%) from both mode user groups reported being unaware of the benefits of a travel plan. However, a relatively higher proportion of the other mode(s) user group reported to have 'to a moderate extent' (16.09%) or 'to a great extent' (12.38%) awareness towards the travel plan in comparison with the car user group.

An indirect question was designed to capture the respondents' views towards reducing car use and promote alternatives. The respondents were given five options and asked to choose the most effective option to reduce traffic congestion. The result is presented in Figure 8.16 by the mode user groups. The approaches to reduce the use of cars were broadly similar among the travel mode user groups. *Improving the quality of public transport* appeared to be the most popular option to reduce congestion by both mode user groups. Interestingly, the highest difference between the proportion of the responses was observed for the *reduce car use* option. More than half of the respondents from the other mode(s) user group cited *reduce car use* as an option in comparison with just over one third of those (35.79%) from the car user group.

The car users were asked to express their intention to walk to work if the necessary measures were introduced to support the walking behaviour of the staff. Around two–thirds of the respondents (63.33%) reported to have no intention to walk. Only over a quarter of the respondents (27.08%) reported to have intention to walk on its own or as a link with their car journeys. Only a small proportion of the respondents (4.9%) had expressed their intention to walk to work everyday in a week. The study findings suggest that a higher emphasis should be placed on forming intention to change mode choice behaviour.

The car user group were given nine options and asked to choose five key incentives/solutions that encourage them to walk to and from their main workplace (see Figure 8.17). The provision of *financial incentives* was cited as a key option by the highest proportion of the respondents (51.91%), which was followed by *health benefits of walking* (49.68%), *safe and continuous pedestrian routes* (40.76%), *flexible car parking permits* (36.31%) and *walking buddy* (35.35%). However, in the face of the ongoing NHS funding constraints, the potential of providing financial incentives to encourage walking to work is limited in practice.

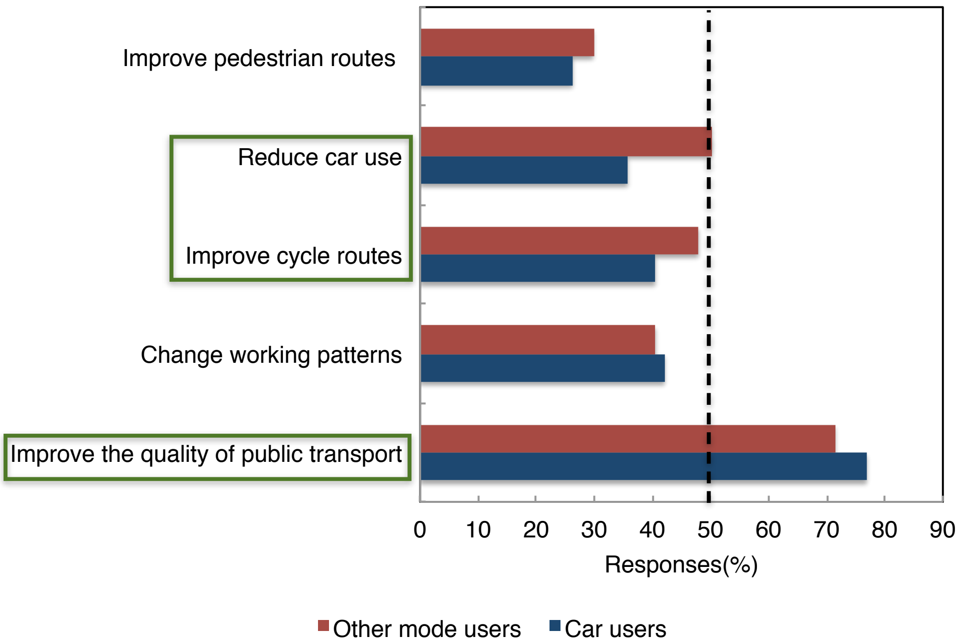


Figure 8.16: The approaches to reduce road traffic congestion by travel mode user groups. The most popular approach to reduce traffic congestion among both travel mode user groups was *improve the quality of public transport*. A relatively lower proportion of the car user group cited *reduce car use* and *improve cycle routes* as approaches to reduce traffic congestion.

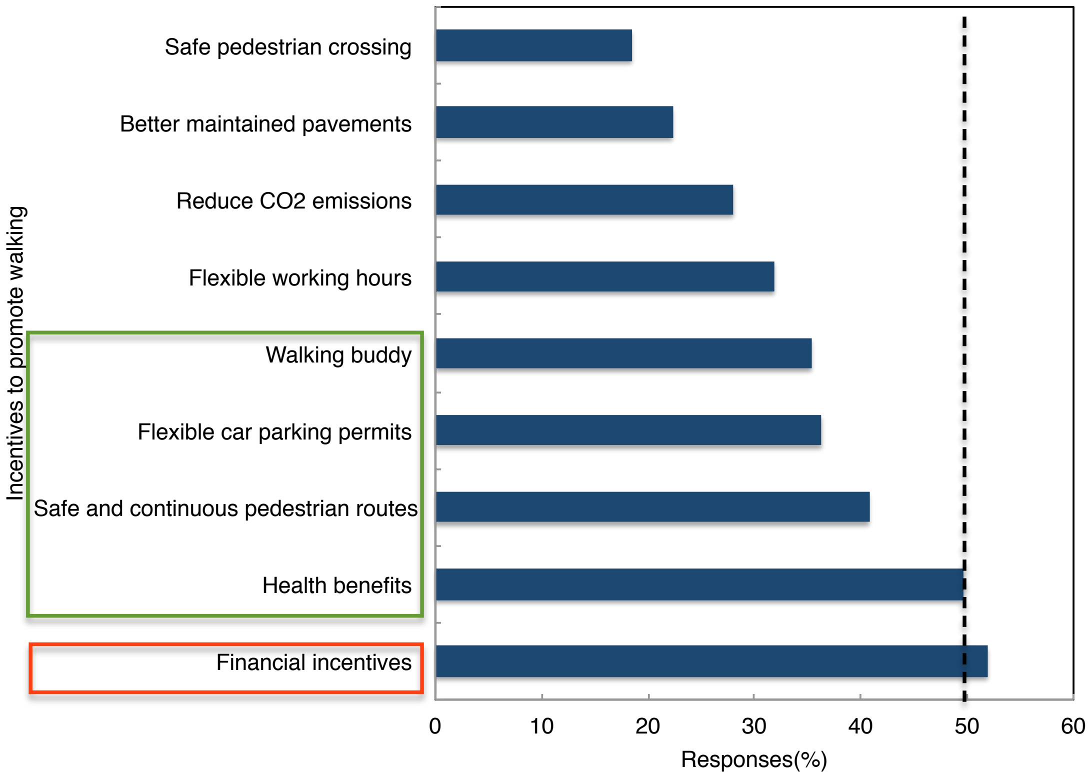


Figure 8.17: Incentives to encourage walking. The highest proportion of the respondents were willing to walk if *financial incentives* were provided. However, the healthcare authorities prefer to encourage walking through cost–effective measures. The highly cited and cost–effective options are shown within green rectangular box.

8.13. Discussion on hospital staff travel behaviour

Research conducted during Phase 2 sought to examine the travel behaviour characteristics and identify the key determinants for intention to change travel mode choice behaviour of the NHS hospital staff based on a theoretical framework. The investigation was informed by a nation–wide survey, telephone interviews and secondary sources.

8.13.1. Hospital staff travel behaviour characteristics

First, the sample distribution of the survey was found to be broadly similar to the NHS staff population by gender and job role. The working patterns of the hospital staff differ by job roles. Therefore, it could be suggested that the responses proportionately reflected the views of a wide variety of NHS staff with various working patterns. However, a higher number of sample population was required to suggest the statistical generalisation of the results. The analysis of the descriptive statistics shows that more than half of the respondents commuted by car or car–sharing alone on a regular basis; and were considered as the target population for changing travel behaviour. The socio–demographic profile of the car user group was dominated by specific characteristics, such as female, high income, no children, and middle–aged group (i.e. 45 to 59). The findings echo with prior research findings that the propensity of using cars was higher among women or individuals with a high income (Curtis, 1996; García-Palomares, 2010; Goudie, 2002).

The analysis of the descriptive statistics also indicate which factors may have supported the frequent use of cars. According to the findings, most of the respondents of the car user group were with an authorised NHS car parking permit and access to at least one car per adult within the household. Access to low cost or free car parking permit at work and a higher access to cars reported to have facilitated the use of cars (Curtis and Headicar, 1997; Rye, 1999; Stokes, 1996). Moreover, a relatively higher proportion of the car user and other mode user(s) group were from hospitals located near the city centre and edge of the town respectively. It is widely acknowledged that high density, mixed–use areas with good access by alternatives facilitates the use of alternatives (Cervero, 2002; Dargay and Hanly, 2007; Frank et al., 2007; Zhang et al., 2012).

A clear distinctive view of the walking environment was also evident from the findings of the structured interviews. Participants from the city–based hospitals were satisfied with the walking environment in and around the hospital site. In contrast, Participant four from the hospital near the countryside rated access by walking to the hospital as unsafe and inconvenient because of narrow lanes and hills. The review of both public health and transport literature on walking reveals that accessibility (measured in various types) is strongly correlated with walking behaviour.

However, both literature also suggests that the built environment alone may not always lead to an increase in walking behaviour (Handy et al., 2006). Interestingly, the share of each mode user group by access to a travel plan was broadly similar. The evidence collected in this study was insufficient to reach a conclusion on the possible impact of the travel plans on the existing staff travel patterns. However, the evidence found calls for further investigation into the impacts of situational factors on existing staff travel behaviour.

As anticipated, the average commuting time, commuting distance, and annual average car mileage of the car user group were relatively higher in comparison with the other mode user group. Only a small proportion of the car user group were residing within a close proximity from their main workplace. The findings thereby support the potential for promoting walking as a link with car journeys. Such consideration carries higher implications for those hospitals attempting to meet the increasing demand for car parking spaces during peak hours and address other transport problems, such as congestion on local roads (Enoch, 2012).

However, effective measures to promote walking need to take into account the personal consequences of walking as a link, such as increased travel time. The questions arises, *who are more likely to walk?* and *under what circumstances?*. Findings from the telephone interviews provide valuable insights in support of the arguments. Participant one and two reported to have an early start (i.e. by 8.00am) to secure an on–site car parking place. The on–site car parking facilities reach their capacity by 8.00am, therefore, the late starters reported to have used the park and ride service. The hospital travel plans reviewed also reported the cases of illegal on–street car parking once the car parking facilities within the vicinity of the site reached their capacity during peak hours.

Several issues emerge from the travel context of hospitals, including: (a) a priority to provide on–site car parking spaces for the patients; (b) the existing car parking facilities being insufficient to meet the peak hour parking demand; and (c) high average commuting distance limiting the use of alternatives except for metropolitan cities with good access by public transport, such as London, and Cardiff. There are two possible solutions to address the issues: (a) encouraging the staff to reside within a close proximity to the hospital to enable the use of alternatives; and (b) the provision of off–site car parking facilities to accommodate the additional demand for car parking spaces during peak hours.

The relative comparison between the time spent and maximum time willing to spent on commuting indicates who are more likely to change travel mode choice behaviour. According to the data, a high proportion of the staff with a lower commuting time (e.g. up to 15 minutes, 15 to 30 minutes) were willing to spend more time on commuting. In contrast, a high proportion of the staff with a commuting time over 30 minutes were intended to spent less time on commuting. The above findings suggest that the car users with a lower commuting time should therefore be encouraged to walk as a link with car journeys. Moreover, the staff with a higher commuting time should be encouraged to reside within a close proximity to the hospital site.

Research was deemed necessary to understand the motivations behind the choice of residential location. Interestingly, a clear distinction emerged between the two travel mode user groups from the data analysis. For a considerably higher proportion of the other mode user group(s) the choice of residential location was guided by travel behaviour issues, such as proximity to workplace. In contrast, a considerably higher proportion of the car user group cited preference for the countryside as a key motivation behind the choice of residential location. The differences in the choice of residential location may also explain why the average commuting time and distance were higher among the car user group. Previous research also found that the choice of residential location is closely associated with life–situation, life–style, work, housing, finance, environmental concerns, and travel (e.g. access to workplace, school, shops) (Curtis, 1996; Salomon and Ben-Akiva, 1983; Stanbridge et al., 2004). There are two implications of the research findings.

First, the healthcare authorities should, therefore, encourage their staff to consider residing in an area within a proximity to the main workplace and with a good access to alternative modes of transport. The evidence found from prior research suggests that the staff may consider relocating only if outweighing the factors associated with relocation appears beneficial and following a change in life situation, such as starting–up a new job, and becoming a parent (Stanbridge et al., 2004). Many organisations encourage their new employees to reside within a proximity to the workplaces.

Second, the consideration of new hospital locations should be supported by the in–depth knowledge of the staff's preference for housing and other services. However, future research needs to explore the interrelationships between choice of residential location and travel behaviour to better understand: (a) which staff groups are more likely to relocate? (b) when to propose re–location packages? and (c) how to identify new hospital sites to suit the housing needs of the hospital staff? Therefore, the provision of off–site car provides a more immediate solution to the issues experienced by the hospitals.

The analysis of the descriptive statistics shows a dissimilarly in the distribution between two travel mode user groups by different factors. Following the analysis of the descriptive statistics, the Mann–Whitney U tests were performed to examine if the characteristics of the travel mode user groups was significantly different from each other. The findings show that the level of average household income; average number of children and number of cars of the car user group were significantly higher than the other mode user(s) group. A higher average household income indicates a higher affordability to bear the expenses associated with car use. It also suggest a high level of household income may have facilitated car use, therefore, an increased cost in car use alone is unlikely to have a high impact on changing travel mode choice behaviour. The findings therefore, pose a question on how to encourage the car users to change their travel mode choice behaviour.

Consideration to socio–economic and personal factors that may increase car–dependency is vital to design effective and more acceptable travel plan measures. A significantly higher average number of children for the car user group also suggest, the staff with a higher number children used cars more frequently. The staff with more children are likely to have higher responsibilities for looking after the children at home and thereby, commuting trips may become time constrained and involve trip chains (i.e. picking up and dropping off children at school/nursery). The staff with a higher number of children may walk or incorporate walking with car journeys only if a higher flexibility is offered to adjust the increased travel time with their working arrangements. For example, no penalty for lateness, and reduced working hours.

The objective mobility characteristics of the car user group was also significantly different from the other mode user(s) group. The average number of commuting days of the car user group was significantly lower suggesting that a higher proportion of the car user group were part–time staff. A high use of cars by part–time staff is also reported by previous research (Curtis, 1996). However, the reasons why the part–time staff were more inclined to car use remain unclear. As evident from the descriptive statistics the average commuting time, commuting distance, and annual average mileage of the car user group were found to be significantly higher. In the absence of reliable alternatives a higher commuting distance is likely to act as a constrain to change travel mode choice behaviour.

Moreover, the car user group was with a higher average working duration at current workplace. The propensity of developing habitual behaviour is higher among individuals travelling within the same travel context for a longer duration (Verplanken and Wood, 2006). Besides, a higher proportion of the old NHS staff were with a car parking permit and higher commuting distance, which may explain why the frequency of using cars was higher among the relatively old staff.

Moreover, on average the car user group placed a significantly higher importance on all of the modal attributes when compared with the other mode(s) user group. The finding suggests that on average the car user group had a significantly higher expectation from their commuting trips. The relative cost of walking trips is lower than car trips. Using cars for short trips indicate that the cost aspect of the journey was outweighed by the other benefits of using cars. A question arises under what circumstances the staff with an authorised NHS car parking permit may intend to walk with car journeys, if there is a provision of a lower cost off–site car parking facility. In other words, under what circumstances the staff may intend to trade–off the comfort of car journeys for relatively cost effective walking trips.

The respondents' beliefs towards the importance of the modal attributes based on the Spearman's ρ correlation tests were found to be interrelated. However, the strength of the connection varied from weak to moderate. Security concerns in particular was moderately associated with comfort, flexibility, and reliability. The findings suggest that introducing measures to improve the staff's perception towards pedestrian security is likely to improve their beliefs towards comfort, flexibility and reliability of walking. It was also evident from the Mann–whitney U tests that on average the car user group was significantly less satisfied with the situational factors related to walking, which is likely to have an impact on their evaluation of walking experience. A significantly lower satisfaction value by the car user group could be attributed to either biased perceptions towards the walking environment or the indirect impact of a higher expectation from commuting trips. The Spearman's ρ correlation tests show that the staff's satisfaction with the situational factors related to walking were significantly associated with each other. The above findings suggest the need for introducing measures to improve the overall perception towards the walking environment.

Understanding the motivational patterns behind the use of travel modes provide a basis for designing personalised, individualised and flexible interventions to encourage change in travel mode choice behaviour (Gardner, 2008). According to the study findings, more than half of the respondents cited *the only viable option* as one of the key motivations behind car use. Car may become the only viable option for staff with a higher commuting distance and a lack of access to the alternatives. Individual's perceptions towards car dependency may not always reflect the actual circumstances. However, identification of the proportion of the staff, who are car dependent may provide an indication of the staff who could use alternatives as a regular or occasional basis. A higher proportion of the staff also cited *work commitments* as a key motivation behind car use. Work commitments may limit the use of cars. However, all trips made by an individual may not be car dependent. Therefore, a travel plan should offer a greater flexibility that allows the use of cars for car–dependent trips as well as provide incentives to encourage the use of alternatives, such as walking.

In contrast, a high proportion of the staff reported to have walked to work because of the affective and instrumental benefits of walking, such as *like to walk*, *improve physical fitness*, and *to save money*. An individual with a high motivation towards walking may not walk to work unless it is a viable option for commuting trips. The study findings also show that the motivations behind walking were also guided by practicalities of walking for commuting trips. Therefore, strategies to promote walking should place a higher emphasis on promoting the benefits of walking and address the factors that increase the viability of walking.

8.13.2. Determinants for intention to change travel mode choice behaviour

Following the analysis of the travel behaviour characteristics of the NHS staff, structural equation modelling was performed to identify the determinants for intention to change travel mode choice behaviour. First, seven constructs as proposed in the theoretical framework were extracted based on the exploratory factor analysis. Confirmatory factor analysis was performed on the preliminary results extracted by the EFA. PBC failed to meet the construct validity criteria and subsequently removed during the confirmatory factor analysis. Therefore, the respondents beliefs towards the presence of constraints that may prohibit walking remain unclear. The respondents had no experience of walking to work, which may have contributed to a distorted control perception (Ajzen, 1991; Bandura, 1997). Moreover, the relative effects of attitudes, perceived norm and perceived behavioural control in predicting intentions vary with respect to the individual and behavioural characteristics (Fishbein and Ajzen, 2010). Gardner (2008) conducted a cross–sectional study to examine the impacts of TPB constructs on driving behaviour. Multiple hierarchical regression analysis was performed on 190 responses collected from the UK residents. Surprisingly, perceived behavioural control towards car use was found to be negatively correlated with intention to car use and car use behaviour.

In the presence of constraints, the formation of intentions is generally insufficient to predict behaviour (Armitage and Conner, 2001). The barriers experienced during moving through the stages of changing behaviour may impede the implementation of intention into behaviour (Gardner and Abraham, 2008). The car users interpretation of the barriers is, in particular, important to achieve an effective outcome once they intend to change. Evidence suggests that in conditions where the volitional control is low, perceived behavioural control mediates the association between intention and behaviour. In such circumstances, perceived behavioural control can have a direct influence on performing behaviour by increasing the feeling of control and supplying with additional efforts required to successfully accomplish a particular behaviour. Therefore, introducing travel plan measures to improve perceived behavioural control of the staff are likely to improve their perceived ability to walk for commuting purposes on its own and with car journeys.

The remaining six constructs satisfied the criteria for both convergent and discriminant validity Fornell and Larcker (1981). Structural equation modelling was performed, once the measurement model was finalised. Despite extracting a small amount of average variance (28%) the latent construct - intention to change travel mode choice was retained in the model because of its significance in the research context. A low average variance of a construct results in a high measurement error, which suggests the effects of unobserved variables (Dillon, 1984). Alternatively, evidence emerges from the previous studies strongly suggest that the strength of intention is likely to be weak in the presence of habit (Ajzen, 1991; Friedrichsmeier et al., 2013; Klöckner, 2013).

Cognitive attitude towards walking and objective mobility were identified as the direct determinants for intention to change travel mode choice behaviour. The reasoned cognition - cognitive attitude towards walking accounted for a low amount of variance in intention to change. This finding could be interpreted in different ways. A moderate relationship between intention to change and cognitive attitude towards waking may suggest a relatively lower evaluation of the overall utility of walking by the car users when compared with the other mode(s) users (Handy et al., 2006; Panter and Jones, 2010; Panter et al., 2014). It could also be because of the residual effect of the unobserved variables, such as subjective norm, and other variables. The impact of subjective norms in determining intentions to walk is usually low among individuals with car use habits (Ajzen, 1991; Klöckner et al., 2003; Klöckner and Matthies, 2004).

As a philosophical observation, the statistically significant latent constructs alone are unlikely to explain intention to change travel mode choice behaviour. Availability of data limited the types of relationship that could be tested. The indicators used for this study were initially selected based on literature review, which may not be salient to the hospital staff. In this study, cognitive attitudes were measured based on utility–based beliefs towards car use and walking. Previous studies suggests that individuals with preference for self–oriented benefits over socially–beneficial consequences are more likely to use car (Van Vugt et al., 1995). Therefore, future studies may investigate the impacts of attitude towards wider such as environmentally friendly and personal such as reduced cognitive effort, relaxing, and benefits of walking on intention to change travel mode choice behaviour (Wardman et al., 2001). Future studies may carry out a scoping study involving the hospital staff prior to developing a conceptual framework to identify the salient beliefs associated different constructs.

In addition, insights from the telephone interviews also suggested that several other potential local transport and organisational factors including availability of car parking spaces, car parking charges, employers' attitude towards a travel plan may have impacts on intention to change travel mode choice. For example, the car parking policies for the hospital are independently determined by the corresponding NHS Trusts held responsible for managing the hospitals. The Nottingham University Hospitals NHS Trust has a car parking charging policy in place, whereas the car parking facilities is free of charge for the staff of the Derbyshire Community Health Service NHS Trust have.

Stokes (1996) suggested that free car parking space at work is a significant factor for supporting car dependency. A better understanding of the situational factors will improve the explanatory power of the model.

Past behaviour or objective mobility is widely used as a proxy measure of habit (Ouellette and Wood, 1998; Triandis, 1977; Wood et al., 2002). A significant negative impact of past behaviour on intention to change suggests that there was an influence of resistance to change on intention to change (Murtagh et al., 2012b). Therefore, disrupting the behaviour is likely to be difficult in practice (Stoll-Kleemann et al., 2001). The car users tend to hold a desire to have control over car use and avoid negative affective consequences of sharing personal spaces. Perceived effort required to use alternatives was found to be positively correlated with decisions to drive. Under a new travel decision-making context, an individual may decide to use car as a reasoned action. Habits arise from repeatedly performed reasoned actions within a stable context (Friedrichsmeier et al., 2013; Verplanken et al., 1994).

In the absence of deliberation, a goal–behaviour association is established, which prompts behaviour once a goal is activated. If the context remains unchanged, an intention to change travel mode choice is likely to concur with habits. Habits may have two different forms of effect within the TPB framework: as an independent proximal determinant of behaviour (Bamberg and Schmidt, 2003), and as a moderator between the intention and behaviour relationship (Verplanken et al., 1994). Previous research demonstrated that intentions and behaviour relationship is inversely proportional with habit strength (Verplanken et al., 1994). It means, in the presence of strong habits, the association between intentions and behaviour or the predictive ability of the salient reasoned cognitions may become weak, and habits may predict behaviour independently (Gardner and Abraham, 2008; Gardner, 2009; Triandis, 1977; Verplanken et al., 1994, 1997). A study by Gardner (2009) based on a sample of university–based car commuters *($n = 107$)* found that in the presence of strong to moderate habit, the association between intentions and behaviour was non–significant *($\beta = .13$, $p = .48$; $\beta = .05$, $p = .71$, respectively).* Conversely, intention had a significant effect on behaviour *($\beta = .22$, $p = .02$)* in the presence of weak habit.

The propensity of adopting habitual behaviour is higher among commuters with long commuting distance (Gardner, 2009). The negative impact of past behaviour reflected the impact of habit on intention to change travel mode choice behaviour. The lower variance of objective mobility in explaining intention to change may also suggest that habit may have a direct impact on behaviour. Moreover, the impact of perceived behaviour control was found to be non–significant. It suggests that the perceived presence of constraints had no significant impact in determining intention to change. In contrast, in the absence of habit the car users were more likely to use a combination of travel modes and change mode choice behaviour in response to measures designed to influence the reasoned constructs. The evidence found in this study supports the prevalence of habitual behavioural characteristics among the car user group (Verplanken et al., 1994). However, there was insufficient to suggest the possible strength of habit in determining travel mode choice. The research findings call for future research to investigate further to what extent habit may deter intention to change travel mode choice behaviour.

Both cognitive attitude towards walking and car use were positively associated with their corresponding affective attitude towards situational factors. However, the strength of the associations were relatively weak. Findings from the Mann–Whitney U tests shows that the car users' satisfaction towards the situational factors related to walking was much lower when compared with the other mode(s) user group. An association between two latent constructs is a non–causal relationship. However, evidence emerged from the literature suggests that an individual with a higher satisfaction with the situational factors related to walking or the walking environment is likely to form a positive attitude towards walking (Bagley and Mokhtarian, 2002; Saelens and Handy, 2008). Therefore, a weak association suggests that a car user with a high positive attitude towards walking may not have a high satisfaction with the walking environment. The literature strongly suggests that the car users tend to hold negative or biased perceptions towards alternatives, such as walking or walking environment (Gardner, 2008). To improve the car users attitude towards walking it is vital to introduce measures to strengthen the association between the cognitive attitude walking and affective attitude towards the walking environment.

An individual with a higher perceived utility of walking, a higher satisfaction with the situational factors related to walking and a lower objective mobility are more likely to have intention to change travel mode choice behaviour. The findings suggests that two individuals with the same objective mobility and different cognitive attitude towards walking may express different views about intention to walk. The findings support the predictive utility of the TPB in the context of healthcare and are consistent with previous empirical research (Bamberg and Schmidt, 2003).

8.13.3. Research implications

The association between the past and future behaviour depends on whether the context is favourable for sustaining the formation of past behaviour. A question arises: "how to address the determinants for changing travel mode choice behaviour to secure an effective outcome?" Only a quarter of the car user group intended to change travel mode choice. Therefore, a higher emphasis should be placed on forming individual's intention to change mode choice travel behaviour. A study by Mutrie et al. (2002) found that a "Walk to work out" campaign was successful in increasing walking to work among economically advantaged women, who were already considering to walk. In the prevalence of habit, intention to walk may not lead the formation of walking behaviour. Previous research suggest that individuals with implementation intention are more likely to change travel behaviour than those with a behavioural intention to change (Fujii and Taniguchi, 2005). Requesting a behavioural plan from the staff help to form their implementation intention. Travel feedback programs (TFPs) with a behavioural plan proven to have a higher impact on changing travel behaviour than those without a behavioural plan (Fujii and Taniguchi, 2006).

Policy measures to promote walking should be designed by asking under which circumstances the car users may trade–off driving for walking. Individuals are more likely to walk when they are organised and committed to walking (Pooley et al., 2011b). Under what circumstances the similar commitments could be established for the car users. The overall findings suggest that the car users were more likely to walk when they feel more positive towards the utility of walking and satisfied with the surrounding walking environment. Satisfaction with the walking environment also demonstrates a higher control with the surrounding environment (Gardner and Abraham, 2007). Besides, the car users were more likely to walk when the autonomy and empowerment they feel by engaging in an activity that improve physical fitness and reduce the environmental impact.

The findings suggest that measures to promote walking should place a higher emphasis on improving the overall utility of walking and quality of the walking environment alongside raising awareness towards the negative impacts of car use (Fujii and Taniguchi, 2006). As walking is not as time efficient as car journeys, therefore, campaigns to promote walking should focus on addressing the affective impacts of a potentially more time consuming journey. For example, the negative affective impacts (e.g. anxiety) of a relatively long journey can be reduced by improving the attractiveness of the walking environment. Previous research suggests that perceptions of the walking environment may differ from the actual conditions (Haenlein and Kaplan, 2004).

By comparing how the actual walking environment is perceived by different travel mode user groups may provide useful insight to inform strategies to promote walking. Strategies to promote walking need to place a higher emphasis on highlighting the health benefits of walking. Regular car users tend to hold biased perceptions regarding the walking experience. Therefore, introducing measures, such as trial walking around the hospital site(s) may help to improve the staff perceptions towards walking (Gardner, 2008). Moreover, introducing measures to encourage drivers to acknowledge their control over reducing the negative environmental impacts of car use may increase their moral obligation to car use.

The review of hospital travel plans (see Section 7.3) shows that only a small proportion of the hospitals collected information on the state of the physical environment to support walking. According to a review study by Macmillan et al. (2013), organisational travel plans from across the world have paid little attention to improving the physical environment to support the alternatives. Substantial investment to improve the built environment and pedestrian infrastructure have brought a wide range of benefits to the communities in the USA (Handy et al., 2006). Changes in the built environment may not always lead to changes in walking behaviour. Elias and Shiftan (2012) conducted stated preference experiment among 342 car users and found that improving pedestrian–road safety level had no significant effect on intention to walk for short trips.

Under such circumstances, interventions to change habitual behaviour should be designed with a focus to the following issues:

- changing the context to prevent habitual responses to particular situation (Ogilvie et al., 2007);
- inducing a deliberate decision process prior to behaviour (Verplanken and Aarts, 1999); and
- forming implementation–intentions that considers when, where and how a behaviour will be performed.

Changes in the travel context are expected to hinder habitual responses to situational cues as behavioural habits are connected to the situation. The habit discontinuity hypothesis states that when change in context disrupts individual's habits and initiate the deliberate decision–making process (Verplanken et al., 2008). The self–activation hypothesis states that when values are incorporated, the self–concept are activated, these are more likely to guide behaviour. Combining these two hypotheses, it was predicted that context change enhances the potential of incorporating important moral values that help to guide travel behaviour by activating the deliberate decision making process or the results support the notion that context change can activate important values that guide the process of negotiating sustainable behaviours. Situational changes include alterations to the physical environment, providing economic incentives, and car parking management policy.

Many healthcare authorities have introduced measures to facilitate change in travel mode choice behaviour (Essex Rivers Healthcare NHS Trust, 2006; Salisbury NHS Foundation Trust, 2010; Western Sussex Hospitals NHS Trust, 2010). Restrictive measures to limit the use of cars have been proven to be effective (Derby Hospitals NHS Foundation Trust, 2014). The eligibility for a car parking permit is determined based on a set of criteria (Essex Rivers Healthcare NHS Trust, 2006; Salisbury NHS Foundation Trust, 2010; Western Sussex Hospitals NHS Trust, 2010). However, if living within a proximity to the workplace limit the eligibility to apply for a parking permit or handing over the existing parking permits, the staff may choose to reside further away from their workplace.

Residing close to the main workplace increase the potential of using alternative modes of transport. However, previous studies questioned the feasibility of using one travel mode for all commuting trips made by an individual. For example, Gärling et al. (2002) proposed a conceptual framework to demonstrate the impacts of travel demand management measures on the modal attributes of the travel options drawing on the concept of goal setting theory. The influence of the personal and situational factors on travel choices is expressed as disturbances. Despite placing the same reference value for each travel option, individuals who walk to work may choose different travel options due to unexpected personal commitments or during bad weather (e.g. heavy rainfall) (Klöckner and Friedrichsmeier, 2011). For example, an unexpected meeting at work or heavy rainfall may impose extra time pressure that may change the reference value attached to each modal attribute for the trip. It was suggested that driving is considered as an alternative if the rainfall is perceived as a strong disturbance that affect the level of convenience and comfort by walking. A similar conclusion was drawn by a German study that bad weather (e.g. rain, cloudy day) increases the likelihood of travelling by car and decreases the likelihood of walking (INFAS and DIW, 2004).

Thøgersen and Møller (2008) performed an experimental study among 1,000 car commuters. According to the study, there was an increase in the use of public transport among experimental group with a free one–month travelcard. However, four months after the experiment, the use of public transport was found to be lower among the experimental group when compared with the control group. The study findings suggest that such economic incentives may increase the motivation to use public transport and disrupt habit in the short–term. Similar findings were reported by other studies (Abou-Zeid et al., 2012). However, breaking car use habits in the long–term may require introducing measures that help restructuring the decisional context. Such persuasive techniques are therefore more effective in motivating car users with weak or no habit to walk to work (Gardner, 2009).

The significance of a robust car parking strategy in reducing the use of cars has been highlighted in many studies (Cairns et al., 2010; DfT, 2009a; Ryley, 2008). Shoup (2008), a world renowned academic expert in parking strategies proposed an innovative flexible car parking strategy for the universities. The strategy differs from the traditional fixed rate monthly car parking charging policy; and allows the university employees and students to pay for the duration they use the car parking facilities at the university vicinity. The car parking charges are variable to time of the day and location of the car park. For example, charges for the central car parks are higher than the peripheral car parks; and parking is free for all during off–peak hours. Thereby, this flexible and innovative car parking strategies offer rewards to the drivers for using alternative travel modes with car or on its own. If higher commuting distance limit the use of alternatives, the hospital authorities may need to consider such innovative strategies to manage their travel demand in the future.

Following a measure to limit the use of cars, the individuals may either commute by alternative modes of transport with resentment, disinterest and resistance; or alternatively with a willingness that reflects the inner acceptance of the utility of alternative modes of transport. An effective intervention should aim to achieve the former scenario, which is led by a self–endorsed goal and a sense of volition. The car users may not have a positive attitude towards walking, however, knowing how to promote more active and volitional forms of motivation is an essential strategy for designing successful incentives to encourage walking. In conclusion, commuting is a relatively stable behaviour (Bamberg and Schmidt, 2003), therefore, longitudinal data were unlikely to produce a significantly different results unless interventions were being implemented to change travel mode choice behaviour. Future research may explore the impacts of travel plan measures on changing travel mode choice behaviour.

8.14. Summary

This chapter reports on the results of the findings from Phase 2. The data analyses were performed in two stages. First, the socio–demographic characteristics of the sample population was analysed using descriptive statistics. The differences in socio–demographic characteristics, objective mobility, perceptions towards the modal attributes and walking environment were tested using Mann–Whitney U tests. The results from the descriptive statistics analysis and Mann–Whitney U tests suggest that the characteristics of the car user group (who used cars alone to commute to work) was significantly different from those of the other mode(s) user group (who used alternative mode(s) or mixed modes). Structural equation model was used to test the research hypothesis. Based on the model estimation results, *Hypothesis* 1_c, *Hypothesis* 2_a, *Hypothesis 3* and *Hypothesis 4* were accepted, and the remaining hypotheses were rejected. Thereby, the findings supported the predictive utility of the TPB in the context of healthcare (Bamberg and Schmidt, 2003).

The car user group exhibited the following characteristics: (a)the use of a single mode in a stable context (Chen and Chao, 2011; Gardner, 2009; Friedrichsmeier et al., 2013; Ouellette and Wood, 1998); (b) a weaker intention to change travel mode choice behaviour (Ajzen, 1991; Friedrichsmeier et al., 2013; Klöckner, 2013); (c) a moderate attitude towards walking and the situational factors related to walking (Handy et al., 2006; Klöckner and Friedrichsmeier, 2011; Panter and Jones, 2010; Panter et al., 2014); and (d) a non-significant perceived behavioural control towards walking to work (Klöckner and Friedrichsmeier, 2011); (e) a negative impact of objective mobility or existing behaviour on intention to change travel mode behaviour (Gardner, 2009). Thereby, the primary assumption of the study that *the car users are likely to have the prevalence of car use habits* was considered true. However, there was insufficient evidence to suggest the relative strength of car use habits. The research findings call for future research to investigate further to what extent habit may deter intention to change travel mode choice behaviour.

Chapter 9

Conclusions, recommendations and further work

9.1. Introduction

This final chapter begins with summarising the research undertaken in this PhD to achieve the five research objectives (See Section 1.6). In light of the knowledge gaps identified based on literature review, this PhD contributes to four key domains of knowledge (Gray, 1996). A set of recommendations were proposed for the consideration of the NHS Acute Trusts based on the evidence found in this study to better inform the travel planning process. A summary of the research limitations and how future research could overcome the limitations encountered during this study is discussed next. Finally, drawing upon the key findings this research suggests policy directions for the NHS to address travel planning issues.

9.2. Achievement of original objectives

Despite having a high policy emphasis on reducing the use of cars by the National Healthcare Service (Armitage et al., 2006; NHS SDU, 2013; Sir Derek Wanless et al., 2007), there is a lack of prior research with a focus on the transport issues related to healthcare professionals (Melia, 2012). Therefore, a deductive approach has been used to narrow the focus of the study. Based on a comprehensive literature review of workplace travel plans, this study aimed to identify the determinants of intention to change travel mode choice behaviour from car to walking on its own or in conjunction with car use. The key research question of the study was "what are the key determinants of intention to change travel mode choice behaviour?" The research methods employed to achieve the research objectives are summarised below.

9.2.1. Objective One

A comprehensive review of workplace travel plans was conducted to identify the key determinants of a successful travel plan. To acquire a better understanding of the key issues related to the effectiveness of hospital travel plans in practice a nationwide survey was conducted among the NHS hospital travel plan co–ordinators during the first phase of the PhD. Forty seven responses were received from 39 NHS Acute Trusts, accounting for 34% of the 115 NHS Acute Trusts with a travel plan. The study has shown that transport issues experienced by most of the hospitals can be characterised as high car use and associated externalities, such as congestion on local roads, on–site congestion, high demand for car parking spaces, and lack of public transport.

The Spearman's ρ correlation tests were used to measure the travel plan co–ordinators' perceptions towards the effectiveness between travel plan measures to promote walking and discourage the use of cars. The results showed that the effectiveness of measures to promote walking (e.g. promotional materials and activities to promote walking) were positively associated with measures designed to change the situational context by offering objective benefits or improving the situational constraints. In addition, the effectiveness of measures to introduce car parking charges was positively correlated with the effectiveness of measures to promote walking (e.g. incentives for walking and improved pedestrian access). The results found in this study are consistent with previous research that demonstrates a combination of positive and restrcitie measures are more effective in reducing the use of cars and/or promoting walking (Cairns et al., 2002, 2004, 2010; Enoch and Ison, 2008; Enoch and Zhang, 2008; Taylor and Newson, 2008).

According to the findings from Survey 1: Hospital travel plan survey, despite having a high potential to promote walking as a key travel option, the measures to promote walking were regarded as the least effective by the NHS travel plan representatives. To further explore the issues associated with designing travel plan measures twelve hospital travel plans were reviewed based on a coding framework developed in this study based on existing policy guidance and literature review. The data analyses from Phase 1 suggest that despite employing of a combination of positive and restrictive travel plan measures to change travel mode choice, the lack of robust evidence–base (e.g. identify the key constrains to change travel mode choice) inform the travel planning process may have affected the overall success of the travel plan measures. Thereby, Objective One of the study *to examine workplace travel plans with a focus to the key determinants of a successful travel plan* is met.

9.2.2. Objective Two

As discussed in Chapter 5, the review of travel behaviour literature led to the development of a theoretical framework to address the areas of research gaps. Several studies investigated the influence of different factors in explaining intention to use a travel mode. The constructs used are pertinent to a single travel mode. However, there is a lack of experimental studies with a focus to investigating the key determinants of intention to change, especially from car to walking on its own or with other travel modes. Therefore, as recommended by Ajzen (1991), this study included constructs both related to car and walking. The subjective utility of a travel mode is closely associated with the satisfaction of the travel environment. Therefore, both cognitive and affective attitudes were included in the theoretical model. Since, these issues have not been comprehensively examined following the Theory of Planned Behaviour approach, three research questions were developed to address the research gaps. The theoretical framework and the research questions formed the foundations for the research hypotheses.

As presented in Chapter 6 the theoretical model was developed to identify the key determinants for intention to change travel mode choice behaviour and included six key elements, namely socio–economic, situational, attitude, PBC, objective mobility, and intention to change travel mode choice. Attitude was represented by four latent constructs. Each of the latent constructs was hypothesised to have a direct effect on intention to change travel mode choice. In total, eight research hypotheses were proposed. All the constructs were operationalised to that they can be measured accurately as possible. The items used to assess each of the latent constructs were selected based on the findings from the literature review and Survey 1: Hospital travel plan survey. The theoretical framework is illustrated in Chapter 5. Thereby, Objective Two of the study *to develop a theoretical framework to demonstrate the impacts of socio–economic, situational and psychological factors in changing travel behaviour based on the Theory of Planned Behaviour* has been achieved.

9.2.3. Objective Three

The research methodology used is discussed in Chapter 6. Following the literature review, a questionnaire was developed in consultation with the Estates and Facilities Department; Barking, Havering and Redbridge University Hospitals NHS Trust; and Havering Council in order to improve the clarity and comprehension of the questionnaire at a level the general NHS hospital staff could understand as discussed in Chapter 6. The latent constructs were operationalised based on the concept of Expectancy–value Theory (Fishbein and Ajzen, 2010). The data were collected using convenience sampling and the sample characteristics of the respondents showed that the data were representative of the target population of the NHS staff.

The travel behaviour characteristics of the sample population were first analysed using descriptive statistics. The sample population was classified into two groups based on their travel mode choice behaviour, namely car user group and other mode(s) user group. The results from the Mann–Whitney U tests showed that the sample characteristics of the car user group was significantly different from those of the other mode user group. Thereby, Objective Three of the study *to examine the travel mode choice behaviour characteristics of the NHS hospital staff within the context of travel plans* is met.

9.2.4. Objective Four

First, normality, standard deviations, and standard errors of the variables were tested to check the suitability of the data for multivariate analysis. The results of Cronbach's α and item–total correlations indicated that the measurement scale were reliable. Following the assessment of internal consistency, exploratory factor analyses were performed to identify a set of items for each model construct. The EFA analyses identified six components and confirm the reliability of the measurement scales as proposed in the theoretical framework. However, the EFA does not provide a comprehensive assessment of construct validity and unidimensionality, which are essential elements of the measurement theory (Gerbing and Anderson, 1988; Hair et al., 2006). Confirmatory factor analysis was performed to refine and support the preliminary results found from the EFA, the results are briefly summarised below.

The initially included items of the latent constructs that were with insufficient cross–loadings with no theoretical justification were removed. The final Cronbach's α scores for the constructs remained relatively high indicating adequate reliability. The final outcomes provided robust factor structures that served as a basis for subsequent model assessment. Finally, the theoretical framework was tested using structural equation model. Cognitive attitude towards walking and objective mobility were identified as the direct determinants for intention to change travel mode choice behaviour. Four hypotheses proposed in the theoretical model were supported by the data and remaining four hypotheses were subsequently rejected.

The findings suggest that an increase in cognitive attitude towards walking would contribute to an increase in intention to change, which in turn may increase change in travel mode choice behaviour. A higher level of objective mobility could result in a lower level of intention to change, which is in–line with existing research. A higher level of satisfaction with the situational factors related to walking would result in a higher level of utility towards walking. Thereby, satisfaction with the situational factors related to walking may have a positive indirect or mediating effect on intention to change.

Measures to improve individual's perceptions towards walking alongside improving the walking environment are likely to improve their attitude towards walking, which in turn increase their intention to change. The pathways suggest that if the level of objective mobility (e.g. travel time, travel distance, annual average car mileage) is lower then there will be a higher level of cognitive attitude towards walking which in turn will lead to an increase in intention to change. Drawing upon the above findings it could be suggested that the theoretical framework was partially supported by the data. Thereby, Objective Four of the study *to identify the key determinants for intention to change travel mode choice behaviour of hospital staff* has been satisfied.

9.2.5. Objective Five

The use of a widely acknowledged standard framework to develop and evaluate the effectiveness of travel plan measures was not evident from the study findings. The concept of the Model for Planned Promotion was developed by integrating the aspects of the PRECEDE and PROCEED model (Green and Kreuter, 1999) and the intervention mapping approach (Bartholomew et al., 2006). This model is widely used in public health research to design interventions to promote healthy behaviour following six steps: (1) problem analysis; (2) risk behaviour analysis; (3) analysis of behavioural determinants; (4) development of intervention; (5) implementation and dissemination; and (6) evaluation of the intervention. The model proposes that each step needs to be supported by an evidence–base underpinned by established theories of changing behaviour (e.g. Theories of Changing Behaviour and Theory of Planned Behaviour) and evaluated by rigorous methods to ensure the satisfactory completion of the step. A set of recommendations were proposed for each step of the Model for Planned Promotion for the consideration of the NHS Acute Trusts in light of the evidence found in this study to better inform the travel planning process. Thereby, Objective Five of the study *to provide recommendations to inform the design of effective travel plan measures for hospital staff* has been achieved.

9.3. Recommendations for the NHS Acute Trusts

In general, the NHS Acute Trusts should consider the following issues to ensure the successful completion of the travel planning process:

- **allocation of resources** - resources to develop, implement, and manage a travel plan should be allocated prior to the travel planning process to avoid delays caused awaiting for the senior management approval for resources. The NHS authorities should consider working in collaboration with academic organisations to minimise the cost and resources required to carry out the travel planning process (Horton, 2000; Wartman et al., 2009);

- **skilled travel plan co–ordinators** - the NHS Acute Trusts should consider employing travel plan co–ordinators with the knowledge and expertise in: (a) changing travel mode choice behaviour; (a) survey design and execution; (b) data processing and analysis using statistical techniques; and (c) reporting and disseminating study findings (Kaseje et al., 2015). ; and
- **data collection methods** - a combination of methods should be used to collect the data as recommended by the best–practice guidance to inform to travel planning process, including: site survey, staff travel survey, travel audit and focus group workshops (TfL, 2006).

Besides, the practical implications of the study are addressed by providing recommendations based on the concept of Model for Planned Promotion. The following recommendations are made in light of the evidence found in this study to ensure the successful completion of each step of the Model for Planned Promotion.

9.3.1. Step 1: Problem analysis

The travel planning process should begin with identifying the 'central problem' or the 'reason why' a travel plan needs to be introduced in the given policy, local, and organisational context. The employer needs to assess what are the implications of a travel plan or what may happen in future if there is no travel plan based on the analysis of the available information, for example, modal share, demand for car parking spaces, and CO_2 emissions. An action plan should be produced clearly stating what actions required within a timeframe to identify the solution to address the problem.

9.3.2. Step 2: Risk behaviour analysis

The NHS Acute Trusts should determine what types of travel behaviour are of major concerns based on the analysis of past and existing travel behaviour of the hospital staff. For example, the types of behaviour may include, habitual car use behaviour or the use of cars alone for commuting to work; and the frequent use of cars use of cars for short and long trips. SMART targets should be set based on the identification of the targets groups for changing behaviour. Individuals with a physical inability to walk should be excluded from the target group for changing travel behaviour.

9.3.3. Step 3: Analysis of behavioural determinants

The determinants for changing mode choice behaviour vary with respect to the stages of changing behaviour. The target group for changing mode choice behaviour of the study were under either precontemplation (i.e. not ready to change or no intention to change) or contemplation (i.e. thinking of changing or has intention to change) stages of changing behaviour (Prochaska and DiClemente, 1984). In the context, interventions should be designed with a focus on two areas: *(1) intention formation; and (2) implementation intention.*

Intention formation - First, interventions to form intentions to walk for commuting purposes should be underpinned by the knowledge of determinants for changing intentions in the given context. A conceptual/theoretical framework should be designed prior to the data collection outlining the key determinants of changing intention to change travel behaviour. Prior to the main staff travel survey, the NHS authorities should carry out a scoping study to identify the beliefs that are salient to the staff. The theoretical framework should be operationalised following the scoping study. A staff travel survey should be designed to collect the information required to test the theoretical framework. The data should be analysed using robust methods, such as structural equation modelling.

Implementation intention - Second, despite having intentions to change travel behaviour the staff may not walk when confronted with real–life circumstances or unless they have the implementation intentions (Armitage and Conner, 2001; Fujii and Taniguchi, 2005). In the presence of habits the relationship between intention and behaviour is weak; therefore, interventions should be introduced to strengthen the relationship. The second types of interventions target at encouraging individuals to act on their intentions to walk for commuting purposes. Therefore, interventions should be informed based on the knowledge of internal or external factors that may constrain or facilitate walking for commuting purposes.

The interventions designed to promote walking are more effective when they are tailored to individual needs and targeted at individuals who have already expressed intention to change. Lack of consideration to the context may reduce the potential impact of the interventions to change behaviour despite the participants' willingness to change (Ogilvie, 2004; Ogilvie et al., 2007). Measures to encourage the implementation intentions walking should, therefore, be informed based on the knowledge of:

- internal or external factors that may constrain or facilitate walking for commuting purposes;
- the practicalities of the journey;
- the extraneous activities incorporated into commuting; and
- the image of walking to work and the cultural context.

9.3.4. Step 4: Development of intervention

Designing travel plan measures was beyond the scope of the study. However, based on the literature review and evidence found, the following recommendations could be suggested to develop effective travel plan measures. From the strategic perspective, the NHS authority should consider introducing a combination of positive and restrictive measures to address the determinants for changing travel mode choice behaviour.

Measures to promote walking - A range of initiatives should be introduced to encourage walking among the target groups for changing behaviour. First, as a pre–requisite, measures should be introduced to address any situational factors that may constrain walking to work, such as provision of safe and continuous pedestrian routes. The NHS authorities should work in collaboration with the local authorities to introduce short–term and long–term measures to improve pedestrian access to and from the hospital sites.

Prior to implementing the key travel plan measures, promotional materials, and persuasive campaigns should be introduced to strengthen the association between moral obligation to reduce car use and car use; and to reinforce a positive attitude towards walking (Gärling and Fujii, 2009; Schwartz, 1977). Such measures may focus on highlighting: (a) the changes made to improve the walking environment; (b) the negative consequences of car use; (c) the benefits of walking; and (d) promotional activities and incentives introduced to encourage walking.

Persuasive campaigns should include both messages and images to highlight the cognitive (e.g. improve physical fitness, save money) and affective benefits (e.g. relaxing) of walking to motivate the target groups (Haddock et al., 2008). Attitude towards a travel mode is a relatively stable construct when compared with motivation. Travel plan measures designed to increase motivation to walking could have a relatively immediate effect on travel mode choice behaviour among staff in comparison with those designed to influence attitudes. Therefore, a range of measures should be introduced to motivate the hospital staff.

The highest proportion of the hospital staff intended to walk in response to financial incentives. However, in the course of recent the NHS funding cut, financing such initiatives are not the preferred option by the NHS authorities. The NHS authorities should consider introducing alternative incentives with a higher emphasis to accommodating flexible working arrangements for those who walk to work (Pooley et al., 2011a). Such measures may include, flexible working hours, no penalty for lateness (i.e. especially for those who are time–constrained), and walking buddy schemes that allow employees living within proximity walking to work together. Walking to work with a companion or walking buddy in a pleasant walking environment is likely to reduce the negative effect associated with relatively long journeys and safety concerns.

Measures to reduce car use - The NHS authorities should consider introducing flexible and innovative car parking strategies that offer rewards to car users for using alternative travel modes with a car or on its own. If higher commuting distance limit the use of alternatives, the NHS authorities should consider encouraging their staff to use electric cars and cars with low CO_2 emissions. In the long–term, the NHS authorities should encourage the staff to reside within a close proximity to their main workplace that is facilitated by multimodal access.

9.3.5. Step 5: Implementation and dissemination

The key organisational and individuals issues that should be taken into consideration during the implementation of travel plan measures is outlined below.

Sharing resources - The NHS authorities should consider using a 'stepped wedge' design approach to ensure the effective implementation of travel plan measures (Brown and Lilford, 2006). According to this approach, several NHS authorities work together to gain practical and ethical benefits through the creation of a shared and mutual learning environment. By randomising the order of interventions being implemented by them over a period an NHS authority can take into the issues experienced by other organisations to ensure a successful implementation of the interventions (Macmillan et al., 2013).

Communicating effectively - Promotional materials containing persuasive messages to change travel mode choice behaviour are more effective if: *(a) it comes from a credible source; (b) it contains strong arguments; and (c) receivers pay careful attention to those arguments.*

Introducing measures before changes in life events - Travel plan measures are generally more effective when delivered in association with a disruption of a stable context, such as a change in personal circumstances, and introducing measures to limit the use of cars (Bamberg and Schmidt, 2003; Gardner, 2009). Therefore, the NHS authorities should consider encouraging their staff to walk following changes in key life events or personal circumstances (e.g. residential relocation, becoming a parent, starting a new job) to achieve a better outcome (Bamberg et al., 2003; Fujii and Taniguchi, 2006; Klöckner and Matthies, 2004). Environmentally concerned individuals are more receptive to act upon their values when they face a situation of context change. Interventions would, therefore, provide more value–for–money and a greater probability of success when these are targeted to motivated individuals at times of context change.

Increasing acceptance of measures - Issues associated with car parking charges could be resolved through adequate consultation with the hospital staff by taking into account their individual circumstances. Ring–fencing the income generated from car parking charges to provide improved facilities to promote alternative modes for transport may also help to increase the acceptance of such measures (Ryley, 2010).

Sufficient time should be allowed to switch from car to a slower travel mode. Despite having the window of time after the switch individuals may not be satisfied with the time pressure. Introducing flexible working hours for those who commute by alternative modes of transport may address this issue.

9.3.6. Step 6: Evaluation of the intervention

The impacts of the travel plan should be monitored on a regular basis using a robust method that can distinguish the actual impacts of the travel plan measures from the changes in travel mode choice due to changing circumstances. The individual travel plan measures should be improved in accordance to their performance on a regular basis.

9.4. Contribution to knowledge

This PhD project contributes to knowledge to the following areas (Gray, 1996):

- research focusing on the NHS hospital staff travel behaviour;
- application of the concept of Model for Planned Promotion in transport;
- employing a new research methodology to carry out the research; and
- developing a theoretical framework to operationalise intention to change travel mode choice behaviour.

Research with a focus on the NHS hospital staff travel behaviour - The PhD attempts to contribute to a better understanding of the travel mode choice behaviour of the NHS hospital staff within the scope of a travel plan by drawing attention to the knowledge gaps identified during the review of literature. Findings from the Phase 1 show that despite having a potential to promote walking, measures to promote walking were cited as the least effective by the hospital travel plan co–ordinators. The review of hospital travel plans suggests that a lack of consideration to the issues related to the travel mode choice behaviour of the staff may have affected the success of the travel plan measures to promote walking. Besides, findings from the Spearman's ρ correlation tests show that the effectiveness of measures to promote walking was positively associated with measures to restrict the use of cars. The findings highlight the significance of developing effective measures to promote walking to achieve a high reduction in use.

Application of the concept of Model for Planned Promotion in transport - Theory–driven interventions are regarded as more effective in changing travel behaviour (Bartholomew et al., 2006). In public health research, the applications of theoretically underpinned behavioural change interventions have been proven to be successful in promoting healthy behaviour, such as physical activity, quit smoking, and drug addiction. However, in transport, travel plan are designed with a lack of focus on the explicit theoretical rationale between measures and their intended effects on changing travel behaviour (Gärling and Fujii, 2009). The Model for Planned Promotion is widely used to design interventions to promote healthy behaviour following six steps (Conner and Norman, 2005): *(1) problem analysis; (2) risk behaviour analysis; (3) analysis of behavioural determinants; (4) development of intervention; (5) implementation and dissemination;* and *(6) evaluation of the intervention.* The model proposes that each step needs to be supported by evidence–base underpinned by established theories of changing behaviour and evaluated by rigorous methods to ensure the satisfactory completion of the step. The concept of the Model for Planned Promotion has been used to investigate the travel mode choice behaviour of the NHS hospital staff within the scope of a travel plan.

Employing a new methodology to carry out the research - The sequential actions used to conduct the research based on a methodological framework developed in this study. There is a limited number of studies across the world with a focus on the transport issues of the healthcare staff. To contribute to the knowledge gap, this study was designed into three phases. Phase 1 and Phase 2 were designed to investigate the key issues related to hospital travel plans and staff travel behaviour respectively. Two questionnaires, a coding framework and theoretical framework were developed based on literature review and evidence found in the study to carry out the research. Measuring habit is inherently difficult and often subject to self–reported bias. The staff are often reluctant to participate in such surveys fearing that their responses may affect their rights to use cars. Therefore, an indirect approach was used to collect the data required to investigate the travel behaviour characteristics of the NHS hospital staff. It was assumed that the hospital staff with car use habits were likely to exhibit a set of characteristics as summarised from the literature.

Developing a theoretical framework - A theoretical framework has been proposed depicting the determinants for intention to change travel mode choice behaviour. The theoretical framework was developed by incorporating three added dimensions into the originally proposed Theory of Planned behaviour:

- two constructs for cognitive attitudes towards car use and walking;
- two constructs for affective attitude towards situational factors related to car use and walking; and
- objective mobility as a proxy measure for habits.

Six constructs, out of the seven constructs: (a) CAC: Cognitive attitude towards car use; (b) AASFC: Affective attitude towards the situational factors related to car use; (c) CAW: Cognitive attitude towards walking; (d) AASFW: Affective attitude towards the situational factors related to walking; (e) PBC: Perceived behavioural control; (f) OM: Objective mobility; and (g) IC: Intention to change travel mode choice behaviour - originally proposed in the theoretical framework were found to be statistically valid. Cognitive attitude towards walking and objective mobility were identified as the key determinants of intention to change travel mode choice behaviour. The car user group exhibited the following characteristics: (a) the use of a single mode in a stable context (Chen and Chao, 2011; Gardner, 2009; Friedrichsmeier et al., 2013; Ouellette and Wood, 1998); (b) a weaker intention to change travel mode choice behaviour (Ajzen, 1991; Friedrichsmeier et al., 2013; Klöckner, 2013); (c) a moderate attitude towards walking and the situational factors related to walking (Handy et al., 2006; Panter and Jones, 2010; Panter et al., 2014); (d) a non-significant perceived behavioural control towards walking to work (Klöckner and Friedrichsmeier, 2011); and (e) a negative impact of objective mobility or existing behaviour on intention to change travel mode behaviour (Gardner, 2009). The evidence found in this study supported the prevalence of car use habits among the hospital staff (Verplanken et al., 1994) and the predictive utility of the TPB in the context of healthcare (Bamberg and Schmidt, 2003). This study contributes to the growing body of research concerning psychological factors by exploring the complex interrelationships between the determinants for intention to change the travel mode choice behaviour of the NHS hospital staff.

The significance of developing effective travel plan measures to reduce the use of cars among the NHS hospital staff is widely acknowledged but little explored. This study attempted to contribute to the knowledge gaps, thereby, will provide a fundamental basis for further research into this area.

9.5. Further research and limitations of the study

Despite following a rigorous research method and data analysis techniques several limitations were encountered during the course of the study. Therefore, the findings presented in the thesis should be interpreted in light of the following limitations.

Due to time constraints, convenience sampling was used as a sampling technique to collect the data for Survey 1: Hospital travel plan survey and Survey 2: Hospital staff travel behaviour survey. Convenience sampling is a non–probability sampling technique as the sample is drawn with any underlying probability–based selection method but due to their convenient accessibility. The key advantage of the sampling technique is, it is easy to employ and cost–effective. In contrast, the key limitation of the technique is the sample population may not be representative of the target population as the data were collected based on a self–participatory approach or from those who volunteered to take part in the survey. Therefore, statistical generalisation of the results based on convenience sampling is not valid. Future studies may consider collecting data through a random sampling method, which may require management support from the individual NHS authorities.

Moreover, the NHS representatives assessed the content, clarity, and length of the questionnaire first before deciding to circulate it to the staff. It should be noted that the number of variables that can be used to measure the relative attractiveness of different modes is not limited by the model itself, it was guided by the information that could be conveniently obtained through the survey.

As a cross–sectional study the research undertaken in this study did not consider intention to change travel mode choice behaviour over time. It is recommended that future research should consider examining the dynamic impacts of the determinants of intention to change over different points in time. The effects of subjective norm and habit on intention to change have not been measured as part of the study. The inclusion of these constructs will provide a better explanatory power to the model.

Further empirical analysis should explore the association between the psychological constructs and situational aspects specific to the NHS organisation, such as employee car parking ratio, congestion on local roads, on–site congestion, car parking charging policy, and the quality of the walking environment in and around the hospital site. This will provide a better understanding of how the car users perceptions towards travel environment may differ from the actual state. The results may shed light on how individual perceptions towards the utility of a travel mode may vary with respect to situational environment.

The relationships between the latent constructs were tested and validated using structural equation model. However, this study did not attempt to explore the causal relationships between the constructs based on the cross–sectional data analysis. Exploring causal relationships by employing quasi–experimental method could be an area of future research. The use of integrated choice and latent variable (ICLV) models that incorporate discrete choice models with structural equation model to examine the influence of the underlying psychological factors associated with travel mode choice provides a deeper understanding of the underlying decision making process behind travel mode choice (Ben-Akiva et al., 1999). In the past the applications of ICLV were mostly limited to examining the direct effects of latent variables on choice and the casual relationships between latent variables have been overlooked. However, the recent studies the hierarchical relationships between the latent variables and discrete choice analysis is interpreted by the Expectancy–value Theory (supported by Theory of Planned Behaviour). Despite having the conceptual appeal, the applications of ICLV in travel behaviour research have been limited as the full estimation of information required by the model was considered as a rather complex process. Due to time and resource constraints, ICLV has not been used as part of the research, however, the employment of ICLV as a tool to investigate travel behaviour will provide a better insight into the underlying mechanisms behind travel mode choice behaviour.

To secure a more sustainable change in the long–term further research needs focus on investigating how preference for residential location varies among the hospital staff and how to design strategies to encourage the staff to reside within a close proximity to their main workplace. People tend to progress through different stages on their way to successful change. Interventions should be tailored for participants, who are at different stages of changing travel behaviour. Future research needs to explore the impacts of travel plans throughout the stages of changing travel behaviour (Prochaska and DiClemente, 1984). Finally, there is a clear need for further research in the health-care settings to promote the use of active modes of transport among the staff in long–term. There is a scope for carrying out collaborative research between the academics and practitioners with a focus to the principles of cognitive behavioural change.

9.6. Conclusions

The significance of implementing effective travel plans at a wider scale to tackle the magnitude of the problems associated with high car use by the NHS staff is widely acknowledged. Despite the increasing take–up of hospital travel plans, their overall impact on reducing car use has been reported to be low. The evidence found in this study highlight the significance of developing effective measures to promote walking to increase the overall effectiveness of measures to reduce car use. However, it was also found that despite having a potential to promote walking among the hospital staff, the measures to promote walking were cited as the least effective by the hospital travel plan co–ordinators. The lack of success of the travel plan measures could be attributed to the lack of quality data and methods used to inform the travel planning process. The allocation of sufficient resources and skilled staff is key to generate quality evidence base to inform and monitor the travel planning process (De Gruyter et al., 2014). The recent NHS funding cuts are likely to affect the budget available to develop and implement the travel plans by the individual trusts. Therefore, the NHS Trusts should consider working in collaboration with academic institutions to create a mutually beneficial platform to share resources and expertise.

Findings from Survey 2: Hospital staff travel behaviour survey confirm that a high proportion of the NHS hospital staff relied on cars alone for commuting trips. The characteristics of the car user group was significantly different than the other mode(s) user group. The car user group exhibited the characteristics of the habitual behaviour, which further emphasises the need for developing innovative measures to achieve a significant outcome. This study findings also suggest the significance of improving the walking environment to increase the car users' perceptions towards the utility of walking for commuting trips. The effect of short–term interventions has been proven to be ineffective in securing a long–term change in habitual car use behaviour (Abou-Zeid et al., 2012). Therefore, the NHS Trusts should consider introducing cost–effective measures such as flexible car parking policies that reward car users every time they use alternatives, such as walking. However, in the long–term the NHS Trusts should consider introducing measures to encourage their employees to reside within a proximity to the main workplace to reduce their commuting distance. This study provides a basis for further conceptualisation of travel behaviour change and identifies several areas that need further investigation related to designing interventions to promote walking in the context of healthcare.

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Appendix A

Training courses attended

As part of this PhD programme I successfully completed 36 courses, over 38 sessions – totalling 108.5 hours, not including online courses. Details of the training courses are provided in Table A.1.

Table A.1: Training courses completed.

Date	Hours	Course title
28 Jun 2010	3.0	Getting the Most out of Supervision
5 Jul 2010	3.0	Influencing - how to get out of your own way
20 Jul 2010	3.0	Reading for Research
28 Sep 2010	2.5	What is a Literature Review?
29 Sep 2010	3.0	Reflective Activities for Research
30 Sep 2010	2.5	Tools for Creative Thinking
1 Oct 2010	3.0	Career Planning - Career Management for Researchers
5 Oct 2010	3.0	Time and Self-management
29 Nov 2010	3.0	Managing your PhD as a Project
23 Mar 2011	2.0	Chi-squared Tests (analysing two-way tables)
25 May 2011	2.5	Keeping your Research Up-to-Date for Postgraduates
21 Jun 2011	2.5	Conference Presentation Skills - Part B
5 Jul 2011	2.0	VIVA - What Happens?
6 Jul 2011	3.0	Writing up your PhD Thesis
11 Jul 2011	3.0	Successful Interviews - Career Management for Researchers
11 Oct 2011	2.5	Conference Presentation Skills - Part A
19 Oct 2011	2.0	Questionnaire Design
26 Oct 2011	2.0	Introduction to the Design of Surveys and Experiments
2 Nov 2011	2.0	Introduction to Statistical Methodology
9 Nov 2011	2.0	Paired and Unpaired t-tests
16 Nov 2011	2.0	Chi-squared Tests (analysing two-way tables)
30 Nov 2011	2.0	Introduction to Linear Regression and Correlation
9 May 2012	2.0	Non-parametric Tests
6 Jun 2012	2.5	Creating and Measuring your Bibliometric Impact for PGRs
25 Sep 2012	3.5	STARs (Successful Teaching and Assessment for Researchers)
13 Nov 2012	4.0	Teaching Skills - Preparing to Teach and Promoting Learning*
5 Feb 2013	4.0	Teaching Skills - Preparing to Teach and Promoting Learning*
7 Mar 2013	6.5	Research Conference - Research That Matters
22 Apr 2013	1.5	Academic Writing Style - The Role of the Noun Phrase
8 May 2013	1.5	Copyright and your Thesis
25 Jun 2013	3.0	Teaching Skills Option C - Supervising Practical Activities

* Course taken over two sessions.

Appendix B

Questionnaires

B.1. Survey 1: Hospital travel plan survey

Introduction to the survey

The survey aims to obtain an overview of the key aspects associated with hospital staff travel plans in the UK.

The information provided will be processed in accordance with data protection principles as set out in the Data Protection Act.

If you have any comments or suggestions regarding the questionnaire survey, then please feel free to contact me at:

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Section A: About you and your organisation

1. Your title

◯ Mr ◯ Miss ◯ Ms ◯ Mrs ◯ Other

2. First name

3. Last name

4. Your job title

5. Your organisation

Section B: Background information on your travel plan

6. Which of the following transport issue(s) apply to your organisation? Please select all that apply to your organisation.

- ☐ On-site congestion
- ☐ Congestion on local roads
- ☐ Lack of parking spaces
- ☐ Road side parking
- ☐ High car use
- ☐ Increasing demand for car parking spaces
- ☐ Poor access by public transport
- ☐ Poor pedestrain access to and from the site
- ☐ Poor access by cycling to and from the site
- ☐ Lack of facilities for walking
- ☐ Lack of facilities for cycling

Other (please specify)

7. Does your organisation currently have a travel plan?

- ○ Yes (If yes, please go to Q8)
- ○ No (If no, please go to Q22)

8. Who was responsible for developing the travel plan in your organisation?

- ○ In-house team
- ○ External consultants
- ○ In-house team jointly with external consultants

Other (please specify)

9. Which department(s) within your organisation is/are responsible for implementing and monitoring the travel plan?

10. In which year was the travel plan introduced?

11. Do you have any modal shift target(s)?

- ○ Yes (If yes, please go to Q11)
- ○ No

12. Please specify what are the modal shift targets (%) and timescales to achieve these targets.

Car	
Car sharing	
Public transport	
Walking	
Cycling	

Section B: Motivations behind developing your travel plan

13. How important are the following reasons for introducing your travel plan?

	Very Important	Important	Moderately important	Of little importance	Unimportant	Don't know
Reduce carbon emissions	○	○	○	○	○	○
Promote health and well-being	○	○	○	○	○	○
Meet regulatory requirements	○	○	○	○	○	○
Meet corporate social responsibility	○	○	○	○	○	○
Save money	○	○	○	○	○	○
Increase staff retention	○	○	○	○	○	○
Improve accessibility	○	○	○	○	○	○
Reduce road side parking	○	○	○	○	○	○
Lack of parking spaces	○	○	○	○	○	○
Changing attitudes of staff towards travel	○	○	○	○	○	○
Expansion/redevelopment of the hospital site	○	○	○	○	○	○

Please specify any other reason(s) and indicate their specific importance.

14. In your view, how important are the following reasons for the future development of the travel plan.

	Very Important	Important	Moderately important	Of little importance	Unimportant	Don't know
Reduce carbon emissions	◯	◯	◯	◯	◯	◯
Promote health and well-being	◯	◯	◯	◯	◯	◯
Meet regulatory requirements	◯	◯	◯	◯	◯	◯
Meet corporate social responsibility	◯	◯	◯	◯	◯	◯
Save money	◯	◯	◯	◯	◯	◯
Increase staff retention	◯	◯	◯	◯	◯	◯
Improve accessibility	◯	◯	◯	◯	◯	◯
Reduce road side parking	◯	◯	◯	◯	◯	◯
Lack of parking spaces	◯	◯	◯	◯	◯	◯
Change in attitudes of staff towards travel	◯	◯	◯	◯	◯	◯
Expansion/redevelopment of the hospital site(s)	◯	◯	◯	◯	◯	◯

Please specify any other reason(s) and their relative importance.

Section B: Travel plan measures

15. How do you collect the information required to develop travel plan measures? Please select all that apply to your organisation.

- ☐ Staff travel survey
- ☐ Car parking audit
- ☐ Staff forum
- ☐ Site assessment
- ☐ Travel audit
- ☐ Staff feedback

Other (please specify)

16. In your view, how important are the following factors while designing travel plan measures.

	Very important	Important	Moderately important	Of little importance	Unimportant	Don't know
Organisational commitment to reduce car use						
Availability of resources						
Pedestrain access to and from the site						
Provision for cycling						
Provision for public transport						
Staff perceptions of the quality of public transport						
Organisational culture to car use						
Staff working pattern (e.g. shift working)						
Distance from workplace						
Staff health and fitness						
Staff personal commitments						
Weather						

Please specify any other factor(s) and indicate their specific importance.

17. How effective have the following travel plan measures (where applicable) been in reducing the use of single occupancy cars in your organisation?

	Very effective	Effective	Moderately effective	Little effective	Ineffective	Don't know	Not applicable
Incentives for walking							
Improved facilities for walking							
Improved pedestrain access							
Incentives for cycling							
Improved access by cycling							
Improved facilities for cycling							
Promotional materials and activities to encourage walking and cycling							
Improved access by public transport							
Discounts on public transport							
Restrictions on parking permits							
Increased car parking charges							
Car-sharing club							
Easy access to information on public transport and car-sharing							
Changing working pattern							

Please specify any other measure(s) and indicate their specific effectiveness.

Section B: Monitoring your travel plan

18. How often do you monitor your travel plan?

19. Which of the following measures do you use to monitor your travel plan? Please select all that apply to your organisation.

- ☐ Change in modal share
- ☐ Cost reduction per trip
- ☐ Car parking space/employee ratio
- ☐ Average vehicle occupancy status
- ☐ Cost reduction per employee
- ☐ Change in personal circumstances
- ☐ Reduction in total vehicle kilometres

Please specify any other measure(s) you use to monitor your travel plan that is/are not included above.

20. In your view, which of the following step(s) is/are the most challenging part of a travel plan decision making process.

- ☐ Collect the information required to produce the travel plan
- ☐ Develop/identify travel plan measures
- ☐ Implement the travel plan
- ☐ Monitoring the impacts of a travel plan

21. In your view, what are the key barriers to changing staff travel behaviour.

Section B: Questions for those without travel plans

22. Do you have any travel schemes to reduce the use of cars or promote the use of sustainable modes of transport (e.g. walking, cycling, public transport, car sharing)?

- ○ Yes (If yes, please go to Q23)
- ○ No (If no, please go to Q32)

23. Please name the key travel schemes you have in the following box.

24. In which year did you first introduce the travel scheme(s)?

25. Who was responsible for developing the travel schemes in your organisation?

- In-house team
- External consultants
- In-house team jointly with external consultants

Other (please specify)

26. Which department(s) within your organisation is/are responsible for implementing and monitoring the travel schemes?

27. How important are the following reasons for introducing the travel schemes?

	Very Important	Important	Moderately important	Of little importance	Unimportant	Don't know
Reduce carbon emissions						
Promote health and well-being						
Meet regulatory requirements						
Meet corporate social responsibility						
Save money						
Increase staff retention						
Improve accessibility						
Reduce road side parking						
Lack of parking spaces						
Changing attitudes of staff towards travel						
Expansion/redevelopment of the hospital site						

Please specify any other reason(s) and indicate their specific importance.

28. How do you collect the information required to develop travel schemes? Please select all that apply to your organisation.

- ☐ Staff travel survey
- ☐ Car parking audit
- ☐ Staff forum
- ☐ Site assessment
- ☐ Travel audit
- ☐ Staff feedback

Other (please specify)

29. In your view, how important are the following factors while designing travel schemes.

	Very important	Important	Moderately important	Of little importance	Unimportant	Don't know
Organisational commitment to reduce car use	○	○	○	○	○	○
Availability of resources	○	○	○	○	○	○
Pedestrain access to and from the site	○	○	○	○	○	○
Provision for cycling	○	○	○	○	○	○
Provision for public transport	○	○	○	○	○	○
Staff perceptions of the quality of public transport	○	○	○	○	○	○
Organisational culture to car use	○	○	○	○	○	○
Staff working pattern (e.g. shift working)	○	○	○	○	○	○
Distance from workplace	○	○	○	○	○	○
Staff health and fitness	○	○	○	○	○	○
Staff personal commitments	○	○	○	○	○	○
Weather	○	○	○	○	○	○

Please specify any other factor(s) and indicate it's specific importance.

30. How often do you monitor the travel schemes?

31. In your view, which of the following step(s) is/are the most challenging part of a travel scheme decision making process.

- ☐ Collect the information required to produce the scheme
- ☐ Identify the specific strategies to be used for the scheme
- ☐ Implement the scheme
- ☐ Monitor the impacts of the scheme

Section C: About your future travel plan activities

32. Do you have any plan to conduct a staff travel survey in the near future?

- ◯ Yes (If yes, please go to Q33)
- ◯ No (If no, please go to Q34)

33. Please write in the following box, when are you planning to conduct a staff travel survey.

34. I am interested in conducting a case study to explore the factors that help to change the travel behaviour of hospital staff. Would you be interested in taking part in the case study?

- ◯ Yes (If yes, please go to question 35)
- ◯ No
- ◯ Not sure

35. Please write your contact information in the following box.

Name

Telephone number

Email

Thank you for your time and taking part in the survey.

B.2. Survey 2: Hospital staff travel survey

Introduction to the staff travel survey

Fahmida Khandokar, a PhD student at Loughborough University is conducting a survey to study the use of travel methods by hospital staff within the NHS. The information provided will be treated as confidential and used solely for academic purposes.

The survey may take 7 to 12 minutes. Please note that, for the first 200 completed responses there will be a prize draw with a chance to win 15 M&S vouchers of £20. The deadline for completing the survey is Friday, 18 January **2013.**

If you have any questions regarding the survey, then please feel free to contact the researcher at:

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Section A: Journey to work

*1. What is your full home postcode?

2. Please select which hospital site is your main workplace.

Hospital name

Other (please specify)

3. How long have you worked at this site?

- Up to 6 months
- 6 months to 1 year
- From 1 year to 2 years
- From 2 years to 3 years
- From 3 years to 5 years
- More than 5 years

4. What is the maximum time you are willing to spend commuting to or from work (each way from your current home)?

- ◯ 0 to 15 minutes
- ◯ 16 to 30 minutes
- ◯ 31 to 45 minutes
- ◯ 46 to 60 minutes
- ◯ More than 60 minutes

5. How many days a week do you use the following methods to get to and from work?

	N/A	1 day	2 days	3 days	4 days	5 days	6 days	7 days
Car	◯	◯	◯	◯	◯	◯	◯	◯
Carshare	◯	◯	◯	◯	◯	◯	◯	◯
Walking on it's own	◯	◯	◯	◯	◯	◯	◯	◯
Walking for more than 10 minutes with car journey	◯	◯	◯	◯	◯	◯	◯	◯
Cycling	◯	◯	◯	◯	◯	◯	◯	◯
Bus	◯	◯	◯	◯	◯	◯	◯	◯

Other (please specify)

***6. Please rate how important the following factors are to you when selecting travel methods to get to and from work?**

	Very important	Important	Neither important nor unimportant	Unimportant	Very unimportant
Cost	◯	◯	◯	◯	◯
Time	◯	◯	◯	◯	◯
Convenience (i.e. available when needed)	◯	◯	◯	◯	◯
Comfort	◯	◯	◯	◯	◯
Security during early mornings and at night	◯	◯	◯	◯	◯
Flexibility (i.e. able to stop and do other duties)	◯	◯	◯	◯	◯
Reliability (i.e. arriving on time)	◯	◯	◯	◯	◯

Other (please specify)

7. What is your opinion about the following facilities to and from your main workplace?

	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied
Street lighting	◯	◯	◯	◯	◯
Pedestrian crossings	◯	◯	◯	◯	◯
Personal security at early mornings and nights	◯	◯	◯	◯	◯
Quality of pavements (i.e. feeling safe while walking in all weather conditions)	◯	◯	◯	◯	◯
Continuity of pedestrian routes	◯	◯	◯	◯	◯
Overall on-site walking facilities of the hospital site	◯	◯	◯	◯	◯

Other (please specify)

8. Is your journey to and from work only by a car?

◯ Yes

◯ No

Section A: Journey to work

1. Do you walk for all or part of your journey to and from work?

◯ Yes

◯ No

Section A: Journey to work

1. Do you have a car parking permit issued by the NHS trust you work for?

◯ Yes

◯ No - but I have applied

◯ No - applied but a permit denied

◯ No - not intending to apply for a car parking permit

Other (please specify)

2. Where do you park? Please tick boxes as appropriate.

- ◯ On-site hospital car park
- ◯ Other off-site car park(s)
- ◯ Off-site car park authorised by the NHS trust
- ◯ On local roads

Other (please specify)

3. How long does it take for you to get to and from work by a car?

	up to 15 minutes	16 to 30 minutes	31 to 45 minutes	46 to 60 minutes	More than 60 minutes
Car	◯	◯	◯	◯	◯

4. What are the reasons for using a car for all or part of your journey? Please tick up to five main reasons for normally using a car.

- ☐ To save time
- ☐ To save money
- ☐ Too far away from home
- ☐ To carry heavy stuff
- ☐ Comfort
- ☐ Convenience (i.e. available at all times)
- ☐ Bad weather
- ☐ Security concerns
- ☐ Only viable travel option
- ☐ Physical inability to use other modes
- ☐ Personal commitments (e.g. drop off/collect children, caring for elderly)
- ☐ Work commitments (e.g. shift working, site visits)

Other (please specify)

5. Please rate your views on the use of a car to get to and from your main workplace.

	Very easy	Easy	Neither easy nor difficult	Difficult	Very difficult
Car	◯	◯	◯	◯	◯

6. How do you feel about the use of a car to get to and from your main workplace?

	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied
Car	◯	◯	◯	◯	◯

***7. Please rate your overall car journey experience to and from your main workplace on the following aspects.**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Cost effective	◯	◯	◯	◯	◯
Time efficient	◯	◯	◯	◯	◯
Convenient (i.e. available at all times)	◯	◯	◯	◯	◯
Comfortable	◯	◯	◯	◯	◯
Secure (i.e. fear of personal security)	◯	◯	◯	◯	◯
Flexible (i.e. able to stop and do other duties)	◯	◯	◯	◯	◯
Reliable (i.e. arriving on time)	◯	◯	◯	◯	◯
Relaxing (i.e. stress-free)	◯	◯	◯	◯	◯

8. What is your opinion about the following aspects while using a car to get to and from your main workplace?

	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied
Quality of road networks	◯	◯	◯	◯	◯
Traffic on the way to work	◯	◯	◯	◯	◯
Availability of car parking spaces	◯	◯	◯	◯	◯
Car parking charges	◯	◯	◯	◯	◯
Time spent on finding a car parking space	◯	◯	◯	◯	◯

Other (please specify)

9. Please rank in order what are the five main barriers to the use of travel methods other than a car to get to and from your main workplace? Where, 1 being the first barrier and 5 being the fifth barrier.

	1	2	3	4	5
Too far away from home	○	○	○	○	○
Increased travel time	○	○	○	○	○
Inconvenience	○	○	○	○	○
Lack of viable alternatives	○	○	○	○	○
Security concerns during early mornings and at night	○	○	○	○	○
Work commitments (e.g site visits, shift hours)	○	○	○	○	○
Personal commitments (e.g. dropping off children and/or partner)	○	○	○	○	○

10. Which of the following incentives/solutions would encourage you to walk to and from your main workplace? Please tick up to five main incentives/solutions.

- ☐ Safe and continuous pedestrian routes
- ☐ Better maintained pavements
- ☐ Safer pedestrian crossings
- ☐ Friend/colleague(s) to walk with you
- ☐ Financial incentives (e.g. discount on car parking permits)
- ☐ Flexible car parking permits
- ☐ Flexible working hours
- ☐ Health benefits (e.g. reduce the risks of heart attack and type 2 diabetes)
- ☐ Reduce CO2 emissions

11. If solutions/incentives are provided to address the travel needs of the staff, how often do you think you will be able to walk for all or part of your journey to and from work?

- ◯ Everyday in a working week
- ◯ At least 2 to 3 days a week
- ◯ At least once in a week
- ◯ At least once in fortnight
- ◯ At least once in a month
- ◯ Not at all
- ◯ Don't know

Other (please specify)

Section A: Journey to work

1. How long does it take for you to get to and from work by the following travel methods?

	Up to 15 minutes	16 to 30 minutes	31 to 45 minutes	46 to 60 minutes	More than 60 minutes
Walking on it's own	◯	◯	◯	◯	◯
Walking for more than 10 minutes with car journey	◯	◯	◯	◯	◯

2. Please tick up to five main reasons for walking for more than 10 minutes as part of your journey to and from work.

- ☐ To save money
- ☐ Live close to work
- ☐ Acceptable journey time
- ☐ Most practical travel option
- ☐ Do not hold a car parking permit
- ☐ Avoid congestion delays
- ☐ Difficulties with car-parking
- ☐ No car available
- ☐ Do not have a driving license
- ☐ Do not like driving
- ☐ Like to walk
- ☐ Convenient
- ☐ Stress-free
- ☐ Improve physical fitness
- ☐ Environmental concerns

Other (please specify)

3. Please rate your views on the use of the following travel methods to get to and from your main workplace.

	Very easy	Easy	Neither easy nor difficult	Difficult	Very difficult
Walking on it's own	◯	◯	◯	◯	◯
Walking for more than 10 minutes with car journey	◯	◯	◯	◯	◯

4. How do you feel about the use of the following travel methods to and from your main workplace?

	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied
Walking on it's own	◯	◯	◯	◯	◯
Walking for more 10 minutes with car journey	◯	◯	◯	◯	◯

***5. Please rate your overall walking experience to and from your main workplace on the following aspects.**

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Cost effective	◯	◯	◯	◯	◯
Time efficient	◯	◯	◯	◯	◯
Convenient (i.e. available at all times)	◯	◯	◯	◯	◯
Comfortable	◯	◯	◯	◯	◯
Secure (i.e. no fear of personal security)	◯	◯	◯	◯	◯
Flexible (i.e. able to stop and do other duties)	◯	◯	◯	◯	◯
Reliable (i.e. arriving on time)	◯	◯	◯	◯	◯
Relaxing (i.e. stress free)	◯	◯	◯	◯	◯

Section B: Travel plans

1. To what extent are you aware of the benefits of a travel plan?

◯ To a great extent
◯ To a moderate extent
◯ To some extent
◯ To a small extent
◯ Not at all

2. In your view, which of the following options would reduce congestion on local roads around your main workplace?
Please tick three most important options.

- ☐ Improving the quality of bus services
- ☐ Improving pedestrian routes
- ☐ Improving cycling routes
- ☐ Reducing the use of cars
- ☐ Providing flexible working hours

Other (please specify)

Section C: About yourself

1. What is your job role?

Job role

Other (please specify)

2. What is your gender?

- ○ Female
- ○ Male

3. What is your age group?

- ○ 16 - 19
- ○ 20 - 29
- ○ 30 - 44
- ○ 45 - 59
- ○ 60 - 64
- ○ 65 and over

4. What is your approximate average household income per year?

- ○ Below £15,000
- ○ £15,001 to £30,000
- ○ £30,001 to £45,000
- ○ £45,001 to £60,000
- ○ £60,001 to £75,000
- ○ Over £75,000

5. How many children under the age of 18 currently live in your household?

- No children
- 1 child
- 2 children
- 3 children
- More than 3 children

6. How many days a week do you commute to work?

- 1 or 2 days
- 3 or 4 days
- 5 days or more

7. How many adults (more than 18 years old) currently live in your household?

- 1 adult
- 2 adults
- 3 adults
- 4 adults
- More than 4 adults

8. What type of housing tenure do you hold? Please tick one.

- Owner
- Tenant
- Lodger
- Shared/joint ownership

Other (please specify)

9. Which type of housing do you currently live in?

- Detached
- Semi-detached
- Terraced
- Flat/apartment
- Hospital accommodation

Other (please specify)

10. How long have you lived in your current house?

- ◯ Up to 6 months
- ◯ 6 months to 1 year
- ◯ From 1 year to 2 years
- ◯ From 2 years to 3 years
- ◯ From 3 years to 5 years
- ◯ More than 5 years

11. Which of the following factors played an important role when you chose the area you currently live in? Please tick up to four most important factors.

- ☐ Proximity to workplace
- ☐ Access to good retail facilities
- ☐ Proximity to town/city centre
- ☐ Good quality housing
- ☐ Easy access to public transport
- ☐ Reasonable house price
- ☐ Access to good schools
- ☐ Preference for countryside
- ☐ Access to good leisure facilities

Other (please specify)

12. How many cars are owned by your household?

- ◯ None
- ◯ 1 car
- ◯ 2 cars
- ◯ 3 cars
- ◯ More than 3 cars

13. Do you have a driving licence?

- ◯ Yes - full UK driving licence
- ◯ Yes - provisional licence
- ◯ No

Other (please specify)

14. What is your annual car mileage? For car owners only

- ◯ 0 to 3,000 miles
- ◯ 3,001 to 6,000 miles
- ◯ 6,001 to 9,000 miles
- ◯ 9,001 to 12,000 miles
- ◯ 12,001 to 15,000 miles
- ◯ More than 15,000 miles
- ◯ Don't know
- ◯ Not applicable

15. Do you have any health conditions that may affect your ability to walk for up to 30 minutes a day?

- ◯ Yes
- ◯ No
- ◯ Don't know

16. Do you have a blue disability parking badge?

- ◯ Yes
- ◯ No

Section D: Additional comments

1. If you have any additional comments about your travelling experience to work, please write in the following box.

Section E: Prize draw

1. Would like to enter into a prize draw with a chance to win 15 M&S vouchers of £20?

- ◯ Yes
- ◯ No
- ◯ Not sure

Section F: Contact information

1. If yes, please provide the following information:

Name	
Preferred contact information	

Thank you for your time and taking part in the survey.

Appendix C

Ethical clearance form

Ethics Approvals (Human Participants) Sub-Committee

Ethical Clearance Checklist

Has the Investigator read the 'Guidance for completion of Ethical Clearance Checklist' before starting this form?	Yes ✔	No

Project Details

1. Project Title: **Investigating the impacts of socio-economic, psychological and situational factors in changing travel behaviour of hospital staff in the context of travel plans.**

A nationwide survey will be conducted among the NHS hospital staff in England by Fahmida Khandokar a PhD student at the School of Civil and Building Engineering, Loughborough University.

Applicant(s) Details

2. Name of Applicant 1: Fahmida Khandokar	10. Name of Applicant 2:
3. Status: PGR student	11. Status: UG Student/PGT student/PGR Student/Staff
4. School/Department: School of Civil and Building Engineering	12. School/Department:
5. Programme (if applicable): PhD	13. Programme (if applicable):
6. Email address: [redacted]	14. Email address:
7a. Contact address: [redacted]	15a. Contact address:
7b. Telephone number: [redacted]	15b. Telephone number:
8. Supervisor: No	16. Supervisor: Yes/No
9. Responsible Investigator: Yes	17. Responsible Investigator: Yes/No

Participants

Vulnerable groups

18. Will participants be knowingly recruited from one or more of the following vulnerable groups?		
Children under 18 years of age	**Yes #**	No ✔
Persons incapable of making an informed decision for themselves	**Yes #**	No ✔
Pregnant women	**Yes #**	No ✔
Prisoners/Detained persons	**Yes #**	No ✔
Other vulnerable group Please specify:	**Yes #**	No ✔

Chaperoning Participants

19. Will participants be chaperoned by more than one investigator at all times?	Yes	**No***	**N/A†** ✔
20. Will at least one investigator of the same sex as the participant(s) be present throughout the investigation?	Yes	**No***	**N/A†** ✔
21. Will participants be visited at home?	**Yes***	No ✔	**N/A†**

Researcher Safety

22. Will the researcher be alone with participants at any time?	Yes	No ✔
If Yes, please answer the following questions:		
22a. Will the researcher inform anyone else of when they will be alone with participants?	Yes	**No***
22b. Has the researcher read the 'guidelines for lone working' and will abide by the recommendations within?	Yes	**No***

Methodology and Procedures

23. Please indicate whether the proposed study:

Involves taking bodily samples (please refer to published guidelines)	**Yes #**	No ✔
Involves using samples previously collected with consent for further research	**Yes #**	No ✔
Involves procedures which are likely to cause physical, psychological, social or emotional distress to participants	**Yes #**	No ✔
Is designed to be challenging physically or psychologically in any way (includes any study involving physical exercise)	**Yes #**	No ✔
Exposes participants to risks or distress greater than those encountered in their normal lifestyle	**Yes***	No ✔
Involves collection of body secretions by invasive methods	**Yes***	No ✔
Prescribes intake of compounds additional to daily diet or other dietary manipulation/supplementation	**Yes***	No ✔
Involves pharmaceutical drugs	**Yes***	No ✔
Involves use of radiation	**Yes***	No ✔

Involves use of hazardous materials	**Yes***	No ✔
Assists/alters the process of conception in any way	**Yes***	No ✔
Involves methods of contraception	**Yes***	No ✔
Involves genetic engineering	**Yes***	No ✔

Involves testing new equipment	**Yes†**	No ✔

Observation/Recording

24a. Does the study involve observation and/or recording of participants?	Yes	No ✔
If **Yes**:		
24b. Will those being observed and/or recorded be informed that the observation and/or recording will take place?	Yes	**No***

Consent and Deception

25. Will participants give informed consent freely?	Yes ✔	**No***

Informed consent

26. Will participants be fully informed of the objectives of the study and all details disclosed (preferably at the start of the study but, where this would interfere with the study, at the end)?	Yes ✔	**No***
27. Will participants be fully informed of the use of the data collected (including, where applicable, any intellectual property arising from the research)?	Yes ✔	**No***

28. For children under the age of 18 or participants who are incapable of making an informed decision for themselves:			
a. Will consent be obtained (either in writing or by some other means)?	Yes	**No***	N/A
b. Will consent be obtained from parents or other suitable person?	Yes	**No***	N/A
c. Will they be informed that they have the right to withdraw regardless of parental/guardian consent?	Yes	**No***	N/A
d. For studies conducted in schools, will approval be gained in advance from the Head-teacher and/or the Director of Education of the appropriate Local Education Authority?	Yes	**No***	N/A
e. For detained persons, members of the armed forces, employees, students and other persons judged to be under duress, will care be taken over gaining freely informed consent?	Yes	**No***	N/A

Deception

29. Does the study involve deception of participants (i.e. withholding of information or the misleading of participants) which could potentially harm or exploit participants?	Yes	No ✔
If **Yes:**		
30. Is deception an unavoidable part of the study?	Yes	**No***
31. Will participants be de-briefed and the true object of the research revealed at the earliest stage upon completion of the study?	Yes	**No***
32. Has consideration been given on the way that participants will react to the withholding of information or deliberate deception?	Yes	**No***

Withdrawal

33. Will participants be informed of their right to withdraw from the investigation at any time and to require their own data to be destroyed?	Yes ✔	**No***

Storage of Data and Confidentiality

34. Will all information on participants be treated as confidential and not identifiable unless agreed otherwise in advance, and subject to the requirements of law?	Yes ✔	**No***	
35. Will storage of data comply with the Data Protection Act 1998?	Yes ✔	**No***	
36. Will any video/audio recording of participants be kept in a secure place and not released for any use by third parties?	Yes ✔	**No***	
37. Will video/audio recordings be destroyed within ten years of the completion of the investigation?	Yes ✔	**No***	
38. Will full details regarding the storage and disposal of any human tissue samples be communicated to the participants?	Yes	**No***	N/A ✔
39. Will research involve the sharing of data or confidential information beyond the initial consent given?	**Yes***	No ✔	
40. Will the research involve administrative or secure data that requires permission from the appropriate authorities before use?	**Yes***	No ✔	

Incentives

41. Will incentives be offered to the investigator to conduct the study?	**Yes†**	No ✔

42. Will incentives by offered to potential participants as an inducement to participate in the study?	**Yes†** ✔	No

Work Outside of the United Kingdom

43. Is your research being conducted outside of the United Kingdom?	Yes	No ✔
If **Yes**:		
44. Has a risk assessment been carried out to ensure the safety of the researcher whilst working outside of the United Kingdom?	Yes	**No***
45. Have you considered the appropriateness of your research in the country you are travelling to?	Yes	**No***
46. Is there an increased risk to yourself or the participants in your research study?	**Yes***	No
47. Have you obtained any necessary ethical permission needed in the country you are travelling to?	Yes	**No***

Information and Declarations

Checklist Application Only:
If you have completed the checklist to the best of your knowledge, and not selected any answers marked with an * or †, your investigation is deemed to conform with the ethical checkpoints. Please sign the declaration and lodge the completed checklist with your Head of Department/School or his/her nominee.

Checklist with Additional Information to the Secretary:
If you have completed the checklist and have only selected answers which require additional information to be submitted with the checklist (indicated by a †), please ensure that all the information is provided in detail below and send this signed checklist to the Secretary of the Sub-Committee.

Checklist with Generic Protocols Included:
If you have completed the checklist and you have selected one or more answers in which you wish to use a Generic Protocol (indicated by #), please include the Generic Protocol reference number in the space below, along with a brief summary of how it will be used. Please ensure you are on the list of approved investigators for the Generic Protocol before including it on the checklist. The completed checklist should be lodged with your Head of Department/School or his/her nominee.

Full Application needed:
If on completion of the checklist you have selected one or more answers which require the submission of a full proposal (indicated by a *), please download the relevant form from the Sub-Committee's web page. **A signed copy of this Checklist should accompany the full**

submission to the Sub-Committee.

Space for Information on Generic Proposals and/or Additional Information as requested:

19. Will participants be chaperoned by more than one investigator at all times?

Only a web-based questionnaire will be distributed among the participants in the first instance. Therefore at this stage, it is not known whether the participants will be chaperoned by more than one investigator at all times.

42. Will incentives be offered to potential participants as an inducement to participate in the study?

The participants of the survey can enter into a prize draw with a chance to win store vouchers offered by the researcher.

For completion by Supervisor

Please tick the appropriate boxes. The study should not begin until all boxes are ticked.

- ☑ The student has read the University's Code of Practice on investigations involving human participants
- ☑ The topic merits further research
- ☑ The student has the skills to carry out the research or are being trained in the requires skills by the Supervisor
- ☑ The participant information sheet or leaflet is appropriate
- ☑ The procedures for recruitment and obtaining informed consent are appropriate

Comments from supervisor:

[redacted]

Signature of Applicant: [redacted]

Signature of Supervisor (if applicable):

Signature of Head of School/Department or his/her nominee:

Date: 01/12/2012