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BEDRIJFSECONOMISCHE WETENSCHAPPEN

master in de verkeerskunde: mobiliteitsmanagement
(Interfacultaire opleiding)

Masterproef

The influence of the parking situation at a destination on travelers' departure time decision

Promotor :
Prof. dr. Davy JANSSENS

Copromotor :
De heer Petrus VAN DER WAERDEN

Pascal Atemnkeng

Masterproef voorgedragen tot het bekomen van de graad van master in de verkeerskunde , afstudeerrichting mobiliteitsmanagement

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KNOWLEDGE IN ACTION

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PREFACE

Towns and cities are important urban areas witnessing growth. This growth is coupled with social, economic, and management problems. Urban management is often adopted as a policy instrument to control the vices and benefits of urban growth. The allocation of parking is very important in modern-day management of many cities. Parking plays a very significant role in several travel related decisions. This research work demonstrates the influence of parking characteristics on drivers' departure time decisions on the one hand and on the other hand, it examines the personal and trip characteristics that influence individuals' to adapt their departure time decisions with respect to specific parking characteristics. The conclusions derived from this study are certainly going to improve parking management in urban centers.

It took a great deal of discipline, courage and will-power to push through this piece of work as many challenges were faced. For instance, the distribution of invitation cards to answer the internet-based questionnaire that were used to collect the needed data for the analysis, the collection and assembling of various literature studies to form a body of knowledge which this thesis represents.

In the face of these challenges, I acknowledge and thank my co-promoter, Peter VAN DER WAERDEN for his stimulating discussions, valuable ideas, orientation, patience and proper supervision of this thesis. I also thank my promoter, Professor Davy JANSSENS for his great ideas and suggestions that helped to shape the content of this work. I equally extend my gratitude to the entire IMOB team and most particularly other staff whose support and encouragement contributed immensely towards the realization of this work.

The care, love and concern of my beloved wife Mrs. Atemnkeng Asongtia Ntongawoh, my mum, Madam Anyinkia Florence Fortuchang and the entire family members is also highly appreciated. Many thanks go to my classmates and friends whose valuable support contributed to make my stay in Belgium a unique one. I hereby extend my gratitude to everyone who contributed to the realization of this work. Thank you.

ATEMNKENG PASCAL
UHASSELT, BELGIUM
20/08/2012

DEDICATION

This work is dedicated to my Dad, Chief Fonkengim Paul Nchongayi, who left this world on the 16th of August 2006 at the age of 56. He taught us that 'the crown of education is the best crown in the world'. As his soul rest in perfect peace, so do I accept his absence, gather the courage, fortitude and strength to pick up the pieces and continue this Earthly Journey!

SUMMARY

Car parks are of important concern to many urban planners and drivers alike. Their positions, characteristics, and condition of use are very vital in permitting economic activities and the fluent movement of persons in the city. This research work demonstrates the influence of parking characteristics on drivers' departure time decisions on the one hand and on the other hand, it examines the personal and trip characteristics that influence individuals' to adapt their departure time decisions with respect to specific parking characteristics. An extensive review is presented in this respect and for a more practical analysis; the city of Hasselt and its environs were selected. This research work is highly recommended for students, car drivers, academic researchers and urban planners.

For the analysis, the research concentrates on car drivers who drive to the city of Hasselt from its surrounding villages such as Diepenbeek and Alken. An internet-based questionnaire was designed and used to collect the necessary data. A hundred and seventy respondents completed the questionnaire successfully and were used for the analysis.

Taking into account the fact that the responses were multivariate and discrete (departure time and work/study trips), and coupled with the fact that the dependent variables followed a particular order, a Multinomial logit (MNL) model was employed in analyzing the empirical data. With the used of this model, selected predictor variables (age, sex, gender, education, travel time, visit frequency, trip purpose and home location) are fitted with the aim of investigating those variables that significantly influence departure time decisions and the adaptation of departure time for work/study trips with respect to parking characteristics.

In investigating the factors that influence departure time decisions, a MNL model, principally the proportional odds model (POM) was used to model the effect of the predictor variables. This model revealed that, of the predictor variables; gender, age, trip purpose and travel time significantly affects individuals' departure time decisions while education, home location, visit frequency probably do not have any influence on departure time decisions.

In examining the factors that influenced the adaptation of departure time for work/study trips with respect to specific parking characteristics in the city of Hasselt, three MNL models were separately used. This was because the questions concerning specific parking characteristics (high parking demand, parking tariff, and the walking distance between the parking lot and final destination) were examined independently. The selected predictor variables remained the same

as those in the previous research question. The outcomes of the models were promising and revealed the following results.

The first MNL model that examined the effects of high parking demand in the city of Hasselt on the adaptation of departure time for work/study trips revealed that, of the predictor variables, age (elderly) and travel time (longer travel time) significantly influences car drivers to adapt their departure time for work/study trips.

The second MNL model revealed that, trip purpose, education (higher education) and travel time (longer travel time) significantly influences car drivers' adaptation of departure time for work/study trips with respect to parking tariffs.

The third MNL model showed that, age (elderly) and education (higher education) significantly influences car drivers' to adapt their departure time for work/study trips because of the walking distance between parking facilities and the centre city of Hasselt.

As a concluding remark, it is important to note that, different factors do influence car drivers' departure time decisions and their adaptation of departure time decisions with respect to specific parking characteristics. A proper understanding of these factors will help to improve parking management in cities such as Hasselt. For instance, an understanding of the fact that the elderly and the educated adapt more to the walking distance between parking facility and the city centre could help city parking management to institute parking facilities at the outer ring of cities since parking demand will not be reduced but simply, users will adapt their departure time decisions.

For further study, it will be very necessary to investigate how car drivers will adapt their departure time decisions taking into account different levels of parking tariffs.

This project is divided into five chapters. Chapter one and two presents the background information on parking, chapter three discusses the research methodology, chapter four presents the data analysis while chapter five highlights important results and conclusions and develops important questions for further research.

Keywords: Departure time decisions, Adaptation of departure time decisions, parking characteristics, travel decisions, trip purpose and multinomial log model.

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LISTS OF ACRONYMS

TDM…….	Travel demand management
JICA…….	Japan International Cooperation Agency
UNESCAP……...	United Nations Economics and Social Commission for the Asia Pacific
ECMT……...	European Conference of Ministers of Transport
CBD……	Central Business District
ITE.....	Institute of Transportation Engineers
ITS.....	Intelligent Transportation Systems
PGI.....	Parking Guidance and Information
AASHTO……	American Association of State Highway and Traffic Officials
OECD……	Organization for Economic o-operation and Development
EDA……...	Exploratory data analysis
POM……...	Proportional Odds Model
MNL……...	Multinomial Logit Model
FHWA……	Federal Highway Administration
ASCE…….	American Society of Civil Engineers
IIA……...	Independences of Irrelevant alternatives
P&R……	Park and Ride facilities

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Car parking plays an important role in supporting the socio-economic activities of people. Given an increase in car ownership and the insufficient number of parking lots in many urban areas, parking is today a call for concern both for urban management and the car driver alike (Seik, 1997). While policy makers are on the move to optimize the use of available parking positions, car drivers desire to have a place where they can park their cars. Expansion in infrastructure is no longer a feasible solution to solve increasing parking demand problems in many urban centers so as to enhance socio-economic activities of the town (Molnar & Alexopoulos, 2008). Therefore, many urban areas have adopted parking policies in other to improve mobility in the city and also, as a Travel Demand Management (TDM) policy which improves the transportation system.

Parking policies are more cost efficient and environmentally friendly measures to accommodate the increasing motorization in cities where there is already the lack of space and necessary resources to build more parking lots. For instance, Andrew Nash (2003) points that many Western and Central European countries have resorted to implementing innovative parking solutions like peak-hour parking fees and other parking control measures to address the high demand for parking. An efficient parking control measure provides users with better services, high frequencies, reliability, reduces pollution, congestion and improves the parking behavior of people (AASHTO 2004; OECD/ECMT 2007; Molnar & Alexopoulos, 2008). Thus, the knowledge on how parking policies influences travel decisions can be used as a viable tool to restrain the volume of trip ends in an area where it is no longer possible to build more roads to meet travel demands either because of the lack of space or resources (AASHTO 2004; Katherine 2008).

An understanding of the parking situation at a particular location is very important for all car drivers. It may induce drivers to alter their departure time decisions, mode choice, trip time as well as the locations to be visited (Bhat, 1997; Turvey 1985; Hess 2001; AASHTO 2004). Car drivers may loss time, money, opportunities, go late to work or school, because of a poor

understanding of the parking situation at a given location (UNESCAP (1992). Parking situation refers to the different existing parking conditions at parking lots at a given space and time. It embodies the parking tariff, the level of parking demand, and the distance of the parking facilities from available shops, work, school, leisure or train locations.

Several research works have been carried out to demonstrate the influence of parking on different aspects of individuals travel behavior. For instance, while Shiftan & Burd-Eden (2000) insinuates that parking situation significantly influences mode choice, Shoup (2002) points out that parking situation determines the number of trips to be made. Parking situation also significantly affect the destination choice (Paniati, 2007), route choice (Kaplan & Bekhor, 2010), shifting departure time choice for non-work trips (Steed & Bhat, 2000), and adjusting duration of travel time (Polak & Axhausen 1990).

However, little is known with regards to the extent to which parking characteristics do influence drivers' departure time decisions on the one hand and on the other hand, the extent to which personal and trip characteristics do influence individuals' to adapt their departure time decisions with respect to specific parking characteristics. This thesis seeks to investigate these influences. An understanding of the influences will be very useful in designing effective parking policies which can help to avoid unnecessary adverse effects. For instance, an understanding of the personal and trip characteristics that influences travel decisions can be of help in shifting peak-hour trips to off-peak trips, easing congestion, reducing noise and limiting environmental pollution (Litman, 2011).

To collaborate the above view, Isler et al. (2005) argues that effective parking policies can only be set up with an understanding of car drivers' parking behavior and their opinions regarding various aspects of parking facilities. On the one hand, the trip characteristics that this thesis will focus on are; the visit frequency, the trip purpose, home locations, and travel time. On the other hand, personal characteristics of car drivers that have to be investigated include; gender, age and the educational level.

1.2 Research aims

This research aims at demonstrating car drivers' personal and trip characteristics that influence their departure time decisions and the adaptation of departure time decision with respect to specific parking characteristics at the destination. It duels on the following:-

- Investigate the relationship that exists between car drivers' departure time decision and the personal and trip characteristics.
- Examine the personal and trip characteristics of car drivers that influence their adaptation of departure time decisions for work/study trips with respect to specific parking characteristics at the destination.

1.3 Research questions

This research is motivated by the lack of knowledge on personal and trip characteristics that influence car drivers' departure time decisions as well as the adaptation of departure time decision for work/study trips with respect to the parking characteristics at the destination. Specifically, this research poses three major questions:-

- To what extent does the parking situation at the destination influence travelers' departure time decisions?
    - How can the parking situation at a destination be defined?
    - How does the parking situation influence travel decisions?
- What are the personal and trip characteristics of car drivers that influence departure time decisions?
- To what extent does the personal and trip characteristics of car drivers that influence their adaptation of departure time decisions for work/study trips with respect to specific parking characteristics at the destination?
    - To what extent does the personal and trip characteristics of car drivers affect the adaptation of departure time decisions of work/study trips with respect to high parking demand?
    - To what extent does the personal and trip characteristics of car drivers affect the adaptation of departure time decisions of work/study trips with respect to parking tariff?

- To what extent does the personal and trip characteristics of car drivers affect the adaptation of departure time decisions of work/study trips with respect to walking distance between parking facilities and the final destination?

1.4 Research methodology

The importance of developing and using a specific research methodology in such an academic work cannot be understated. An appropriate use of a research methodology increases our understanding of the subject matter and the scientific underpinnings that is required for such work. There are various ways in which the research methodology can be classified with the most generally acknowledged distinctions being the qualitative and quantitative research methods. However, this study will apply both the qualitative and quantitative analysis while focusing on the personal and trip characteristics of car drivers that influence departure time decisions and adaptation of departure time for work/study trips with respect to specific parking characteristics at the destination.

A quantitative research method embodies the collection and analysis of scientific literature studies pertaining to car parking and parking situations. A considerable amount of literature studies principally from scientific journals, and books will be very instrumental. Scholarly journals and articles discussing attitudes and behavioral responses to parking measures by Van der Waerden et al. (2006), modeling departure time choice in the context of activity scheduling behavior by Ettema & Timmermans (2002), the effects of parking control on the destination choice by Turvey (1985), and many others will be very instrumental in providing a good answer for the first research question.

The qualitative research method involves the personal collection of data, analysis and the interpretation of the results. This research methodology will be used to answer the second and third research questions of this thesis. For the analysis, the research concentrated on car drivers who drive to the city of Hasselt from its surrounding villages such as Diepenbeek and Belzen. An internet-based questionnaire was designed and used to collect the necessary data. A hundred and seventy respondents completed the questionnaire successfully and will be used for the analysis.

The responses were discrete and the dependent variables followed a particular order, thus a MNL model will be used for the analysis. With the used of this model, selected predictor variables (age, sex, gender, education, travel time, visit frequency, trip purpose and home

location) are fitted with the aim of investigating those variables that significantly influence departure time decisions and the adaptation of departure time for work/study trips with respect to parking characteristics.

More so, to model the impact of the personal and trip characteristics of car drivers influencing their adaptation of departure time decisions with respect to specific parking conditions, three separate MNL models will be fitted. These models will be fitted with respect to specific parking characteristics such as high parking demand, parking tariff and the walking distance from parking facilities to final destination. These analyses provided a good answer for the third research question.

The data analysis was performed in SPSS and complemented by SAS statistical software package. With the use of these statistical editors, it is easy to come out with frequency distributions, descriptive statistics, correlations matrix and models that explicitly give an insight of the survey data.

1.5 The value of this research

An understanding of parking characteristics and its influence on car drivers' departure time decisions is very essential for parking policies in cities. Despite the importance of these findings, little attention has been directed towards this research domain. This research work contributes its quota as a whole to parking management in cities by highlighting key factors influencing car drivers' departure time decisions and their adaptation of departure time decisions with respect to specific parking conditions.

Recognizing the significant contribution of this study to urban planning and policy making, a reasoned study of this kind could make an extraordinary contribution within the field of transportation sciences. Besides, this study will also add to the information pool on transportation sciences for academics and policy makers in this emerging and profound field of studies. In addition, this study is quite unique as it uses original data collected through internet-based questionnaire and thus, dealing with the reality on the ground.

Moreover, since it is difficult to set up effective parking policies which are aimed at reducing congestion, pollution, and improving air quality within the urban shed air without any ideal knowledge on the adverse effects on individuals and the society as a whole, an understanding of car drivers' behavioral response in this context will be an effective way to implement such viable policies.

Given the importance of this research, it is worth noting that since urban space and the funds required for projects are scarce resources, decisions on how to use them cannot be taking lightly (Ortuzar & Willumsen 1990). Hence, changes in transportation system cannot be made instantaneously; rather, they are undertaking over a period of time and in this light, it is necessary to carry out feasibility studies far ahead of the actual implementation to understand how such policies can affect travel decisions and thus, achieving its objectives. This research can be credited for its significance in providing support in parking related decision making schemes.

1.6 Research outline

This research work is made up of five chapters. The current chapter gives a general introduction to the research while outlining the aims, research questions, methodology and research value.

The second chapter engages on a literature review of parking and its influence on travel decisions. This chapter examines travel decisions in a general context before looking at specific aspects of travel decisions such as departure time decisions. It further presents a broader theoretical framework on departure time decisions and defines the parking situations at the destination. This review is intended to provide a good answer for the first research question and to aid the research and the development of proceeding chapters.

Chapter three undertakes an in-depth description of the data collection procedure, the survey method, the study area, and the data source. This chapter also highlight on the limitations and potential problems that were involved in data collection.

Chapter four undertakes an in-depth exploratory data analysis with the use of histograms, correlation matrix and MNL models. It also presents the analysis of empirical research findings.

Chapter five summaries the research findings, reveals the limitations of the research and highlights of some recommendations. The chapter ends with proposals of further research topics.

Bibliography and important appendices are also included after chapter five.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The recognition of parking as a significant instrument of travel demand management (TDM) has made parking a significant instrument to urban planners and transportation engineers. Parking plays an important role in many travel related decisions such as the destination choice, the mode choice, departure time decisions, and the route choice of car drivers (e.g., Litman 2011). However, the extent to which the personal and trip characteristics of car drivers as well as the parking characteristic do influence these decisions is still unknown.

This chapter discusses an extensive literature study on parking and travel decisions. While recognizing the fact that this literature study is not an exhaustive review, scientific literatures relevant for this thesis have been discussed. The review presented in this chapter is divided into parts. Section 2.2 discusses the various travel decisions and section 2.3 highlights on the parking situations. Section 2.4 concludes this chapter with a summary of issues emerging from the literature.

2.2 Parking and Travel decisions

A lot has been said about parking and its influence on individual travel decisions. Many transportation scholars have demonstrated how parking influences individual travel decisions. For instance, Litman (2011) argues that parking pricing may have great influence on travelers' route choice, mode choice, destination choice and trips generation.

However, the uncertainty with which the personal and trip characteristics of car drivers as well as the parking characteristics do influence individuals' travel decisions necessitated this study. An understanding of the relationship between personal and trip characteristics and travel decisions of car drivers can be of significant interest to urban planners and transportation engineers to be able to tailor policies that can promote efficient use of limited car parks, encourage the use of public transport, and discourage private car usage.

This section presents a review on the general aspects of travel decisions with respect to parking policies and departure time decisions.

2.2.1 General aspects of travel decisions

Due to the fact that parking situations significantly influences travel decisions; mode choice, route choice, destination choice and trip generations, this section examines the findings that surrounds parking and individuals travel decisions and thus will shade light on parking policies and it influence on travel decisions.

2.2.1.1. Mode choice behavior

The travel mode choice is a very important aspect in any travel decision. It refers to the various means available for use by individuals to make their trips and may include bike, car, bus, train or tram. Hsieh et al. (1993) argued that, since travel is a special form of consumption behavior in terms of intangible and consumption on-site, travel mode choice decision may be affected by the trip characteristics, past experience and the destination attributes which may include the parking conditions. Also, transport mode choices are equally influenced by the length of stay at the destination, travel purpose and travel costs which include parking charges (Hsieh et al. 1993).

On another note, Hess (2001) in the book "The effect of free parking on mode choice" argues that, "if travelers can park their cars at work for free, they are more likely to travel with car than with public transport". To corroborate this view, Hess (2001) points to the fact that, the American society provides 85 million free parking spaces at work and that because of this 91% of people who commute to work drive on cars. This argument is evidence to the fact that free parking at work encourages the mode choice behavior of travelers. Hess (2001) used data from house hold activity survey to model the interdependence of parking cost and mode choice decision for trips to the Oregon Central Business District (CBD). The model predicted that with free parking, 62% of commuters use cars for their commuting trips and 16% commuted in car pools.

In corroboration to the idea that behavior is mentally represented as the association between goals and actions, Aarts & Dijksterhuis (2002) argue that when a travel behavior is consistent, the activation of travel goal in the memory automatically activates travel mode choice. Therefore, parking policies which may include parking attributes at the destination are probably influential in determining travel mode choice behavior.

In another perspective, Van der Waerden et al. (2006) carried out a research concerning car drivers' attitudes and preferences with respect to some possible parking policies with the use of a multinomial logit model. According to these scholars, the most favorite response of change in behavior due to parking measures was that of choosing another transport mode for a trip. This is an indication to the fact that parking policies appears to have an influence on individuals related mode choice behavior.

Moreover, O'Fallon et al. (2004) investigated car drivers' responsiveness to parking policy and mode choice behavior in three urban areas in New Zealand. A stated choice experiment was conducted on two parking related policies which could affect travelers' decisions of driving to work/studies. Based on the stated choice experiment, respondents could choose between seven mode choices which included; using a car, carpool, public transport, walking, P&R facilities, cycling and others. The research indicated that many car drivers choose to continue driving in their own cars. The influence was highly significant in employment practices where company-owned vehicles were used, with free on-site parking facilities provided and also in situations where cars were used for work-related trips during business days.

2.2.1.2. Trip Generations

Trip generation refers to the total number of vehicle trips made from one zone to another (Shoup, 2002). The number of trips leaving a particular zone is known as trip productions where as the number of trips entering an area is known as trip attractions. The number of trips produced by an area depends on certain factors amongst which parking policies, trip purpose, and users' characteristics are instrumental. Zones attracting these trips equally have some important determining factors such as the accessibility of the area, the supply of parking facilities, land-use pattern, office opening hours, and employment opportunities in the area.

Shoup (2002) in his book, "Roughly Right Or Precisely Wrong", studied the number of vehicle trips generated in a few suburban sites in the USA. In this book, Shoup (2002) point to the fact that parking policies and trip generation are a poorly understood phenomena that need to be studied. He however noted that, the relationship that exists between trip generation and parking policies depends on the price of parking. To corroborate this view, Shoup (2002) argued that, in America, motor vehicles alone consume one eighth of the worlds' total oil production because of ubiquitous free parking policy, automobile dependency, and high trip generation.

Based on this analysis, the Institute of Transportation Engineers (ITE, 2003) cautioned that, both transport engineers and urban planners have to consider the warnings of Lewis Mumford (1981) in quotes: “The right to have access to every building in the city by private motorcar in an age where everyone possesses such a vehicle is actually the right to destroy the city”. It is on this note that Shoup (2002) cautioned urban planners to modify trip generation with the use of parking pricing, ridesharing, and also with enhancement of pedestrian facilities.

2.2.1.3. Destination choice

The ease with which travelers can find a parking space at a destination can influence the decision people make about travelling to a particular destination (Paniati, 2007). He argues that better information concerning available parking spaces through Intelligent Transportation Systems (ITS) has help to reduce the uncertainty involved in finding a car park at the destination by travelers, limit the need of recirculation around car parks in search of parking space and thus, influence peoples’ destination choices.

Pre-trip parking information through ITS, makes it easy for users to know exactly where available parking facilities and free parking spaces exist at any particular time in a parking lot. Therefore, a travelers’ destination choice can greatly be influenced if a travelers have a pre-knowledge about a parking facility, parking capacity, hours of operation, parking costs, and the form of payment. Paniati (2007), holds that ITS has been in operation in Europe and Japan since the early 1970s with the intention to reduce congestion, limit environmental impacts of car use, reduce drivers frustrations often associated with the search for free parking space at the city centers and thus, influences their destination choices. This implies that ITS, is an instrumental parking policy that probably helps in the influencing of travelers destination choice.

2.2.1.4. Parking search time

The choice of parking type is a commonplace decision problem tackled daily by many car drivers (Polak & Axhausen, 1990). This is because a parking choice is typically the outcome of complex interaction between individual drivers’ parking preferences, instantaneous availability of parking opportunities, ease with which to find a parking space, and the prevailing traffic conditions involved in getting to a parking facility. Polak & Axhausen (1990) argued that travel time duration is not only represented by the time spent driving but also the time spent queuing

for a space in a car park, searching for a parking facility and walking to the final destination. With respect to the time used in search of a free parking space, these scholars contend that, drivers generally have preferences on some desired parking locations when approaching the city center and that, these preferences depends on the ease with which to fine a car space, purpose of the trip, perception of parking characteristics and the inherent tastes and attitudes of different drivers.

Drivers who have a good knowledge of the settings of parking facilities may be able to identify accurately specific parking facilities that they wish to use, while those that have inferior levels of information may only be able to form vague intentions of the type and locations of parking. From this argument, it seems that drivers who have no prior knowledge of the area cannot select any specific parking place until at least some searching is carried out to establish the opportunity that is available. Even well informed drivers are not certain to find the desired parking facilities since this depends on the instantaneous availability of parking opportunities at the time they wishes to park. Hence, during peak periods, drivers compete for the use of most attractive spaces and can therefore; never completely avoid the necessity to sometimes engage in parking search, which thus result to increases in parking search time.

In another perspective, Shoup (2006) conducted studies in some major cities on parking-search time and found that, an average parking-search time is eight minute. Shoup, (2006) argues that if parking-search time could be reduced, it would lead to significant gain in terms of time, production, traffic flow, fuel consumption, pollution and noise reduction. Hence, parking search time has an effect on drivers' travel time because it increases the total travel time to the final destination (Bonsall & Palmer, 2004).

2.2.1.5. Route choice behavior

In the absence of hard hitting TDM measures, parking policies are probably the most effective ways to influence travelers' route choice behavior. Parking policies affect peoples' travel decisions concerning place of visit, route choice and eventually the choice of parking lot at the destination (Bithell, 2009)

Kaplan & Bekhor (2010) modeled the behavioral framework that encompasses the combined choice of driving route search and parking type to explore the impact of parking-related policies as TDM tools for congested urban areas. In the model, Kaplan & Bekhor (2010)

holds that Parking Guidance Information (PGI) system influences route choice decision, relieves traffic congestion, alleviates the uncertainties and the burdens associated with cruising-for-parking.

On another perspective, Waterson et al. (2001) and Bonsall & Palmer (2004) argue that, drivers may choose between an on-street or off-street parking facility and then after, plan a parking-search route that is subject to the vehicle size constraint. These scholars points that drivers may reconsider their decision to park at an off-street space in case there is no vacant space within their spatiotemporal constraints. Upon the selection of the off-street parking, the driver chooses among the available parking facilities located within a certain radius from the destination. This change in the choice of off-street parking changes the actual destination of the trip from the location of the activity to a location closer to the parking facility and consequently, influences the choice of the chosen route at the time of parking-search point. In most cases, shorter routes, non-congested routes and routes with little delay due to parking activities would be preferred by off-street parkers (Bonsall & Palmer, 2004).

On another note, these scholars argue that, drivers who choose to park on-street would decide upon the parking-search starting point and develop a search route in the vicinity of their destination until they find an available parking space. Normally, routes with greater parking opportunity and intensive parking activity would be preferred by on-street parkers. A model formulation by Kaplan & Prato (2010) for the study of on-street parking, assumes that in the absence of information regarding the availability of on-street parking facilities, drivers can only choose the route along which they hope to fine an available parking place.

2.2.2. Departure time decisions

It is increasingly becoming important to study the departure time decisions of travelers because of its significances in the realization of viable transportation policies such as noise, pollution and congestion reductions during peak-hour periods. It is based on this context that, this research is inspired to examine the personal and trip characteristics that influence departure time decisions of car drivers. Scholars such as Abkowitz (1981), Mannering (1989) and Hendrickson & Plank (1984), have examined departure time decisions for shopping trips with respect to travelers demographic characteristics, transport system characteristics, work-related attributes, and real-time information provision regarding traffic delays. These scholars holds that, among the individual socio-demographics characteristics that influence departure time, age

influences individuals decisions in that, old persons are more likely to pursue shopping trips later in the day than younger individuals. While with respect to sex, women appear to participate more likely in shopping activities during the afternoon off-peak and peak periods. These scholars found that travel time, travel cost, and the level-of-service do not appear to have any substantial impact on departure time choice for shopping trips. This is probably because shopping activities are organized around work constraints and other households schedule considerations and are pursued at the most convenient time within these schedule considerations.

In the past, emphasis on departure time decisions were laid on the consequences of travel periods like congested times of the day. Of recent, Bhat (1998) and Steed & Bhat (2000), have examined departure time decisions of travelers in the context of work trips. In these studies, they hold that travelers who perform non-work trips have more flexible departure time decisions than individuals who perform work trips. In one perspective, Steed & Bhat (2000) hold that transportation control measures like parking pricing can have significant impact on departure time decisions of travelers for non-work trips than for work trips. They argue that most non-work trip travelers prefer to shift their departure time decisions to less congested times of the day because their activities are probably not tied to clock time like those of individuals who travel for work trips. Based on the argument of Steed & Bhat (2000) one may be tempted to say parking which is one of the TDM measures equally have an influence in the context that is being examined.

In another perspective, Ettema & Timmermans (2002) claim that travelers' departure time decisions depends on the schedule of activities which in turn depends on the marginal utility to be gained from a trip compared to other activities in the schedule. These scholars argued that, the utility derived from a trip may include the satisfaction and comfort involve in driving from the origin to destination which may include, driving time, parking search time and the walking time between parking facilities and final destination. This means that the utility derived from activity is the total satisfaction gained from time that is spent on the activity. This implies, longer activity time resulting from less total travel time means more utility. This probably implies that travelers' departure time decisions will probably depend on the parking situation at the destination and how such situations will affect the total travel time and utility to be gained from other related activities to be performed.

From the above argument, one may be tempted to say that travelers gain low utility at the destination where there is high anticipated parking demand, parking tariff, and longer walking distance between parking lots and final destination, and may probably influence the adaptation of their departure time decisions to gain time that may be lost in search of a parking space and walking to final destination.

This section proceeds by outlining the factors that influence departure time decisions and the psychological aspects of individuals' parking behavior.

2.2.2.1. Factors that influence departure time decision

Several factors probably have an influence on travelers' departure time decisions. For instance, scholars like Yamamoto et al. (2000), have carried out studies on departure time and holds the argument that "if one departs at a time with higher congestion levels, travel will take longer time and less time will be remaining to participate in activities at the destination and hence, shorter activity duration". Ettema & Timmermans (2002) acknowledges this by arguing that, departure time decisions has an impact on the possibility of allocating time to activity that may yield maximum utility. These scholars point to the fact that, congestion which varies by time-of-day may influence travelers to trade-off the allocated available travel time which includes parking search time and activity time at the destination. Hence, the parking situation at the destination including for instance, parking demand, tariff rate, and walking distance between parking facilities and final destination may have an influence on departure time decision because, if travelers know that they will spend longer time in search of free parking space due to high parking demand during peak hours, they will adjust their departure time in order to be able to park freely without any waste of time in search of parking space and as such will be able to maximize the time used at parking facilities and walking to the final destination. Consequently, travelers will often have to adapt their departure time decisions depending on the parking situation at the destination. Ettema & Timmermans (2002) argue that a shift in departure time decision depends on the marginal utility to be gained at the destination or that at the origin. These scholars reiterate that, if the utility to gain at the destination is higher than that at the origin, individuals will depart earlier to be able to derive maximum utility by putting in more time on the activity at the destination.

Based on the above analysis, it can therefore be stated that, longer parking search-time because of a high parking demand and a considerable walking distance between parking facilities and the final destination will probably influence individuals to adapt their departure time in order to be able to gain time at parking facilities so as to derive maximum benefits from longer activity duration at the destination. However, the personal and trip characteristics that influenced such a decision are still not known.

According to Snijder (2000), the proximity of parking facilities to final destination, safety of parking locations, and room for maneuver around parking facilities are important factors that influence individuals choice of parking facility and departure time. These factors may probably have an influence on travelers' departure time decisions in that, in order to ensure the safety of vehicles or avoid longer walking distance to final destination due to high occupancy at parking facilities that are closer to the final destination, travelers may shift the departure time to avoid such adverse effects.

In another perspective, Van der Waerden et al. (2006) carried out a study on car drivers' attitudes and preferences with respect to possible parking measures at the campus of Eindhoven University with the use of multinomial logit model. According to these scholars, parking tariff influences car drivers' to choose another transport mode (public transport or bike). The influence of this behavior by parking tariff therefore means that, car drivers' departure time decisions will apparently be influenced.

2.2.2.2. Psychological aspects of individuals' parking behavior

Since this research is aimed at examining peoples' behavior with respect to related parking characteristics at the destination, it is important to evaluate the psychological aspects that influence behavioral enactment vis-à-vis parking. This is in respect to the assertion that, effective parking management policies can only be set up with an understanding of car drivers parking behavior and their opinions regarding various aspects of parking facilities (Isler et al. 2005). In addition, it would be valuable to understand which aspects of the personal and trip characteristics that influence peoples' departure time decisions and adaptation of departure time decisions with particular attention paid to the parking situation at the destination. An understanding of car drivers' departure time decisions as a consequence of the parking situation at the destination can help transportation planners and policy makers to be able to tailor policies which can meet the

needs of the city in terms of mobility management, safety, accessibility and livability (OECD/ECMT, 2007).

Psychological aspects that influence parking behavior are determined by attitudes and behavioral intentions, consistent with the theory of Reasoned Action of Fishbein & Ajzen (1975) and also, based on the later version of this theory, the theory of Planned Behavior (Ajzen, 1991). According to these theories, an individual can have an attitude with regards to a particular object (parking, person, group, event, or idea), which will lead to the formation of a behavioral intention consistent with attitude which in turns drives behavior. In both theories, however, attitude alone appears to be insufficient to predict intentions and subsequently behavior. Hence, in addition to attitude, Aarts et al. (1997) and Verplanken & Aarts, (1999) argued that habitual aspects of behavior are key factors that influence traffic behavior. The assertion by Verplanken & Aarts (1999) however, extends the theoretical approach of behavior by including the role of Habit and Situational factors.

Griffioen-Young et al. (2004) presented a model that describes behavior as a choice of parking at a particular location. These scholars argue that, Attitude, Intention, Situations and Habits are factors that directly or indirectly influence parking behavior. Figure1 below illustrates the formation of behavioral intention and consequently the performance of behavior (parking).

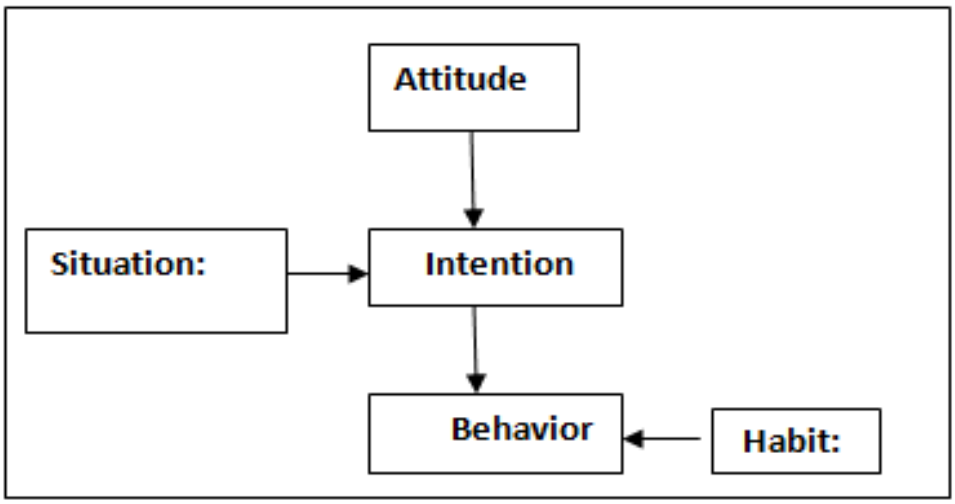

Figure 1: Factors that influence behavior (Griffioen-Young *et al.* 2004)

Based on this analysis, Fishbein & Ajzen (1975) contended that there are generally two types of behavior which include, reasoned behavior and automatic behavior.

Reasoned behavior according to Fishbein & Ajzen (1975), being behavior that is well thought-out before performance and this behavior is influenced by intention according to the model above by Griffioen-Young et al. (2004). Behavioral intention is however, determined by attitude (parking attitude) and situations (parking situation) as defined above. Attitude in this case can be referred to as car drivers' attitude towards particular parking characteristic (location, maneuvering) while situations includes; high parking demand, tariff rates, walking distance between parking facilities and final destination are psychological factors that influence parking choice and hence departure time decisions. This implies, the formation of attitude will lead to behavioral intention and consequently, performance of behavior (parking behavior)

It is also the contention of Fishbein & Ajzen (1975) that, automatic behavior is neither conscious nor intentional and needs little attention in its execution. Habitual parking behavior is an example of automatic behavior performed without being preceded by a conscious thought process and thus, directly influences parking behavior.

Individuals' reasoned parking decisions depends on the weighted characteristics of the parking situation. According to Griffioen-Young et al. (2004), parking characteristics have different weights to a parking choice and decision making. Some of these characteristics include;

- Parking systems: This includes the means of payment, tariff structure and proximity to the destination.
- Environmental situations: These are the available parking alternatives, familiarity with the area and the weather conditions.
- Trip characteristics: These include trip purpose, time of trip, duration of parking, and the number & type of passengers.

2.3 Parking situations at the destination

It is very important defining parking characteristics at this point because this research aims at investigating some of them and their impact on travel decisions. It will be valuable therefore, to draw attention to pertinent parking characteristics that are to be examined. Amongst parking characteristics, the major parking characteristics that this research will be examining includes; high parking demand, parking tariff and walking distance between parking facilities and final destination.

2.3.1 Occupancy rate

The occupancy rate at parking facilities is the actual number of vehicles at a specific time in a given parking facility. Occupancy rate can be used to examine the constraints that parking has on travelers at a destination. An understanding of such constraints and how travelers will adapt themselves to minimize such effects can enable policy makers to use parking as a powerful tool to manage and influence traffic patterns. This can be achieved through Intelligent Transport Systems Technology which is a dynamic control strategy.

Moreover, maximum and minimum daily occupancy rates at parking facility can be helpful metrics in assessing the overall parking demands of car drivers and could at such help to determine their departure time decisions.

Given that parking facilities are probably constrained during peak hours and that drivers may choose to depart earlier or later in order to avoid adverse parking effects, the knowledge of occupancy rate influence on car drivers' departure time decision is valuable (Litman, 2011). An understanding of this influence will be valuable for policy makers in the implementation of strategic transportation policies aimed at influencing traffic flow, easing congestion, reducing pollution and improving residential environments without any adverse effects on travelers.

2.3.2 Parking tariff

The parking tariffs including parking charges, parking user tax, parking space tax, and parking cash-out are all mechanisms which may be used to influence travelers' mode choice behavior and departure time decisions (OECD, 2002). In most large cities, parking tariffs are often highest in CBD and in other congested areas of the city. The amount of parking tariff charged usually varies depending on the hour of the day and location of the parking facility (Litman, 2011). Parking tariff is an effective way of motivating drivers to refrain from driving during peak hours (OECD, 2002). A perfect understanding of how parking tariffs can influence drivers' departure time decision is important. Shoup (2005) argue that accurate parking pricing would solve many parking and transportation problems.

Parking tariffs have been implemented in many cities with the intention of allocating scarce parking spaces, reducing congestion, and restraining incoming traffic. It is in this light that, parking tariffs are often differentiated depending on the location, length of stay and arrival/departure time, so as to achieve its objectives. Parking policies which allows people to

pay for parking according to arrival and departure time may have substantial positive effects on departure time decisions of car drivers and the welfare of city dwellers because of its significant role in congestion and pollution reduction (Shoup, 2005). If car drivers pay for parking in relation to their arrival time, length of stay and location of the facility, then their movements and departure time decisions will probably be influenced.

This thesis goes further to study the effect of parking tariff on car drivers' adaptation of departure time decisions which may further aid the mitigation of traffic flow and transportation problems.

2.3.3 Walking distance between parking and final destination

The proximity of car parks to final destination is another important parking characteristic that needs to be examined because of the significance this has in determining the parking choice behavior of individuals. According to Ji et al. (2007), it is one of the five important factors that affects parking choice behavior of travelers. The factors which affect the parking choice behavior according to Ji et al. (2007) includes; the walking distance from car parks to final destination, type of parking facility, parking fee, available parking spaces and driving time. This therefore implies that, the walking distance between car parks and final destination is probably an important factor in determining drivers' departure time decisions.

Moreover, Button & Hensher (2001) argue that the walking distance between parking facilities and final destination varies from one individual to another depending on the activity to be undertaken, duration of stay, size of urban area and the proximity of car parks to final destination and thus, probably have an influence on departure time decisions.

2.4 Summary of Emerging Issues from the literature

This literature study demonstrates that, the relationship between parking policies and travel decisions are fairly well researched topics. Though, personal and trip characteristics are instrumental in such decisions, they have received relatively little attention. The literature review shows that scholars have laid more emphasis on examining how parking policies influence individuals travel decisions. It equally reveals that, most travelers' respond to changes in parking policy by either changing their mode choice, reducing the number of trips, changing their destination, changing route choice, adjusting their departure time, Changing their travel time and/or adjusting the duration of travel.

Moreover, journals, books and articles of scholars such as Fishbein & Ajzen (1975), Yamamoto, et al.(2000), Ettema & Timmermans (2002), AASHTO (2004), Van der Waerden et al. (2006), Litman (2011) and others, have offered this research a valuable material. These scholars have written on various aspects of parking policies and travel decisions but have failed to stress the potentials of their studies by applying it on personal and trip characteristics that influence departure time decisions. Despite the fact that this review has been extensive and instrumental in enlightening the effects of parking policy on travel decisions, it is unable to represent the role that personal and trip characteristics has on departure time decisions and on the adaptation of departure time decisions. Thus, this master thesis complements most of the studies by focusing on empirical specification to investigate on the one hand, the relationship that exists between individual personal and trip characteristics and departure time decisions, and on the other hand, the personal and trip characteristics of car drivers that influence the adaptation of departure time decision while taking into consideration parking characteristics at the destination.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The literature review presented in chapter two clearly demonstrates that parking plays a very important role in each travel decision. Parking policies therefore are very instrumental in determining individuals' travel behavior. Despite these theoretical findings, the influence of personal and trip characteristics on individuals' departure time decisions and adaptation of departure time decisions relative to particular parking characteristics have not been properly investigated. In this light, the research seeks to investigate these influences using the city of Hasselt, Flanders-Belgium as a case study. This research further assumes that parking characteristics around the city of Hasselt probably leaves car drivers with a number of departure time decisions such as; the choice to depart early so as to park at a facility closer to the final destination, the choice to depart later and park at the outskirt of the city, the choice to pay less and walk for a longer distance to the final destination. Another possible decision may be that, car drivers may decide not to change his/her departure time at all because of his/her departure time habit for trips like business and work/study which are tied to clock time.

This chapter discusses the research strategy put in place for this study in section 3.2, it discusses the data collection procedure in section 3.3 and the framework for data analysis in section 3.4. Important conclusions with regards to the above findings are equally highlighted in section 3.5. This chapter on the research methodology is very important because it sets a framework to answer the second and third research questions.

3.2 Research strategy

A research strategy is a very important part of the research methodology for any good dissertation. A good research strategy will help to identify appropriate ways of collecting data to ensure the success of any study. According to Jugenheimer et al. (2010), several research strategies which could be implemented to complete a dissertation study includes; case study, survey, observation, interview, focus group, questionnaire etc. These scholars argue that, a case study is a research strategy that helps in the investigation of real world information by relating it to the study objectives. Also, interview is a strategy that can significantly help in the acquisition of qualitative information that supports the data in the most efficient manner. These scholars

acknowledge that, with the use of interview, a face to face interaction can enable researcher to get the most appropriate information. Moreover, another important strategy that could be implemented to obtain unexplored information is the questionnaire method (e.g., internet-based questionnaire, paper based questionnaire). This strategy is significant in that, it justifies the data and support other information obtained from literature review.

The research strategy that this thesis adopts comprises of a case study in which an internet-based questionnaire will be used to collect data on the study context. Though an interview would have given meaningful results to this research, an internet-based questionnaire was chosen because the study area is very geographically dispersed. It was not even possible to conduct a sample survey given the usual problem of non-response and time constraint.

The city of Hasselt, Flanders-Belgium and its surrounding neighborhoods were chosen as a case study. A multinomial logit model was used to examine or model the effects of the personal and trip characteristics on departure time decisions and the adaptation of departure time decisions with respect to specific parking characteristics at the city of Hasselt. The reason for choosing the MNL model is because of the ordinality of the response variables and its significance in behavioral modeling.

In order to gain an insight of respondents' departure time behavior, this research employed a 'directed departure time choice' to collect the necessary data. 'Directed departure time' here means that, each respondent chooses among the specified departure times, the time that will enable him/her to arrive at the destination by 10:00am for instance. In this light, the stated 'directed departure times' that were used included; ≤8:45am, around 9:00am, around 9:15am, around 9:30am, around 9:45am, and >9:45am.

Internet-based questionnaires have been widely used in collecting data by scholars. As earlier mentioned above, it is a survey method that can be used to acquire unexplored information that justifies the data and support other information obtained from literature review. Since this survey method was adopted to collect the data used in this piece of work, it would be valuable to examine its advantages and disadvantages.

3.2.1 Advantages of internet-based questionnaires

According to Jugenheimer et al. (2010 -P93), an internet-based questionnaire strategy have some outstanding advantages which include the fact that:-

- It is easy to use an internet-based questionnaire to collect large amount of data in a relatively short time period.
- Responses from internet-based questionnaire can automatically be inserted into a database that can be used in software packages for further processing. Examples of such software packages include, SPSS, SAS, Access, and excel.
- The cost of developing internet-based survey is very low.
- With internet-based questionnaire, there is the possibility to prevent people from completing more than one questionnaire. This can be achieved by providing a password or putting the survey on a page that can only be accessed directly without a link to it from other pages.
- With internet-based questionnaire, it is easy to enhance the design of questionnaires with the use of fonts, colors, visuals, and formatting. These options are not possible in other types of surveys.
- An internet-based questionnaire produces more honest answers to sensitive questions and personal issues than other survey methods like paper and pencil or face to face interview.
- It is possible for people to provide longer answers to open-ended questions through internet-based questionnaires than in other kinds of self-administered surveys.

3.2.2. Disadvantages of internet-based questionnaires

Despite the advantages of internet-based questionnaire, Jugenheimer et al. (2010) acknowledges that this survey method however, has some disadvantages. The disadvantages stems from the fact that;

- A random sample of the targeted population for the purpose of generalizing findings is almost impossible with this survey method. This is due to the fact that, the lists of possible respondents do not represent the whole population because the people who have access to internet may be different from those that don't have. Thus, the elderly and those with low economic and educational background are less likely to have access to internet services.

- Moreover, it has been proven that, with the use of internet-based questionnaire, people easily terminate their responses in the middle of the questionnaire, probably because of long questionnaires. This is not the case with personal interview (face to face interview).
- Furthermore, it has always been difficult to guarantee anonymity and confidentiality with internet-based questionnaire because of the open nature of most online networks.

3.3 Data Collection and information

The data collected provides an excellent opportunity to obtain empirical data on the personal and trip characteristics that influence travelers' departure time decisions. Highlights are made here on the survey area and the questionnaire design.

3.3.1 Survey area

The data for this research is collected from car drivers who live in Diepenbeek and surrounding villages of Hasselt, and do drive and park around the city of Hasselt. The surrounding villages of Hasselt from where the data was collected included: Diepenbeek, Bilzen, Geetbets, Maasmechelen, Meeuwen, Tongeren, Alken, Overpelt, Neerpelt, Bree Sint-Truiden, Houthalen, and Genk. To increase the response rate, some additional invitations were sent by email to friends and colleagues.

This research is not intended to be an exhaustive study of the personal and trip characteristics that influence departure time decisions of all car drivers in the study area, but is aimed at predicting the personal and trip characteristics influencing car drivers' departure time decisions. Since little attention has been paid to this research domain, this will greatly improve city parking policy making.

The reasons for selecting Diepenbeek and the surrounding villages around Hasselt are;

- Hasselt offers a high activity generation and has limited parking supply.
- The area also offers a selection of off-street and on-street parking opportunities within reasonable distances from possible activity locations.
- Moreover, the area has high traffic intensity during peak hours and thus, leading to high parking demands.
- Finally, the area offers different parking tariff rates depending on the arrival time and characteristics of the parking facility.

The aforementioned standards make the study area suitable for this study.

3.3.2 Questionnaire design

The questionnaire design was very important in collecting the necessary data pertaining to the personal and trip characteristics that influence travelers' departure time decisions. Questions that were part of the questionnaire could be found in appendix A, but could be subdivided into four parts as highlighted below.

- Personal characteristic. This part of the questionnaire was made up of questions on gender, age, education, possession of drivers' licenses, free parking cards and home locations.
- Trip characteristics. This part of the questionnaire was made up of questions about the visit frequency, travel time and trip purpose. The trip purpose to Hasselt was grouped into four specific activities including; shopping, work/study, social/recreation and connecting train. This section of the questionnaire was intended to provide answers on trips that influence departure time decisions.
- 'Directed' departure times. These are specified departure times from which respondents were expected to choose any of the specified times that he thinks will enable him to arrival at his main destination (city of Hasselt) to perform his activity.
- Adaptation of departure time for work/study trips with respect to specific parking characteristics at the destination. This section of the questionnaire was to collect data on the personal and trip characteristics that influence car drivers to adapt their departure time decisions with respect to a given parking characteristic. The re-coded variables used for this purpose can be found in appendix C.

In the process of data collection, invitation cards were personally distributed between the months of November and December 2011. These cards were distributed from door to door or face-to-face contact i.e. dropped into respondents' postal boxes or approaching potential respondents especially at car parks around the study vicinity and asking them to participate. With this approach, approximately 2500 invitation cards were distributed randomly within the study area. The total invitation cards were assumed to be small compared to the total population of the study area with respect to the trips made to Hasselt. The invitation cards had an internet link which gave respondents an access to the internet-based questionnaire. Figure 2 below represents a sample of the invitation cards that were used.

Figure 2: The invitation card

Out of 2500 invitation cards that were distributed, 205 respondents attempted answering the questions and only 195 respondents completed the questionnaire successfully. This therefore, represented just 7.8% of the total cards that were distributed. This is just a confirmation of the fact that non-response is a pertinent problem in collecting necessary data for each and every research.

3.4 Framework for data analysis

Collecting data is not sufficient to provide tangible information that could be used for important policy development. A good method for data analysis is necessary to give an insight to hidden information found in datasets. This research considers data analysis to be very important. It employs the use of software packages, principally SPSS and SAS. For exploratory data analysis, these statistical tools will aid the production of frequency distributions, histograms, tables, and correlations matrix that will permit the selection of particular models in order to fit the data set.

Since the dependent variables (departure time and work/study trips) had multiple responses, a Multinomial logit model which takes account of multi-response dependent variables will be applied. This modeling approach according to FHWA et al. (2007) considers the discrete nature of dependent variables and at the same time, it is flexible in using appropriate explanatory variables for different dependent variables.

The MNL model has a number of diagnostic tools as compared to other generalized linear models. For instance, it can be applied using a number of common statistical packages. According to FHWA et al. (2007. p69), the principles of multinomial logit model are built on the assumption that, the choice between any pair of alternatives (response variable) is independent of the availability of other alternatives. In another note, FHWA et al. (2007), argues that the problem with MNL model is that of the independence of irrelevant alternatives (IIA). This problem arises because the error terms are assumed to be independently distributed from each other. According to these scholars, the IIA assumption may lead to unrealistic predictions, though it has the advantage in that the likelihood function is quite easy to compute.

To understand how the model works, FHWA et al. (2007) hypothesize that; if there are J categories of response variables (e.g., departure time), this means that one has to construct J-1 equations from the MNL model. Each of these J-1 equations is a logistic regression comparing a group with the reference category. Suppose the utility function according to FHWA et al. (2007) is:

$$U_{ki}=X_K\beta_i + \varepsilon_{ki} \quad \ldots\ldots\ldots\ldots\ldots 1.1$$

Where X_K denotes the individual independent variables **k**, β_i denotes the coefficient associated with each independent variable **k** and ε_{ki} is the error term. Suppose the dependent variable (departure time) q, is subjected to different levels or categories from 0 to I, then

$$q_K=\text{j, if } U_{kj} \geq U_{ki} \text{ for j} \neq i \quad \ldots\ldots\ldots\ldots\ldots\ldots 1.2$$

In this thesis and based on the formulation above, the two models to be computed can be represented as follows;

First model: Departure time as the dependent variable

For a given set of departure times i = 0, 1, 2, 3 4, 5, and 6,

The model for departure time decision can be represented as U_{k0}, representing before and around 8:45am in the dataset, U_{k1} representing around 9:00am in the dataset, U_{k2} representing around 9:15am, U_{k3} representing around 9:30am, U_{k4} representing around 9:45am and U_{k5} represents after 9:45am. For these seven categories, it requires six equations, one for each category in relation to the reference category which in this case is the last category.

Second model: Frequency of work/study trips as the dependent variable

The model for the frequency of work/study trips can be represented as follows:

Given i = 0, 1, 2. Where U_{k1} represents 'sometimes', and U_{k2} represents 'regularly'. For the three categories, it requires two equations, one for each category in relation to the reference category, which in this case is the first category ('never').

Given that the responses for the dependent variable (work/study trips) were collected in three separate questions with respect to a specified parking characteristic, three models were also generated to determine the personal and trip characteristics that influence the adaptation of departure time for work/study trips. In such a situation, FHWA et al. (2007) teaches that, the general logistic equation for MNL will be given as

$$P(q_k = j)=\frac{e^{X_k \beta_i}}{1+\sum_{i=1}^{j} e^{X_k \beta_i}} \quad \ldots\ldots\ldots\ldots\ldots 1.3$$

According to FHWA et al. (2007), when the reference category is set to zero, the equation for the probability is presented as in equation 1.3 above.

FHWA et al. (2007) acknowledges that, the estimation can be performed using the maximum likelihood formulation (ML) in which the log of the likelihood function is given as:

$$\log L=\sum_{k=1}^{k} \sum_{j=1}^{j} q_{kj} \log(P_{kj}) \ldots\ldots\ldots\ldots\ldots\ldots 1.4$$

With q_{kj}=1 if the departure time and frequency of work/study trips falls in category j and q_{kj}= 0 otherwise.

3.5 Limitations and potential problems related to data collection

The process of data collection witnessed enormous problems and challenges. Apart from personal challenges faced in distributing the invitation cards such as the time frame (cold winters) and biking around all villages around Hasselt, non-response was the most experienced problem. Though, a reasonable amount of invitation cards (2500) were distributed, the response rate remained enormously low, probably due to lack of internet access for some respondents in the study area to have access to the online questionnaire. Out of 2500 invitation cards distributed, 195 respondents completed the questionnaires successfully. However, this project had to proceed with these completed responses given time constraints.

CHAPTER FOUR: STUDY RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the data collected by means of empirical techniques that were discussed in section 3.5. It gives a description of the data, analyzes the personal and trips characteristics that influences car drivers' departure time decisions and adaptation of departure time decisions with respect to specific parking characteristics at the destination, and investigates the correlation between the variables.

Prior to the investigation of interactions between variables, a profile of all related variables will be elaborated to set a framework for the study and to select the model that fits the data set. It should be noted that the analytical software packages used in this analysis are SAS & SPSS. This chapter proceeds with a description of the dataset in section 4.2, exploratory data analysis in section 4.3, an outline of the personal and trip characteristics used in section 4.4, departure time frames in section 4.5, variable correlation in section 4.6, and a model of factors influencing departure time decisions and adaptation of departure time decisions in sections 4.7 and 4.8.

4.2 Data Description

The data used for this research was personally collected in the months of November and December 2011 with the use of internet-based questionnaires. The data was collected from residents who lived in Diepenbeek and in the surrounding villages of Hasselt and do drive to Hasselt for various activities including work/study, shopping, social/recreation, train connection and others. The original data is stored in SPSS format and consists of 205 observations including 15 respondents who reacted but did not complete the questions. The data was exported into SAS 9.2 where the necessary transformation was performed. In the transformation process, all respondents who have never visited the city of Hasselt were deleted from the data set and as a

result, only 170 observations were considered for further processing. Table 3 below describes the relevant variables in the dataset.

Table 1: Relevant variables in the dataset

Variable Name	Description
ID	Identification number
Gender	Female & Male
Age	<35yrs, 36yrs - 55yrs and >55yrs
Educational level	Primary & others, Secondary, higher non universities, University
Visit frequency	Never; Sometimes; Regularly; Often
Travel purpose	Not applicable; Work/study; Shopping; Social/recreation; Connecting train, and others
Work/study trips	Never; Sometimes; Regularly; Often and Always
Shopping trips	Never; Sometimes; Regularly, Often and Always
Social/recreation	Never; Sometimes; Regularly; Often and Always
Train connection	Never; Sometimes; Regularly; Often and Always
Driving license	Yes, and No
Parki ng cards	Yes and No
Residence	Diepenbeek and Surrounding Villages of Hasselt
Travel time	10 minutes, 15-20 minutes, 25-30 minutes
Departure time	≤8:45AM; Around 9:00AM, Around 9:15AM; Around 9:30AM, Around 9:45AM, and >9:45AM

4.3 Exploratory data analysis

In order to gain an insight of the data, an exploratory data analysis (EDA) was conducted. Given the nature of the data, tables, bar charts, histograms and a correlation matrix will be used to display the data results. The EDA aims to analyze the personal and trip characteristics of respondents in other to display the distribution of responses based on gender, age, education, home location, departure time, trip frequency and trip purpose.

4.3.1. Gender and Age

Figure 3a below, gives an overview of the distribution of respondents with respect to gender. The distribution shows that approximately 69% and 31% of males and females respectively, participated in the survey. The responses with respect to gender don't portray sex distribution in Belgium. This is because the United Nations world population prospects (2007), asserts that sex distribution in Belgium is almost of equal proportions, with an anticipated medium variation of almost 49% and 51% males and females respectively. The reason for the disparity in the response rate between males and females in the study area may have been the facts that, male respondents probably drive and park at the city of Hasselt than females do. This may also have been due to the fact that, females probably were more reluctant to participate on the survey than male population.

With respect to age distribution, figure 3b below shows that, approximately 44% and 38% of the sampled population were younger than 35 years and between the ages of 36 and 55 respectively. Also, approximately 19% of the sampled population was older than 55 years. This shows that, respondents who fall around the middle aged group responded to the questionnaire than the elderly population. The reasons for the low response rate amongst the elderly people may have been the lack of computer skills and internet availability to access the internet-based questionnaire. Another reason could have been that, elderly people drive less to the city of Hasselt than the youths.

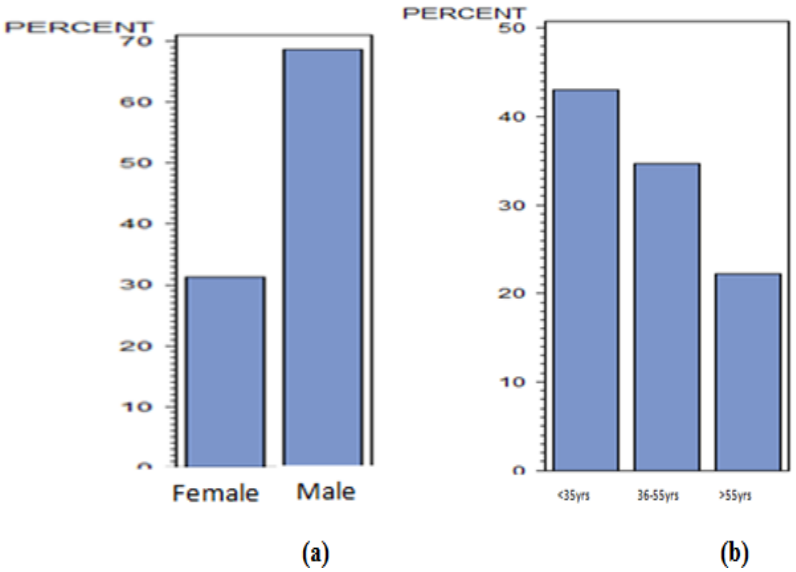

Figure 3: Distribution of gender (a) and age (b)

4.3.2. Education

With respect to educational qualification of respondents, Figure 4 below shows that approximately 34% of respondents had obtained a higher non-university certificate. Generally, the distribution shows that approximately 82% of respondents have at least a certificate from secondary school and above. The high response rate from people with higher educational qualifications coincides with the high literacy rates of 99% in Belgium, as illustrated in Statistics Belgium (2007), UNICEF (2007) and UNDP (2007).

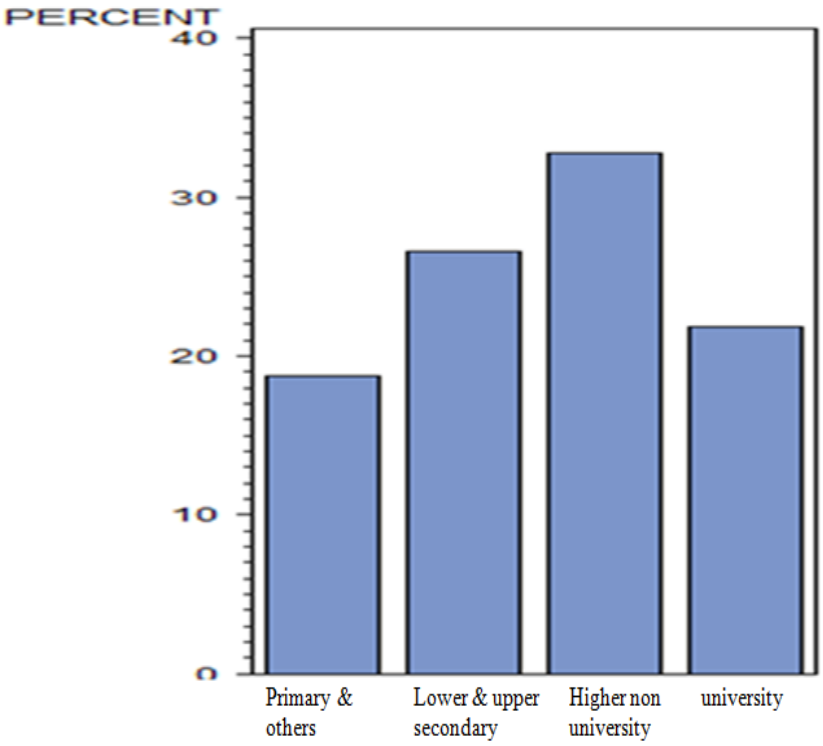

Figure 4: Educational distribution

4.3.3. Drivers licenses and parking cards

Figure 5 below presents the distribution of drivers' licenses (a) and free parking cards (b). The distribution shows that approximately 98% respondents had a drivers' license and amongst which, only 1% of them own a free parking card at the city of Hasselt. The distribution probably indicates the degree of car ownership and usage around the vicinity of Diepenbeek and surrounding villages of Hasselt. Also, the fact that only few people own free parking space in Hasselt equally demonstrates the city's policy towards car usage. However, these two variables are not interesting for future analysis and will not be included in the modeling process because they have a very skewed distribution.

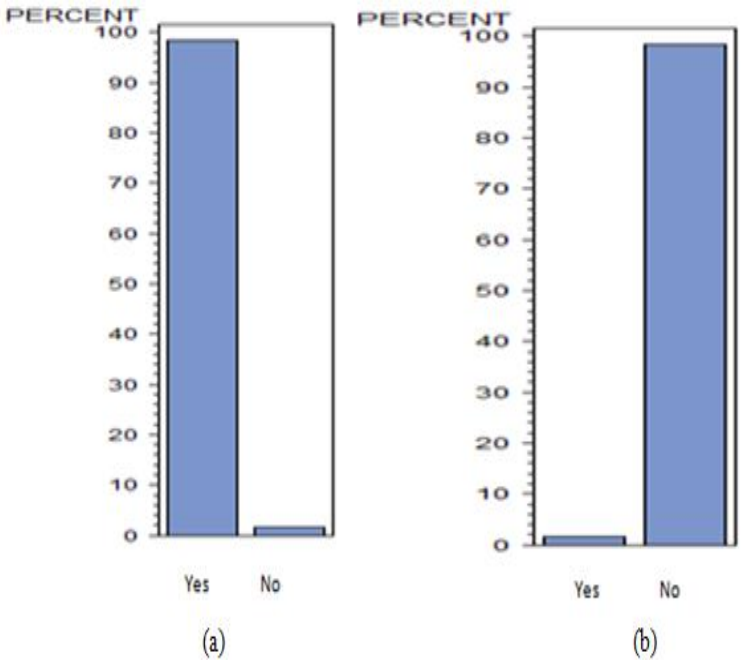

Figure 5: Distribution of drivers' license (a) and parking cards (b)

4.3.4 Home location

The data for this research was collected in Diepenbeek and in the surrounding villages of Hasselt. These surrounding villages include; Lanaken, Bilzen, Geetbets, Maasmechelen, Meeuwen, Tongeren, Alken, Overpelt, Neerpelt, Bree, Sint-Truiden, Houthalen and Genk. The importance of home locations in estimating the travel time from home to final destination necessitated the investigation of home distribution over the study area. All respondents in the neighborhood of Hasselt were re-coded as 'villages around Hasselt', because the travel time from these locations to the city of Hasselt were similar. Based on this re-coding, the distribution on figure 6 shows that, approximately 63% and 37% of the respondents live in Diepenbeek and the surrounding villages of Hasselt respectively. This signifies that, residents of Diepenbeek participated in the survey than those that live in the surrounding villages of Hasselt. This is probably because Diepenbeek is more accessible or closer to Hasselt than other villages in the neighborhood of Hasselt. This may also be due to the fact that the average travel time from Diepenbeek to Hasselt is 10 minutes, which is shorter than 15 minutes average travel time from surrounding villages of Hasselt.

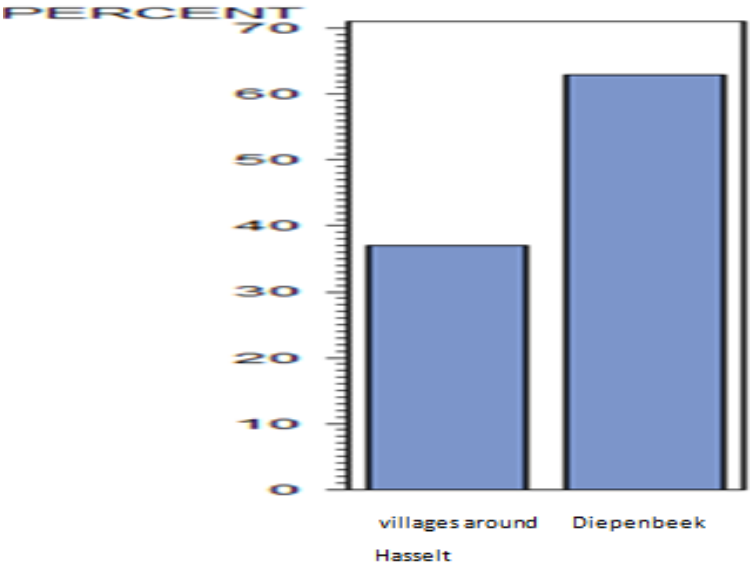

Figure 6: Distribution of home locations

4.4 Trip characteristics

The trip characteristics that this research is aimed at examining include; trip purpose, trip frequency, travel time and departure time. Trip activities are gaining popularity in current transportation research studies. Individuals undertake trips for social, political, educational or economic reasons, which may include; work, study, social, recreation, etc. This section evaluates the distribution of respondents over the above trip characteristics.

4.4.1. Trip purpose

Figure 7 below shows the distribution of respondents over different trip purposes. The histogram shows that approximately 50% respondents go to Hasselt for shopping, while 27% goes there for work/study purposes and approximately 23% for other trips purposes, which includes social/recreational and train connection. The distribution shows that Hasselt is probably a commercial city and attracts many people for shopping reasons as most respondents go there for shopping.

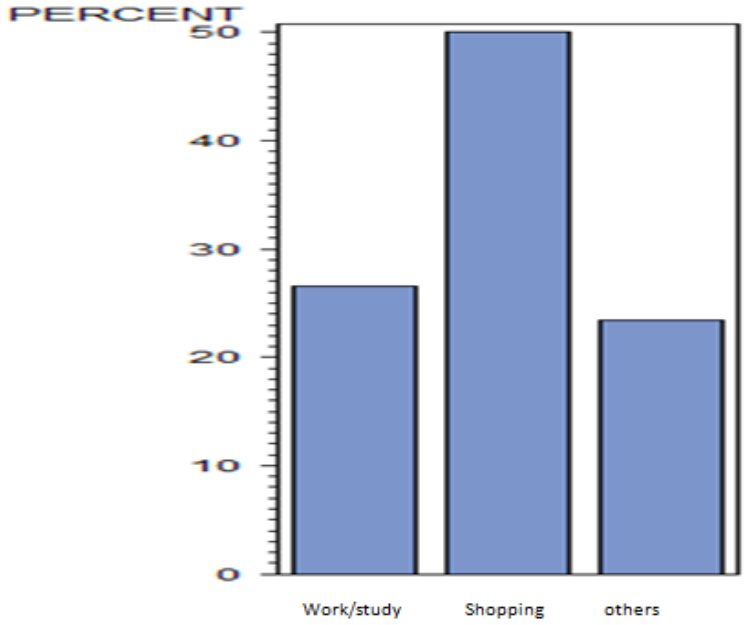

Figure 7: Distribution of trip purpose

4.4.2. Trip frequency

Trip frequency is another important factor in this research that is worth investigating. Based on figure 8 below, respondents trip frequency to Hasselt is distributed over four covariates, which includes; Never, sometimes, regularly and often. Due to the reality in the nature of this work, respondents who have 'never' visited the city of Hasselt were deleted from the data set. Therefore, only respondents who have visited Hasselt were considered for further analysis because, people who have never been to Hasselt cannot give reasonable answers on the study context. The distribution of trip frequency in Figure 8 below, shows that approximately 60% respondents who visit Hasselt go there 'sometimes' while 30% do that 'regular' and just 10% do that 'often'.

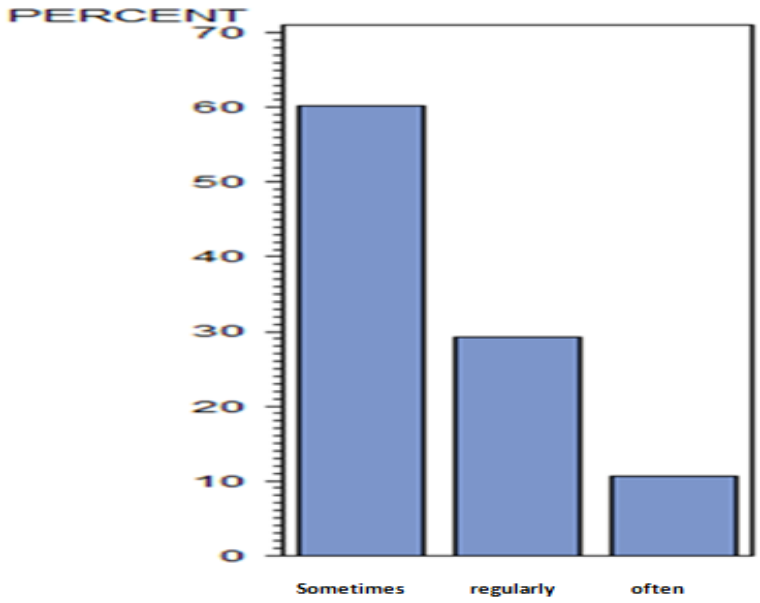

Figure 8: Distribution of visit frequency

4.4.3. Travel time

Figure 9 below shows the distribution of respondents travel time from home location to the city of Hasselt. The histogram shows that 44% of respondents travel for 15 to 20 minutes, while approximately 22%, used 10 minutes to get to the city of Hasselt and also, approximately 34% travel for 30 minutes. The fact that about 66% respondents travel between 10 to 20 minutes means that, most respondents live closer to the city of Hasselt. The distribution shows that, it takes an average of 15 minutes and 20 minutes from Diepenbeek and surrounding villages respectively to arrive at the city of Hasselt.

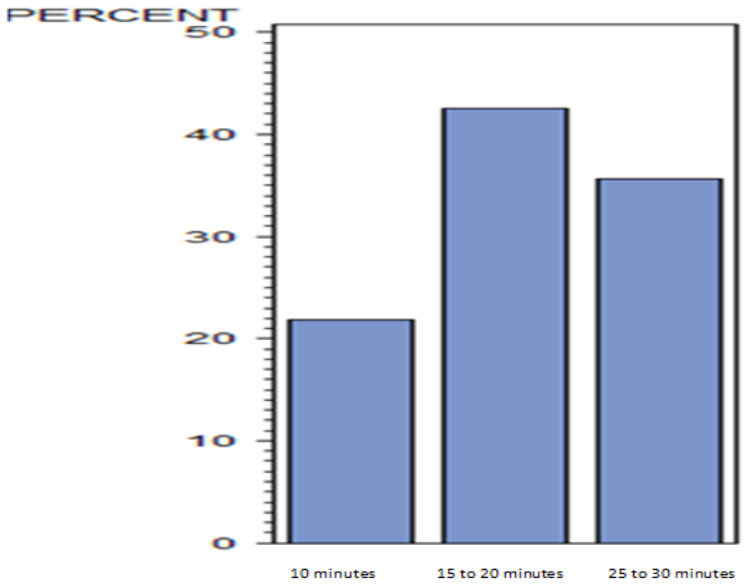

Figure 9: Distribution of travel time

4.5 Departure time

The departure time choice that each respondent is expected to choose is a 'directed' departure time because the departure time was constraint to the arrival time at the destination (10:00am). In response to the question regarding departure time choice, respondents had to choose between the specified departure times which included; ≤8:45am; around 9:00am, around 9:15am; around 9:30am, around 9:45am and >9:45am. This is the time that can permit their arrival at the destination at the required time (10:00am). The distribution of departure time as presented in figure 10 below shows that approximately 35% and 27% respondents preferred to depart around 9:30am and 9:45am respectively. Also, approximately 31% leave their homes between 9:85am and 9:15am. The fact that approximately 66% respondents departs around 9:30am probably means that, most of them live closer to the city of Hasselt.

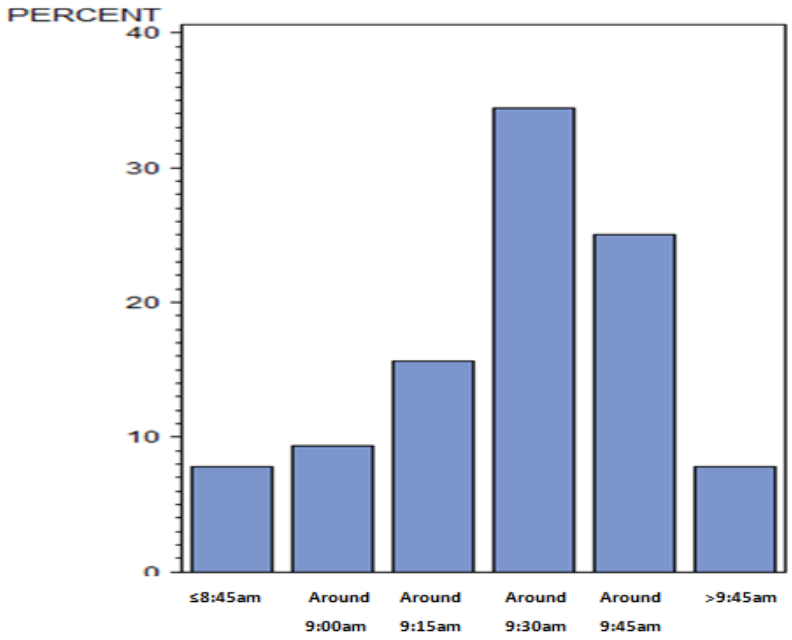

Figure 10: Distribution of departure time.

4.6 Correlation between variables

Graphical representation of this study conveys a lot of interesting results which will be discussed in more details in section 4.8. However, before this discussion, a correlation matrix will be computed to investigate variables that are associated with each other. A correlation matrix is a convenient way to summarize the relationship between variables in a single table.

According to Sharma (2005), a correlation analysis helps in determining the degree of relationship between two or more variables. This scholar argues that a positive correlation exist when a data set follows an upward sloping direction. This means that, a positive correlation occurs when both variables are increasing or decreasing at the same time. Also, Sharma (2005) acknowledges that, a negative correlation occurs when the variables are going in opposite directions. This means that, as one variable increases the other decreases, implying that, the dataset follows a downward slopping direction. Sharma (2005) points out that, if the data doesn't follow one of the above predictable patterns, it means no correlation exist between the variables. This scholar equally acknowledges that, a correlation is signified by the positive or negative sign on the values, which includes; (r = 0 to +1) and (r = 0 to -1) for positive and negative correlations respectively. Sharma (2005) also argues that an important feature of a correlation lies on its strength and that, the closer the number is to one, the stronger the relation

is regardless of whether it carries a positive or negative sign and also its direction. Figure 11 below, presents a good example of the possible relationships between two variables, X and Y.

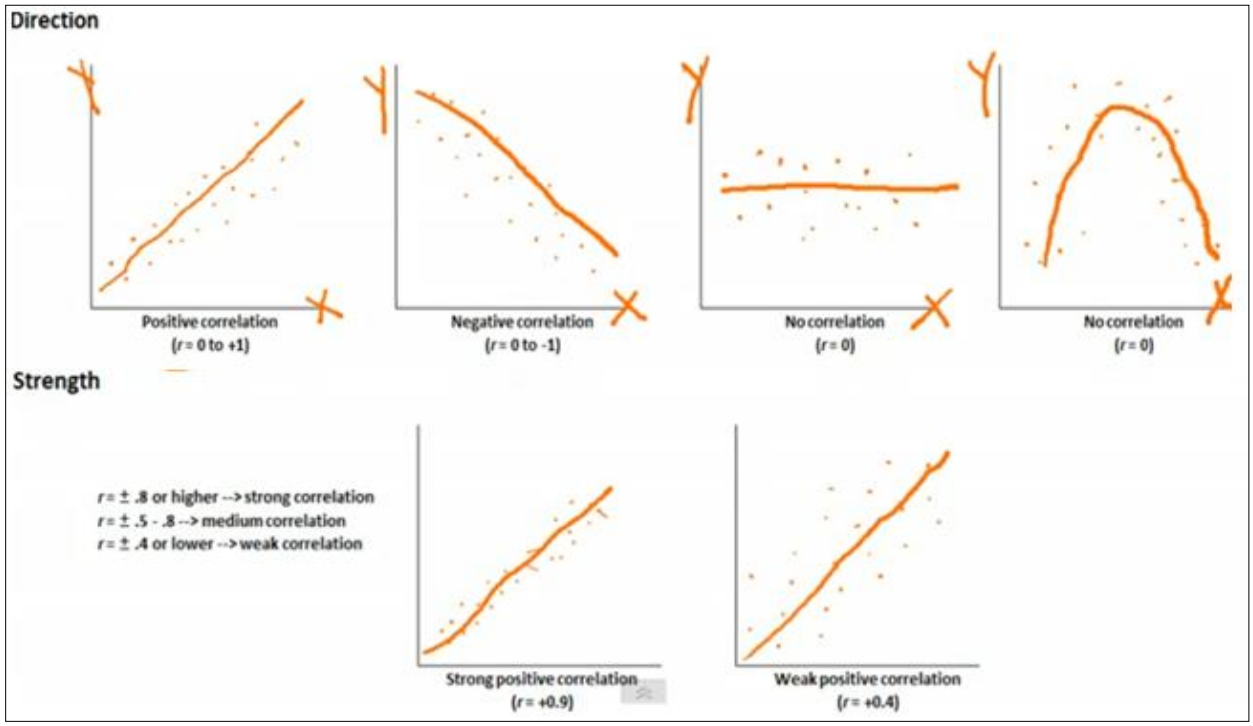

Figure 11: Correlation between variables (http://www.youtube.com/watch?v=Ypgo4qUBt5o&feature=related)

With respect to the data set collected for this thesis, the correlation matrix is presented on table 4 below and shows that, few of the observed variables have a strong relationship. However, the most significant relationship can be seen between age and ownership of free parking card (r=.163*). This means that, there is a positive direct relationship between peoples' ages and ownership of free parking cards. This means that, the older one becomes, the more likely he is to own a free parking card. Thus, people with ages >55years are more likely to have a free parking card in the city of Hasselt than those in the middle age group.

Another observed relationship is between free parking cards and home locations (r=.176*). The relationship shows that, there exist a positive direct relationship between free parking cards and home locations. Thus, people who own free parking cards are more likely to be living in the surrounding villages of Hasselt than in Diepenbeek. This is because of the positive sign on the correlation coefficient and the coding of home location (-1=Diepenbeek, 1=surrounding villages of Hasselt) in the dataset.

Finally, a relationship also exist between free parking cards and travel time (r=.162*). There is a positive direct relationship between free parking cards and travel time from home locations to Hasselt. This means that respondent who own free parking cards travel on average for longer distances than people who have no parking cards. This is also because of the positive sign on the correlation coefficient and the coding of the travel time (-1≤15minutes, 1=15 ≤25). The positive sign on the correlation coefficient means that, an increase in the number of people who own free parking cards will results to increase in the number of those that travel longer distances.

Table 2: correlation matrix

		Correlation Coefficient							
		Gender	Education	Age	Trip frequency	Drivers license	Parking cards	Travel time	Home location
Spearmans rho	Gender	1.000	.030	.070	.086	.085	-.008	-.093	-.083
	Education		1.000	-.092	-.100	.030	-.137	-.082	.064
	Age			1.000	.081	.018	.163*	.078	.089
	trip frequency				1.000	.010	.028	-.046	.147
	Drivers license					1.000	.016	.043	-.028
	Parking cards						1.000	.162*	.176*
	Travel time							1.000	-.046
	Home location								1.000

***Correlation is significant at The 0.05 level (2-tailed).*

The rest of the variables are not associated with each other. The least associated variable is found between gender and free parking cards with a (r = -.008). Therefore, it would be better to leave out 'free parking cards' in the analysis because of its association with other variables.

4.7 Modeling factors that influence departure time decision

Considering the second initial objective which is aimed at determining the factors that affect departure time decisions of car drivers, the association between response variable (departure time) and the respective predictors variables (personal and trip characteristics) will be investigated with the use of a multinomial logit model, principally; the proportional odds model (POM). This model is chosen because of the ordinality of the response variable. Many statistical software packages such as SPSS and SAS are some of the available options for researchers in analyzing generalized linear models. These statistical software packages used different techniques to estimate the parameters. The proportional odds model, also known as the cumulative odds model (Armstrong & Sloan, 1989) is one of the most commonly used model for analyzing ordinal categorical data and it is one of the classes of the generalized linear models. According to Armstrong & Sloan (1989), the proportional odds model works with logit or natural log of the odds for estimating the parameters.

Based on the this context, the Multinomial logit model, specifically; the POM that has been used in fitting the variables at a significant level (alpha=5%) revealed that, of the predictor variables; age, trip purpose, education and travel time significantly affected individuals' departure time decision, while gender appears to affect the departure time decision at 10% level of significance. Home location, and visit frequency similarly appears not to have any discernible effect on departure time decisions. This suggests that, education, home location and visit frequency should probably be removed from the model. Table 3 below clearly displays the type III analysis of the main effects of the POM, which shows the change in the fit of the model resulting from discarding any one of the covariates: - gender, age, education, home location, visit frequency, trip purpose or travel time while keeping the others in the model.

Table 3: Type III Analysis of effects

Source	DF	p.value
Gender	1	0.0881
Age	2	<.0001
Education	3	0.0322
Home location	1	0.2813
Visit frequency	2	0.2824
Trip purpose	2	0.0018
Travel time	2	<.0001

Table 4 below, presents the parameter estimates, standard errors and P.values of the predicted variables. From the analysis of the maximum likelihood estimates, the odds ratio for age, (young vs. old) is exp(-1.4523) = 0.2340, which is statistically significant with a P.value of 0.0012. This means that the probability for old peoples' departure time decision to be influenced is approximately 4 times greater than for young people. This implies that, age probably has an influence on departure time decision.

The maximum likelihood estimates for this study also predicts that, the odds ratio for education (higher non university vs. university) is exp(1.1887) =3.2828 and is statistically significant with a p.value of 0.0062. This means that the probability of departure time decision for people with higher non university certificates is about 3 times greater than for those with university graduates. This implies that, the departure time decision for people with higher non university certificates is probably more likely to be influenced than that of people who have university certificates.

Moreover, the odds ratio for trip purpose (shopping vs. other trips) is exp(1.4429) = 4.233.This also means that, the probability of departure time decision for shopping trips is approximately 4 times greater than for other types of trips.

Furthermore, with respect to travel time, the analysis also shows that the probability of departure time decisions for people who travel longer distances is approximately 6 times greater than for those who travel short distances. Implying that, the departure time decision for people who travel longer distance is probably more likely to be influenced than for those who travel short distances to the city of Hasselt.

Table 4: Parameter Estimates of Proportional odds model

Parameter	Level	DF	Estimate	S. E	P.Value
Intercept1	≤8:45am	1	-3.2696	0.9361	0.0005
Intercept2	9:OOam	1	-1.2096	0.9096	0.1836
Intercept3	9:15am	1	0.7012	0.9043	0.4381
Intercept4	9:30am	1	2.6199	0.9435	0.0055
Intercept5	9:45am	1	5.9725	1.0068	<.0001
Intercept6	>9:45am	0	0.0000	0.0000	.
Gender	Female	1	0.5672	0.3341	0.0896
Gender	male	0	0.000	0.0000	.
Age	<35yrs	1	-1.4523	0.4489	0.0012
Age	36-55	1	-1.9429	0.4633	<.0001
Age	>56	0	0.0000	0.0000	.
Education	Primary/others	1	0.2278	0.5571	0.6825
Education	Secondary	1	0.4926	0.4609	0.2851
Education	Higher Non university	1	1.1887	0.4339	0.0062
Education	University	0	0.0000	0.0000	.

Parameter	Level	DF	Estimate	S. E	P.Value
Home location	Surrounding of Hasselt	1	0.6411	0.5958	0.2820
Home location	Diepenbeek	0	0.0000	0.0000	0.0000
Visit frequency	Sometimes	1	0.3208	0.5170	0.5349
Visit frequency	Regularly	1	0.8180	0.5759	0.1555
Visit frequency	Often	0	0.0000	0.0000	.
Trip purpose	Work/study	1	0.2294	0.4580	0.6165
Trip purpose	Shopping	1	1.4429	0.4740	0.0023
Trip purpose	Others	0	0.0000	0.0000	.
Travel time	10minutes	1	-4.0858	0.7111	<.0001
Travel time	15≤20minutes	1	-3.4649	0.6567	<.0001
Travel time	25≤30minutes	0	0.0000	0.0000	.

4.8 Modeling factors that influence the adaptation of departure time decision with respect to parking characteristics

Considering the second research objective that is aimed at examining the personal and trip characteristics that influences peoples' adaptation of departure time decision for work/study trips with respect to specific parking characteristics at the destination, the association between dependent variable (work/study trips) and independent variables (personal and trip characteristics) will be investigated with the use of multinomial logit (MNL) model because of the ordinality of the dependent variable. The formula for maximum likelihood function presented in equation 1.4 of section 3.6, will be used to estimate the effects.

In the survey, the dependent variables; 'work/study trip1', 'work/study trip2' and 'work/study trip3'; are re-coded with three responses, which includes; 'sometimes', 'regular',

and ‘never’. These dependent variables are modeled with the explanatory variables including; age, gender, education, visit purpose, travel time, home location and visit frequency.

It will be worthwhile presenting the core parking situations that are being investigated to give a highlight of the models that will be presented below. The following denotations stand for the different parking situations:

- Work/study trip1: high parking demand at the destination.
- Work/study trip2: parking tariff.
- Work/study trip3: walking distance between parking facilities and final destination.

As earlier indicated in section 3.6, three MNL models will be computed to examine the personal and trip characteristics that influence car drivers to adapt their departure time decision for work/study trips with respect to the above parking situations.

4.8.1 First Model: Adaptation of departure time for work/study trips with respect to high parking demand

Table 5 below presents the distribution of responses for the adaptation of departure time decision for work/study trips with respect to high parking demand at the destination. The table shows that 36.7% respondents ‘never’ adapts departure time decision because of high parking demand at the city of Hasselt, while 45.6%, ‘sometimes’ adapts their departure time decisions and only 17.7% of the sampled population on ‘regular’ bases adapts their departure time decisions.

Table 5: Case processing Summary (Work/study vs. high parking demand)

		N	Marginal percentage
Work/study trip1	Never	58	36.7%
	Sometimes	72	45.6%
	Regular	28	17.7%
Valid		158	100%
Missing		12	
Total		170	

The dependent variable is re-coded in three levels

Table 6 presents the model fitting information of the dataset. The overall fitting measures are satisfactory. This is because the model fits the data significantly well at 0.05 alpha level, and the test statistics $X^2 = 62.503$, with a p.value < 0.000. The likelihood ratio test (see appendix B1), also shows that age, education, and travel time are highly significant. This means that, these variables do have a significant effect on the adaptation of departure time for work/study trips with respect to high parking demand at the city of Hasselt. Generally, the fitting information demonstrates that, the data is highly skewed and has a kurtosis distribution of variables.

Table 6: Model fitting information (work/study vs. high parking demand)

Model	Model Fitting criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept only	297.317			
Final	234.814	62.503	24	.000

Table 7 below shows the parameter estimates of the model. There are two sets of parameters which represents two binary comparisons made between three alternative responses on work/study trips to the city of Hasselt. The response, 'never' is the reference category.

The parameter estimates with respect to age shows that, an increase in age while controlling other variables will result to 1.029 increase for people who 'sometimes' visit Hasselt as opposed to those that 'never', visit Hasselt. This is equivalent to an odds ratio of 2.798 ($e^{1.029}$). This means that, increase in age will make people more likely to adapt their departure time decisions. Specifically, and based on the coding of this variable, this estimates shows that the probability of 'sometimes' and 'regular' increases for old people (>55yrs) and decreases for young people (≤55yrs) in relation to the probability of 'never'. This implies that, old people are more likely to adapt their departure time decisions because of high parking demand at the city of Hasselt than young people.

Also, the travel time to the center city of Hasselt also presents interesting results in that, it has a parameter estimate of .821 and an equivalent odds ratio of 2.273($e^{.821}$). Specifically, this shows that the probability of 'sometimes' increases for respondents who travel longer distances (20-25minutes) and decreases for those that travel shorter distances (<15 minutes) in relation to 'never'. This probably indicates that, people who travel longer distances are more likely to adapt their departure time decisions with respect to high parking demand at the city of Hasselt than those that travel short distances. This may be logically correct because people who travel longer distances are more likely to come across congestion on the way than those who travel short distances to the city of Hasselt. In this light, people who live far and travel longer distances will probably be more likely to adapt their departure time to avoid shortage of parking space due to high parking demand at the city of Hasselt.

The rest of the variables which include; education, gender, trip purpose, and visit frequency appears to have no significant influence peoples' adaptation of departure time decisions. This is because these variables are neither significant at 5% nor at 10% level of significance.

Table 7: Parameter Estimates (Work/study vs. high parking demand)

Work/study trip1[a]		**B**	**S. E**	**Sig.**	**Exp(B)**
sometimes	Intercept	-1.395	.830	.093	
	Age1	.486	.315	.123	1.625
	Age2	1.029	.332	.002	2.799
	Gender	.642	.453	.156	1.900
	Education1	.100	.487	.838	1.105
	Education2	-.227	.382	.552	.797
	Education3	-.466	.342	.172	.627
	Visit purpose1	.140	.325	.667	1.150
	Visit purpose2	-.117	.320	.714	.889
	Travel time1	-.258	.338	.446	.773
	Travel time2	.821	.325	.011	2.272
	Visit frequency1	.304	.308	.325	1.355
	Visit frequency2	.149	.361	.679	1.161
Regular	Intercept	-.590	.931	.526	
	Age1	.199	.354	.574	1.221
	Age2	.687	.370	.063	1.987
	Gender	-.399	.517	.440	.671
	Education1	-.467	.698	.503	.627

	Education2	.667	.453	.141	1.948
	Education3	.496	.416	.233	1.642
	Visit purpose1	.142	.405	.727	1.152
	Visit purpose2	-.032	.383	.932	.968
	Travel time1	-.487	.426	.252	.614
	Travel time2	.303	.408	.457	1.354
	Visit frequency1	-.281	.371	.450	.755
	Visit frequency2	.614	.414	.138	1.847

a The reference category is: 'Never'

4.8.2 Second model: Adaptation of departure time for work/study trips with respect to parking tariff

With respect to the personal and trip characteristics that influence car drivers' adaptation of departure time decision for work/study trips with a given parking tariff at the city of Hasselt, table 8 below presents the distribution of dependent variable (work/study trip). The table shows that 52.5% of the survey population 'never' adapts departure time decision, while 37.3% 'sometimes' adapts departure time and only 10.1% do that on 'regular' bases.

Table 8: Case processing summary (work/study trips vs. parking tariff)

		N	Marginal percentage
Work/study trips2	Never	83	52.5%
	Sometimes	59	37.3%
	Regular	16	10.1%
Valid		158	100.0%
Missing		12	
Total		170	

This variable has been re-coded into three levels

Moreover, table 9 presents the model fitting information of the dataset. The outcome of the predictive model shows that, the model fits the data well because at 5% alpha level, the test statistics $X^2 = 53.361$ and p.value<0.001. Also, the likelihood ratio test (see appendix B2) shows that education, visit purpose and travel time are highly significant: This means that, these independent variables do have a significant effect on the adaptation of departure time decision for work/study trips with respect to parking tariff at the city of Hasselt. Generally, the fitting information is an indication to the fact that, the data is highly skewed and has a kurtosis distribution of variables.

Table 9: Model Fitting Information (work/study trips vs. parking tariff)

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	273.728			

Final	220.367	53.361	24	.001

Table 10 below presents the parameter estimates of the MNL model that examines the personal and trip characteristics that influences adaptation of departure time decision for work/study trips with respect to the parking tariff at the city of Hasselt. This model presents two sets of parameter estimates that represents two binary comparisons made between three responses on the work/study trips, with the reference category being 'never'.

The estimates shows that, an increase in educational level while controlling other variables will result to car drivers who 'sometimes' make work/study trips to Hasselt as opposed to 'never', decreasing by -.900. This is an equivalent odds ratio of 0.407($e^{-.900}$). Implying that, an increase in the level of education will make car drivers less likely to adapt their departure time because of parking tariff at the centre city of Hasselt. Specifically, these estimates shows that, the probability of 'sometimes' decreases for car drivers who hold higher level of education and increases for those with low level of education in relation to the probability of 'Never' when it comes to decisions on departure time with respect to parking tariff. This means that, people who have high level of educational qualifications are less likely to adapt departure time decisions for work/study trips due to parking tariff at the centre city of Hasselt than those with low level of education. This may be logically correct because car drivers with high level of education may be well to do people and also are better paid. In this case, the educated people will not be influenced to adapt their departure time because of parking tariff. Also, activities of educated people are probably activities that are tied to clock time and thus, make it difficult for them to adapt departure time because parking tariff.

Moreover, travel time from home locations to the centre city of Hasselt also presents interesting results. The results shows that for an increase in travel distance while controlling other variables, people who 'sometimes' make work/study trips to Hasselt as opposed to 'never', increases by .572. This is equivalent to an odds ratio of 1.771($e^{.572}$). Implying that, for any unit increase in travel distance, car drivers will be more likely to adapt departure time decisions. Specifically, the probability of 'sometimes' increases for people who travel longer distances (>25 minutes) and decreases for those that travel shorter distances (≤25 minutes) in relation to 'never'. This implies people who travel longer distance from homes to the centre city of Hasselt

are more likely to adapt departure time decisions due to parking tariff at the destination than those that travel shorter distances.

Table 10: Parameter Estimates (Work/study trips vs. parking tariff)

work2[a]		B	S.E	Sig.	Exp(B)
Sometimes	Intercept	-.176	.781	.822	
	Age1	.386	.307	.208	1.471
	Age2	.518	.318	.104	1.678
	Gender	-.250	.431	.562	.779
	Education1	.337	.468	.471	1.401
	Education2	-.183	.374	.625	.833
	Education3	-.900	.343	.009	.407
	Visit purpose1	.040	.302	.894	1.041
	Visit purpose2	-.705	.305	.021	.494
	Travel time1	-.139	.352	.692	.870
	Travel time2	.572	.299	.056	1.772
	Visit frequency1	.246	.307	.423	1.279
	Visit frequency2	-.161	.361	.656	.851
Regular	Intercept	-1.010	1.085	.352	
	Age1	-.255	.441	.563	.775
	Age2	.454	.395	.250	1.575

	Gender	-.477	.595	.423	.621
	Education1	.111	.689	.873	1.117
	Education2	.113	.493	.819	1.119
	Education3	-.177	.450	.693	.838
	Visit purpose1	-.026	.457	.955	.975
	Visit purpose2	-.328	.428	.444	.721
	Travel time1	.308	.438	.482	1.360
	Travel time2	-.432	.468	.357	.650
	Visit frequency1	.065	.476	.892	1.067
	Visit frequency2	.705	.507	.164	2.024

a The reference category is: 'Never'

4.8.3 Third Model: Adaptation of departure time for work/study trips with respect to the walking distance between parking facilities and final destination

The adaptation of departure time for work/study trips with respect to walking distance between parking facilities and the city centre of Hasselt presented on table 11 shows the distribution of responses. The table shows that 34.2% respondents 'never' adapt departure time because of the walking distance between parking facilities and centre city of Hasselt, while 48.7% respondents 'sometimes' adapts departure time decisions and only 17.1% respondents do that on 'regular' bases.

Table 11: Case processing Summary (work/study trips vs. walking distance)

		N	Marginal Percentage
Work/study trips3	Never	54	34.2%
	Sometimes	77	48.7%
	Regular	27	17.1%
Valid		158	100.0%
Missing		12	
Total		170	

This variable is re-coded in three levels

Again, table 12 presents the outcome of the predictive model fittings. The table shows that the model fits the data well. This is because at 0.05 alpha level, the test statistics X^2 = 49.515, p.value<0.002. Moreover, the likelihood ratio test (see appendix B3) shows that education is highly significant: This means that, education has significant effects on the adaptation of departure time decisions for work/study trips with respect to walking distance between parking facilities and the centre city of Hasselt. Generally, the fitting information is an indication to the fact that the data is highly skewed and has a kurtosis distribution of variables.

Table 12: Model Fitting Information (work/study3 trips vs. walking distance)

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	295.002			

Final	245.487	49.515	24	.002

Table 13 below presents the parameter estimates of the MNL model for the adaptation of departure time for work/study trips with respect to walking distance between parking facilities and the city centre of Hasselt. The model presents two sets of parameters representing two binary comparisons made between three responses on work/study trips ('sometimes', 'regularly' and 'never'). The reference category is 'never'.

The parameter estimates with respect to age shows that, increase in peoples ages while controlling other variables will result to people who 'sometimes' go to Hasselt for work/study activities as opposed to 'never', increasing by .522. This is an equivalent odds ratio of 1.685($e^{.522}$). Specifically, the parameter estimates shows that, the probability of 'sometimes' increases for old people (>40yrs) and decreases for young people in relation to the probability of 'Never'. This means that, old people are probably more likely to adapt their departure time for work trips due to walking distance between the parking facilities and the centre city of Hasselt.

Moreover, the estimate with respect to education also shows that, the probability of 'regular' increases for people with higher education and decrease for those with low level of education in relation to 'never'. This means that, people with higher education are probably more likely to adapt their departure time for work/study trips due to the walking distance between parking facilities and the centre city of Hasselt.

The rest of the variables including; gender, travel time, trip purpose, and visit frequency appears to have little or no influence on car drivers' adaptation of departure time decision on the said context.

Table 13: Parameter Estimates (work3 trips)

Work3[a]		**B**	**S.E**	**Sig.**	**Exp(B)**
Sometimes	Intercept	-.396	.781	.612	
	Age1	.489	.297	.100	1.630
	Age2	.522	.299	.081	1.686

	Gender	.367	.432	.396	1.443
	Education1	.186	.460	.686	1.205
	Education2	-.526	.365	.149	.591
	Education3	-.382	.320	.232	.682
	Visit purpose1	.065	.310	.835	1.067
	Visit purpose2	-.275	.303	.364	.760
	Travel time1	-.060	.332	.856	.941
	Travel time2	.486	.311	.118	1.626
	Visit frequency1	.248	.294	.399	1.281
	Visit frequency2	-.199	.337	.556	.820
Regular	Intercept	-5.682	.975	.000	
	Age1	.252	.361	.485	1.286
	Age2	.591	.366	.107	1.806
	Gender	-.281	.513	.584	.755
	Education1	-15.183	1.065	.000	2.547E-007
	Education2	5.122	.577	.000	167.619
	Education3	4.791	.000	.	120.375
	Visit purpose1	.083	.425	.844	1.087
	Visit purpose2	.008	.385	.984	1.008
	Travel time1	-.072	.411	.861	.931

	Travel time2	.097	.393	.804	1.102
	Visit frequency1	.663	.455	.145	1.940
	Visit frequency2	.334	.507	.510	1.397

The reference category is: 'Never'

4.9 Conclusion

Despite the fact that respondents were relatively small compared to the number of invitation cards given out, the results still show important trends worth taking note of. First of all, the data demonstrate that men are more likely to participate in surveys than women, that educated persons do participate in surveys more than the less educated, that older people are more likely to have a parking card than the youth and also that people who live closer to the city are less likely to have a parking card.

Secondly, the data demonstrates that, age, trip purpose, educational level and the travel time significantly affects car drivers' departure time decisions.

Lastly, the data also reveals that, with the knowledge of high parking demand in a city, the old and those travelling for long distances (much travel time) will probably adapt their departure time decisions. It equally shows that car drivers will adapt their departure time decisions for work/study trips due to changes in parking tariff given that they will have to travel longer distances. In this respect, car drivers will probably modify their departure times for work/study trips, when they are travelling long distances than when they are making short trips. This is in line with Steed & Bhat (2000) assertion that, transportation control measures like parking pricing have a significant impact on the departure time decision of travelers for non-work trips. Theses scholars argue that, most non-work trips travelers' prefer shifting their departure time decisions to less congested times of the day because their activities may not be tied to clock time as in the case of work trips. Old people will often adapt their departure time decisions when going for work/study trips due to a change in the walking distance between the parking facility and the final destination.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The aim of this research has been to assess the influence of parking characteristics at the destination on individuals' departure time decisions. The interest has been to investigate the personal and trip characteristics that are influential in such a decision. The list of specified objectives within the study context was to;

- Know the extent to which the parking situation at the destination influences travelers' departure time decisions.
- Investigate the relationship that exist between departure time decisions, personal and trip characteristics of car drivers.
- Examine the personal and trip characteristics which are influential in the adaptation of departure time decision for work/study trips with respect to specified parking characteristics at the destination.

This chapter summarizes the research findings, reveals the limitations of the research, highlights some recommendations and gives further research proposals.

5.2 Summary of findings

The literature review presented in chapter two was very instrumental in answering the first research objective. As a summary of this review, it was clearly realized from many studies that the parking situation at a destination including; occupancy rate, the parking tariff and the walking distance to final destination significantly affect departure time decisions. Apart from these, it was also realized that attitude, intention, habit and situation influences behavior which

may be the departure time decision. In this respect, the level of congestion and parking search time are equally important factors influencing departure time decisions. On a more serious note, the parking situation at a destination is very important in influencing the mode choice, destination choice, route choice as well as the trips generations.

With respect to the personal and trip characteristics that influence departure time decision, the results of using a MNL model, principally the POM revealed that gender, age, trip purpose, and travel time significantly affected individuals' departure time decisions while visit frequency and education were relatively insignificant in determining departure time decisions.

On the other hand, the results of using three MNL models to model the personal and trip characteristics of car drivers influencing their adaptation of departure time decisions were as follows. The results from the first model revealed that, age (elderly) and travel time (longer travel time) has an influence on the adaptation of departure time decisions for work/study trips with respect to high parking demand at the city of Hasselt. Gender, education, trip frequency, visit purpose and home location appeared to insignificantly influence car drivers' adaptation of departure time decision with respect to high parking demand.

The second model revealed that, education (higher education) and travel time (longer travel time) probably affects the adaptation of departure time decisions for work/study trips to the city of Hasselt with respect to the parking tariff.

Finally, the third MNL model that investigated the effects of walking distance between parking facilities and final destination also revealed that, age and education are probable personal characteristics that influence individuals to adapt departure time decisions for work trips to the city of Hasselt. The trip purpose and gender appeared to have no influence on car drivers' adaptation of departure time decisions due to walking distance from parking facilities to the final destinations.

From the empirical study, it appears as if age and education has a significant influence on both departure time decision and the adaptation of departure time decision with respect to parking characteristics while gender probably has little or no influence on departure time decisions.

5.3 Limitations and recommendations

Although this research is solid, it has some limitations and at such, conclusions need to be viewed in terms of a caveat. This is because the conclusion of the study is only based on the

extensive review of related literature and empirical results of the case study. The limitations results from the fact that the research was greatly hampered by the difficulties of finding literature studies pertaining to the study context. Only a few major journals have been written with respect to departure time decisions and the influence of parking characteristics on individuals' adaptation of departure time decisions. Consequently, the research relied on some particular authors like Ettema & Timmermans (2002) and Yamamoto et al. (2000) who had written on this topic. This research is however, appealing to other interested researchers to carry out additional research on this topic. Such empirical data would add further richness to this work and would however, compromise the focus of the research.

Another limitation is the failure to have obtained a reasonable and outstanding response rate from respondents which reflects the population size of the study area. This would have yielded a more qualitative and empirical evaluation that reflects the true behavioral pattern of car drivers' within the study area. The failures to have obtained a sound data was due to the unenthusiastic attitude and the ageing nature of residents within the study area, who probably do not have internet access or any idea on the usage of computers.

Furthermore, since respondents were not actually faced with the true choices of their departure time because of 'directed departure time decisions', this may have distorted their actual desired departure time decisions. However, it is difficult to collect real world data especially as the extent of 'bias' and the ability for mitigation has been the subject of much discussion (Bennett, & Rolfe, 2006; Carlsson, & Martinsson, 2001). For instance, in transportation, the presence of empirical studies on TDM policies like parking policies, offers a counterbalance to claims derived from imaginary data.

Again, surveys are generally subjected to behavioral distortions like; information bias, strategic bias, and survey fatigue. This is supported by the fact that, behavior distortions have long been recognized by behavioral researchers (Himmelfarb, 1993). Normally, a behavioral distortion occurs when an answers provided by respondents do not accurately reflect their genuine intentions, behavior, feelings, belief, or opinions. The motivations for behavioral distortions according to Himmelfarb (1993), actually stems from the fact that, people hide their true responses either to avoid legal prosecutions, project or protect particular identities, protect their privacy, obtained social approval and avoid social disapproval. This research may not have been an exemption, though, the potential effects of these actions, were reduced and mitigated

through a careful design of the questionnaires. However, the ability to collect large sample size and potential information bias hampered these mitigations.

It should be noted that, parking characteristics which have been overlooked are some of the levers available to policy planners to re-orientate the current pattern of urban development and transport system. In this regard, parking characteristics can be described here as 'low hanging fruits' amongst a raft of available options to planners because according to, IHT, (2005); Shoup, (2005); and Valleley, et al. (1997), a well-designed parking policy can contribute to the promotion of a more efficient use of the transport network, low emissions, better and more inclusive urban designed. Poorly designed parking policies can act in the opposite direction, and thus, should not be designed or developed in isolation, but with the understanding of its impacts on individual behaviors (Marsden, 2006). The desire to use parking measures as a means to restrain vehicle traffic, improve environmental quality and or encouraged the use of non-car mode choice are policies worth undertaking because they are probably appropriate potential measures for a strong and vibrant economy.

5.4 Further Research

This research was limited in examining the personal and trip characteristics that influence car drivers' departure time decisions and the adaptation of departure time for work/study trips with respect to specified parking characteristics in the following ways;

Further research could be; to examine the personal and trip characteristics that influence car drivers' adaptation of departure time decision for social/recreation, train connection and shopping trips with respect to parking characteristics at the destination.

Further research can also be carried out to examine the effects of parking policies on peoples' lifestyles. The research objective will not only be limited to specific parking characteristics, but will evaluate changes in peoples' lifestyles as a result of parking policy implementation. This research will examine the connection between lifestyles modeling and the implementation of parking policies in general and will be based on the assessment of changes in lifestyles with respect to specific parking policies.

On a more serious note, since non response may have resulted from the lack of internet access by many potential respondents, it would be interesting to institute both a face to face interview alongside internet-based questionnaire. It will also be necessary not to direct the departure time choices so as to obtain real life information.

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LIST OF APPENDIX

Appendix A: Questions that were part of the questionnaire

1. Current behavior

1 **How often do you visit the centre city of Hasselt as a person or driver?**

☐ Never ☐ Sometimes ☐ Regular ☐ Often

2 **What is the most important purpose of the visit?**

☐ Not applicable ☐ Work/ study ☐ Shopping ☐ Social/ recreation ☐ Connecting Train ☐ Others

3 **How long does it take a car trip from your residence to the city of Hasselt?**

☐ Approximately 10 minute ☐ Approximately 15 minute ☐ Approximately 20 minute ☐ Approximately 25 minute ☐ Approximately 30 minute

4 **Suppose your appointment is at 10:00AM, when do you leave by car?**

☐ Before 8:45AM ☐ Around 8:45AM ☐ Around 9:00AM ☐ Around 9:15AM ☐ Around 9:30AM ☐ Around 9:45AM ☐ After 9:45AM

2. Personal characteristics:

5 **What is your gender and year of birth?**

☐ Male ☐ Female Year of birth:.....

6 **What is your highest educational level?**

☐ Primary education ☐ Lower secondary ☐ Upper secondary ☐ Higher Non university ☐ University ☐ Others

7 **Do you have a car or a vehicle license?**

☐ Yes ☐ No

8 **Do you own a special parking card for the city of Hasselt?**

☐ Yes ☐ No

9 **In which village or city do you live? ……..**

3. Questions on adaptation of departure time.

10 In what amount of uncertainty do next categories of times influence your departure time?

	Never	Sometimes	Regularly	Often
Driving time to a parking facility close to destination	□	□	□	□
Parking space search time	□	□	□	□
Walking time to destination from park	□	□	□	□

11. Do you adapt your departure time due to high demand at parking facilities for each type of trip?

	Never	Sometimes	Regularly	Always	Often
Work/study trips	□	□	□	□	□
Shopping trips	□	□	□	□	□
Social recreational trips	□	□	□	□	□
Train connections	□	□	□	□	□

12. Do you adapt your departure time due to parking tariff for each type of trip?

	Never	Sometimes	Regularly	Always	Often
Work/study trips	□	□	□	□	□
Shopping trips	□	□	□	□	□
Social recreational trips	□	□	□	□	□
Train connections	□	□	□	□	□

13. Do you adapt your departure time due to walking time between car parks & final destination for each type of trip?

	Never	Sometimes	Regularly	Always	Often
Work/study trips	□	□	□	□	□
Shopping trips	□	□	□	□	□
Social recreational trips	□	□	□	□	□
Train connections	□	□	□	□	□

APPENDIX B: LIKELIHOOD RATIO TESTS ON ADAPTATION OF DEPARTURE TIME DECISIONS

B1 Likelihood Ratio tests results on the adaptation of departure time for work/study trips with respect to high parking demand at the centre city of Hasselt.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	237.712	2.897	2	.235
age1	237.269	2.455	2	.293
age2	246.112	11.297	2	.004
Gender	239.079	4.264	2	.119
education1	235.589	.775	2	.679
education2	238.710	3.895	2	.143
education3	240.656	5.841	2	.054
Visit purpose1	235.037	.223	2	.895
Visit purpose2	234.954	.140	2	.933
Travel time1	236.307	1.492	2	.474
Travel time2	241.601	6.787	2	.034
Visit frequency1	237.218	2.404	2	.301
Visit frequency2	237.122	2.307	2	.315

B2 Likelihood Ratio tests results for the adaptation of departure time for work/study trips with respect to the parking tariff at the centre city of Hasselt

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	221.271	.904	2	.636
age1	222.729	2.362	2	.307
age2	223.741	3.373	2	.185
gender	221.167	.799	2	.671
education1	220.895	.528	2	.768
education2	220.725	.358	2	.836
education3	227.795	7.428	2	.024
Visit purpose1	220.394	.026	2	.987
Visit purpose2	225.883	5.515	2	.063
Travel time1	221.196	.829	2	.661
Travel time2	226.393	6.025	2	.049
Visit frequency1	221.019	.651	2	.722
Visit frequency2	223.149	2.782	2	.249

B3 Likelihood Ratio test results for the adaptation of departure time for work/study trips with respect to walking distance between parking facilities and centre city of Hasselt

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	248.103	2.616	2	.270
age1	248.264	2.777	2	.249
age2	249.646	4.159	2	.125
Gender	247.313	1.826	2	.401
education1	252.940	7.453	2	.024
education2	253.438	7.951	2	.019
education3	249.738	4.251	2	.119
Visit purpose1	245.545	.057	2	.972
Visit purpose2	246.560	1.073	2	.585
Travel time1	245.531	.044	2	.978
Travel time2	248.295	2.807	2	.246
Visit frequency1	248.002	2.514	2	.284
Visit frequency2	246.732	1.245	2	.537

Appendix C: Re-coded variables used in SPSS for modeling factors that influence adaptation of departure time decision for work/study trips.

Travel time	**Travel time 1**	**Travel time 2**	
10 minutes	-1	-1	
10-15 minutes	1	0	
20-25 minutes	0	1	
Visit purpose	**Visit purpose1**	**Visit purpose 2**	
Work/study	1	0	
Shopping	0	1	
others	-1	-1	
Education	**Education1**	**Education2**	**Education3**
Primary & others	-1	-1	-1
Secondary	1	0	0
Higher non university	0	1	0
University	0	0	1
Age	**Age1**	**Age2**	
<35 yrs	-1	-1	
35-55 yrs	1	0	
>55 yrs	0	1	
Gender			
Males	-1		
Females	1		
Visit frequency	**Visit frequency1**	**Visit frequency2**	
Never	1	0	
Sometimes	0	1	
Regularly	-1	-1	
Home locations			
Diepenbeek	-1	Surrounding villages around Hasselt	1

Appendix D: SAS codes used on the proportional odds model.

```
proc print data=sasuser.pascal;run;
data atem;
set sasuser.pascal;
rage=2011-age; run;
proc print data=atem; run;
data atem;
set atem;
if rage<35 then cage=1;else
if 36<=rage<=55 then cage=2;else
if rage>55 then cage=3;
if education=3 then educat=1;else
if education=7 then educat=1;else
if education=4 then educat=2;else
if education=5 then educat=3;else
if education=6 then educat=4;
if reden=1 then delete;else
if reden=2 then reden=2;else
if reden=3 then reden=3;else
if reden=4 then reden=4;else
if reden=5 then reden=4;else
if reden=6  then reden=4;
if bezoek=1 then delete;else
if bezoek=2 then bezoek=1;else
if bezoek=3 then bezoek=2;else
if bezoek=4 then bezoek=3;
if rijtijdhasselt=1 then rijtijdhasselt=1;else
if rijtijdhasselt=2 then rijtijdhasselt=2;else
if rijtijdhasselt=3 then rijtijdhasselt=2;else
if rijtijdhasselt=4 then rijtijdhasselt=3;else
if rijtijdhasselt=5 then rijtijdhasselt=3;
```

```
if woonplaats=1 then wnpltscat=1;else
wnpltscat=0; run;
data atem1;
set atem;
if 1<=dep_has<=2 then dephas=1;else
if dep_has=3 then dephas=2;else
if dep_has=4 then dephas=3;else
if dep_has=5 then dephas=4;else
if dep_has=6 then dephas=5;else
if dep_has=7 then dephas=6; run;
 proc print data=atem1;run;
data atem1(drop= id finished age);
set atem1; run;
proc print data=atem1;run;
/*creating histograms of responds variable*/
proc gchart data=atem1;
vbar cage/discrete type=percent; run;
proc gchart data=atem1;
vbar gender/discrete type=percent; run;
proc gchart data=atem1;
vbar educat/discrete type=percent; run;
proc gchart data=atem1;
vbar wnpltscat/discrete type=percent; run;
proc gchart data=atem1;
vbar reden/discrete type=percent; run;
proc gchart data=atem1;
vbar rijtijdhasselt/discrete type=percent; run;
proc gchart data=atem1;
vbar rijbewijs/discrete type=percent; run;
proc gchart data=atem1;
vbar pkaart/discrete type=percent; run;
```

```
proc gchart data=atem1;
vbar Dephas/discrete type=percent; run;
proc gchart data=atem1;
vbar bezoek/discrete type=percent; run;
proc contents data=atem1;run;
proc freq data=atem1;run;

/*proportional odds model, on factors affecting departure time choice to hasselt*/
proc genmod;
class    gender cage educat wnpltscat bezoek reden rijtijdhasselt;
model dephas =gender cage educat wnpltscat bezoek reden rijtijdhasselt  / dist=multinomial
link=clogit lrci type3; run;
```

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The influence of the parking situation at a destination on travelers' departure time decision

Richting: **master in de verkeerskunde-mobiliteitsmanagement**
Jaar: **2012**

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Atemnkeng, Pascal

Datum: **23/08/2012**