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Improving Travel Satisfaction
with Public Transport

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Improving Travel Satisfaction with Public Transport

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Acknowledgements

First and foremost, I would like to thank my supervisors Yusak Susilo and Oded Cats for the opportunity to continue my studies at KTH, for their wise feedback, guidance and their consistent support and understanding.

To my workmates at Teknikringen 10 and 72 that have made my working days better, either at the lunch breaks, in the corridors or outside the office. Special thanks to Chengxi Liu and Joram Langbroek for their close support, feedback and friendship.

To my family.

Stockholm, January 2017

Roberto

Abstract

Continuous urban growth, environmental issues, competition for limited space, longer commuting distances as well as the need to promote equity and equality in society are the primary reasons that make the improvement of public transport (PT) services and the attraction of more travelers to shift from car to PT a key policy area in many countries across the globe.

The existing link between PT travelers' satisfaction, ridership and loyalty prove the relevance of improving overall trip satisfaction. The three papers included in this Licentiate thesis present an array of approaches and methodologies aiming at increasing overall satisfaction with PT door-to-door trips while covering important issues that previous research has failed to address. These knowledge gaps include: disregarding the different needs and priorities of different type of travelers; overlooking the evolution over time and across geographical areas that overall satisfaction and satisfaction with specific service attributes may experience; and, neglecting the importance of access and egress legs.

Based on the Swedish customer satisfaction barometer (Svensk Kollektivtrafik barometer – SKT), an investigation of the determinants of PT satisfaction and their evolution over time for PT users in the years 2001-2013 (Paper I) shows that: a) the deterioration of overall satisfaction with PT in Sweden in recent years is driven by a decrease in satisfaction with customer interface and length of trip time; b) these two service aspects as well as operation are found as key determinants of overall satisfaction which users consistently rate among the least satisfactory.

The diversity of needs and priorities of SKT travelers was reduced into 5 distinctive multi-modal travelers' groups (Paper II). These travelers' groups exhibited geographical disparities and an in between-groups overall similarity in the importance attached to the service attributes. Nevertheless, some noticeable differences could be observed. The service attributes' importance levels reveal overall changes in appreciations and consumption goals over time. The more frequent PT user segments are more satisfied across the board and are characterized by a more balanced distribution of attribute importance whilst one of the groups - rural motorist commuters - are markedly dissatisfied with the service operation attributes.

A number of both normative and heuristic satisfaction aggregation rules are tested on METPEX (A Measurement Tool to determine the quality of the Passenger EXperience) dataset for different types of trip configurations (Paper III). This is done to understand how travelers combine trip leg's satisfaction into an overall evaluation of their trip, and to investigate the relative importance of satisfaction with access, main and egress legs for the whole travel experience of door-to-door trips. The results show that normative rules can better reproduce overall travel satisfaction than heuristic rules, indicating that all trip legs need to be considered when evaluating the overall travel experience. In particular, weighting satisfaction with individual trip legs with perceived trip leg durations yield the best predictor of overall travel satisfaction, especially when applying a penalty for each waiting time of 3 or 4 times in-vehicle or walking time.

This set of papers would help authorities to better evaluate and cater for travelers' needs by supporting the allocation of resources and prioritization of measures in the most impactful part of the door-to-door trip.

Sammanfattning

Kontinuerlig urban tillväxt, miljöproblem, konkurrens om begränsat utrymme, längre pendlingsavstånd samt behovet av att främja rättvisa och jämlikhet i samhället är de främsta anledningarna till förbättringar av kollektivtrafikens (KT) tjänster och attraktionskraft för att få fler resenärer att byta från bil till KT och därmed en viktig politisk fråga i många länder över hela världen.

Den befintliga kopplingen mellan KT-resenärens tillfredsställelse, antalet passagerare och lojalitet visar betydelsen av att förbättra resans övergripande tillfredsställelse. De tre artiklar som ingår i denna licentiatavhandling presenterar en rad tillvägagångssätt och metoder som syftar till att öka den totala tillfredsställelsen med KT i "från dörr till dörr"-resor samt täcker viktiga frågor som tidigare forskning har misslyckats med att ta itu med. Dessa kunskapsluckor inkluderar de olika behov och prioriteringar som olika typer av resenärer har, utveckling över tid och över geografiska områden som total tillfredsställelse och tillfredsställelse med specifika serviceattribut kan påverkas av samt försummelsen av resans av- och påstigningsdelar.

Baserat på den svenska kundtillfredsställelsebarometern Svensk Kollektivtrafikbarometer (SKT) visar en undersökning av bestämningsfaktorerna för KT-tillfredsställelse och deras utveckling över tiden för KT-användare under åren 2001-2013 att (Artikel I): a) det skett en försämring av den sammanlagda tillfredsställelsen med KT i Sverige under de senaste åren som drivits av en minskning av tillfredsställelsen med kundgränssnittet och resans tid; b) att dessa två serviceaspekter samt drift är helt avgörande för övergripande tillfredsställelse och som resenärer konsekvent graderar bland de minst tillfredsställande.

Mångfalden av behov och prioriteringar för SKT-resenärer reducerades till 5 distinkta multimodala resenärsgrupper (Artikel II). Dessa resenärsgrupper uppvisade geografiska skillnader och en i mellan-grupper övergripande likhet i vikt som fästs vid serviceattribut. Likväl kan några märkbara skillnader observeras. Serviceattributens betydelse avslöjar övergripande förändringar i uppskattnings- och konsumtionsmål över tid. De mer frekventa KT-användarsegmenten är mer nöjda över hela spektret och kännetecknas av en mer balanserad fördelning av attributens betydelse, medan en av grupperna – bilpendlare på landsbygden - är markant missnöjda med service- och driftattribut.

Ett antal både normativa och heuristiska regler för aggregerad tillfredsställelse testas på METPEX-data (A Measurement Tool to determine the quality of the Passenger EXperience) för olika typer av resekonfigurationer (Artikel III). Detta görs för att förstå hur resenärer kombinerar delresors tillfredsställelse i en övergripande utvärdering av hela resan och för att undersöka den relativa betydelsen av tillfredsställelse med påstignings-, huvud- och avstigningsdel för hela reseupplevelsen i "från dörr till dörr"-resor. Resultaten visar att normativa regler bättre kan återge övergripande resetillfredsställelse än heuristiska regler, vilket tyder på att alla resans delar måste beaktas när man utvärderar den samlade reseupplevelsen. I synnerhet ger viktning av tillfredsställelse med individuella delresor och de upplevda delresornas restider den bästa predikatorn för övergripande resetillfredsställelse, särskilt vid tillämpning av en väntetidsvikt på 3 eller 4 gånger i fordons- eller gångtid.

Denna uppsättning artiklar skulle kunna hjälpa myndigheter att bättre utvärdera och tillgodose resenärernas behov genom att stödja tilldelning av resurser och prioriterandet av åtgärder i den mest effektfulla delen i en "från dörr till dörr"-resa.

Resumen

El rápido crecimiento urbano, problemas medioambientales, la competencia por el uso de espacios cada vez más limitados, el aumento de la distancia en los viajes pendulares así como la necesidad de fomentar una sociedad más equitativa e igualitaria, son algunas de las principales razones que hacen de la mejora de los servicios de transporte público (TP) y del trasvase de usuarios del transporte privado motorizado al TP una política clave en muchos países del mundo.

La relación existente entre la mejora de la satisfacción del usuario de TP con el incremento de usuarios y de su fidelidad, prueban la importancia de mejorar la satisfacción global del usuario con el viaje. Los tres artículos incluidos en esta tesis de mitad de doctorado, en Suecia *Licentiate thesis*, presentan un variedad de enfoques y métodos que tienen como objetivo incrementar la satisfacción global con los viajes de puerta a puerta (desde el origen hasta el destino final) en los que el transporte público está involucrado, a la par de cubrir cuestiones importantes que no han abordado estudios previos. Estas lagunas de conocimientos incluyen: ignorar las distintas prioridades y necesidades de distintos tipos de viajeros; pasar por alto que tanto la satisfacción global con el viaje como la satisfacción con los atributos específicos del servicio pueden experimentar cambios a lo largo del tiempo y entre diversas zonas geográficas; y, el obviar la importancia que otras etapas del viaje (acceso y egreso), diferentes a la principal, pueden ejercer sobre la valoración global del viaje.

Basado en el barómetro sueco de satisfacción del usuario de transporte público (SKT), se estudian los determinantes de la satisfacción con el TP y su evolución temporal, para usuarios de TP y para el período 2001-2013 (Artículo I). El artículo muestra que: a) el deterioro de la satisfacción global con el TP sueco experimentado en los últimos años se debe a la disminución de la satisfacción con el modo en el que la agencia de TP gestiona las quejas y el trato con los usuarios (*customer interface*), y de la duración del viaje (*length of trip time*); b) frecuencia y la fiabilidad del servicio (*operation*) se suman a los dos ya mencionados atributos del servicio como factores determinantes de la satisfacción global con el TP. Son precisamente estos tres atributos los que consistentemente reciben unas valoraciones situadas entre las menos satisfactorias.

Basándose en las características de tipo socio-económico, en las del viaje y en coeficientes de accesibilidad, se obtienen cinco grupos de viajeros multimodales relativamente homogéneos, los cuales ayudan a simplificar la complejidad existente, en términos de necesidades y prioridades, de todos los viajeros suecos - SKT (Artículo II). Los cinco grupos de viajeros exhiben disparidades geográficas y, en general, una semejanza entre grupos en la importancia atribuida a los atributos del servicio. Sin embargo, existen algunas diferencias notorias. A lo largo del tiempo, los niveles de importancia de los atributos del servicio revelan cambios generales en las apreciaciones y objetivos de consumo. Los grupos de viajeros que viajan más frecuentemente con transporte público están, de forma generalizada, más satisfechos con el viaje y muestran una distribución más equilibrada de la importancia dada a los atributos del servicio. Se hace destacable la marcada insatisfacción que uno de los grupos − los automovilistas rurales pendulares (*rural motorist commuters*)- muestran con los atributos relacionados con la operación (fiabilidad y frequencia).

Una serie de reglas de agregación de la satisfacción del viajero, tanto normativas como heurísticas, son examinadas en el conjunto de datos de METPEX (Una herramienta de medición para determinar la calidad de la experiencia del viajero) para distintos tipos de configuraciones de viaje (Artículo III). El objetivo de este artículo es; entender como los viajeros combinan la satisfacción con cada una de las etapas del viaje en su valoración global del viaje, e investigar la importancia relativa que cada una de las tres etapas del viaje (acceso,

principal y egreso) tienen sobre la experiencia de un viaje completo de puerta a puerta. Los resultados muestran que, en comparación con las reglas heurísticas, las reglas normativas pueden reproducir de una mejor manera la satisfacción global con el viaje; indicando que todas las etapas del viaje necesitan ser consideradas cuando se evalúa la experiencia global del viaje. En particular la ponderación de la satisfacción con cada una de los segmentos del viaje[1] con la duración percibida para cada una de los segmentos del viaje produce el mejor indicador de la satisfacción global del viaje, especialmente cuando se aplica una penalización por cada minuto de espera equivalente a 3 o 4 veces el tiempo en movimiento y/o caminando.

Éste conjunto de artículos pretende ayudar a las operadores y autoridades pertinentes a evaluar y proveer de la mejor manera posible las necesidades de los viajeros mediante la priorización de medidas y asignación de recursos a la parte más relevante del viaje multimodal puerta a puerta.

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[1] Un segmento del viaje (trip leg) es la parte más pequeña en la que se descompone un viaje de puerta a puerta. Una etapa del viaje puede estar compuesta de uno o más segmentos del viaje.

Included papers

I. Cats, O., Abenoza, R., Liu, C. and Susilo, Y. Evolution of Satisfaction with Public Transport and Its Determinants in Sweden: Identifying Priority Areas. In *Transportation Research Record: Journal of the Transportation Research Board,* No. 2538, Transportation Research Board of the National Academies, Washington, D.C., 2015, pp. 86-95.

Presented at National Conference in Transport Research, Norrköping, Sweden, October 21-22nd, 2014.

Presented at TransportForum, Linköping, Sweden, January 8-9th, 2015

II. Abenoza R.F., Cats O. and Susilo Y.O. Travel satisfaction with public transport: determinants, user classes, regional disparities and their evolution. Transportation Research Part A: Policy and Practice. Vol. 95, 2017, pp. 64-84.

Presented at the National Conference in Transport Research, Karlstad, Sweden, October 21-22nd, 2015.

III. Abenoza R.F., Cats O. and Susilo Y.O. How does travel satisfaction sum up? Decomposing the door-to-door experience for multimodal trips**.**

Presented at the National Conference in Transport Research, Lund, Sweden, October 18-19th, 2016.

Submitted for presentation to NECTAR Conference, Madrid, Spain, May 31-June 1st, 2017

Submitted for publication to Transportation Research Part A.

Other related papers

Ettema, D.F., Abenoza R.F. and Susilo, Y.O. Satisfaction with intermodal trips in Stockholm: How do service attributes influence satisfaction with the main mode and with the journey as a whole?, The 95th Annual Meeting of Transportation Research Board, Washington DC, 2016, USA.

Declaration of contribution

I. In paper I, Roberto F. Abenoza was mainly responsible in performing the large majority of the analyses; in the preparation of figures, tables and maps and in writing the first draft of chapter 4.

II. In paper II, Roberto F. Abenoza was responsible for the majority of the work in all of it stages.

III. In paper III, Roberto F. Abenoza was responsible for the majority of the work in all of it stages.

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1. Introduction

In today's world, people need to travel. They need to move from one place to another to carry out a wide range of activities. These may include compulsory and non-compulsory activities such as working, studying, doing the grocery, meeting friends and family or performing some leisure.

This travel need, in conjunction with continuous urban and population growth and increasing travel distances, may entail a large pressure on the transport infrastructure and, if inappropriately handled, may constrain local and regional economies. These issues might arise as the result of land consumption, strong competition for limited and central spaces, deterred travels, longer travel times, traffic congestion, parking difficulties, more energy consumption or air and noise pollution (Greene and Wegener, 1997). For example, it is estimated that congestion problems are a sheer economic burden worldwide representing a 2% of the GDP in Europe and a 2-5% in Asia (MSTfD, 2014). In addition, air pollution costs, due to illness and premature deaths, are estimated to be 3.5 trillion US $ annually in the 35 OECD countries plus China and India (MSTfD, 2014). Furthermore, in developed societies, there is a growing need to achieve a healthier lifestyle, where active modes such as walking and cycling are the best exponent. Frequently, active modes are a component of multi-modal Public Transport (PT) trips and thus PT trips involve a higher physical activity than private motorised modes. An additional concern in todays' world is road safety. Here again, PT modes cause considerably less fatalities per billion kilometers traveled than that caused by private motorised and active modes (Savage, 2013). Moreover, PT has the potential to be socially equalitarian since it can provide transport for all and thus it does not exclude the young, the elderly, students, low income and disabled travelers from traveling (Holmgren, 2007).

For all the above reasons, increasing PT ridership or simply promoting it has become a priority at different geographical levels. At a global scale, in 2014, the United Nations established that sustainable transport is one of the fundamental pillars to accomplish the goals set in their 2030 agenda for sustainable development. This agenda consists of 17 sustainable development goals which are directly or indirectly related to sustainable transport via targets and indicators. Some of the recommended measures to achieve sustainable transport are connected with promoting and improving PT. At an international level, in 2009, the International Association of Public Transport (UITP) set the goal of doubling the market share of PT worldwide by 2025. UITP's high ambitious goal would mean to almost double 2012 PT shares of the developed (39%) and developing cities (23%). At a continental scale, in 2011, the EU set out a White Paper with a more realistic goal of doubling PT use in urban areas by 2030. Finally, a national effort, "the Swedish doubling project", a project which aims to double 2006 swedish PT market share (18%) by 2020 proves the importance given to PT.

PT authorities and operators are interested in increasing ridership and travelers' satisfaction. Their level of interest depends on the modality of contracts (eg. managerial, gross or net contracts) signed between both entities. Bonus and malus are applied to incentivize the operator to keep high service standards. The incentives are applied to meet specific targets such as revenue, patronage or quality incentives. These quality incentives include fulfilling overall satisfaction targets or meeting specific service performance measures levels.

Increasing PT ridership might be attained by means of offering a PT service that fulfills travelers' needs, and that in addition is affordable and accessible. However, improving, enhancing and extending PT comes with a cost. PT investments are usually expensive and are made with public funds. Therefore, given limited resources, it is essential to identify the main

service elements and attributes that can increase ridership. These service attributes are denominated quality of service attributes (QoSA) and are believed to influence overall travel satisfaction. There is a general agreement that an increase in overall satisfaction leads to an increase in customer loyalty, which can result in customer retention and ridership increase (eg. Cervero, 2000; Syed and Khan, 2000). Therefore, in order to prioritize the most effective measures and policies to increase ridership, this work aims to investigate the determinants and parts of the trip that influence the most overall satisfaction with PT.

Determinants of travel satisfaction may vary not only among individuals but also between different geographical regions and over long time periods. Since individuals are capable of learning and adapting over time, their appreciation towards service provision may also change over time. In addition, factors such as urban form, transport accessibility and climate also impact individual travel needs (Liu et al., 2014). Thus, it is of the utmost importance to understand how satisfaction with regard to specific service indicators evolves over time and varies among geographical contexts (Paper I).

In addition, identifying users' priority areas will help stakeholders to prioritise their investment (Paper II). This is especially important for making PT more attractive to specific target groups such as travelers who do not use PT frequently. Evidence-based knowledge on such patterns will facilitate the planning and operations of PT services to better tailor them to travelers' needs. This would help the authorities to concentrate their policies on a manageable group of travelers, rather than performing market segmentation based on numerous combinations of traveler groups' socio-demographic and external characteristics. Moreover, benchmarking similar geographical regions through the comparison of their perceived performance may allow regional stakeholders to transfer best practices.

Understanding how satisfaction with individual trip legs aggregates to the overall travel experience for different types of trips (Paper III) will enable to identify which particular trip segment(s) need(s) to be improved. Therefore, it will allow practitioners to better evaluate and cater for travelers' needs by supporting the allocation of resources and prioritization of measures. In addition, Paper III will allow making a more fair assessment of PT operators' role in contributing to travel satisfaction when different stages of the trip are provided by different operators.

This study will connect earlier research of the variables that increase overall travel satisfaction and will expand its focus by studying different related and interconnected aspects that previous research and market have overlooked. The identified knowledge gaps are related to the evolution over time of determinants of travel satisfaction (Paper I) and of service attribute specific satisfaction (Paper II); with the variability of satisfaction across different geographical areas (Paper II); with the investigation of different segments of travelers' needs (Paper II); and with the study of the most relevant part of the trip for different types of door-to-door trip (Paper III).

This licentiate cover essay consists of 7 sections. Section 1, introduction, presented background to the topic, briefly mentioned the main thesis's objectives and presented the main assumptions used in this licentiate thesis. A literature review of the state-of-the-art research in travel satisfaction with PT services is given in Section 2. This is followed by the in-depth presentation of both; the general and the paper-specific objectives of this thesis, Section 3. Data and methodology are included in the following section, Section 4. Section 5 includes the results of the articles for the work described in this cover essay. Section, 6 discusses the more remarkable aspects. The final section, Section 7, concludes the thesis, discusses the usefulness

of the proposed methods and gives an outlook into the future. The articles that are published and under review are appended at the end.

2. Previous research

The present section aims to describe the state-of-the art in traveler satisfaction, to define key terms and concepts and to show that this research project is founded in well-grounded theory and methods.

2.1. Service quality – Customer satisfaction and its components

It is widely believed that Service quality is the outcome of comparing customer expectations with perceptions of the actual service performance (eg. Parasuraman et al., 1985). Customer satisfaction, in turn, can be defined as the overall level of fulfilment with customers' expectations (Tyrinopoulos and Antoniou, 2008) and as the outcome of cumulative and single-experience encounters. The main difference between service quality and customer satisfaction is that in the former judgments are more specific and cognitive-wise whereas in the latter, judgments are more holistic and affective-wise (Oliver, 1997). Despite the fact that some authors have argued about their differences; in practice both terms are used interchangeably, and this is how these terms are treated in this thesis.

Hensher et al. (2003) argued that although travelers may perceive specific aspects of service quality as either positive or negative, it can be assumed that the overall level of travel satisfaction is best measured by how an individual evaluates the total package of services offered. This service offered, or Quality of Service Attributes (QoSA), refer to a set of instrumental measures which characterize and describe the perceived quality of the PT service. However, some of these service aspects are expected to be more important than others. The importance attached to various service attributes can be measured using stated preference surveys (which ask people how much they value a particular feature) and revealed preference studies (which evaluate the choices people actually make when facing trade-offs between various attributes). In addition, service attributes' importance can be obtained directly or can be derived through a large number of statistical methods (De Oña and De Oña, 2014). Previous studies have shown that direct service attribute's importance ratings are poor at determining the more relevant service attributes in a model (eg. Gustafsson and Johnson, 2004). For the latter, the determinants of overall travel satisfaction are derived through statistical analyses (Papers I and II).

Similarly, overall travel satisfaction can be obtained directly ("How satisfied are you with PT services?") or indirectly by deriving an overall satisfaction measure. There are different models that can derive an overall travel satisfaction index. ServQual (Parasuraman et al., 1985) is one of the earliest and most well-known models. This is in short a model that defines service quality as the difference between expectations and perceptions so that marketing efforts can be addressed to closing this gap. Variations of ServQual include ServPerf (eg. Cronin and Taylor, 1994) and other indexes based on different methods and theories such as the service quality index (Hensher and Prioni, 2002) or the customer satisfaction index (Hill et al., 2003). At a national level, there are important analytical tools to calculate a customer satisfaction index and to find out which are the most relevant attributes of satisfaction (eg. American customer satisfaction index or European customer satisfaction index - ECSI).

2.2. Customer satisfaction surveys and their variables

Measuring the service quality in PT can be done by means of customer satisfaction surveys or performance measurements. Customer satisfaction surveys can be collected retrospectively or in real-time; can be carried out in different environments (ie: on-board, at stations, on the phone) and through different methods (ie: web-online, paper and pencil, smartphone apps, focus groups). Quality performance measurements are in turn collected via mystery shopping surveys and direct performance measurements. Customer satisfaction surveys can be composed of perception and expectation of overall travel satisfaction and of specific QoSAs. In addition, there are some other instrumental and non-instrumental variables that can be frequently found including: socio-demographic, travel characteristics and travel attitudes.

Measurement of PT travel satisfaction can embrace a broad range of QoSA. Previous research has investigated the set of key QoSA that better explain overall travel satisfaction. The European Committee for Standardization (ECS), for example, provided a widely used categorization of QoSAs that influence on travel satisfaction (CEN, 2002). This categorization is presented in a standardized norm, EN 13816:2002, which contains a catalog of 8 quality criteria: availability, accessibility, information, time, customer care, comfort, security and environmental impact. Each of these quality criteria is made up of a series of general QoSA which include, in turn, a number of more specific QoSA. For instance, the general QoSA *customer interface*, includes satisfaction with how enquiries are handled and with how complaints are handled. The QoSAs employed in Papers I and II represent almost[1] all the aforementioned quality criteria.

2.3. Determinants of overall travel satisfaction

Understanding the factors that lie beneath travelers' satisfaction and how they relate with service performance and different improvements (Nathanail, 2007) is a key issue for stakeholders and transport authorities when aiming to attract both existing and potential users. By factors we refer to the QoSAs that influence the most the overall travel experience.

A large number of studies (eg. Eboli and Mazzulla, 2012; Brons et al., 2009) argued that functional attributes (e.g. *frequency* and *reliability*) are the QoSAs that influence the most overall satisfaction. Others (Stradling et al., 2007) included a different set of service attributes: *ticketing arrangements*, *safety information* and *cleanliness*. Weinstein's study (2000) added to Stradling's list *accessibility*, *on-board design* and *ride comfort*. Information related attributes (*pre, on-route* and *on-board information*) and the design of station and interchange points were found to be a key determinant of satisfaction by other scholars (eg. Hernandez et al., 2016; Eboli and Mazzula, 2012). However, Iseki and Taylor (2008) found that it was much more relevant to reduce waiting times and to improve service reliability than dealing with infrastructure issues.

2.3.1. Elements impacting on overall travel satisfaction

Trip and socio-demographic characteristics are believed to influence on the overall trip evaluation. Trips made by soft modes (walking and cycling), as the main mode, have consistently been found (Friman et al., 2013; Paez and Whalen, 2010) to obtain higher overall evaluations than those made by car, and much higher than those made by PT. Nevertheless, all PT modes are not equally regarded. Some studies indicate that bus travelers (Mouwen, 2015;

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[1] With the exception of environmental impact.

Bordagaray et al., 2014) are the most satisfied while others demonstrate that rail and light rail (Ory and Mokhtarian, 2005; Beirao and Cabral, 2007) users are the ones with the highest travel evaluations.

Trip duration and travel distance have been reported to negatively influence the overall level of travel satisfaction (Ory and Mokhtarian, 2005; Cantwell et al., 2009). But, as Susilo et al. (2012) stated it is not only nominal travel time that counts but also how travelers´ perceive it.

In addition, some authors hypothesize that overall travel satisfaction is related to social well-being and thus since well-being is larger for younger and elderly these groups would have a larger satisfaction (Ettema et al., 2010). The previous statement was also proved by Van't Hart (2012) when ascertaining that travelers over 65 were amongst the most satisfied.

2.3.2. Elements influencing the determinants of overall travel satisfaction

According to the literature, travelers' needs are highly influenced by travelers' characteristics, car availability, travel characteristics and travel attitudes. For example, Dell'Olio et al, (2011) proved that *ride comfort* has a much higher importance for the elderly than for any other age group. Gender influence was confirmed by Yavuz and Welch (2010) when they found that women feel less secure (*freedom from crime*) and give more relevance to information. Concurring with the latter, Dell'Olio et al. (2011) found that cleanliness of PT was more highly valued by women.

2.3.3. Travelers' Segmentation

Market segmentation techniques help in the investigation the heterogeneity in travelers' evaluation of PT services. There is a wide range of stratification techniques (ie: decision tree algorithms, cluster analysis) and many types of variables that can be used as segmenting variables. The stratification in previous studies has been based on: travel habits and preferences (Krizek and El-Geneidy, 2007), socio-demographic and trip characteristics (Bhat, 1997; De Oña et al., 2014), travel attitudes and socio-demographics (Shiftan et al., 2008), trip characteristics, satisfaction and trip practicality (Jaques et al., 2009) and on travel attitudes (Anable, 2005; Beirao and Cabral, 2008).

To the author's knowledge there is only a single study that goes a step further and investigates the determinants of travel satisfaction for each travelers' group (De Oña et al., 2016). Their analysis is based on cross-correlations and shows that middle aged women have a higher preference for a more frequent service while young students' relative importance is higher with *punctuality*.

2.3.4. Overall travel satisfaction and service attribute over time and across regions

In spite of the importance of the foregoing results, it is essential to bear in mind that reported satisfactions are subject to personal expectations and therefore may continuously change over time. For instance, service attributes that are perceived to be modern and fashionable, such as low-floor vehicles, internet access on-board and real-time information displays, may become prominent, and taken for granted over time (Kano et al., 1984; Diana, 2008; Susilo et al., 2012).

Travel satisfaction and its determinants change from region to region. There is a disparity in overall satisfaction levels depending on the urban area/community size and on the socio-demographic profile (Friman and Fellesson, 2009). Furthermore, other geographical

factors as well as differences in PT service and infrastructure, culture and tradition, may influence overall travel satisfaction (Fellesson and Friman, 2008).

2.4. Aggregation of experiences

Several authors point out that all trip legs, as part of a multi-episodic experience, are believed to contribute to the overall trip experience (Susilo and Cats, 2014; Ettema et al., 2016). Almost all previous studies investigated the aggregation of retrospective multi-episodic experiences in a domain different than transport. In general, their results point out that heuristic rules (peak, peak-and-end, serial position) were superior in explaining the aggregation of experiences than normative rules (equal average, moving duration weighted, complex duration weighted). The only investigation in the transport field found that that the overall trip satisfaction of commuters can be modelled as a weighted average of the satisfaction with individual legs, where legs were weighted by their respective duration (Suzuki et al., 2014).

2.4.1. Multi-modal door-to-door trips

A trip can be defined as a continuous sequence of legs from an origin to a destination and with a single main purpose (Axhausen, 2007). A trip leg is a continuous movement with one mode of transport which includes any waiting times immediately before or during that movement. Waiting times include any transferring times. Thus, multi-modal door-to-door trips have an origin and a destination, consist of two or more trip legs of which one is identified as the main trip leg, and at least one as an access or egress leg.

2.5. Theoretical models

Travelers' satisfaction is the main central concept of this thesis. Barsky (1992) postulates that the best two theories that explain travelers' (customer's) satisfaction are disconfirmation paradigm and expectancy-value concept. The latter theory explains that a person's behavior is a function of the value given to a goal and the expectations to achieve that goal (Fishbein and Ajzen, 1975). The disconfirmation paradigm includes five components: expectations, perceived performance, confirmation/ disconfirmation of beliefs, satisfaction and repurchase intentions (Oliver, 1980). This model postulates that travelers' satisfaction is a function of expectations with the service and the perceived performance of the service (QoSA). Expectations and perceptions result in either disconfirmation, when the perception exceeds expectations, or confirmation of belief when the perceptions of the service underperform expectations (Figure 1).
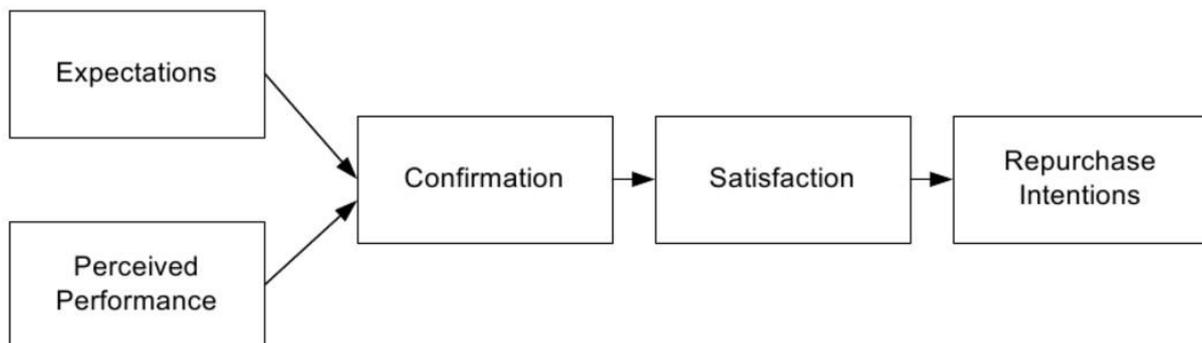
Figure 1: Expectation-disconformation theory

A very well-known theory is the satisfaction gap theory. This theory conceptualized by Parasuraman (1985) explains the factors affecting service quality based on a series of gap between marketer and consumer. The relevant gap for this thesis is the gap between expected service and experience service.

The next conceptual model best summarizes the large amount of aspects that influence overall travel satisfaction. This is a personal adaption of the European Customer Satisfaction Index - ECSI (Figure 2) that shows a number of components, called drivers of satisfaction that influence and explain customer satisfaction. These components include:

- Image, linked with customers' perception of the company running the service, but also to the perception of the whole PT service or of the one particular mode. Mass-media and hearsay may influence it;

- Customer expectations, related to the forejudgment of the service made by the customer and in part based on prior experiences;

- Perceived quality of product, it entails the quality of the product itself (i.e.: *frequency* and *length of trip*) and;

- Perceived quality of the service, it involves services that are provided around the product (i.e.: customer service and travel guarantee).

A fifth element that affects satisfaction is the price-quality relationship which is a function of the expectations placed in the product and its quality. PT service consumption, reflected through the optic of the customer satisfaction index (overall travel satisfaction), will eventually result in either positive or negative effects. Positive effects may lead to customer retention, recommendation of the service and greater price elasticity; while the negative effects may result in customer losses, use discouragement and less price tolerance.
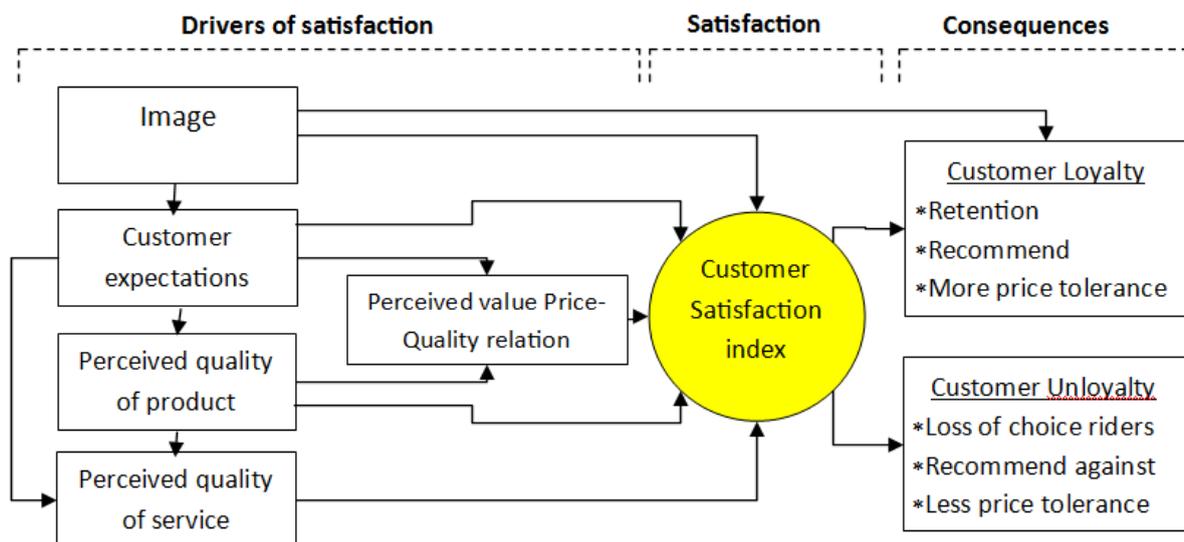
Figure 2: Personal adaptation of ECSI customer satisfaction model

Customer loyalty is considered a product of customer satisfaction (Lai et al, 2009) and can be defined as customer attitude encompassing repurchase and recommendation intentions (eg. Zeithaml et al, 1996). Previous empirical studies carried out in different industries proved that there is a positive influence of customer satisfaction on customer loyalty (Lai and Chen, 2010).

2.5.1 Thesis's conceptual model

A number of conceptual relations and empirical findings found in the literature review were used to construct the conceptual model for this thesis.
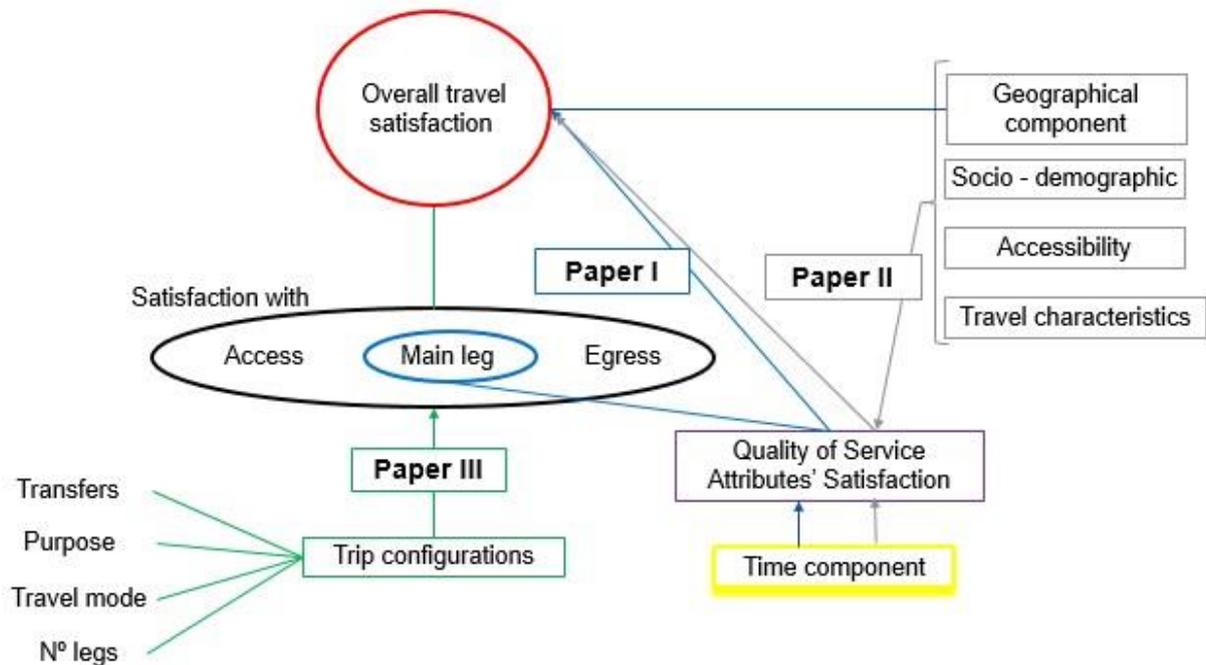

Figure 3: Thesis' conceptual model

Therefore, this thesis's conceptual model includes the following. In Paper I, the main determinants of overall travel satisfaction are investigated. The determinants are quality of service attributes (QoSA) and are related to the main trip leg. The evolution over time of the determinants of overall travel satisfaction is also studied. In Paper II, the impact that travel characteristics, socio-demographics and accessibility measures seem to have on overall travel satisfaction and on QoSAs is investigated. In addition, the geographical variation of overall travel satisfaction and of the QoSA are studied. In Paper III, the influence on overall travel satisfaction of the different trip legs and stages is investigated for door-to-door trips. Finally, given that trip characteristics (trip configurations) have been seen to influence on overall travel satisfaction it also covers the relative weight of the legs for different trip configurations.

3. Objectives

In the first section we have seen that increasing PT use has a number of positive implications on environment, health, congestion and social equality amongst others. In addition, various studies indicate that traveling can have negative effects on human well-being such as carrying over to work or home stress derived from commuting (Novaco and Gonzales, 2009) or annoyances experienced in PT (Friman and Gärling, 2001).

Given the relation between ridership and overall satisfaction, the overarching aim of this thesis is to gain a better understanding of the latter so stakeholders can adopt the right measures to increase it. Gaining a better insight on overall travel satisfaction is done by investigating their

determinants and investigating which part of the trip exerts a larger influence on overall satisfaction.

Achieving this goal is not an easy task, not only because of the fierce competition of private motorised vehicles but also due to the inherent complexity of multi-modal door-to-door trips and the difficulties that entail dealing with different profile of travelers who use distinct travel modes and live in diverse geographical areas. Previous research showed that different travelers have different needs and priorities and that these are influenced by the characteristics of the main mode (e.g. Mouwen, 2015; Ettema et al., 2010). In addition, these needs may vary over time reflecting changes in travelers' expectations.

In light of all the aforementioned and in order to fulfil our objective, this research project should not solely consider an average traveler at a single moment in time and single geographical location, but study a combination of them. This is why is studied first in this thesis the QoSAs that influence the most overall travel satisfaction (determinants) for PT users (Paper I). The project continues by investigating the determinants of travel satisfaction for different travelers' segments without forgetting the temporal component and analysing the geographical dissimilarities (Paper II). These travelers' segments are coherent based on socio-demographic, travel characteristics and accessibility measures. In the final part of this thesis it is explored whether generally overlooked parts of door-to-door trip (access and egress legs) influence overall satisfaction and thus whether they are of relevance to improve the travelers' experience (Paper III). The investigation is done for different trip configurations which are classified in regard of their purpose, presence of transfers, trip complexity and their travel modes.

Specifically, the main research questions (RQ) that this thesis covers are:

RQ1) Which are the main determinants of PT satisfaction? (Paper I);

RQ 2) Do these determinants remain stable over time? (Paper I);

RQ 3) How many and which are the market segments that travelers can be classified into? (Paper II);

RQ 4) Which are the main determinants of satisfaction with PT for the different market segments? (Paper II);

RQ 5) Does the importance of QoSAs change over time for each travelers' segment? (Paper II);

RQ 6) Does overall satisfaction vary for different geographical regions? (Paper II);

RQ 7) How do travelers combine their retrospective door-to-door travel experiences? (Paper III);

RQ 8) For different trips configurations, What is the relative importance of satisfaction with access, main and egress legs on the whole travel experience? (Paper III).

This thesis aspires to provide an answer to the set of interwoven research questions aforestated. To achieve this objective different methodologies and rich datasets in terms of sample size, geographical diversity and time span are used.

4. Data

To achieve this thesis's goals, we employ two main types of data, core and ancillary data. Core data, is the principal source of data which includes all sort of variables used to carry out the main analyses. The core data sources come from Swedish Public Transport Association –SKT - (Paper I and II), Transport Analysis (Paper II) and METPEX (Paper III). Ancillary data sources have different purposes which include the identification of the samples, the application of weights and the evaluation and characterization of sample groups. The sources providing this sort of data include Sweden Statistics – SCB - (Papers I, II and III), Geonames and *Trafikanalys* (Paper II).

SKT (*Svensk Kollektivtrafik*), a trade organization representing the regional PT agencies of the 21 Swedish counties, conducts since 2001 a rolling survey aimed to monitor developments in the PT market. Respondents are telephone interviewed on a regular basis year-round. The results of the survey are summarized annually into a 'Swedish Public Transport Barometer' (SPTB) which provides an overview of satisfaction and attitudes towards PT across Sweden. In each of the papers including this dataset we used the SPTB datasets available at every moment, and thus the timeframes spanned from 2001 to 2013 (Paper I) and from 2001 to 2014 (Paper II). In Papers I and II, the common set of variables comprised; overall travel satisfaction and satisfaction with the 12 quality of service attributes (QoSAs) available throughout the corresponding time-spans. The scale of measurement was Likert-scale from 1-Very dissatisfied to 5-Very satisfied. Besides the common set of dependent and independent variables included in the models, a combination of socio-economic and travel characteristics variables (gender, age, occupation, driving license, car availability, frequency of travel by PT and by car, distance to work/school) were included in descriptive statistics (Paper I and II), correlation analyses (Paper I) and segmenting analysis (Paper II).

The dataset employed in Paper III, METPEX trial survey, was obtained from METPEX (A Measurement Tool to determine the quality of the Passenger EXperience), and FP7 EU project which aimed to develop a Pan-European standardised measurement tool to measure travelers' experience across door-to-door trips. This dataset was collected in 2013, through retrospective and on-site surveys, in 8 different European cities (ie: Stockholm, Bucharest or Dublin). The questionnaire was designed to address the entire door-to-door trip and different travel modes, and thus facilitate the analysis of overall travel satisfaction and how it varies as a function of the satisfaction with individual attributes, travel characteristics, trip legs and service factors. The set of variables included in the main analysis of Paper III were overall satisfaction with the entire journey; satisfaction with each of the trip legs; both perceived and expected moving and waiting travel times; trip purposes and transport modes. Additionally, some other socio-economic variables were used to characterise the dataset.

SCB data was utilized for different purposes. It was used to assign proportional weights on year-specific ratios between both county and gender in the SPTB sample when compared with the general population based on SCB (Paper I and II). In addition, the 5 geographical regions of Papers I and II were based on density of population at a county level and a unit of urban continuum (*tätort*) was employed in cross-correlation analysis.

Transport analysis (*Trafikanalys*), a governmental agency responsible for transport analysis policy, is the data source for the proximity and accessibility measures for year 2011 used in the segmentation process of Paper II.

Finally, a worldwide geographical database, Geonames, is used in Paper II to link, through postcode numbers, individual samples from SPTB to accessibility measures from *Trafikanalys* and municipalities.

In brief, the methodology employed in this thesis includes a set of statistical and multivariate analysis techniques containing: descriptive statistics, correlation analysis, principal component analysis, cluster analysis, ordered logit models and the estimation of marginal effects.

5. Contribution of this thesis. The papers

As a result of the methodologies adopted and the rich datasets analyzed, a number of interesting results were obtained in all three papers. These results are unique amongst the current literature in that they add a very often disregarded, temporal component on travel satisfaction studies, but also in that they employ a well-grounded methodology to investigate the main stages of multi-modal door-to-door trips. The main results are presented in the following sub-sections.

5.1 Results of paper I

Using time-series data from SPTB (2001-2013), Paper I analyzed how users' satisfaction with PT services and its underlying determinants evolve over time. The analysis considered PT users only and it is one of the first and only studies to focus on the important temporal dimension. Furthermore, the analysis approach which culminates in a priority map could be used as a market analysis tool to assess PT priority areas.

Answering **RQ1**, the results show that *customer interface*, *operation* and to a lesser extent also *length of trip time*, are found key determinants of overall satisfaction which users consistently rate among the least satisfactory. The two dimensions considered in the priority map, QoSAs' relative satisfaction and relative importance behave differently over time. While satisfaction, in general, remains rather constant, relative importance fluctuates year after year. However, the QoSAs remain in the same position of the priority map and thus the determinants of travel satisfaction stay invariable – answering **RQ2**. In addition, overall satisfaction with PT in Sweden follows a negative trend in recent years (2010-2013). This is driven by a decrease in users' satisfaction with most QoSA, but in particular with *customer interface* and *length of trip time* which are among the most important determinants of overall satisfaction.

Finally, the methodology employed in this paper: calculating normalized average satisfaction values for the QoSAs, estimating satisfaction year-specific Ordered Logit Models, calculating marginal effects from the models' coefficients, and representing the combination of these two elements in a priority map, allows for easy comparison amongst QoSAs.

5.2 Results of paper II

This paper proposes a methodological framework that can be applied to different and varied geographical contexts. The framework allows to: disentangle the intrinsic complexities of Swedish travelers by reducing traveler heterogeneity into a small number of coherent traveler groups; determine the importance attached by each travelers´ group to PT QoSA and, investigate whether QoSAs' importance ratings vary over time.

The market segmentation strategy adopted was based on socio-demographic attributes, travel characteristics and accessibility measures, which were found to influence travelers'

expectations and needs in previous research. The cluster analysis results classify Swedish travelers into five groups: (i) inactive travelers; (ii) long distance commuters; (iii) urban motorist commuters; (iv) rural motorist commuters; and (v) students – answering **RQ3**.

The contrast of perceived satisfaction and relative importance of the QoSAs reveals the existence of four attributes that should be prioritized by stakeholders: *customer interface, operation, network* and *length of trip time* – answering **RQ4**. Interestingly, the results suggest an overall similarity in the priority list of QoSAs between travelers' segments. Nevertheless, some noteworthy differences that do not alter the composition of the priority list can be observed. For example, the more PT intensive user segments (inactive and students) are more satisfied across the board and are characterized by a more balanced distribution of QoSA importance. This might be due to a higher evaluation of more recent experiences and a more integrative knowledge of the service components. Rural motorist commuters are markedly dissatisfied with service operation attributes (*length of trip time, network* and *operation*). Moreover, they consider these QoSAs to be more important compared with other travelers' groups.

The variability of QoSA importance levels over time and across segments unveils an overall change in appreciation and consumption goals. In brief, attributes related to information and the functional and operational aspects of the service have gained importance whilst those related to comfortability, image and the services provided around the product have become less influential – answering **RQ5.** Additionally, the investigation of variability over time and space across segments of overall satisfaction revealed that the smaller county regions have the largest overall satisfaction. These findings are in line with previous research (Diana, 2012) – answering **RQ6**.

Interestingly, PT captives[2] are more satisfied with the overall travel experience than choice riders, 3.73 and 3.44 respectively (in a 1-5 likert scale). This is in contrast to previous studies where for example; both transit and private vehicle captives are more dissatisfied than choice riders when stating that they would like to use more an alternative travel mode (St-Louis et al., 2014).

5.3 Results of paper III

This paper contributes to the literature (e.g. Suzuki et al., 2014; Miron-Shatz, 2009; Kahneman, 2000), on combining multi-episodic experiences and provides novel empirical evidence in the transport domain. The results of this study allow identifying the trip legs that influence the most travelers' overall trip evaluations.

In general, normative rules (eg. simple average or average weighted by waiting/transfer times) were found to be better predictors of retrospectively aggregating experiences than heuristic rules. These findings resonate with previous research (e.g. Suzuki et al., 2014; Miron-Shatz, 2009) and indicate that no trip leg can be neglected since all of them have an impact on overall travel satisfaction. The average weighted rule that considers both moving (in-vehicle/walking) and waiting times (Duration weighted complex -DWC) performed particularly well, especially when applying a waiting time weight of 3 or 4 times in-vehicle or walking time (DWC3 and DWC4) – answering a part of **RQ7**. Nonetheless, the way travelers aggregate their door-to-door trips varies in regard of the type of trips (trip configurations). Hence, trip characteristics should be considered when multi-modal trips are investigated - answering a part of **RQ7**.

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[2] Those without a car and with no driving license.

As mentioned above, all trip legs are shown to be relevant in constructing an overall evaluation of door-to-door trips. However, the main trip leg followed at a considerable distance by the access legs are identified to be the most relevant part of the trip, regardless of the trip configuration – answering **RQ8**.

A very strong inter-correlation is found, across the board, between access and egress legs which may support the belief that first and last miles could be roughly considered as a single entity. However, train trips, are a noticeable exception to this assertion. The former being probably due to the very different access/egress's mode composition generally occurring in train trips (e.g. Givoni and Rietveld, 2006) and in our data.

6. Discussion

Objective-wise the interrelation among the 3 papers is evident. Their common objective is to gain a better insight into overall travel satisfaction so that travelers' satisfaction can be increased by the relevant stakeholders.

The results of Paper I and II suggest that the determinants of travel satisfaction have an overall similarity amongst different travelers' groups, also when compared to a general model[3] and to a PT-user only. This goes against our previous beliefs and implies that any successful measures introduced by operators and authorities to improve the main determinants are expected to contribute in increasing travelers' satisfaction across the board. Having said that, the existence of certain differences among traveler segments calls for the deployment of measures that cater for their specific priorities. For example, inactive travelers are most keen on direct connections, while infrequent PT users such as rural motorists attach great importance to customer interface. Efforts and measures to improve these dimensions should be therefore made in relation to the specific target group.

The fact that PT-users only (Paper I) and all travelers' segments (Paper II) regard *operation* as a more important QoSA than *network* suggests that stakeholders could do better by providing more frequent services in the main and trunk lines rather than a large number of low-frequency lines in the hope of minimizing the number of transfers required. The former offers economical and operational benefits in addition to the higher importance attached to it in forming travel satisfaction. Providing more frequent services is in line with Paper III results which emphasize the importance of waiting and transferring times. In contrast, the deterioration of satisfaction with *customer interface* (Papers I and II) is related to the reputation of the PT agency and could be addressed by improving both internal (mechanisms to handle passengers' complaints) and external communication (media, marketing). Maintaining a sense of security (*freedom from crime*) is also crucial as it is an important determinant of overall satisfaction and an area that PT users in Sweden are generally satisfied with. *Freedom from crime* is not only related to the security measures adopted by the PT authority (video surveillance system or security guards) but also to the national regulations fighting and punishing crime and to the crime index of the area that the PT serves. Improving the perception that traveling by PT is fast (*length of trip time*) involves both shortening nominal on-board travel time and improving seat availability, on-board comfort and travel time usability (Susilo et al., 2012).

Papers I and II add to the literature by including *customer interface* and *freedom from crime* to the set of QoSA that are known to influence travel satisfaction. This set includes;

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[3] Model which includes all travelers together.

duration of the trip (*length of trip time*), frequency (*operation*), reliability of the service and ticket cost (Tirachini et al., 2013).

Paper III findings indicate that main trip leg's relative weight on overall trip satisfaction is higher than the one of access/egress legs. This finding validates the results of Papers I and II which focused on analyzing the determinants of trip satisfaction for the main leg. At the same time, Paper III findings substantiate the research done by many other scholars on exclusively the main trip leg. In addition, the results imply that the most relevant door-to-door trip legs include PT modes, with their associated waiting and (sometimes) transfer times. This fact, together with the success of DWC (Duration weighted complex) rules signify that, in consonance with previous research (Iseki et al., 2006), waiting and transferring times are badly perceived and penalized by travelers, and thus their perception is to be improved. Moreover, if practitioners having a limited budget are to investigate PT door-to-door trips they may do better in surveying aspects related to the main PT leg.

7. Conclusions

This work finds the determinants of travel satisfaction for PT users and different travelers' segments and investigates whether these determinants and QoSA importance values change over time. The results of the analyses yield *operation* (service frequency), *length of trip time* (duration, speed) and *customer interface* (service providers' responsiveness) as the service aspects that should be prioritized by the appropriate entities, either transit agencies or operators, or both.

The overall stability of the determinants of travel satisfaction over time, as found in Paper I, are good news for stakeholders since it suggests that PT users keep the same list of QoSA on their priority list. Therefore eventual costly long-term investments and measures carried out to improve the perception of these QoSA might be well appreciated by future travelers. The results of Paper II strengthen the results attained in Paper I by demonstrating that the importance attached to the key determinants of satisfaction (*customer interface*, *operation* and *length of trip time*) grows or remains constant over time. In addition, the results of Paper III are essential to validate the results and implications obtained in Papers I and II since the first two papers focus on the main trip leg attributes.

The relation between service quality and customer satisfaction has been largely controversial. The assertion that an increase in supply leads to an improvement in satisfaction has proved to have its supporters (e.g. Barabino et al., 2012) and critics (eg. Friman and Fellesson, 2009). This relation is one of the main pillars and key assumptions of this thesis. An additional general assumption made in Papers I and II is that service attributes of the main trip leg are sufficient to explain overall travel satisfaction. This assumption is derived from the overwhelming focus of previous research on studying the service attributes of the main leg. However, this assumption is tested in Paper III and yielded positive results, therefore validating our assumption.

The main aim of this Licentiate thesis is to gain insight into overall travel satisfaction. The results of this thesis can be used by stakeholders to increase travelers' satisfaction. The achievement of this aim aspires to increase PT ridership at the expense of private motorised modes. Private motorised modes are the natural competitor to beat for medium and long distances. However for short distances, also soft modes come into scene. As previous studies have shown, increasing the attractiveness and utility of PT too much, may have undesired

effects of decreasing the share of non-motorized modes. For example, this is what Cats et al. (2014) found that occurred in Tallin (Estonia) when free public transport policy was introduced.

A limitation regarding the conclusions of Papers I and II comes from the nature of the data analyzed, time series cross-sectional data. The nature of the data does not allow to follow the same individual over time. Therefore it is not possible to assess whether changes in prevalence reflect a trend or simply differences between different groups of participants sampled from the population. In addition, cohort effects may alter the results.

It will be interesting to contrast PT performance indicators with PT travelers' satisfaction, as a way to compare whether travelers' satisfaction valuations are at random. After studying the variability of the determinants of satisfaction (Paper I) and of the importance attached to the different QoSA (Paper II) it would be interesting to investigate seasonal variations that could shed light on the impacts of changes in demand levels and weather on travelers' evaluations. The formulation of a pyramid of travelers' needs (Perone et al., 2005) for different users and modes through quantitative analyses would also be of interest to provide a deeper insight on the basic, medium and higher priorities of different PT travelers. Paper III showed how the legs in which waiting times and transfers (stations and stops) are involved have a higher relative weight in the construction of the evaluation of the overall experience. Therefore it would be of relevance to examine the role of infrastructure and passenger oriented service provisions in influencing door-to-door travel satisfaction.

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