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CENTRO DE TECNOLOGIA E GEOCIÊNCIAS
Programa de Pós-Graduação em Engenharia Civil
Área de Transportes e Gestão das Infraestruturas Urbanas

THE ROLE OF INFORMATION IN TRANSIT USE BY UNDERGRADUATE AND GRADUATE STUDENTS IN BRAZIL AND DENMARK

Mayara Moraes Monteiro

Recife, Brazil, February 2016

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MAYARA MORAES MONTEIRO

THE ROLE OF INFORMATION IN TRANSIT USE BY UNDERGRADUATE AND GRADUATE STUDENTS IN BRAZIL AND DENMARK

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THE ROLE OF INFORMATION IN TRANSIT USE BY UNDERGRADUATE AND GRADUATE STUDENTS IN BRAZIL AND DENMARK

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Advisor: Prof. Leonardo Herszon Meira, PhD.
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With the fast improvement of technology, accompanied by changes in the lifestyle and the growth of cities, that made the Public Transport (PT) system more complex, delivery of integrated information on PT systems in an efficient and clear way are of the outmost importance but not always available. This study sought to understand the relation between travel information, PT use intentions and non-habitual travel (at night). The hypothesis is that PT use intentions are related to the perceived usefulness and the ease-of-use of the system, which are related to information quality and real-time information availability. The hypothesized relations are anchored theoretically in the Extended Technology Acceptance Model and validated empirically in two sources of data: (i) Copenhagen (Denmark), characterized by a highly integrated PT system with an advanced web-based information system; (ii) Recife and Natal (Brazil), characterized by a lower perceived Level Of Service (LOS) and non-integrated information sources. The data was collected through a tailor-made survey answered for 1,123 university students in Denmark and Brazil. Structural equation models were employed for explaining the use of PT as a function of the observed respondent characteristics and the latent constructs. The results show: (i) information quality is essential for explaining PT use; (ii) perceived information quality is directly and positively related to perceived LOS, convenience and familiarity with the PT system; (iii) the use of real-time information is positively related to information quality and familiarity, while it is negatively associated with perceived PT security; (iv) PT use at night is positively related to habitual PT use and information search.

Key words: information systems; public transport; technology acceptance model; structural equation models; mode choice.

Recife, February 2016

Resumo da dissertação submetida à Universidade Federal de Pernambuco como parte dos requisitos necessários para a obtenção do grau de Mestre em Engenharia Civil.

O PAPEL DA INFORMAÇÃO NO TRANSPORTE PÚBLICO POR ESTUDANTES DE GRADUAÇÃO E PÓS-GRADUAÇÃO NO BRASIL E NA DINAMARCA

Mayara Moraes Monteiro

Orientador: Prof. Leonardo Herszon Meira, PhD.
Co-orientador: Prof. Otto Anker Nielsen, PhD.

Com a rápida melhoria da tecnologia, acompanhada por mudanças no estilo de vida, e o crescimento das cidades, que tornou o transporte público (TP) muito mais complexo, entregar informação integrada do sistema de transporte de uma forma eficiente e clara é de extrema importância, mas nem sempre está disponível. Este estudo procurou entender a relação entre informações sobre viagens, intenções de uso de TP e viagens não habituais (à noite). A hipótese é que as intenções de uso de TP estão relacionadas com a percepção sobre a utilidade e a facilidade de uso do sistema, que estão relacionados com a qualidade da informação e a disponibilidade de informação em tempo real. As relações hipotéticas são ancoradas teoricamente na Extensão do Modelo de Aceitação Tecnológica e validado empiricamente através de duas fontes de dados: (i) Copenhague (Dinamarca), caracterizado por um sistema de transporte altamente integrado com um avançado sistema de informação baseado na web; (ii) Recife e Natal (Brasil), caracterizadas por um nível de percepção do nível de serviço como mais baixo e fontes de informação não integradas. Os dados foram recolhidos através de um questionário feito sob medida e respondido por 1.123 estudantes universitários na Dinamarca e no Brasil. Modelos de equações estruturais foram utilizados para explicar a utilização do TP em função das características observadas dos respondentes e os construtos latentes. Os resultados mostram: (i) a qualidade da informação é essencial para explicar o uso do TP; (ii) a percepção da qualidade da informação está direta e positivamente relacionada com a percepção do nível de serviço, conveniência e familiaridade com o sistema de TP; (iii) o uso da informação em tempo real está positivamente relacionado com a qualidade da informação e familiaridade, enquanto está associado negativamente com a percepção de

segurança do TP; (iv) utilização do TP à noite está positivamente relacionada com a utilização habitual do TP e a busca de informações.

Palavras-chave: sistemas de informação; transporte público; modelo de aceitação tecnológica; modelos de equações estruturais; escolha modal.

Recife, fevereiro 2016

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1 INTRODUCTION

It has not been long since the main options for finding information on how to move around city were: to ask other people, to search in printed (paper-based) information such as timetables and road maps, or through directly calling the operator of the transport in question (FARAG and LYONS, 2010). This information was, in general, static and unimodal, i.e. information based on the schedule and related to only one transport mode (See Figure 1).

Figure 1: Ways to find information to travel by Public Transport in the past

Nowadays, with the fast development and improvement of technology (e.g. internet, smartphones, GPS), the sources and available options have increased widely and it is possible to get real time information on stops/stations, in apps or online. What exists currently is a combination of static, dynamic and real time, unimodal, multimodal and integrated multimodal information systems that may be easily found everywhere, when available (Figure 2).

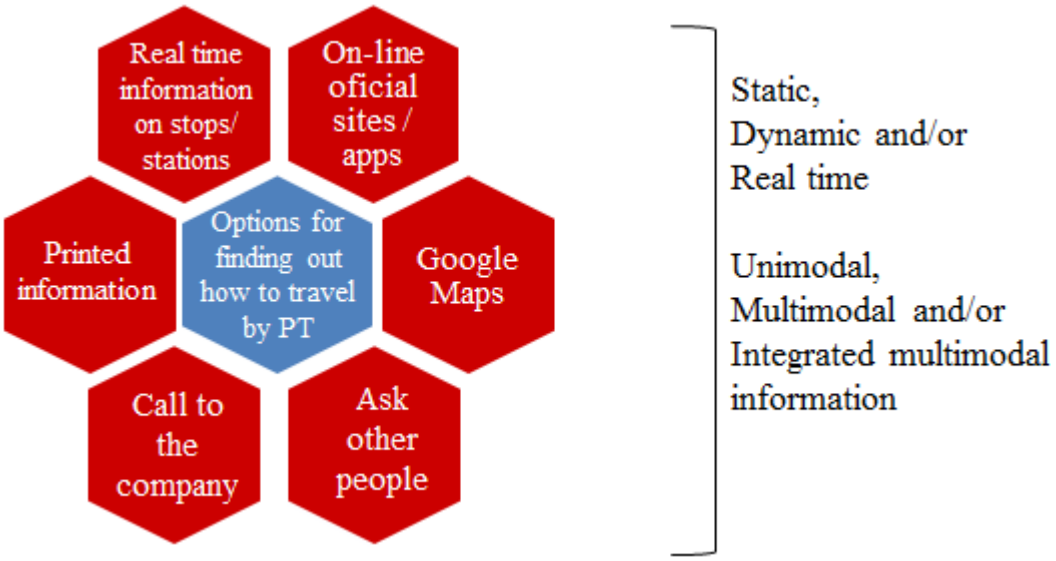

Figure 2: Current ways to find information to travel by PT

The “evolution” of the information sources in public transport came together with other changes closely related to this subject. One of these regards to growth of cities in terms of complexity and size, which in turn causes the transport system to be much more complex, usually in the way of multiple operators and transit modes working together and therefore, making it more difficult to deliver information in an efficient, easy to use, integrated and reliable way.

Another alteration relates to lifestyle, especially of young people, who are more dynamic, characterized by continuously changing residency and activity patterns, due to the need for higher level education, the competition in the labor market, the need for business travel, the higher leisure consumption and the globalization.

Both the complex public transport network and the need to move in complex unfamiliar environments increase the demand for easy to find and clear travel information. The more time people spend moving around in complex public transport environments, the more important it is to get relevant and reliable information in a clear and efficient format for maintaining the activity’s schedule, as well as saving time and money.

However, as the cost-effectiveness of transit information systems and their impact on the users’ travel patterns and modal shift are unclear, many transit operators do not invest in providing public transport information. They believe that public transport users have confidence in their experience and familiarity with the system, word-of-mouth, and operator-specific information (IBRAEVA and FIGUEIRA DE SOUSA, 2014).

In addition to this, in places where the PT has no such reliability, to provide PT information is seen as harmful for the companies. According to Schein (2003) the public transport companies in most Brazilian cities prefers to omit the information under the premise of not exposing their operational failures to users, contradicting their interest. Thus, understanding the relation between information systems and public transport use could support investment decisions in advanced information systems.

Moreover, despite the growing accessibility of information, it is unclear whether it can induce a general modal shift towards transit use (IBRAEVA and FIGUEIRA DE SOUSA, 2014). On the one hand, transit use is considered to be habitual and thus less responsive to

information, but on the other hand, the fact that travelers mainly consider travel time and cost (NIELSEN, 2000; ANDERSON, NIELSEN and PRATO et al., 2014) shows that information is relevant even when transit use is frequent and habitual (ŞIMŞEKOĞLU, NORDFJÆRN and RUNDMO, 2015).

So far, research is scarce regarding the use of information for planning transit trips, and the linkage between seeking transit information and transit use (FARAG and LYONS, 2012). Furthermore, recently published research just emphasizes revealed or stated changes in user's behavior due to proposed or implemented changes in the information system; no more than a few researchers have addressed their investigation efforts to explore the reasons for users' behavior changes.

In line with this, Hou and Chen (2013) reports that a survey conducted in China revealed that 49.5% and 61.3% of travelers would have been willing to consider adjusting their departure time and mode according to pre-trip information.

In its turns, Brakewood, Barbeau and Watkins (2014) conducted a before-after survey for evaluating the impacts of real-time transit information on bus riders in Tampa (Florida), and found a significant change in the waiting time and the feelings associated with the waiting time, but not in the trip frequency or number of transfers. Finally, Dyrberg et al. (2015) found a significant relationship between the role of information, ease of use of transit terminals and multi-modal route choice in the Copenhagen Region.

These studies provide insights into the overall links between external stimuli (i.e., information provision) and the result (i.e., ridership), but do not provide a behavioral framework underlying the result. Farag and Lyons (2012) provided a behavioral framework that explains information use for long-distance trips. They estimated a Structural Equation Model (SEM) for pre-trip transit information use and found that information search relates to travel attitudes and behavior, with information search being negatively related to habitual travel and positively associated with less frequent use.

In this context, this research suggests a rigorous behavioral framework regarding the relationship between the perceived travel information quality and use, the perceived transit system quality, habitual and non-habitual public transport use for intra-metropolitan trips. The

chosen sources of information (Brazilian and Danish) enable the validation of the behavioral framework and the transferability of the structural relations, enlightening the role of information under different conditions of public transport and information provision. Moreover, the sample definition privileged young users, because it could indicate some information use trends.

It is important to mention that due to the fact of this thesis being linked to a Brazilian university (UFPE), an expanded summary in Portuguese was written covering all chapters existing in this research, which is available in the Appendix A of this document.

1.1 RESEARCH OBJECTIVES

1.1.1 Main objective

Clarify the role of information in PT use to university students, through the proposal of a behavioral model based on the Technology Acceptance Model in order to explain habitual and non-habitual transit use, and to reveal the role of information in explaining transit ridership.

1.1.2 Specific objectives

a) To relate the perceived travel information quality and use with the perceived public transport system quality, public transport use and non-habitual public transport use for intra-metropolitan trips according to university students' perceptions;

b) To model the public transport use according to user's socioeconomic characteristics and the effect of travel attitudes, the present perception of public transport system, the perceived familiarity and the social surrounding on the current use of public transport;

c) To find out on the intentions of public transport use in case of improvement of information in Brazil;

d) To support both developing and developed countries to understand better the variables that have influence in public transport use;

e) To provide an evidence-based argument for investment decisions in advanced information systems.

1.2 MAIN CONTRIBUTIONS

a) Propose a behavioral framework for the intentions of Public Transport use with transferability of the structural relations validated by two sources of information (Brazil and Denmark) that have different conditions of public transport and information provision;

b) Reveal the complex relation between transit use frequency, perceived information quality, perceived level-of-service (LOS), perceived usefulness of the transit system, perceived difficulties in using the system (i.e., security, convenience), and perceived familiarity with the transit system through the development of structural equations.

1.3 HYPOTHESES

The behavioral framework enables exploring the following hypotheses:

H1: Perceived information quality is positively related to higher perceived LOS;

H2: Perceived information quality is positively related to higher perceived familiarity;

H3: Real-time information is positively related to higher information quality, perceived familiarity and security;

H4: Habitual public transport use and information search are positively related to non-habitual public transport use.

1.4 CONTENTS

Section 2 presents important concepts related to information available to passengers on public transport, as well as some studies with results that support the importance of information to users.

The theories that underlie the line the reasoning and analysis performed in this study are presented in Section 3. Researches made using these theories in the field of transports are also

showed in this section. The framework related to the hypotheses of this study is presented and explained.

In Section 4 the cities chosen to perform the data collection of this research are presented in order to allow better understanding of the variables related to each city. Their public transport systems and sources of information available are also described and briefly discussed.

The next part of the research, Section 5 presents the information pertaining to the collection of the data used in this research. The factor analysis and the structural equation models are described and explained as well as the indexes necessaries for validation of the results obtained using these methods.

The model estimation is presented in Section 6. The hypotheses are tested and the results found are discussed one-by-one. The frameworks for each country constructed based on the findings are presented, explained and compared.

Lastly Section 7 includes conclusions of this research, summarizing the main findings. Some policy implications are given and recommendations for further work are provided.

2 PUBLIC TRANSPORT INFORMATION TO PASSENGERS

Molinero and Arellano (2002), claim that users have different needs. The first need relates to knowing if the transport service allows a reasonable connection between the origin and destination points (time, headway and price). The second level of information refers to the need to localize the stops/station closer to origin and destination points, as well as identify the transfer points related to the trip.

According to Eveleens Maarse (2011), it is essential that the information is correct, in the right context, with an objective and resulting in a decrease of uncertainty or increase of understanding of something. Dziekan and Kottenhoff (2007) affirm that if the information is not right, it can confuse the customer even more by adding one further uncertain fact. The same author highlights that a reliable information provision is the base for trust in the system and thus for reduce uncertainty.

Gouin, Kéchi and Vincent (1998) say that the information for public transport passengers has some intrinsic aspects extremely important to understand it which can be resumed in some questions. The first question is regarding to “What?”, in other words, “What is the nature of the information to be supplied to the travelers?” As examples: the general information on the network, service identification, routes, headways, prices (GOUIN, KÉCHI and VINCENT, 1998).

The second interrogation is “Where?”, that means “Where the user will be able to access the information?”, as on stops/stations, inside the vehicles, in places with high flow of passengers and online (GOUIN, KÉCHI and VINCENT, 1998). This question combined with the first one can define which information should be present in each of the existing sources.

The third query is “How?", that is “How can the information be communicated properly to the traveler?” Among the possible formats to deliver information are: audio messages, timetables, maps and guides (GOUIN, KÉCHI and VINCENT, 1998).

Finally, the other relevant question about information that needs to be answered is “When?”, that means “When the information should be updated?” The reply for this query usually varies according to the nature of the information, and can be as an example: once in a

year, when changes happen and in case of unforeseen events (GOUIN, KÉCHI and VINCENT, 1998).

The answer of these questions can help to define the main characteristics related to the information to be delivered, the source, the more adequate way to provide and the periodicity of updating them.

Besides these cited aspects related to the information, there are others related to the updating status of information and its scope that must to be clarified in order to better understand what will be presented in the following sections. Thus, the subsequent topic will discuss about some concepts.

2.1 MAIN DEFINITIONS

Information on public transport covers an extensive topic, thus, it is important to explain and clarify the aspects and some concepts that are related to it and that will be presented in this study.

2.1.1 Classification by updating status

Information is usually classified as:

a) Static: does not change in the short term (e.g. routes, timetables, stop/station's location). This is general information about the operation of the system in accordance with the planned process.

b) Dynamic: changes according to planned alterations in the schedule due to work stoppages or similar events; i.e. the planned changes from day to day processes (e.g. planned alterations due to big events, planned maintenance which will change the operation) (BRONS, 2005).

c) Real time: changes continuously, because is characterized by present and continuous activity or progress in system. Brons (2005) says that it is information based on the current state of the service, which therefore also includes unplanned and incidental disturbances and

problems. This includes informing minute by minute the estimated arrival time (real time) or non-planned occurrences.

2.1.2 Classification by scope

On the subject of the scope, it is useful to divide information into:

a) Unimodal Traveler Information (UTI): refers to an isolated transport mode. It can include information on different operators, but only one mode. In this case, the connection between distinct public transport modes is not presented and the possibilities to move around using more than one kind of public transport mode needs to be searched one-by-one.

Thus the coverage of the public transport system cannot be easily accessed, being difficult to determine all the possible origin-destination points within the entire public system. Kenyon and Lyons (2003) say that search for information about public transport options using unimodal information can be an arduous process for the user, and therefore, there is a need for overcoming a number of cognitive barriers before the user choose to use unimodal information.

b) Multimodal Traveler Information (MTI) consists of a single source that has gathered information about more than one transport mode. In other words, these are mutually associated unimodal traveler information that allows the access of a multitude of information, reducing the effort used (KENYON and LYONS, 2003).

c) Integrated Multimodal Traveler Information (IMTI) provides information about different mode choice options and combinations of modes for a particular journey specified by the user within a single information system. This system makes the user require no calculation and, no combination of information or sources, to achieve the desired information (GROTENHUIS, WIEGMANS and RIETVELD, 2007; KENYON and LYONS, 2003).

An integrated system can either contain integrated information only on public transport, making easier the possible transfers existing on a trip or about both public and private transport modes, allowing the user easily compare the options and do their mode choice.

Grotenhuis, Wegmann and Rietveld (2007) say that the information would have greater potential to affect the behavior of users if the data of different modes were integrated.

Lyons and Harman (2002) argue that public transport trips often involve different stages and modes and therefore, information can help to lessen the sense that the journey is disjointed and inconvenient. An integrated information system can make the travel by public transport more comparable with the experience "seamless" of the car trip, promoting public transport as a viable alternative, at least for a few journeys, in relation to the car.

According to Borger and Fosgerau (2012), the generalized cost for passengers is affected by the level of the information provided to passengers when planning their trips in two ways: directly, it reduces the costs related with planning the trip, and indirectly, has the potential to reduce passengers' overall waiting time costs.

Another feature that is important to consider for mitigating the perception of inconvenience in journeys by public transport is how to organize the information through the system and online sources in way that the passenger be able to find them with a minimum cognitive effort.

2.2 ALLOCATION OF THE INFORMATION

It is possible to say that the relevance of each kind of information for the traveler varies according to the step of the trip on which they are. Thus, the next subsections present the main information that is usually found according to the location, based on the literature.

2.2.1 On stops and stations

Firstly, the stops and stations need to have signalization allowing users to recognize it as a part of the system. All stops must be clearly marked, have pavement markings and other elements, facilitating its recognition throughout the city and establishing a common visual identity of the system (Molinero and Arellano, 2002). Moreover, each particular stop/station must have identification through name or number, allowing the user to self-localize in the public transport system and making easier to find information related to that particular point.

It is also relevant that they have operational information aiming to facilitate the use of the system by passengers. In accordance with Molinero and Arellano (2002), stops need to have information on routes that supply the stop, including schedules or intervals of the lines and telephone of the responsible company.

The list of lines allows the passenger to know all the possible destinations starting in a particular place. The information about routes can be presented on maps or through a list with the stops/stations included in the itinerary; in some cases, the estimated time between the current stops/station and the others is also presented. The schedules of lines can alternatively be showed as intervals showing the possible variations in the timetable during the daytime, nighttime and weekends.

Furthermore, show the possible connections with other lines/modes allow users to comprehend the entire network and the linkage related to the lines available in the stop/station and others. This information can be delivered through maps drawn inside the city streets or the geometric scheme of the lines.

Information on fare prices and how/where to buy tickets to pay for the use of the system are also pertinent. Since the fare system varies from place to place, it is important to give information about how it works in the city, allowing the passengers to estimate how much they will spend on their trip.

Stops and stations should also have information on estimated arrival time of the vehicles available either statically or in real time (HWANG et al., 2006). In metro and trains stations, this sort of information is generally available; however, possible due to the a much higher number of bus stops existing in cities, for buses this kind of information is frequently presented only in main stops (i.e. the ones that have higher flow of passengers).

Additionally, Molinero and Arellano (2002) say that in transfer points with multimodal integration, the transmission of information becomes more difficult due to the larger number of services. They add that when the transfer needs to happen according different levels complementary information about the directions of flow of people to facilitate the movement is required.

It is noteworthy to mention that some features that can help blind people in using the public transport system, allowing to some extent their independence, are available such as tactile paving on the sidewalks indicating the stop/station, braille information and audio messages. Train and metro stations usually have, at least, tactile paving on the platforms warning about the proximity of the railway line gap and thus preventing accidents and audio messages. The help features of information cited above is rarely found, especially in bus stops.

2.2.2 On vehicles

The passenger needs to be able to identify the right vehicle to catch to perform the desired trip, so it is important that the vehicles be identified with the lines that they operate (e.g. name, number and/or letter corresponding). Additionally, the value of the fare is also relevant, and should be visible in the front of vehicles, especially when there are fixed fares that vary according to the line used.

Furthermore, the map containing the stops of the line inside the vehicle is extremely helpful, especially for non-habitual users and those who are taking the line for the first time. The information on main points of transfer existing in the line is pertinent, since it allows user to identify the existing connections within the system. Relevant buildings and urban facilities – like gardens or parks – should also receive attention in the line map format.

In accordance to Hwang et al. (2006), the public transport vehicles should also have visual and/or audio automatic announcements inside; e.g. next stop, main roads/streets, transfers points, reference points and final destination. This sort of information allows the passenger to self-localize in the route, minimizing cognitive efforts and the possible stress generated by the trip.

Specifically related to buses, that have staff interacting actively with the public, it is important to train the professionals, enabling them to help passengers with verbal information when requested. Edvardsson (1998) says that the bus drivers and other front-line staff are a crucial part of the system, requiring instructions to answer user's questions in a customer oriented way.

2.2.3 Information available anywhere

This information was in past considered essentially a “planning tool”, because initially a computer was needed to access it. However, due to the fast development of technology, nowadays it can be retrieved anywhere and therefore, can be consulted during trips making the entire journey easier. Since this information is available online, the passenger just has to have a mobile device with internet access to find it.

It is possible to access some of this information through applications that can use the GPS system in the device and deliver information door-to-door updated in real-time according to travelers’ movements, facilitating the trip. According to Hwang et al. (2006), improvements in the tools of the Geographic Information System (GIS) have enabled transport agencies to provide a variety of different map views and tools for its customers to meet the different needs and preferences.

According to Lyons and Harman (2002), the public transport users are concerned about the convenience from the origin to the destination of the trip. Therefore, providing this information can make the physiological effort generally made to find the directions and important points during the trip to be dramatically decreased, since it is only necessary to follow the steps as indicated in the tool.

According to Wardman, Hine and Stradling (2001), a trip is inconvenient when it involves unexpected or unwanted physical, cognitive (or mental) or emotional stress efforts. In this context, the provision of clear and reliable information influence in the way of decreasing the cognitive effort, since this relates to the effort required to collect and process information before and during the journey. On the other hand, if the trip requires search for information or interpretation of information, this effort is likely to increase.

Otherwise, in some cities the online sources available remain static allowing only the consultation of the content of the information available, and/or have only unimodal information, making it difficult to search for ways to move around the system.

In addition to the online information, which can be inquired anywhere, it is also possible to obtain information by calling operators that can give information on the system, and on by

way of print that is generally available in main places around the cities besides the system itself. This paper-based information can be taken and consulted anywhere and usually informs on the general operation of the system and connections modes.

2.3 IMPORTANCE OF INFORMATION IN PUBLIC TRANSPORT

Several studies focusing on different aspects related to information in public transport and its effects in the perception of passengers have been developed. While some authors discuss the different purposes and different effects of each kind of information upon the user, others have shown the importance of search for public transport information for habitual travel and long distance trips.

Molinero and Arellano (2002) argue that captive or regular users require less amount of information (e.g. about changes of schedules, map of the route or location of the stops) than potential users, who will require information such as the price, methods of payment, schedules and routes available for performing the desired trip.

Thus, the information can function as a key factor in the attraction and integration of the new user in the system, directly interfering in their evaluation about the convenience and easy-of-use regarding this transport mode. In consonance with Hope and King (2006), when there is reliable and visible public transport information (with a high standard), people tend to use the service continuously and have more willingness to choose public transport.

In this line of thought, Lyons and Harman (2002) say that in order to influence habitual cars user to consider public transport as an alternative, it is indispensable to expand the extent and scope of the information substantially to make them aware of the opportunity.

Moreover, a study about the impact of information on the quality of travel choices reveals that information unreliability appears to have a double negative effect on choice quality: it induces lower levels of information search, and the acquired information has a lower potential to reduce uncertainty or increase choice-quality (CHORUS, ARENTZE and TIMMERMANS, 2007).

A study about willingness to pay for additional information attributes found that real-time information was considered the most important attribute due to its characteristic of make the travelers fell themselves with more control over the departure and arrival times and, therefore, reduces waiting time. The following highly positively evaluated attributes were: different route options available, information about where and how to purchase tickets, information on the walking route related to the trip and additional timetable schedules that can show the regularity of public transport (MOLIN and TIMMERMANS, 2006).

In an experiment conducted in Japan regarding a new information system on-board train, stop and transfers, information search related to traffic conditions and cabin capacity ratio, were among the leading information searches for both men and women (MATSUMOTO and HIDAKA, 2015).

A survey conducted in China showed that the preferred sources were the information board at bus stops (79.2%) found to be the main method of obtaining public transit information by passengers followed by websites (54.2%) (HOU and CHEN, 2013).

Furthermore, about the frequency of use of PT information, in Bristol a survey conducted by Farag and Lyons (2012) found that respectively 42% and 57% of the respondents sought information always or very often for leisure and business trips over 50 miles within the UK, while 57% checked transit information for unfamiliar trips. In a survey conducted in China, most passengers (77%) affirmed having inquired or used public transit information at least one time per week (HOU and CHEN, 2013).

There are studies also that highlighted information as a quality item of the public transport system that is part of user expectations and therefore have influence in the willingness to use the TP. According Molinero and Arellano (2002), an information system for passengers that has quality is beneficial to the public image of the service and results in a better use of the transport network, potentially increasing the number of users as well as recognition by the user of the value of the transport service.

In a study developed in Porto Alegre, a Brazilian city, the users affirmed to having difficulty in orienting themselves in the travels by PT, because the information was

insufficient; presenting problems related to lack of information both in boarding and disembarkation points and terminals (MAIA, 2012).

According to Edvardsson (1998), quality in public transport can only be achieved when the wishes of the passengers are complied with in a satisfactory manner. The research conducted by Garrido, Oña and Oña (2014), which examined the quality of the public transport service via neural networks, pointed out that information is the third item considered for travelers as most important, being overcome only by frequency and speed. Moreover, information was measured as more relevant than proximity, punctuality, security and courtesy.

Dziekan and Kottenhoff (2007) discuss about 7 main effects found to be related to provision of real-time information, based on the available literature. They are: reduced waiting time, positive psychological factors, such as reduced uncertainty, increased ease-of-use and a greater feeling of security, increased willingness-to-pay, adjusted travel behavior such as better use of waiting time or more efficient travelling, mode choice effects, higher customer satisfaction and better image.

A study developed by TRB (2003), after deploying real-time bus arrival information systems observed improvement in customer service and visibility of public transport, and increase of customer satisfaction and convenience. It was found also that the perception among customers is that the bus service had improved; even though there were no changes in other items, such as frequency of vehicles.

The bus data analyzed from 2002 to 2010 in Chicago showed that the provision of information in real time to bus users resulted in a modest increase in the number of bus trips. This outcome showed that users were more likely to choose public transport, or make more trips by this mode, than when the bus connection information was missing (TANG and THAKURIAH, 2012).

Borger and Fosgerau (2012) stated that companies under different circumstances perform in a different way regarding information provision. According them, fare-regulated companies tend to provide less frequency and less information compared to the welfare optimum and may provide lower quality information to passengers compared to a profit maximizing unregulated company. Moreover, the regulation of both fare and information results in a

supply of high quality information, but induces the company to lessen the frequency of service. Thus, the well-being enhancement due to imposing information requirements on fare-regulated company is limited (BORGER and FOSGERAU, 2012)

Conclusions by Dziekan and Kottenhoff (2007) based on a study conducted in the tram service in the Netherlands, evidenced that it is five times cheaper to improve the quality of public transport by reducing the average perceived waiting time using real-time information at a stop, than by increasing the frequency of the service.

Chorus (2007) draws attention to advanced traveler information services. According to this author these systems are generally designed to be able to provide a traveler, at any time, all the travel information that is relevant at any given time and place in the multimodal transport network, according to personal needs.

On the other hand, Borger and Fosgerau (2012) argue that providing high quality information aims to facilitate the travel of passengers, however, it is important to consider the cost of providing information, since it can be very substantial and increase according to the quality, being independent of the number of passengers (except for printed information).

Thus, it is highly important to research the role of information in public transport use, and which information the user and potential user considers important, in order to not only attract and maintain users, but also justify the investments on it through the understating of the potential effects of providing better quality information.

3 THEORICAL BEHAVIORAL MODELS

Since a long time ago, there have been efforts to understand and explain the behavior. Homans (1974) presented a consistent discussion of theory and research on various aspects of human social behavior, encompassing topics like: interpersonal relationships and interaction structure; power, authority, leadership, cooperation and competition; status, satisfaction, and stratification. Ajzen (1985) stated that the human social behavior should be considered as neither doubtful nor trivial, but as almost well-articulated plans. Among others, these contributions led to the establishment, although a non-paradigmatic one, of three classic persuasion models: Reasoned Action Theory, Planned Behavior Theory, and the Technology Acceptance Model – including its extension. The following topics briefly describe these theories which underlie the development of this research.

3.1 A THEORY OF REASONED ACTION

The Theory of Reasoned Action (TRA) was introduced by Fishbein in 1967 and consists of a theoretical model aimed to estimate the behavioral intentions and its resultant behaviors (AJZEN and FISHBEIN, 1969). A crucial assumption is that human beings usually behave in a reasonable manner, evaluating the existing information and implicitly or explicitly considering the consequences of their actions (AJZEN, 1985).

According to Ajzen and Fishbein (1969), the model is basically an adaptation of the Theory of Propositional Control developed for social behavior by Dulany in 1967 and distinguishes itself due to its outstanding uncomplicatedness. This general theory of human behavior was built also according to previous studies (since 1961) developed by Fishbein, when he wrote on the relationship of the beliefs about an object and the consequent attitude related to that object.

The TRA model has motivational constructs, where the behavior is preceded by the intention to perform that behavior (Figure 3). The more intense is the person's intention, the stronger is the tendency of the person to experiment that behavior and therefore, the greater is the probability of actually performing a defined behavior (AJZEN and MADDEN, 1986). According to Fishbein and Ajzen (1981), the actions are determined by the beliefs of each individual concerning the behavior.

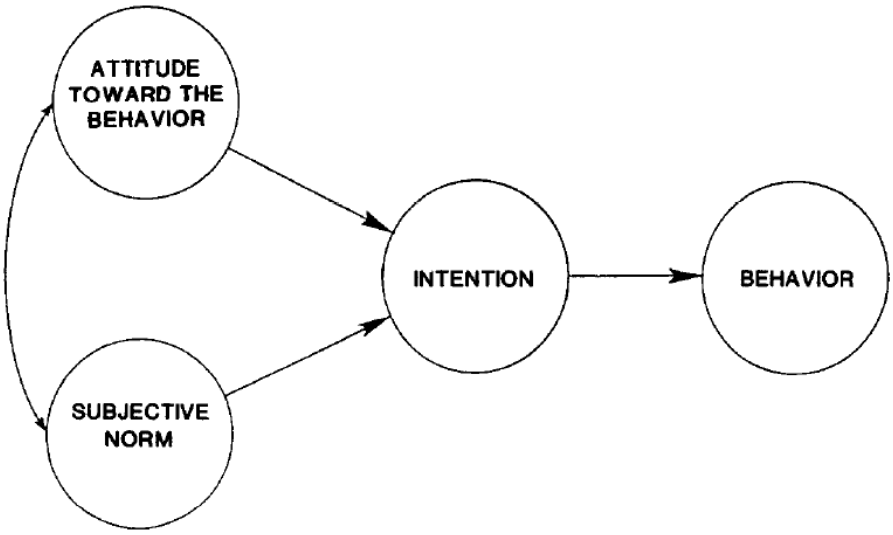

Figure 3: Theory of reasoned action.
Source: Ajzen and Madden, 1986.

Two theoretically independent factors are specified as determinants of intentions (each of them weighted according to its relative importance): individual's attitude and normative beliefs (Figure 3) (AJZEN and FISHBEIN, 1970; AJZEN and MADDEN, 1986).

The first is an individual factor that relates to the attitude toward performing a particular behavior in a given situation, i.e. refers to in what extent a person has an encouraging or disapproving evaluation of the behavior in question. The second determinant is a social factor multiplied by the individual's motivation, i.e. the internal beliefs about what is expected to do in that situation or the perceived social pressure (AJZEN and FISHBEIN, 1969; AJZEN and FISHBEIN, 1970; AJZEN and MADDEN, 1986).

In accordance with the continuous studies developed after the definition of this model, it was found that perceived behavioral control is another determinant to intentions. Thus, Ajzen presented in 1985 an updated extension to the TRA, known as the Theory of Planned Behavior.

3.2 THEORY OF PLANNED BEHAVIOR

The Theory of Planned Behavior (TPB) is an extension of TRA, presented by Ajzen in 1985 and reviewed in 1991, to be used in occasions where the behavior seems not to be completely voluntary and under control, through the account of no volitional factors as

determinants of the behavior (AJZEN, 1985; AJZEN, 1991). The intention in this model is determined by three predictors: attitude towards the specific behavior, the subjective norms and the perceived behavioral control (Figure 4).

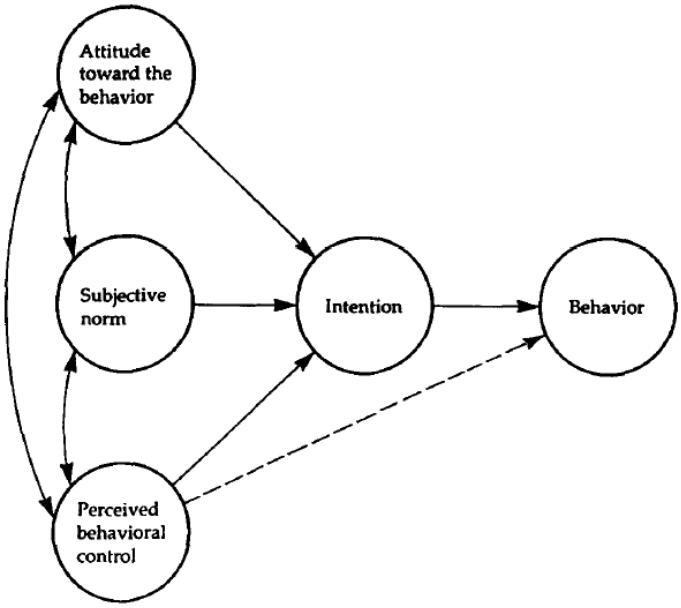

Figure 4: Theory of planned behavior
Source: Ajzen, 1991.

Taking into account the perceived and tangible control over the behavior under consideration as an antecedent to behavioral intentions, the TPB presents an expansion of the TRA (AJZEN, 1985). According to Ajzen (1985), moreover the information on the attitude toward the behavior and the subjective norms, it also necessary to estimate the degree to which individuals are able to exercise control over the behavior in question. Thus, Ajzen (1991) identifies cognitive self-regulation as an important determinant in the behavior when it is not only under voluntary control.

The perceived behavioral control refers to people's judgement about the facilities and difficulty of performing the behavior in question according with their skills, abilities, will power, presence of mind, time, opportunity and so on. The model assumes that people's behavior is strongly influenced by their confidence in their ability to perform it, rather than only dependent on the effort invested (the strength of the attempt) (AJZEN, 1985; AJZEN, 1991).

In other words, a person will succeed in its attempt if possesses sufficient control over internal and external factors that combined with the necessary effort can influence the attainment of the behavioral goal (AJZEN, 1985).

The view of perceived behavioral control presented in TPB is similar to Bandura's concept of perceived self-efficacy (BANDURA, 1977) which is concerned with perception of how well an individual can execute courses of action necessary to deal with prospective situations (AJZEN, 1991).

According to the theory of planned behavior, perceived behavioral control, together with behavioral intention, can be used directly to predict behavioral achievement (AJZEN, 1991).

3.3 TECHNOLOGY ACCEPTANCE MODEL

Davis (1989) proposed another adaptation of the TRA to explain the behavior related to the acceptance of new technology, known as Technology Acceptance Model (TAM), where the intention is also considered the antecedent of the behavior. Based on previous researches related to this subject and on concepts of Information System Theory, Davis developed new measurement scales for two variables that he considered as determinants of intentions of use a particular system: the perceived usefulness and the perceived easy-of-use (DAVIS, 1989).

The perceived usefulness is associated to the individual perception of utility related to a particular system. In order words, people tend to use a system according to the extent which they believe that it will be helpful. On the other hand, the perceived easy-of-use express the extent in which people believe that the effort spent in performing the behavior will not be high (DAVIS, 1989; DAVIS, 1993).

In this model (Figure 5), the perceived easy-of-use has a causal effect on perceived usefulness, because it is assumed that the easier the system is to use the more useful it can be (DAVIS, 1993; VENKATESH and DAVIS, 2000), and together, these two variables are determinants of the attitude toward using and therefore the actual system use (DAVIS, 1993).

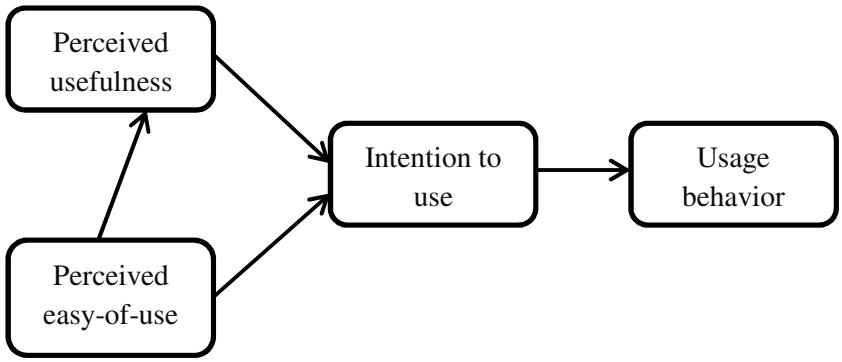

Figure 5: Technology Acceptance Model
Source: Venkatesh and Davis, 2000.

It is noteworthy that the perceive easy-of-use and usefulness are also supported by the Bandura's "self-efficacy theory". In effect, Bandura (1977) distinguishes self-efficacy judgments from outcome judgments. The first is similar to the perceived easy-of-use concept, referring also to the individual's judgement about how well the person see him/herself as being able to execute a defined behavior. Outcomes judgements are analogous to the perceived usefulness, once the first is related to the degree to which an attitude, once efficaciously executed, is believed to be connected to valued outcomes (DAVIS, 1989).

3.4 EXTENDED TECHNOLOGY ACCEPTANCE MODEL

The Extended Technology Acceptance Model (ETAM), also known as TAM2, is an expansion of the TAM, which includes additional theoretical constructs covering social effect processes and cognitive instrumental processes (VENKATESH and DAVIS, 2000). Thus, this model highlights the effect derived from external variables in the perceived usefulness. The perceived ease-of-use also remain having impacts on both directly and indirectly perceived usefulness.

Concerning the social influence processes, this model considers the impacts of three interconnected social forces that have impact on an individual who is analyzing the possibility of use or not a new system (Figure 6): subjective norm, voluntariness, and image (VENKATESH and DAVIS, 2000). Related to the Cognitive Instrumental Processes, it was theorized four determinants of perceived usefulness: job relevance, output quality, result demonstrability, and perceived ease of use (VENKATESH and DAVIS, 2000).

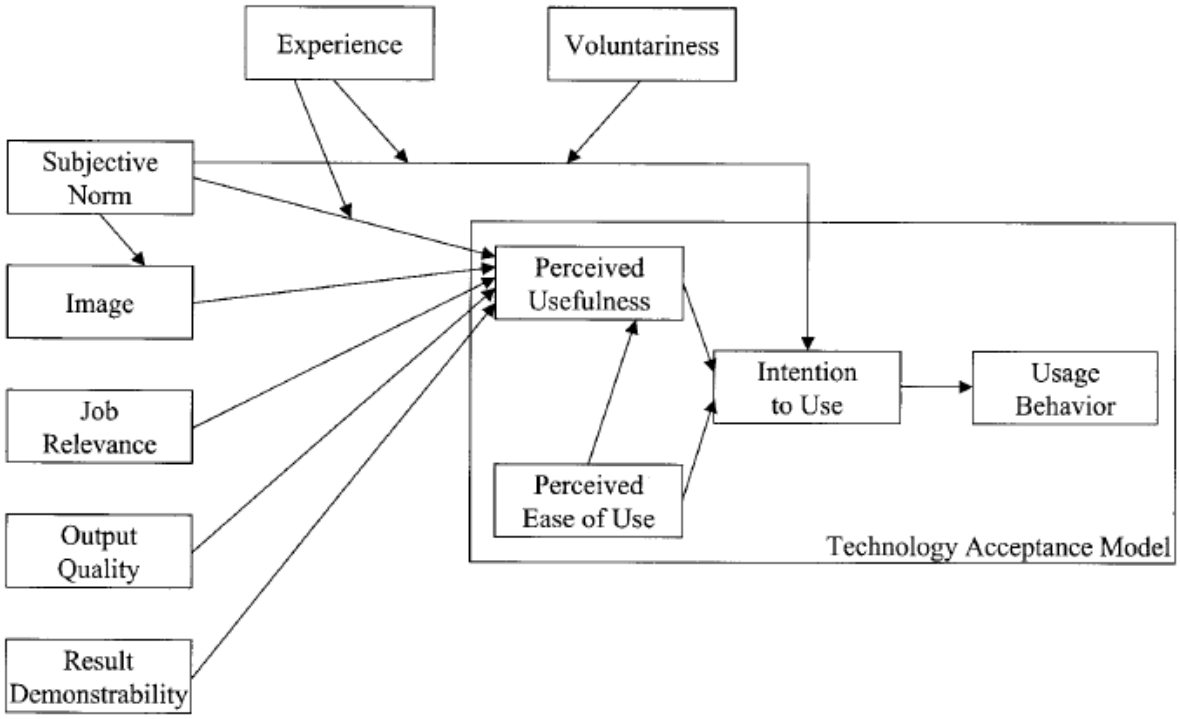

Figure 6: Extension of the Technology Acceptance Model
Source: Venkatesh and Davis, 2000.

The concept of subjective norm presented in the TRA is included in this model (once this variable is not considered in the original formulation of the TAM). It is worthy to mention that while in the TRA and the TPB this variable is included as a direct determinant of behavioral intention, in the ETAM it is hypothesized to have a positive and direct effect on perceived usefulness (VENKATESH and DAVIS, 2000).

Moreover, voluntariness is a moderating variable used to distinguish between the perception of whether the behavior is mandatory or voluntary. The variable image relates to the extent to which the individual perceives the use of the technology as a means of strengthen a status within a social group (VENKATESH and DAVIS, 2000).

Venkatesh and Davis (2000) also defined the others determinants associated to cognitive instrumental processes. Job relevance relates to the individual's perception about the degree of applicability of the technology for her or his job. Output quality refers to the perception of how well a system executes the work necessary to his or her job. Finally, result demonstrability is associated to the degree to which the benefits of an innovation are promptly clear to the potential adopter.

It is important to highlight that the experience acts as a moderator of the subjective norms, due to the assumption that there is a decrease in the direct effect of subjective norms on intentions with increasing experience (VENKATESH and DAVIS, 2000).

3.5 APPLICATIONS IN TRANSPORT

Due to the general approach of all the above theories presented, it is possible to find a wide range of application of these theories to predict behavior. As examples, it is possible to find studies about behavior related to health, diet, leisure, exercise, stop smoking, charity and so on. Regarding to transport field, there is a wide range of studies built on these theories, as will be cited below.

A study conducted by Verplanken, Aarts and Knippenberg (1997) examined the effects that habit may have on the appreciation of information about choice situations and choice options in process of making decisions on travel mode choices. The author's theoretical approach consisted of using the TRA and TPB.

Bamberg, Rölle and Weber (2003) applied the TPB in Germany to examine the effects on travel mode choice by car users. They studied the case of an intervention (combination of information and a free public transport ticket) in a decision context of moving to a new residence. A sample of people was selected and among these only a parcel received a letter presenting the PT company and its services and inviting them to test the service (a free ticket valid one day for all public transport services in Stuttgart was given). After some months, it was verified the effects on the parcel that received the intervention and the group control.

In order to study whether the rescheduling behavior is mostly habitual or results of reasoned processes, Chen, Garling and Kitamura (2004) used the TPB to develop a study in order to examine a basic question: the rescheduling of activity is due to reasoned behavior or is linked to the habit. Their results pointed out that rescheduling behavior is mostly a habitual one.

Haustein and Hunecke (2007) proposed an extended version of TPB aiming to better explain travel mode choice in Germany. The concept of perceived mobility necessities was introduced to TPB and results show that people´s perceptions of mobility-related

consequences of their own living circumstances moderated the relationship between public transport attitude and intention.

The relevance of psychological variables as predictors of the ecological impact of mobility behavior in relation to infrastructural and sociodemographic variables was also analyzed by Hunecke et al. (2007) on the basis of the Theory of Planned Behavior.

Another extension of the TPB was proposed by Cristea, Paran and Delhomme (2013) to examine the role of behavioral options and additional factors in predicting speed behavior.

Moreover, the Technology Acceptance Model (TAM) was adopted in predicting the behavioral intention to use Safety Helmet Reminder system towards a more proper helmet usage among motorcyclists (AMBAK et al., 2013).

Hazen, Overstreet and Wang (2015), also have used the technology acceptance model as the basis to understand one's intention to adopt bicycle-sharing programs in China.

3.6 RESEARCH BEHAVIORAL MODEL FRAMEWORK

The perspective used in this research was the technology acceptance according to the Extended Technology Acceptance Model (ETAM) (Venkatesh and Davis, 2000), which builds on the Theory of Planned Behavior (TPB) (Ajzen, 1991) and extends the Technology Acceptance Model (TAM) (Davis, 1989) with the consideration of subjective norms and product experience. The proposed behavioral framework for transit use was a further extension of the ETAM in order to explore the role of information quality on user acceptance of urban transit services. The model framework is illustrated in Figure 7.

The public transport use was measured by two constructs: habitual and non-habitual; which are hypothesized to be related differently to information needs. According to Farag and Lyons (2012) the habitual transit use requires less information search than non-habitual travel. Habitual transit use was measured by the perceived frequency of transit regardless of trip purposes and time-of-day. Transit use during nighttime is used as a proxy measure for non-habitual transit use.

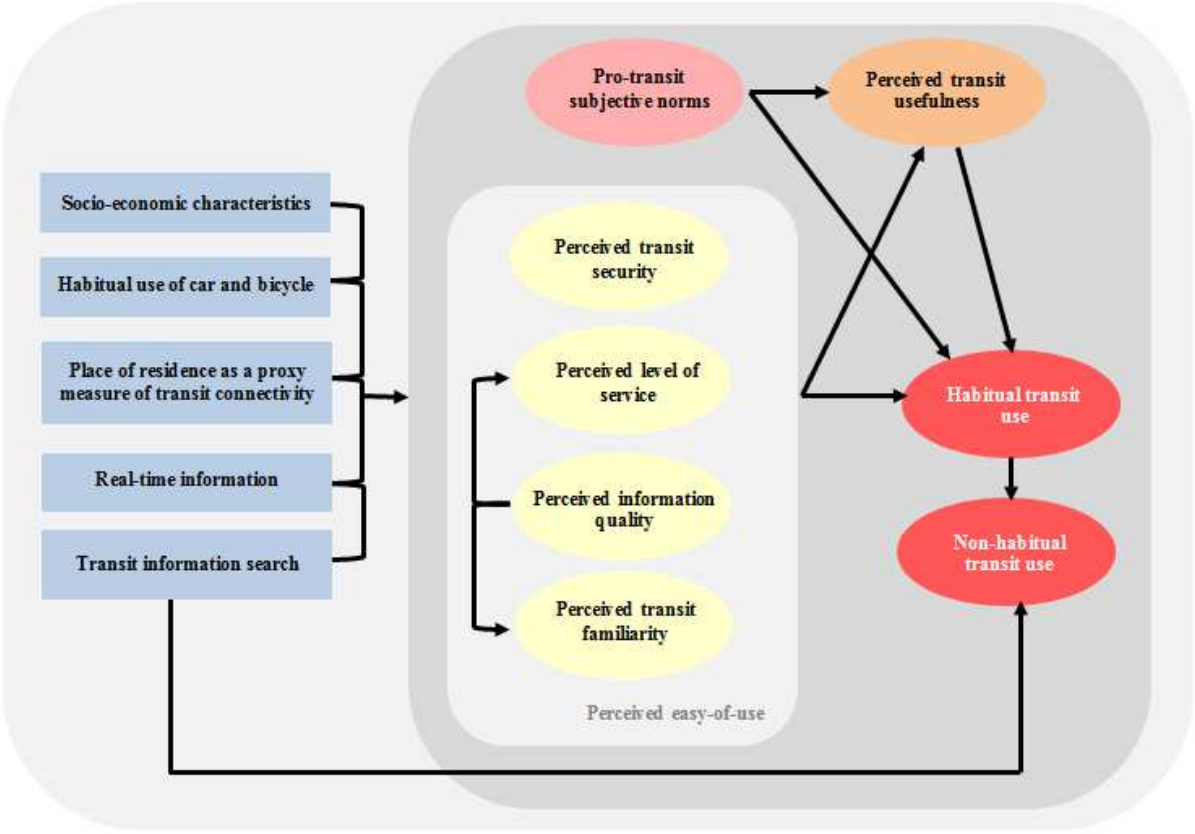

Figure 7: Behavioral model framework: proposed ETAM of transit use

The ETAM (VENKATESH and DAVIS, 2000) does not explicitly consider information provision and quality, and assume that the user experience or familiarity is not related to the ease-of-use, but only to the usefulness of the product. Therefore, the proposed framework is an adaptation of the ETAM to the context of transit use, because transit is a complex and dynamic socio-technological product that requires continuous learning and update by its users.

Moreover, information is provided as an integrated part of the transit service and is essential for an efficient use of the system. Thus, product information and familiarity cannot be viewed as external factors that lead to the initial product choice, but rather as essential factors for the efficient recurrent use of the transit system.

The current framework hypothesizes that information has an additional role on increasing the perceived familiarity and level of service (LOS), which in turn affects the transit perceived ease-of-use and usefulness. Familiarity is viewed as a facilitator for transit use because it

reduces the burden associated with navigating and information search (FARAG and LYONS, 2012; KAMGA, YAZICI and SINGHAL, 2013).

The proposed model framework enables to explore the following hypotheses: i) perceived information quality is positively related to perceived LOS, ii) perceived information quality is positively related to perceived familiarity; iii) real-time information is related to higher perceived LOS, information quality, perceived familiarity and security; and iv) non-habitual transit use is positively related to habitual transit use and information search.

4 CHARACTERIZATION OF THE CITIES

Knowing that each place in the world is unique, containing different variables working through different relationships and environments, it is necessary to characterize the places chosen in this study in order to allow better understanding of the variables related to each city. Thus, the following topics will present the cities one by one, as well as their public transport systems and sources of information available.

4.1 RECIFE

Recife is the capital city of the state of Pernambuco and has the eighth most populous metropolitan area in Brazil (See Figure 8), it comprises 14 municipalities with a total area equal to 2,770.452 km² and 3,914,317 inhabitants (population density equals to 1,412.88 inhab./km²), with more than 1.6 million residing in the core city (IBGE, 2015a).

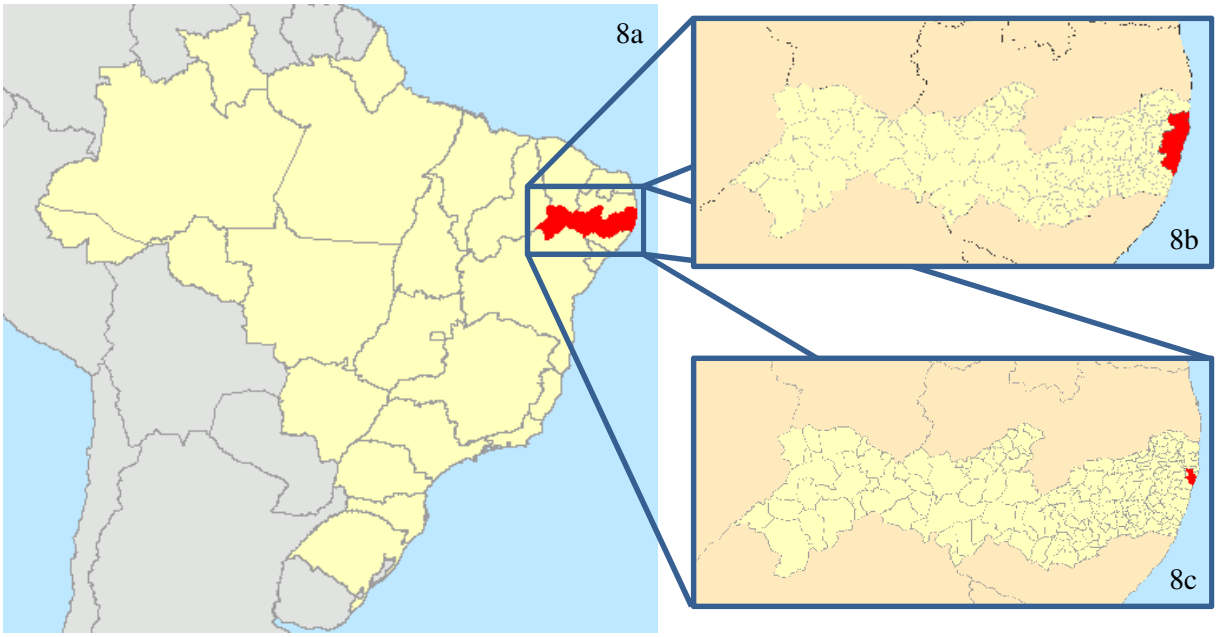

Figure 8: Pernambuco (displayed in red in figure 8a), Metropolitan area of Recife (displayed in red figure 8b) and Recife (displayed in red figure 8c).

The climate of the Região Metropolitana de Recife – RMR (Metropolitan Region of Recife) is tropical rainy, with annual rainfall above 750 mm and average temperature always above 18°C. The relative humidity is high, ranging from 79.2% and 90.7% in the rainiest

months, between April and July, reaching 100% in some municipalities, such as Recife (See figures 9 and 10) (ALHEIROS et al., 2003).

Figure 9: Photograph of Recife
Source: Author.

Figure 10: Photograph of Recife
Source: Author.

The RMR is characterized as the political, financial, educational and cultural center of Pernambuco. Although it covers only 2.81% of the state's area, the RMR concentrates 41.89% of its population. The capital occupies 7.88% of the metropolitan area and condenses 41.31% of its inhabitants in a 218.435 km^2 area (IBGE, 2015b). Detailed data per municipality is available in Table 1.

Table 1: RMR municipalities' socioeconomic data

MUNICIPALITY	**AREA (km^2)**	**POPULATION (2015)**	**HDI (2010)**	**GDP PER CAPITA (2013)**
Abreu e Lima	126.193	98,602	0.679	USD$ 3,426.31
Araçoiaba	96.381	19,816	0.592	USD$ 1,285.18
Cabo de Santo Agostinho	448.735	200,546	0.686	USD$ 9,672.72
Camaragibe	51.257	154,054	0.692	USD$ 1,898.13
Igarassu	305.560	112,463	0.665	USD$ 4,514.65
Ilha de Itamaracá	66.684	24,888	0.653	USD$ 1,929.92
Ipojuca	527.107	91,341	0.619	USD$ 24,656.27
Itapissuma	74.235	25,798	0.633	USD$ 11,450.87
Jaboatão dos Guararapes	258.694	686,122	0.717	USD$ 4,559.54
Moreno	196.072	61,016	0.652	USD$ 2,108.34
Olinda	41.681	389,494	0.735	USD$ 3,198.34
Paulista	97.312	322,730	0.732	USD$ 3,011.92
Recife	218.435	1,617,183	0.772	USD$ 7,483.81
São Lourenço da Mata	262.106	110,264	0.653	USD$ 1,955.09
	2,770.450 (total)	**3,914,317** (total)	**0.677** (average)	**USD$ 5,796.51** (average)

Source: Adapted from IBGE (2015b).

Due to its population density (7,403.50 inhab./km²), Recife is nowadays facing the problem of the saturation of its road system, as has occurred in many metropolis in the world. The following section characterizes the current situation regarding Recife's mobility.

4.1.1 The university chosen

In Recife, the Federal University of Pernambuco – UFPE was chosen to carry out this study. UFPE is a public university that is free of charge for students located in the Northeast of Brazil, in the State of Pernambuco. UFPE is located in a 149 hectares area (UFPE, 2014a) in the west of the city of Recife, in a dense area of mixed land use: residential and commercial. UFPE attracts daily trips from 14 cities in the metropolitan area totalizing about 40 thousand people, including teachers, technical and administrative staff, undergraduate and graduate students, as well as visitors.

Currently, there are 99 undergraduate courses and 128 postgraduate studies courses. The infrastructure consists of over 40 buildings, including rectory, 9 academic centers, 08 supplementary departments, convention center, university club, kindergarden, students housing and university restaurant (UFPE, 2014a).

4.1.2 Urban mobility in RMR

A survey conducted by TomTom in 2014 shows that the city of Recife has the worst congestion levels in Brazil. The same survey also states that Recife has one of the slowest traffic in the world, with an average of 82% of congestion in the evening peak hours and a general congestion level of 45%. What this means is that, in a comparison with a free flow situation, the travel time in Recife is 82% longer in peak periods and 45% longer in general (TOMTOM, 2015). Another research held by the website Numbeo, points Recife as the 10th city in the world where people spend more time in traffic jams, averaging 55.6 minutes per day (VEJA, 2014).

One aspect that highly contributes to this is the huge number of car owners in Recife and RMR (See table 2). In Recife, there is a car for every four people, and Recife's Traffic and Urban Transport Company estimates that, in addition to more than 637,000 motorized

vehicles registered in Recife, over 250,000 motorized vehicles from other municipalities daily circulate in Recife due to the city's centrality and services polarization (CTTU, 2006).

Table 2: Car ownership in Recife and Recife's metropolitan area

	Population July 2015	**Car fleet August 2015**	**Inhabitants / Car**
Recife	1,617,183	405,431	3.99
Metropolitan Region of Recife	3,914,317	738,964	5.30

Source: Adapted from IBGE (2015b) and DETRAN/PE (2015).

Moreover, public transport in RMR operates in 1 out of 3 ways: The first is mixed traffic, where public transport share the same space as that of normal traffic. Secondly, there are priority lanes, where the lane is for use only by public transport, with the exception of right hand turn where private cars may occupy the lane. A third possibility is exclusive lanes, where the design purpose is that only public transport vehicles may use it. As priority or exclusive lanes do not represent a significant fraction of lanes used by PT routes, it ends up being harmed for circulating in most cases in mixed traffic. This decreases public transport's speed, regularity, punctuality and comfort, leading to the increase of user dissatisfaction with the conditions offered by public transport. Thus, people seek to buy a private car in search for more speed and comfort, feeding the vicious cycle described above.

In order to characterize the public transport in Recife and the aspects related to it, the following section describes how the public transport system is composed and how it is performed.

4.1.3 The structure of public transport

4.1.3.1 Overview

The Passenger Public Transportation System – STPP/RMR, planned and managed by the Metropolitan Transport Consortium – CTM known as Grande Recife Consórcio de Transporte, attends Recife's metropolitan area. So, the CTM is responsible for ensuring the quality and universality of services; the infrastructure provision and maintenance; delegating

the production of transport services, through public bidding; regulating the conceded activities and monitoring and updating of concession agreements (GRANDE RECIFE, 2015).

The transport service operation of STPP/RMR is performed by 13 private companies (GRANDE RECIFE, 2015), that operate buses and Bus Rapid Transit (BRT), and a Federal State-owned company – the Companhia Brasileira de Trens Urbanos - CBTU (Brazilian Urban Train Company) - that operate metro and Light Rail Transit (LRT). The STPP/RMR is composed of two systems: Integrated Structural System (Sistema Estrutural Integrado - SEI) and Complementary System (Sistema Complementar - SC).

The idea of SEI came about in 1985 with the objective of prioritizing transport lines, avoiding overlapping routes and integrating RMR by defining a flat fare for each concentric territorial ring traced to divide the whole Metropolitan Area. In SEI's system, through integration terminals, it is possible to physically integrate between all the lines in the system (including buses and metro), enabling several combinations of origin and destination in the RMR (GRANDE RECIFE, 2015). The SEI has a configuration composed of semicircular and radial axes (Figure 11). At the intersections between the arcs and axes, there are integration terminals allowing users to change between lines without having to pay another fare, once they do so without going outside the terminal; this is why this sort of integration is called "physical integration".

In SEI, there are six radial corridors (4 main roads and 2 railways) that converge in Recife CBD, and four perimeter corridors linking the north and south of RMR without passing through the city center (red lines in the Figure 11).

In 2015, SEI had 185 bus lines and 25 integrated terminals, suppling all municipalities of RMR, Lines may be classified as feeder (123 lines), perimeter (just 3), radial (24), interterminal (18), transverse (6) and circular ones (11).

In December 2013, all bus lines together transported 32.912.158 people (GRANDE RECIFE, 2015). The bus system works 24 hours a day, but some lines stop at midnight and the remainders that operate overnight have its frequency reduced.

SEI vehicles have different colors according to different functions they have in the system (see Figure 11):

a) Yellow buses - Feeder Lines: from suburb to the nearest integrated terminal;

b) Red buses - Perimeter Lines: cross large corridors without going through the city center;

c) Blue buses - Radial Lines: From the Integration terminals to the center of Recife;

d) Green buses - Inter terminals Lines: Between integrated terminals;

e) White buses - Circular Lines: From the integrated terminals to its surrounding areas.

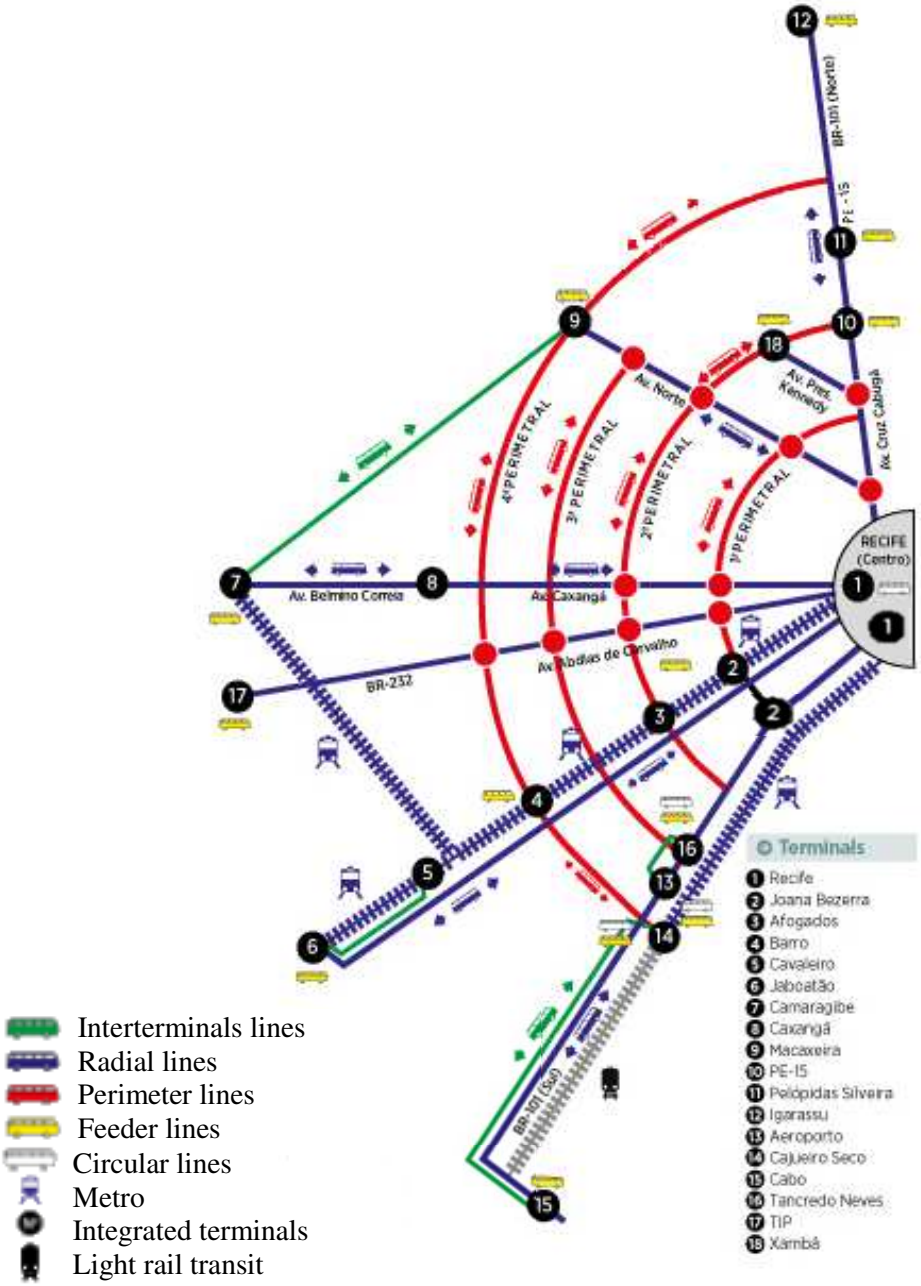

Figure 11: Integrated Structural System

Source: Adapted from Grande Recife (2015).

Moreover, three metro/LRT lines operate in the integrated system from 5 a.m. to 11p.m. In the Metropolitan Region of Recife, 5 municipalities are supplied by the rail system (Recife, Jaboatão dos Guararapes, São Lourenço da Mata, Camaragibe and Cabo de Santo Agostinho): a population of 2,614,710 people, and rail services transport around 245,000 people each workday. The rail system is distributed into 36 stations, of which 12 are integrated and spans for 70.4 km. (CBTU, 2015a). The airport connects directly by a walkway with an integration station that has access to bus, metro and public bicycles.

The initial idea was that SEI quickly would attend all RMR with 40 integrated terminals. However, it now serves only 45% of locations (VASCONCELOS et. al., 2016) and there is no reliable prevision about conclusion of necessary works for the SEI being completely implemented.

The Complementary System covers the rest. The Complementary System does not have any kind of integration or operation in physically integrated terminals, so the users of this system pay a new fare every time they need to do a transfer.

The Bus Rapid Transit – BRT system is also part of the SEI and all 08 lines existing in February 2016 integrate into terminals. There are 2 BRT corridors that nowadays have 39 stations: the North-South Corridor that links the municipalities of Igarassu and Recife, currently runs for 24.15 km and the East-West Corridor that links the Recife's CBD and the city of Camaragibe, currently runs for 14.75 km (Verbal information[1]). This specific road mode has, in some cases, exclusive lanes that make the journey faster when compared to buses, but in the absence of exclusive lanes, the BRT operates in mixed traffic. Moreover, all the vehicles are adapted to the disabled.

It is important to mention that the RMR has less than 50 km of exclusive lanes for public transport, which therefore means that this service, in the vast majority of instances, operates in mixed traffic, increasing travel times. Thus, the high and rising congestion levels has made public transportation by bus, which usually operates without priority in traffic, slow, not punctual, irregular and unreliable (VASCONCELOS et. al., 2016).

[1] Grande Recife, interview conducted in January 2016.

Furthermore, in May 2013 the sustainable project BIKE PE started in Recife's metropolitan region. The state of Pernambuco gave a concession contract to one private company (Serttel) for the operation of the bike sharing service. The bicycles are available in 80 stations distributed in strategic places of the Metropolitan Region of Recife, including in close proximity to integration stations, being a sustainable solution for short trips (BIKE PE, 2016), as Recife has only a total of 39.2 km of bicycle lanes in December 2015 (RECIFE, 2015). According to BIKE PE (2016), from May 2013 to January 2016, 820.796 trips were made using public bicycles, corresponding to 295.47 of carbon credit (1 ton of carbon dioxide (CO2) corresponding to 1 carbon credit). The system is available for use every day from 5a.m. to 11 p.m.

4.1.3.2 Coverage of operating costs

Nowadays, there are 2 kinds of contracts - license and concessions, between the Consórcio de Transporte Metropolitano - CTM (Metropolitan Transport Consortium) and the companies that run the bus and/or BRT systems. The entire metropolitan region was divided into 7 areas and all the lines are organized inside one of these 7. The CTM auctioned off operation of the lines within those areas in 2013, however, until November 2015, only 2 of these areas have had their concession contracts signed with the bus companies, and started to receive subsidy for their operational costs, 11.29% from the State Government (See figure 12).

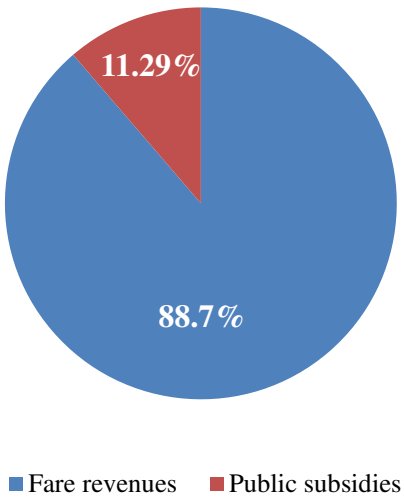

Figure 12: Coverage of operational costs of buses in the RMR in 2015

Source: Adapted from Verbal information[2].

[2] GRANDE RECIFE, interview conducted in November 2015.

In the concession contracts, the fare is defined to be unrelated to the cost of operating the service and the State government is the one responsible for covering operating costs, if these are not covered in the price of the fare. The remaining bus lines continue to be operated under the license contract, where companies receive no subsidy and operating costs are covered by the company itself, through fares (Verbal information)[3].

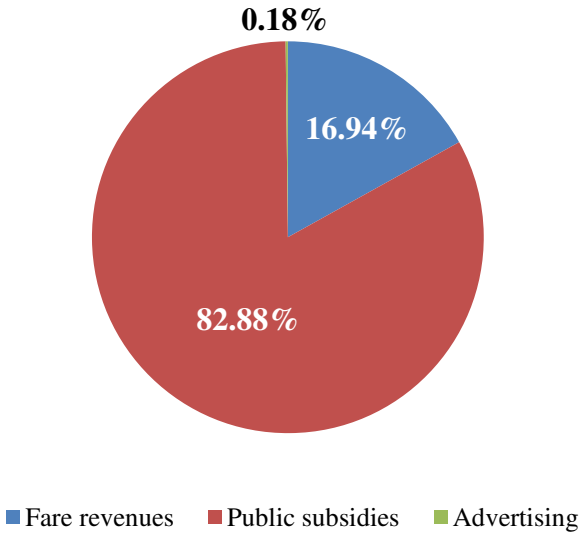

Figure 13: Coverage of operational costs of metro/LRT in the RMR in 2015
Source: Adapted from (Verbal information)[4].

Regarding to the metro system, coverage of operational costs (See figure 13), according to the CBTU/ STU-REC Planning Report of August 2015, only 17.12% of the operational costs were covered by the revenues (16.94% by fare revenues and 0.18% by advertising) and the remaining 82.88% was subsided by the Federal Government (Verbal information)[4].

It is noteworthy to mention that in Brazilian cities, as a rule, the total cost of the bus systems is often covered exclusively by payment of fares, in contrast to European cities, where generally, public transport operating costs are covered by resources from taxes and revenues from fares (IPEA, 2013).

In Brazil, in January 2015, only the city of São Paulo offered significant subsidies. In the others, the bus system (the main public transport mode in Brazil) was paid almost entirely by those who use PT, with only a small percentage of subsidies to cheapen the fare being

[3] GRANDE RECIFE, interview conducted in November 2015.
[4] CBTU, interview conducted in October 2015.

generated through revenue in the way of advertisement, sale of smartcards, among others (MORENO, 2015).

The direct consequence of this is possible to observe in quality items of the system, and therefore in the supply of information about the system, the focus of this research. The next section describes the actual situation of the information system in Recife.

4.1.4 Information available on public transport

The responsibility of provision of information in public transport varies according to the mode and the place/source of information that should exist. In the infrastructure of buses (stop/stations), the responsible party for providing these is Grande Recife Consórcio de Transportes. In buses (vehicles), the Grande Recife is the one responsible for providing the information to the companies that operate the buses, which have to publish it for passengers. For metro/LRT stations and rail vehicles, CBTU is the one responsible.

The following topics will describe the current situation regarding to the supply of information in the different components of the transit system.

4.1.4.1 On vehicles

a) Buses:

a.1) Outside:

a.1.1) Front: There is information about the name and number of the line, fare price, a short list of places that the line covers, direction (suburb or city), and if it suitable for people with disabilities. Moreover, the name of the operating company and the bus number are also displayed (See figures 14 and 15).

a.1.2) Side: The name of the operating company and the bus number (not the line) and if it suitable for people with disabilities.

Figure 14: Bus with information
Source: TV Jornal (2016).

Figure 15: Bus without the complete information that it supposed to have.

a.1.3) Back: The name of the operating company and the bus number (not the line), if it is suitable for people with disabilities and customer service number of the operating company (See Figure 16).

Figure 16: Back of bus

a.2) Inside: There is no visual or audio operational information (e.g.: route, connections, etc) inside buses on the next stop/station. The information available (See figures 17 and 18) contains the number of the line, the bus number, the name of the operating company and customer service number. Operational information will only be added temporarily as a result of future/current line route changes (permanent or caused by special events and circumstances).

Figure 17: Inside bus: information available.

Figure 18: Inside bus: information available.

b) BRT:

b.1) Outside:

b.1.1) Front: There is information about name and number of the line and if it is suitable for people with disabilities. Moreover, the number of the BRT is also displayed (See figure 19).

Figure 19: BRT: front view

b.1.2) Side: The number of the BRT (not the line), the name of the line, the SEI logo (indicating that the BRT is part of the integration system) and that if it is suitable for people with disabilities (See figures 20 and 21).

Figure 20: BRT: side view

Figure 21: BRT: side view

b.1.3) Back: The bus number (not the line), the symbol for whether the BRT is suitable for people with disabilities, and Grande Recife's central free call number (See figure 22).

Figure 22: BRT: back view

b.2) Inside: There is only the bus number and customer service number (See figures 23 and 24). Operational information will only be added temporarily as a result of future/current line route changes (permanent or caused by special events and circumstances).

Figure 23: BRT: information inside

Figure 24: BRT: information inside

c) Metro:

c.1) Outside:

c.1.1) Front/back: There is the direction of the line and the name of the company available (See figure 25).

Figure 25: Metro vehicle: front view

c.1.2) Side: There is information on the name of the company (See figure 26).

Figure 26: Metro vehicle: side view

c.2) Inside:

c.2.1) North line: There is visual and audio operational information about the next station and the direction (destination). Moreover, inside there are maps of the lines and its connections (See figures 27 and 28).

Figure 27: Metro vehicle/North line: inside – map of lines

Figure 28: Metro vehicle/ North line: inside – destination

c.2.2) South line: There are audio operational information about the next station, the direction (destination) and maps of the lines and its connections. However, vehicles on this line do not display visual on next station or direction (destination) information.

d) LRT

d.1) Outside

d.1.1) Front/back: There is information on the direction of the line (See figure 29).

Figure 29: LRT vehicle: front view

d.1.2) Side: There is information on the name of the company and number of vehicle (See figure 30).

Figure 30: LRT vehicle: side view

d.2) Inside: There is visual operational information about the stations in the line, the next station, general information on the system and RMR, and map of metro + LRT (See figure 31).

Figure 31: LRT vehicle: inside view

It is noteworthy to mention that during the use of the LRT in the direction “Cajueiro Seco – Curado” it was observed that the information about destination and stations were wrong during the entire trip (“Informed as Cajueiro Seco – Cabo”).

4.1.4.2 *On stops/stations*

a) Bus:

According to Grande Recife[5] in March 2015, there are 5,816 Bus Stops/stations in the Metropolitan area of Recife, covering a population of 2 million passengers using its 394 bus lines. Stops can be found in one of the six following formats:

a.1) "L" columns (2,753 - 47.33%) - Found in sidewalks where it is not possible to place another format of stop/station. In this case, there is only one thin shelter structure support, where the lines are listed in a metal sheet (40 x 50 cm) at the top. In this type of urban equipment, according Grande Recife, it is not possible to place a list with the bus lines that supply the stop. Therefore, there is only information about name and number for the company responsible for the management of the bus infrastructure (See figure 32);

Figure 32: "L" columns bus stop

a.2) Metal shelters (2,018 - 34.70%) – The information about the lines can be presented in an inner sheet of metal of the support (See figure 33). In addition, the name and number for the company responsible for the management of the bus infrastructure can be displayed;

[5] Information given by Grande Recife through a letter provided by the Legal Coordination on 13 April 2015.

Figure 33: Metal shelters bus stop

a.3) Precast concrete shelter (472 - 8.12%) – These are made of concrete, this format of stop has only one central column, where you could have information on the relation of the lines, the name and number for the company responsible for the management of the bus infrastructure (See figure 34);

Figure 34: Precast concrete shelter

Source: Leal, 2011.

a.4) Shelters with advertisement (406 - 6.98%) – These shelters have an acrylic and metal structure, lighting, benches and advertising panels. They are part of a concession contract signed with a private company; the contract includes providing the list of the bus lines that supply the stop. These are available only in neighborhoods with high passenger flows.

a.5) Signals in concrete pole (87 - 1.50%) – These are used when no other format can be used, and its purpose is to indicate where the stop is located, it contains no information;

a.6) Supports (80 - 1.38%) – These are used for sidewalks where it is not possible to place a metal shelter. In this case, there is only the supports that forms the shelter structure. Similar to the metal shelter, the lines can be listed in the metal sheet. In addition, there is the name and number for the company responsible for the management of the bus infrastructure;

It is important to highlight that according to Grande Recife[6] of the 6 formats of bus stops/stations, only 2,570 (44.10%) have, from their technical point of view, the potential for the installation of PT information. Despite this potential, only 887 (15.25%), merely contains the list of lines (name/number) that supply the stop in March 2015.

b) BRT:

BRT stations have the static information (in Portuguese and English) about the station's name and fare outside. Inside, there are the station's name and boarding directions (See figures 35, 36 and 37).

Figure 35: BRT station: overview

Figure 36: BRT station: access

[6] Information given by Grande Recife through a letter provided by the Legal Coordination on 13 April 2015.

Figure 37: BRT station: inside view

c) Metro:

Metro stations have static information about the station's name, boarding directions, maps of lines and connections, and maps of the surrounding area (in Portuguese and English). Moreover, there is real-time information in the platforms that shows the estimated arrival time of the next vehicle (See figures 38, 39, 40, 41 and 42).

Figure 38: Metro station: inside view

Figure 39: Metro station: boarding directions

Figure 40: Metro station: Network map

Figure 41: Metro station: Map of area

Figure 42: Metro station: real time information

d) LRT:

In the stations that are only supplied by LRT (i.e.: no metro), there is no kind of information. Moreover, there is no system to collect fares, meaning that users who access the Metro/LRT system through the LRT stations do not pay any fare for using the system (See figures 43 and 44).

Figure 43: LRT station

Figure 44: LRT station

4.1.4.3 Accessible anywhere (Pre-trip, ongoing trip)

a) Bus/BRT:

a.1) Official web-site (Grande Recife): In the official website it is possible to look into static information about:

a.1.1) Lines: using the name or number of the line you can obtain the bus route (major roads or well-known places), stops/stations, fare and name of the company that operates the service;
a..1.2) List of lines: you can search per company, per neighborhood within a city, per stop/station and according to the proximity to some well-known places;
a.1.3) Fares: related to each "ring" and some optional lines;
a.1.4) Stops/stations: search for stops according to their numbers;
a.1.5) Timetables: using the name or number of the line you can obtain the timetable for that particular line (just the time that the bus leaves the terminal).

a.2) Central free call service (Grande Recife): This call service works from 7 a.m. to 7 p.m., Sunday to Sunday. Its main purposes are giving static information to people and receiving complaints that passengers may have about the Public Transportation System.

a.3) Citta Mobi online/app (Urbana-PE - Union of Passenger Transport Companies in the state of Pernambuco): This application allows people to search for real time information on arrival time of buses (through GPS installed on the buses). It also displays information on routes and

stops, and whether or not the vehicle is suitable for the disabled. Moreover, it is possible to know where the nearest bus stop is and which lines supply it. The app also allows the user to top up the Metropolitan electronic card (VEM).

b) Metro / LRT:

b.1) Official web-site (CBTU): In the official website it is possible to look into static information about:

b.1.1) Timetables: The entire schedule, only for the LRT, working hours and headways for the metro;
b.1.2) Fare;
b.1.3) Line maps: showing the location of the stations

b.2) Call service (CBTU): This call service works on weekdays and commercial hours. Its main purposes are giving static information to people and receiving complaints passengers may have about the Public Transportation System.

c) Both bus, BRT, metro and LRT

c.1) Moovit app (independent source): It is possible to look into static integrated information combining bus/BRT, metro/RLT and public bike sharing. This allows planning trips based on origin–destination points. Shows the stops over the entire route and walking routes. According to Moovit (interview conducted in December 2015), the information available in the app was initially provided by the Grande Recife and nowadays, a voluntary community of users helps updating the information and mapping of new lines.

c.2) Google Maps online/app (independent source): It is possible to look into static integrated information combining bus/BRT and metro/LRT. This allows planning trips based on origin – destination points, departure and arrival expected times, it also shows the fare corresponding to the displacement. The app also shows the stops over the entire route and walking routes. Moreover, it is possible to easily compare the travel times by car, public transport, walking and by bicycle, which can help the traveler in the choice of transport.

4.1.5 Discussion about the information available

In short, in Recife, there are some sources of information accessible anywhere, however, to date, there is no official website providing passengers with integrated information on public transport, but instead unimodal static information. The fact that the operation is made by several companies, managed on different governmental levels (municipal, state and federal) contributes to the difficulty in the integration of the information.

However, the most critical part is related to the information available in the bus system (vehicles and stations), since the majority of stops/stations do not have even names nor identification numbers. Furthermore, the vehicles do not have route maps nor audible or visual warnings about the next stop/station on board. In addition to this, it is necessary to have some knowledge on well-known reference points (e.g. public institutions, shopping centers, etc) to understand the information given on the outside, front of the buses, about the route. Moreover, this information remains static and unimodal, and does not change based on the direction of travel; there is only a dynamic signboard indicating the direction of travel (city or suburb).

This way, people who do not have access to internet/smartphone (pre-trip) or are in ongoing trips and do not have access to online information, have to ask other passengers or the driver for information about buses, routes and fares.

It is noteworthy to mention that there is a Federal Law in Brazil, known as "*Lei de Mobilidade Urbana*" (Urban Mobility Law) – Nº. 12.587 (BRAZIL, 2012), quoting in its Chapter III, Art. 14 that: "Users of the National Urban Mobility System have the right (…) to be informed at the point of boarding and disembarkation of passengers, free of charge and in an accessible way about routes, timetables, fares and connections with other public transport modes".

Despite of this law, which requires the provision of a minimum of static information, it is observed in many cities the noncompliance of it, where the absence or incompleteness of information is observed in different parts of the system. In Recife, the magnitude of this breach concerned the operators of the bus public transport system, who have searched for ways to improve this situation.

The CittaMobi is a mobile application that was developed by a company hired by the union of Public Transport companies (VASCONCELOS, 2015). It is important to highlight that this tool should have been provided by Grande Recife Metropolitan Transport Consortium, who is the body responsible for the management of the public transport in Recife's Metropolitan Region. According to the local newspaper Diário de Pernambuco (VASCONCELOS, 2015), the consortium has the design of this monitoring tool, which should have come into operation before the FIFA World Cup in 2014.

Since neither Moovit nor Google maps - the integrated information sources available - are not updated officially with official data, the reliability of the information provided is not guaranteed.

According to Grande Recife (2015), each month the Customer central call service receives about 8,000 calls of which 70% are related to information on issues such as bus routes, VEM student and student card. The high number of calls due to passengers enquiring further information on the system highlights the insufficient amount of information currently available.

The current scenario of information only reflects the existing structure on public transport in the RMR, where different transport systems coexist sharing the same physical space and tariff collection system in integration terminals. However, they do not have an operational integration nor do they come to an agreement regarding in the division of revenue generated from such shared system.

4.2 NATAL

Natal, the capital of Rio Grande do Norte's State is the nineteenth most populated city in Brazil hosting about 800,000 inhabitants (See figure 45). This city is the core of a metropolitan area comprising of 12 municipalities and more than 1.5 million inhabitants (IBGE, 2015a).

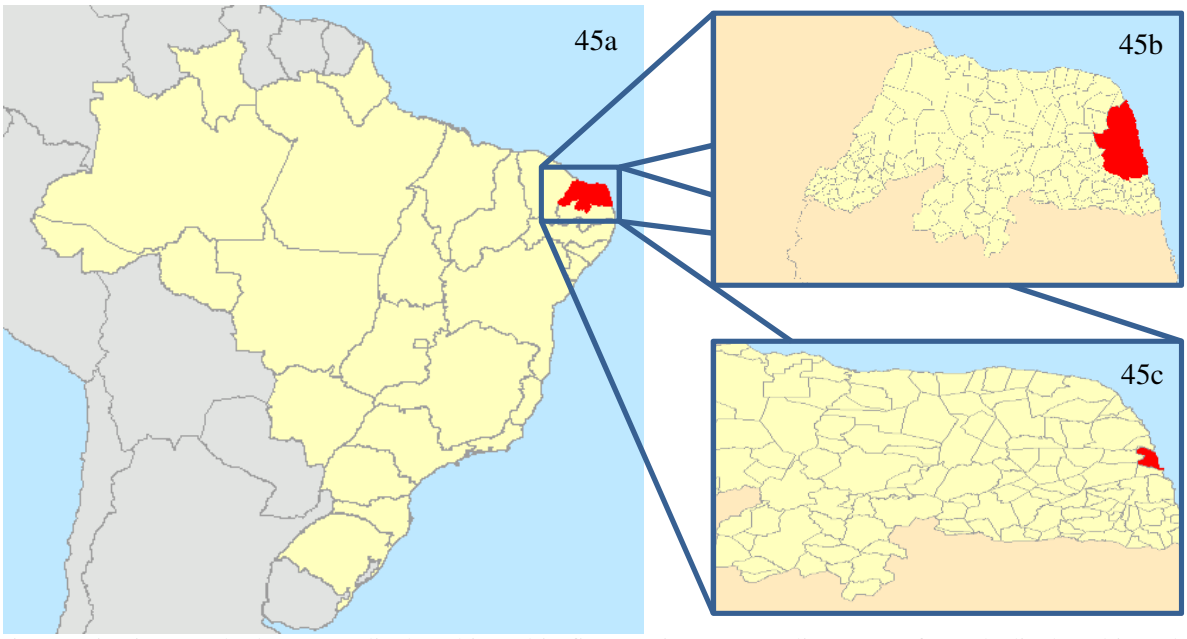

Figure 45: Rio Grande do Norte (displayed in red in figure 45a), Metropolitan area of Natal (displayed in red in figure 45b) and Natal (displayed in red in figure 45c).

The climate of Natal is tropical with temperature ranging from 23.5 °C to 29.7°C. The average relative humidity is 80% and the rainiest months are from April to June (NATAL, 2015). It is also known as "Sun city" because about 300 days per year are sunny; making it one of the most sought after destinations in Brazil's northeastern coast (See figures 46 and 47).

Figure 46: Photograph of Natal
Source: Natal (2015)

Figure 47: Photograph of Natal
Source: Natal (2015)

Natal concentrates the majority of the population (57.30%) of the Região Metropolitana de Natal - RMN (Metropolitan Region of Natal), being the most important city of this region, with a GDP per capita of USD$ 6,034.15 in 2013 (See table 6) (IBGE, 2015b).

Table 3: RMN municipalities' socioeconomic data

MUNICIPALITY	AREA (km²)	POPULATION (2015)	HDI (2010)	GDP PER CAPITA (2013)[7]
Ceará-Mirim	724.38	72,878	0.616	USD$ 1,998.38
Extremoz	139.58	27,525	0.660	USD$ 2,843.68
Ielmo Marinho	312.03	13,400	0.550	USD$ 1,716.68
Macaíba	510.77	78,021	0.640	USD$ 3,932.97
Maxaranguape	131.32	11,831	0.608	USD$ 1,870.09
Monte Alegre	210.92	22,155	0.609	USD$ 1,755.54
Natal	167.26	869,954	0.763	USD$ 6,034.15
Nísia Floresta	307.84	26,606	0.622	USD$ 2,602.62
Parnamirim	123.47	242,384	0.766	USD$ 3,740.77
São Gonçalo do Amarante	249.12	98,260	0.661	USD$ 2,987.32
São José de Mipibu	290.33	43,191	0.611	USD$ 3,189.47
Vera Cruz	83.89	12,016	0.587	USD$ 1,628.56
	3,250.91	**1,518,221**	**0.644**	**USD$ 2858,35**

Source: Adapted from IBGE (2015b).

Having a population density of 5,201.21 inhab./km² and an index of 1.90 travel a day per inhabitant in 2007 (PDTM/RMN, 2008), Natal has some problems related to urban mobility that will be explored in the follow section.

4.2.1 The University chosen

In Natal, the Federal University of Rio Grande do Norte – UFRN was chosen to carry out this study. The UFRN is a public university that is free of charge for students located in the Northeast of Brazil, in State of Pernambuco. The part of UFRN where the study was performed is located in a 123 hectares area. In addition to the various sectors of classes the campus has laboratories and libraries, restaurant, banks, bookstores, art gallery, the post office, outdoor amphitheater and multisport arena (UFRN, 2016).

The UFRN offers 84 undergraduate courses, 9 undergraduate distance learning courses and 86 graduate courses. Its academic community consists of more than 37,000 students (undergraduate and graduate), 3,146 technical and administrative staff and around 2,000 effective teachers, in addition to the substitute teachers and visitors (UFRN, 2016).

[7] Dollar Exchange Rate for 20 October 2015. Exchange Rate of 1.00USD = 3.88BRL

4.2.2 Urban mobility in RMN

The last Origin-Destination survey (2007, apud PDTM/RMN, 2008) conducted in 2007, revealed that the share corresponding to public transport users was bigger than the one correspondent to use of individual transport, but compared to the previous survey made in 1996, it was noticed a slight decrease in the PT use from 66% to 60% and an increase in individual vehicles use (34% to 40%), considering only the motorized trips (See table 7).

Table 4: Trips by mode RMN

	Transport mode	Trips	(%)
Motorized	Public transport	727,377	34.9
	Individual transport	484,293	23.3
Non – motorized	Walk	760,453	36.5
	Bicycle/moped	104,907	5.0
	Others	5,682	0.3
	Total	2,082,711	100

Source: Adapted from origin-destination survey (2007) apud PDTM/RMN (2008).

It is noteworthy that the share of public transport is composed by 68.4% of trips made by inner city buses, 19.3% of trips were made by inter city buses, 5.7% of trips were performed in scholar buses, 4.8% by chartered transport, 1.5% by trains and 0.3% by boats (Origin-destination survey, 2007 apud PDTM/RMN, 2008).

The high rate of trips on foot and the low rate of cycling are also noteworthy. In some extent, the small share of bicycle users is due to the lack of infrastructure compatible to its use in a safe way. In a total, Natal has almost 20 km of bicycle lanes.

One survey conducted in October 2015 in Natal, aiming to identify the profile of bicycle users, showed that 75% of the cyclists have as a destination the work place, 43% have an income from 1 to 2 minimum wages and the distance traveled by the majority of the respondents ranging from 2 to 5 km (PLANMOB NATAL, 2015).

Moreover, the origin-destination survey found that the average travel time for PT users was 55.9 minutes, while only 27.3 minutes for car users. Speeds inferior to 15 km/h were obtained for public transport, while the individual transport presented an average speed of

30km/h (Origin-destination survey, 2007 apud PDTM/RMN, 2008). This scenario reflect the lack of priority given to transit, making this one option less interesting and uncompetitive, as the travel time are twice as much as by car.

Nowadays, in Natal and RMN, the proportion between population and car ownership is as huge as in Recife and RMR. In January 2016, there were 370,693 motorized vehicles in Natal, 213,603 corresponding to cars. Considering the entire Metropolitan region, these numbers were equal to 546,552 and 302,623, respectively (DETRAN/RN, 2016). What that means is that currently there is 1 car for every 4 people in Natal and 1 car for every 5 people in the RMN.

According the Plano Diretor de Transporte Metropolitano da Região Metropolitana do Natal – PDTM/RMN (Master Plan for Metropolitan Transportation in the Metropolitan Region of Natal) (2008), in 2008, during peak hours 9.4 km of traffic jams were recorded and it was expected to growth to 21.8 km in 2017 and 60 km in 2027 if no improvement measure was taken.

Costa and Morais (2014) have compared the travel time of one line that has origin-destination points in the East and West zones of Natal and found that in 2007 the route was done in 75 minutes, while in 2014 the same route was done in 110 minutes, increasing by 46%.

After understanding this context, an increase in the rate of public transport use is essential to improve this scenario, the following section presents the network and modes available in Natal and RMR.

4.2.3 The structure of public transport

4.2.3.1 Overview

Different from the Metropolitan region of Recife, the other Brazilian region analyzed in this study, the public transport of the Metropolitan Region of Natal is not integrated. Each municipality has its own inner city system, which is composed in their majority by microbuses and vans; except the city of Natal, where buses are more abundant. The intercity

systems is composed of bus and rail lines. The latter is operated by a public company: Companhia Brasileira de Trens Urbanos – CBTU (Brazilian Urban Train Company).

Figure 48: Coverage of Conventional System (buses)
Source: STTU, 2015.

Figure 49: Coverage of Optional System (microbuses)
Source: STTU, 2015.

In the city of Natal, the transit system is managed by the municipality is composed of buses (Conventional system) and microbuses (Optional System), which coverages showed in Figure 48 and Figure 49). The former operate with 646 buses performed by a combination of 07 private companies and transports 530,000 passengers daily in 86 lines. The latter has a fleet of 177 microbuses run by individual operators and is responsible for around 50,000 daily passengers in 27 lines (STTU, 2015). There is no integration between both systems and there some of their lines do overlap.

In the case of the rail transit, 2 lines with a total length of 56.2 km connect a total of 22 stations and covers 4 municipalities in the Metropolitan Area: Natal, Parnamirim, Ceará Mirim e Extremoz (CBTU, 2015b). The system is composed of trains and light rail transit – LRT and transports 8,200 passengers daily, on weekdays (See Figure 50).

The north line links Natal to Ceará-Mirim and has 05 departures daily (on weekdays) in either direction. The system works from 06:48 a.m. to 07:58 p.m. in the direction from Natal to Ceará-Mirim and from 05:20 a.m. to 06:22 p.m. in the direction from Ceará-Mirim to

Natal. The average headway between trips is 180 minutes on weekdays. On Saturdays, the system only performs 04 trips and, stops at 16:54 and 15:26, respectively (CBTU, 2015b).

Figure 50: Rail system network
Source: CBTU, 2015b.

The south line links Natal to Parnamirim and has 07 departures daily on weekdays (except on Wednesdays where it has 1 more trip) in either direction. The system works from 06:32 a.m. to 07:30 p.m. in the direction Natal-Parnamirim and from 05:40 a.m. to 06:38 p.m. in the direction Parnamirim-Natal. The average headway between trips is 104 minutes on weekdays. On Saturdays, the system only performs 03 trips in the direction Natal to Parnamirim and 04 in the direction Parnamirim-Natal, stopping at 12:35 p.m. and 01:27 p.m. respectively (CBTU, 2015b).

The lines have physical integration in “Natal station”, where the user can change to the other line. Thus, it is possible travel from Ceará Mirim to Parnamirim or vice versa by paying only 1 fare.

Regarding the bus services between metropolitan urban cores and Natal, these are managed by the State of Rio Grande do Norte through the Departamento de Estradas e Rodagem - DER (Department of Highways and Roads) and consist of around 250 buses and

1,000 microbuses with a global daily use of around 175,000 passengers (See Figure 51 and Figure 52).

Figure 51: Intercity regular system
Source: SIN/RN, 2007.

Figure 52: Intercity optional system
Source: SIN /RN, 2007.

4.2.3.2 Coverage of operating costs

The city of Natal is divided into 3 areas: the first and second are covered by the conventional system and the third is covered by the optional system. The Secretaria Municipal de Mobilidade Urbana - STTU (Municipal Department of Urban Mobility) auctioned off operation of the lines within those areas in 2015 and then made concession contracts with 7 companies (STTU, 2015). Natal's municipal complementary law n. ° 149 (May 2015, 18) defines that the City Council of Transport and Urban Mobility, may allocate up to 30% (thirty percent) of the income of the Municipal Fund of Public Transport to make public subsidies for fares aiming to ensure the social function of Natal's Public System of Urban Public Transport of Passengers . The gratuities and discounts represent an impact in the fare price of 26.14% (STTU, 2015).

The rail system, as it also occurs in Recife, is highly subsidized by the federal government, making the fare really cheap (R$ 0.50 or US$0.13[8]), but on the other hand,

[8] Dollar Exchange Rate for 20 October 2015. Exchange Rate of 1.00USD = 3.88BRL

limiting the quality that can be achieved by this system. It is noteworthy that the fare on the rail system is more than 5 times cheaper than the bus fares.

4.2.4 Information available on public transport

The ones responsible for providing PT information on bus stops in the municipality of Natal is STTU and on bus stops in the Metropolitan Region of Natal is DER. Inside buses it is the responsibility of the company operating the service to ensure information is available. In the rail system, the information is available in both station and on vehicles, and both are the responsibility of CBTU.

The following topics will present the current situation regarding information available in Natal and its metropolitan region.

4.2.4.1 On vehicles

a) Bus: Have information about the name and number of the line, fare price, a short list of places that the line covers, direction (suburb or city). It will also display information on whether or not it is suitable for people with disabilities, the bus number, the name of the operating company and customer service number. There is no visual or audio operational information (e.g.: route, connections, etc) inside buses on the next stop/station.

b) Rail system: Information on the direction of the line and the name of the company can be found inside the carriages. There is also visual and audio operational information about the next stop/station. Moreover, maps of the lines and its connections are also displayed.

4.2.4.2 On stops/stations

a) Bus: It is possible to find the list of lines that supply the stop, but some stops are not properly signaled to indicate that it is indeed a stop.

b) Rail stations: have the static information about the station's name, boarding directions and maps of lines. There is real time information on the estimated arrival time for the next trains.

4.2.4.3 Accessible anywhere (Pre-trip, ongoing trip)

a) Bus:

a.1) Official web-site (STTU): In the official website there was a place to look into static information about bus lines, but it's not been working since 2010 (JORNAL DE HOJE, 2014 apud RODRIGUES, 2014). The only information available is the traffic in some main streets of Natal in real time, through photos taken almost every minute which are then displayed on the site.

a.2) Central free call service (STTU): This call service gives static information to people and receives complaints that passengers may have about the Public Transportation System and traffic.

b) Rail system:

b.1) Official web-site (CBTU): In the official website it is possible look into static information about the schedule and working hours for each line.

b.2) Call service (CBTU): It is possible ask for static information.

c) Both bus and rail system:

c.1) Moovit app (Independent source): It is possible look into static integrated information about buses and rail systems. Allows planning trips based on origin/destination points.

c.2) Google Maps online/app (Independent source): It is possible to look into static integrated information combining buses and rail. Allows planning trips based on origin – destination points, departure and arrival expected times. Moreover, it is possible to easily compare the travel times by car, public transport, walking and by bicycle, what can help the traveler in the modal choice.

4.2.5 Discussion about the information available

The system is not itself integrated physically nor is it been set up to effectively collect fares, present overlap of lines and different smartcards options, exposing the lack of planning and conception of the systems as a composition of a single network. In the information service, this is reflected since there is no official source that provides integrated information and not even unimodal dynamic information accessible anywhere.

In Natal, to date, no integrated official website that provides passengers with an integrated source of passenger information exists.

4.3 COPENHAGEN

Copenhagen (København) is the capital of Denmark and has a population of 589,699 inhabitants in 2015. Its metropolitan region (Hovedstadsområdet) is known as Greater Copenhagen Area (GCA) and has a population of 1,786,469 inhabitants (DENMARK, 2015a).

Figure 53: Map of Denmark (Greater Copenhagen is in blue)

Source: Danish Geodata Agency, 2015 apud DENMARK, 2015a.

The GCA comprises 18 municipalities (See Figure 53) extending for about 3000 sq.km., including: Copenhagen (København), Frederiksberg, Albertslund, Brøndby, Gentofte, Gladsaxe, Glostrup, Herlev, Hvidovre, Lyngby-Taarbæk, Rødovre, Tårnby and Vallensbæk municipalities together with part of Ballerup, Rudersdal and Furesø municipalities and lastly Ishøj City area and Greve Strand City area (DENMARK, 2015b).

Figure 54: Photography of Copenhagen
Source: Author

Figure 55: Photography of Copenhagen
Source: Author

According to Denmark (2015a) the average temperature in Denmark during the year generally varies from 1 °C in January (winter) to 20 °C in August (summer), but great variations in these averages occur in all months.

Being the economic and financial centre of Denmark, Copenhagen (See Figure 54 and Figure 55) is its largest city, having a population density of 6,729.1 (DENMARK, 2015a), what needs to be highlighted is the need for constant monitoring and analysis of issues related to urban mobility.

4.3.1 The universities chosen

4.3.1.1 Technical University of Denmark

In Denmark, the Technical University of Denmark - DTU was one of the chosen to carry out this study. DTU's main campus is located in Kongens Lyngby 15km north of Copenhagen, the capital city of Denmark in a 106 hectares area (DTU, 2015).

In 2014, there were 33 undergraduate courses, 28 MSc Eng. programmes, 25 Joints international MSc programmes and 19 PhD studies courses at DTU. The result of this is the high number of daily trips in the metropolitan area, performed by the teachers, technical and administrative staff, 7041 undergraduate students, 3,270 master students and 1,493 PhD students. The infrastructure consists of over 100 buildings (DTU, 2015).

4.3.1.2 University of Copenhagen

The University of Copenhagen operates in 4 campuses that together totalize 92,11 hectares of area. There are approximately one hundred different institutes, departments, laboratories, centres and museums, among other buildings, form the nucleus of the University, being the place where professors, lecturers and other academic staff, as well as most of the technical and administrative personnel, carry out their daily work (KU, 2014).

Over 200 programmes are offered for study in health and medical sciences, humanities, law, science, social sciences, and theology. In total, in 2014, there were 23,096 undergraduate students, 17,342 graduate students and 3,083 PhD students. Moreover, having a stuff composed by more than 9,000 employees, the University of Copenhagen is one of the largest institutions of research and education in the Nordic countries (KU, 2014), resulting in a high number of daily travels.

4.3.2 Urban mobility in GCA

In GCA a rate of over 50% was observed in the modal share (See Figure 56) for “sustainable modes” (the sum of public transport and soft modes). This rate is even higher in Copenhagen, where 72% of the modal share is composed by sustainable modes. Such a great rates are due to the existence of a very dense public transport system in the area combined with the settled habit of walking and/or biking (CRTM MADRID, 2013).

In consonance with the application prepared by Copenhagen, when the city won the prize of 2014 European Green Capital city (COPENHAGEN, 2014), 98% of Copenhageners have less than 350 m to public transport, where 78% have less than 350 m and 94 % less than 600 m to high-frequency lines (Metro, S-train and A-bus).

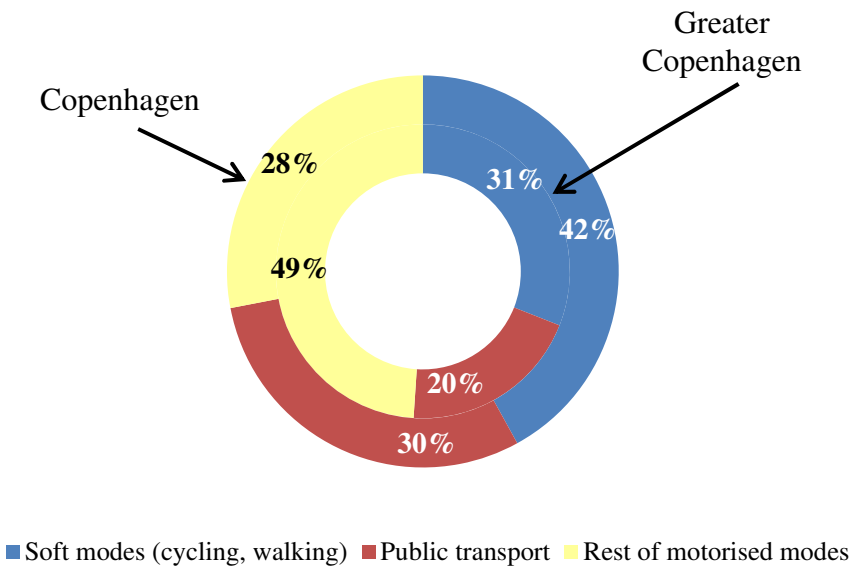

Figure 56: Modal share of trips in Copenhagen and Greater Copenhagen
Source: Adapted from CRTM Madrid, 2013.

As reported by the Danish Ministry of Higher Education and Science (DENMARK, 2016a), only considering Copenhagen, every day a total of 1.1 million kilometers are ridden by bicycles through the 350 km of cycle lanes and 40 km of parkland cycle routes. It is also noteworthy that 1 out of 3 people travel to work or school by pedal-power every day.

Regarding the public policies related to transport, Danish car and motorcycle owners have to pay a Registreringsafgift – RA (Vehicle Registration Tax) upon registering their vehicle, of 105% of its value for vehicles bought for under 12,435.31USD[9] (81,700 kroner), and 150% of the value for vehicles bought for over this amount (BARRETT, 2015).

However, according to EMTA Barometer of public transport in the European Metropolitan Areas 2012 (CRTM Madrid, 2013), there are 326 cars for each 1,000 inhabitants in Copenhagen (1 car to each 3.07 inhabitants).

As reported by Urban Mobility Scorecard Annual Report 2015 (INRIX, 2015a), Copenhagen has an average commute time of 38 minutes and its drivers spend 7.5 minutes in traffic per day, 32.5 hours per year.

[9] Dollar Exchange Rate for 20 October 2015. Exchange Rate of 1.00USD = 6.57DKK

Aiming to improve this scenario, INRIX (2015b) affirms that, in 2015, Denmark has become the first country in the world to have trust in GPS data (from personal navigation devices, mobile apps and fleet vehicles) to monitor traffic and better manage congestion across the country's entire road network (more than 4,000 kilometers ~ 2,500 miles).

The Danish Road Directorate can detect extraordinary traffic queues faster and, through providing real-time traffic information, can deliver more timely information to drivers, alerting them to congestion hot spots and providing re-routing options in good time. This system adapts to weather and real-time traffic conditions (INRIX, 2015b).

4.3.3 The structure of public transport

4.3.3.1 Overview

The transit system and road connections in GCA were developed and operate according to the "Finger Plan" developed in 1948, aiming to align, manage and connect the city's growth and the provision of public transport. At the time, only 2 suburban railways had been established and the proposal was to build railways in to the surrounding area aiming that future suburban developments, instead of forming concentric layers, could assume the shape of extensions or "fingers"; from Copenhagen to Køge, Roskilde, Frederikssund, Hillerød and Helsingør (Dansk Byplanlaboratorium, 1993).

The transit network of the GCA consists of 7 major modes: (i) metro, (ii) local trains, (iii), suburban trains (S-trains), (iv) regional and intercity trains, (v) regular buses, (vi) high-frequency buses (A-buses), and (vii) suburban and express buses (S-buses and E-buses).

The system carries annually almost 220 million passengers on the nearly 450 bus routes and 10 local rail lines spread throughout Zealand (Movia, 2016a). There is free internet in buses and trains.

The metro that serves the CBD of Copenhagen and the airport, is partly an underground rail network and has 3 separate alignments (See Figure 57). Furthermore, runs 24 hours a day, 7 days a week with headways varying from 2 to 6 minutes in the day time and from 7 to 20 minutes at night (Metroselskabet, 2016). The Metro runs through 21 kilometers of both

Copenhagen and Frederiksberg, having 22 stations on route, where 5 of these (Vanløse, Flintholm, Nørreport, Ørestad and Lufthavnen) have connections with the S-Train and regional rail networks (Metroselskabet, 2016).

Figure 57: Copenhagen metro system

Source: Metroselskabet, 2016

Copenhagen's metro is currently undergoing an expansion known as Cityringen circle, which will be finished in 2019. The Cityringen circle line will be a 15 km underground railway with 17 underground stations under downtown Copenhagen, the "bridge quarters" and Frederiksberg (Metroselskabet, 2016).

The metro is owned by Metroselskabet, which is a partnership by the City of Copenhagen (50 %), the Danish Government (41.7 %) and the City of Frederiksberg (8.3 %). The company Ansaldo STS is the one responsible for operating the Metro, with the Metro Service A/S as subcontractor (Metroselskabet, 2016).

The train system is operated by *Danske Statsbaner* (DSB)[10], which is an independent state-owned company. The public transport network in GCA is dominated by the regional trains, and the urban and suburban train lines (S-trains) (See Figure 58). The major part of the system is composed by:

[10] Except the local trains that are operated by Movia.

a) Suburban trains (S-trains): follows the radial finger lines from central Copenhagen to the 5 cities existing in the finger plan. Have a rail network covering 170 km double track, totaling 7 lines, and carry around 345,000 passengers on weekdays (DSB, 2016). The S-trains run between 05:00 in the morning and 00:30 at night, with headways varying from 4 to 20 minutes, according to the line. On Friday and Saturday the trains run once an hour between 01:00 and 05:00, except the line F which runs every half hour during these hours (WONDERFUL COPENHAGEN, 2016). In agreement with the Ministry of Foreign Affairs of Denmark (DENMARK, 2016b), there are 84 S-train stations.

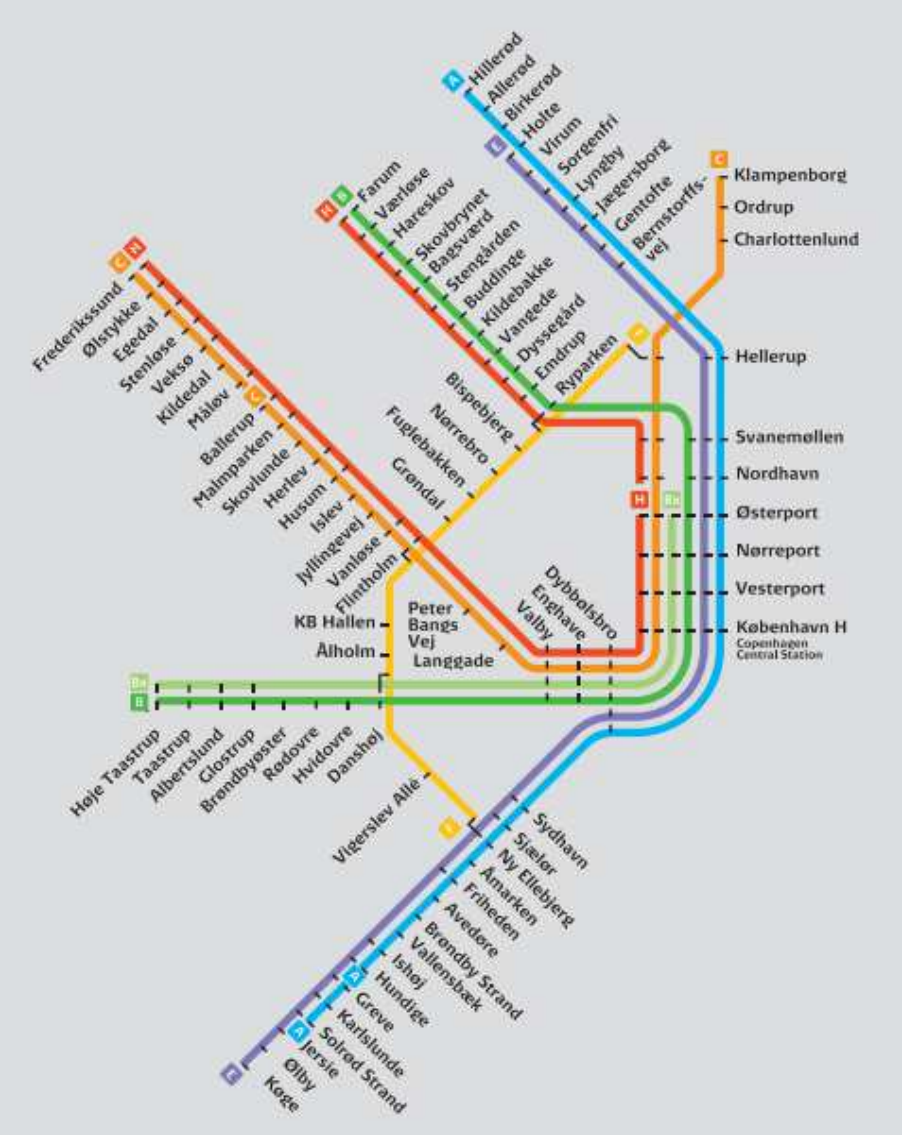

Figure 58: Copenhagen S-train system

Source: Din Offentlige Transport, 2016.

b) Regional and intercity trains: leading north and west of Copenhagen.
c) Local trains: serve the cities near Copenhagen and the rural areas close to and between these cities. These are operated by Movia; a public transport agency.

The buses are operated by different companies regulated by Movia. Lines of different nature run in the Greater Copenhagen Area, where the majority belongs to one of the following:

a) A-buses (yellow and red): are characterized by its high frequency (average 3 min of headway in day hours) supply operation with short travel time in the relevant corridors. These buses are local and serve the inner central part of Copenhagen 24h a day (Movia, 2016a).
b) S-buses (yellow and blue): are characterized by having a frequency of at least every 10 minutes during rush hour and 20 minutes off-peak. These buses operate from 6 a.m. to 1 a.m. These buses complement the trajectory control in finger connections by providing direct links across the railway lines (primarily in rings) and from surrounding municipalities into the central parts of Copenhagen. The primary target group is commuters and secondary is the leisure traveler (Movia, 2016a).

c) E-buses (yellow and green): are express buses that generate direct and extra-fast connections, operating selected (less) stops on the route. As well as S-buses, the E-buses also serve the S-train stations (primarily in rings). Its alignment primarily supports commuting along corridors with many passengers and complements often regular bus lines or S-buses in areas with many passengers (Movia, 2016a).

d) R-buses (yellow and blue): are characterized by having as direct a route as possible between major cities. These buses run twice an hour from 6 a.m. to 8 p.m. and hourly from 8 p.m. to 12 a.m. on weekdays and from 6 a.m. to 12 a.m. on the weekend and holidays. R-buses competitor is often the car and this is why these lines have less stops (better speed) (Movia, 2016a).

There are also special lines that operate only at night and ferries. The later are also responsibility of Movia, but all of which are operated by subcontractors.

Moreover, public electric bicycles that are operated by Gobike supply Copenhagen and to use the system, it is necessary to be more than 18 years of age. The bikes have a built-in tablet with Internet and GPS connectivity. Everything from error reports and user behavior data can be collected. Moreover, through the tablet it is possible to share experiences and routes on social media. The system works 24 hours per day, every day (GOBIKE, 2016).

4.3.3.2 Coverage of operating costs

In 2012, according to CRTM Madrid (2013), 51.9% of the operational costs in the GCA were covered by public subsidies, while 48.1% were from fare revenues (See Figure 59).

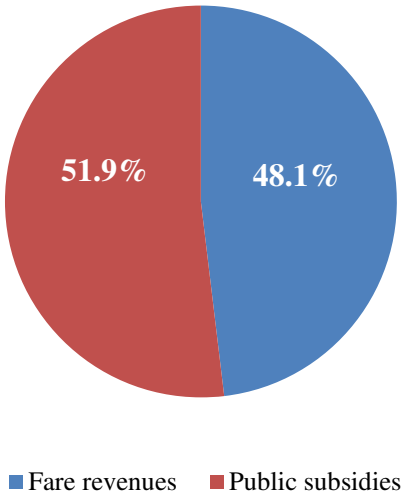

Figure 59: Coverage of operational costs in the GCA in 2012

Source: Adapted from CRTM Madrid, 2013.

Regarding the metro, the Annual Report 2014 of the Metroselskabet I/S (Metroselskabet, 2015), stated that in 2014 the total revenue was 171.69 million USD (DKK 1,128 million), of which 117.50 million USD (DKK 772 million) were from the tariff system and 54.18 million USD (DKK 356 million) primarily were from the lease of the Metro. In total, there was a profit of 17.81 million USD (DKK 117 million) (before financial items).

DSB, the independent state-owned company, which is responsible for trains, saw a profit before tax of 58.75 million USD (DKK 386 million) in 2013 (DSB, 2014).

As it can be noticed, there is a balance between public investments and revenues in order to maintain and operate the system. Such coordination among organizations is reflected in the entire system. The next section describes the actual situation of the public transport information system in Copenhagen.

4.3.4 Information available on public transport

Movia is the company responsible for providing information on public transport in bus stops and local train stations in the Metropolitan Region of Copenhagen and inside buses. In the rail system, the information available in both station and vehicles are the responsibility of DSB. Regarding the online information, the responsibility is of all companies operating the system.

The following topics will present the current situation regarding information available in Copenhagen and its metropolitan region.

4.3.4.1 On vehicles

a) Bus

a.1) Outside

a.1.1) Front: The vehicles have static information about the name and number of the lines, the number of the vehicle and the company that is responsible for the management of the service (See Figure 60).

Figure 60: Front view of Bus 5A

a.1.2) Side: Static information about the number of the line and the company that is responsible for the management of the service (See Figure 61).

Figure 61: Side view of Bus 195

a.1.3) Back: Static information about the number of the line and the company that is responsible for the management of the service (See Figure 62).

Figure 62: Back view of Bus 195.

a.2) Inside: Static information is available in the form of a map of the line showing the stops that have connections with other lines. Moreover, there is real time information informing the current zone and the next stops. In the buses that run in the center of Copenhagen, there are alternatively monitors, which transmit in addition to real-time information on zone, line and next stop, also news, weather forecast and advertisements. It is noteworthy that there is an audio message informing when the zone changes and what the next stop is (only in Danish). There is also printed information available in the form of leaflets, with have general information about the public transport system (See Figure 63, Figure 64 and Figure 65).

Figure 63: Map of the line inside the bus

Figure 64: Real time information on zone in a bus (Zone 51)

Figure 65: Real time information on zone, line and next stop in a bus (Zone 1)

b) Metro

b.1) Outside

b.1) Front/back/side: There is no information, possible due to the barriers existing between the metro vehicle and platform at the stations aiming keep passengers safe, blocking passenger view of the vehicle (See Figure 66).

5

Figure 66: Barriers and metro vehicle

b.2) Inside: Static information is available in a form of a map of the line showing the stops that have connections with other lines (See Figure 67). Moreover, there is real time information displayed (See Figure 68) and audio message informing the next stop (Only available in Danish).

Figure 67: Information of stops on the line

Figure 68: Information on next stop inside metro

c) Train:

c.1) Outside

c.1.1) Front/back: There is information on the letter corresponding to the line (See Figure 69).

Figure 69: Information on front/back of train

c.1.2) Side: There is information about the name and letter corresponding to the line. Moreover, the carriage intended for users with bicycles is signalized (See Figure 70 and Figure 71).

Figure 70: Information on side of train

Figure 71: Information on bicycle train carriages

c.2) Inside: There is information on all stations covered by the line, through real time information that shows where the train exactly is and what the next stop is (See Figure 72). Moreover, an audio message informs the next stop.

Figure 72: Real time information inside train

4.3.4.2 On stops/stations

a) Bus: All bus stops are identified by name and it is possible to consult the static information about lines that supply the stops, its timetables, the direction of the line, what the stops of each line are, the

current zone, map of the zones and the estimated travel time between main stops of the line (See Figure 73).

Figure 73: Minimum set of static information available at a bus stop

Moreover, real-time information on arrival time for the next buses is provided at bus stops in the city center and major locations and static maps of the public transport system showing the path of the lines are provided in high flow passengers stops (See Figure 74 and Figure 75).

Figure 74: Static and real time information on a bus stop

Figure 75: Map on a bus stop

b) Metro: All metro stations are identified by name and it is possible to consult the static information about lines that supply them. Some stations also have totems at the entrance with the map of lines. Inside the stations, there are map of zones, map of the metro paths/stations in the city and maps of the surrounding area (See Figure 76 and Figure 77).

Figure 76: Identification outside the station

Figure 77: Maps of general information at metro entrance

On platforms, there is real time information about the arrival time for the next vehicle (See Figure 78) and maps of the lines (See Figure 80 and Figure 82), including their connections with others metro lines and estimated travel time between stations. Moreover, there is a map of the fare system and general information on the system (purchase of tickets and information sources), map of surrounding area and map of the metro system drawn within the city (See Figure 81). Information about trains is found in metro stations that have connection with this mode (See Figure 79).

Figure 78: Real time information on metro

Figure 79: Real time information on trains inside metro station

There is also printed information available in the form of leaflets, with have general information about the public transport system.

Figure 80: Map of the lines, indicating the current station and giving general rules on the system (Also available in English)

Figure 81: Maps and general information on the system

Figure 82: Map of the lines, indicating the current station

c) Train: All train stations are identified outside by the signal “S” (As seen in Figure 83) and inside by name (See Figure 84).

Figure 83: Identification outside of station.

Figure 84: Identification inside of Holte station.

Inside the stations, it is also possible to consult the static information about lines that supply them, including their connections with others lines and estimated travel time between stations (See Figure 85 and Figure 86).

Figure 85: Maps with all the lines of the train system and its connections

Figure 86: Maps of lines with estimated travel time between stations

On platforms, there is real time information about the arrival time for the next vehicle, including how many carriages make up the coming train (See Figure 87), real time information on whether the lines are on time or delayed (See Figure 88), and there is a map of the zones/fares (See Figure 90). Moreover, there is also real time information on metro in train stations that have connection with this mode (See Figure 89).

Figure 87: Real time information on the next trains

Figure 88: Real time information on the status of the service

Figure 89: Real time information on metro inside train station

Figure 90: Information on zones/fares

4.3.4.3 Accessible anywhere (Pre-trip, ongoing trip)

a) Bus

a.1) Næste bus SMS (Movia): It is a service that informs when the next bus is running, according to the information provided by GPS installed in the majority of buses and takes into account the traffic at the moment. You can send a message and consult the information on:

a.1.1) Departures from stop: It is possible to search for information by name or number of stop and receive an SMS with the next departure for all bus lines from a specific stop. If more detailed information is required, the following inputs can be added in order to refine the search:

a.1.2) Departures for a specific line: By searching for a specific line that runs through the selected stop.

a.1.3) Later departures: By inputting the desired time for departure, the sequence of next departures that runs through the selected stop can be obtained.

a.2) Næste bus app (Independent source): It is a paid app that provides information on the whereabouts of the buses and their estimated arrival time at the nearest bus stop. The app asks all possible inputs, some of which are optional, required for localization of the buses and will then send the SMS to the service described above. In other words, this app assists in the composition of the SMS to be sent to the Næste bus SMS service and allows you to save favorite lines and stations/stops in order to make the information request faster.

b) Metro:

b.1) Official website: Contains timetables for each line (headways), planned changes and map of the system;

b.2) Twitter (@MetroenKBH): Real time information on changes, general operational information and delays.

c) Train:

c.1) DSB app (DSB): It is possible to get the current traffic information on public transport and get a list of departures from the nearest or a particular station.

d) Both bus, metro and train

d.1) Rejseplanen - Journey Planner (app and website): You can access the Rejseplanen from the mobile app or the website, and consult information in English, German and Danish. It is an integrated travel planner system, which enables the user to search among all public transport options by departure or arrival time. The provided information includes walking route, departure times, transfers, maps, ticket price, delays and changes in the system. It is also possible to purchase tickets.

d.2) Movia app (Movia): Starting from your current location, the app shows the nearest stops/stations. From there, the user can select the relevant stop and access information on the next departures of buses and local trains. The information given is based on real time forecasting.

d.3) MitMovia (Movia): This service provides customized traffic information about bus lines and local railways. It is possible to register your favorite lines to a subscription service and receive messages by email and SMS in case of irregularities in the operation or changes in the roadmaps (Movia, 2016b).

d.4) Din Offentlige Transport – DOT (operated by DSB, Movia and Metro company): It is a Danish only website that provide online real time information about the position of buses, metro and trains through maps that show also traffic information, delays and cancelations in the entire system. It is possible to plan a trip by choosing the origin and destination points,

date and time; the system reports options for transport modes and/or possible combinations (information retrieved from Rejseplanen).

Moreover, there is information on prices, zones and the option to put your personal information (e.g. if you are student, worker, disabled, travelling with bicycle or dog, etc), so the system can show the more suitable options/feasible tickets. Furthermore, you can access the other sources of information mentioned above (Metro Twitter, Movia SMS, Rejeseplannen) through this website. Static information is also given (schedules of train, metro and buses).

Figure 91: Map with all existing lines in the region

Source: Din offentlige transport, 2016.

The website additionally shows maps of the region that display the existing public transport modes and its routes (See Figure 91), maps of the surrounding stops and stations, indicating nearby buses and personalized tariff maps based on point of origin for each zone.

d.5) Moovit app (Independent source): It is possible look into static integrated information combining bus, metro and trains. This allows planning trips based on origin–destination points. Shows the stops over the entire route and walking route.

d.6) Google Maps online/app (Independent source): It is possible look into static integrated information combining buses, metro and trains. This allows planning trips based on origin – destination points, departure and arrival expected times. It is also displays price of the fare according to the displacement, the stops over the entire route and walking routes. Moreover, it is possible to easily compare the travel times by car, public transport, bicycle and walking, which can help the traveler in the mode choice.

4.3.5 Discussion about the information available

Moreover the cited options, there are independent sources that show information obtained from the official sources. The most popular is Rejseplanen, which allows users to plan journeys based on date, time and location, while considering all the transport modes. Although it delivers static information, it is widely used possibly due to having an app interface and low instances of deviations from the schedule.

It is relatively easy to find information on public transport (unimodal and integrated). There are sources of information accessible anywhere and the official sources provide multimodal dynamic integrated information.

Despite being operated by several businesses managed by different public companies (Movia, DSB, Metroselskabet) the integration of the information works very well.

Even people who do not have access to internet/smartphone (pre-trip or ongoing trips) can have access to information at stops/stations (on transport modes, routes and fares) or via SMS (next scheduled departure).

5 DATA AND METHODS

5.1 DATA DESIGN AND COLLECTION APPROACH

A travel information web-based survey was designed (See appendixes B, C or D) and piloted among 25 people with the main topics: socioeconomic characteristics, transit use patterns, experience with public transport (perceived level of service, security, usefulness, familiarity and information), social norms (friends and families' attitudes towards public transport), search and use of transit information and the importance attributed to different sources of information.

The socioeconomic characteristics targeted comprised of gender, age, residential arrangement, access to mobile phone with GPS/navigation apps and internet, employment/study status, access to travel options, form of payment for public transport use, residential location and monthly expenses.

Questions related to the transit use patterns elicited the overall frequency of each travel mode (Car - as driver or passenger - , public Transport, bicycle/ walk and Taxi) and the most preferred travel mode to mandatory (education, work) and non-mandatory (leisure, city center, go out at night, go out to unfamiliar places) activities.

Regarding user's own experience with public transport, it was enquired about: perceived level of service (travel and waiting time, information services, comfort, coverage, service reliability, price), usefulness (if PT allows to: go to my activities, go to new places, save time, save money, to avoid driving, make use of the travelling time to do "things"), familiarity (if respondents easily remember: line combinations when asked, the best route, frequency of the lines, closest stops and travel time), information (if it is reliable, clear, complete, easy to find and provides efficient routes) and security (if people are concerned about: being pickpocketed/robbed, being harassed, walking/waiting at night and drunk passengers).

Questions about the social norms involved friends and families' attitudes towards PT: Whether they use PT themselves, if the parents prefer that the respondent does not take public transport and if they judge PT as uncomfortable, unsafe and/or inefficient.

People were also asked about their habits, regarding the frequency of which they seek out information (according to their end destination) and use information (according to the how the information is presented). At the end, people were invited to share their insights on the importance of different sources and kinds of information through a 5-point Likert scale from "very unimportant" (equal to 1) to "very important" (equal to 5). Regarding information, it was examined both existing and potential methods of accessing information in Brazil and the existing methods in Denmark.

Moreover, the items related to the Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM) and Extended Technology Acceptance Model (ETAM) constructs were measured on a 5-point Likert scale from "strongly disagree" (equal to 1) to "strongly agree" (equal to 5).

One more point related to the questionnaire is that, in the Brazilian version, 2 more questions were added at the end of the survey aiming to understand beliefs associated with information improvement:

a) If people believe that the use of the system would be made easier, they would use more frequently and they could find new possibilities to make their travels;
b) If an improvement in the information system was to happen, how often they would use public transport. People were asked to give answers to the same items as those listed in the question at the beginning of the survey, while being presented with the same scale for likelihood of use. Comparing the answers given in the beginning to those given at the end of the survey, enabled to observe to what degree people are willing to change their behavior.

The survey was administered in Brazil to students from universities in Recife (Federal University of Pernambuco) and Natal (Federal University of Rio Grande do Norte) and Denmark to students from universities in Copenhagen (Copenhagen University) and Kongens Lyngby (Danish Technical University) during October 2015 via universities channels and pamphlets/posters disclosure.

The survey was made in English, Danish and Portuguese, since at Danish universities there is a considerable share of English speakers who attend courses. The questionnaire took

approximately 10 minutes to complete. In total, 1,123 answers from academics in Brazil and Denmark were obtained.

In order to increase the sample, respondents were offered a chance to participate in a raffle of 15 gift cards (varying from 100 kr to 500 kr – 15.22 USD to 76.10 USD) in Denmark and 17 gift cards (varying from R$50.00 to R$400.00 – 12.89 USD to 103.09 USD) in Brazil as an incentive to complete the survey. The gift cards could be later redeemed at large stores.

5.2 DATA ANALYSIS

5.2.1 Factor analysis

Initially, descriptive statistics through percentages were developed in order to identify and summarize quantitatively and qualitatively the sample.

The items related to the TPB, TAM and ETAM constructs that were measured on a 5-point Likert scale, and were a mixture of "positively-keyed" and "negatively-keyed" items, needed to be managed before computing the scores of the questionnaire and before conducting any analyses. In this research, the negatively worded questions were reverse scored, so the numerical scoring scale becomes running in the opposite direction (compatible with the positively worded questions).

After that, the internal consistency was verified for Danish and for Brazilian samples in *IBM® SPSS® Statistics Version 21.0* (2012) through the Cronbach's alpha index (CRONBACH, 1951) (Equation 1):

$$\alpha = \frac{n}{n-1} \cdot \left(1 - \frac{\Sigma Vi}{Vt} \right) \qquad (1)$$

Where "n" is the number of questions, "Vi" is the variance of scores of each question and "Vt" is the total variance of overall scores on the entire test.

Pasian (2015) says that this sort of reliability measure wishes to determine if the scale is reliable and is most commonly used when you have multiple Likert questions. According to

Field (2009), for Cronbach's α there is a general agreement that values of 0.7 to 0.8 (cut-off points) are acceptable and values significantly lower indicate an unreliable scale.

Following it, an Exploratory Factor Analysis (EFA) was conducted, also in SPSS®. According to Byrne (2012), EFA should be used in situations where links between the observed variables and latent variables (unobserved) are unknown or uncertain, because is an analysis that allows to determine how, and to what extent, the observed variables are linked to their underlying factors. In other words, as the unobserved variables (also known as latent variables or factors) cannot be directly observed, they have alternatively to be inferred (by means of a mathematical model) from the observed variables (factors' indicators) that can be directly measured.

The method used for extracting the factors was "Principal axis factoring", that analyses shared variance amongst the items. According to Warner (2013), principal axis factoring is the most widely used method in factor analysis.

The rotation method was the orthogonal "Varimax rotation with Kaiser normalization", used to consider in the solution the factors that are not highly correlated with each other. Abdi (2003) says that Varimax is the most popular rotation method, which allows to obtain a simplified output where each initial variable tends to be related with one or a few number of factors, and each factor represents only a small number of variables.

In the results it was observed a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for the Brazilian and the Danish samples. This value was calculated considering $j \neq k$ (Equation 2):

$$KMO = \frac{\Sigma\Sigma r_{jk}^{2}}{\Sigma\Sigma r_{jk}^{2} + \Sigma\Sigma q_{jk}^{2}} \qquad (2)$$

Where the "q_{jk}^2" are the squares of the off-diagonal elements of the anti-image correlation matrix and "r_{jk}^2" are the squares of the off-diagonal elements of the original correlations (KAISER and RICE, 1974 apud DZIUBAN and SHIRKEY, 1974).

Conforming to Field (2009), the KMO represents the quotient of the squared correlation between variables to the squared partial correlation between variables. The values can vary between 0 and 1, where values close to zero indicate dispersion in the pattern of correlations, meaning that the factor analysis is likely to be inappropriate. On the other hand, a value close to 1 indicates that patterns of correlations are relatively dense and so factor analysis should yield different and reliable factors.

In order to examine whether the sample correlation matrix resembles an identity matrix, the result of the Bartlett Test of Sphericity was used (Equation 3):

$$X^2 = -\left[(n-1) - \frac{(2k+5)}{6}\right] \ln |r| \qquad (3)$$

Where "n" is the number of observations, "k" is the number of variables and "r" is the determinant of the correlation matrix[11] (PETT, LACKEY and SULLIVAN, 2003). According to Field (2009), the result of this test is significant when the value is under 0.05 and is highly significant for $p < 0.001$.

After measuring the sampling adequacy, observing the eigenvalues and the scree-plot obtained in the EFA, several different models were tested with different quantity of factors. These amounts of factors, used in order to decide the best number of factors to retain, were the ones close to the slope of the curve where the scree plot levels off. Confirmatory factor analysis (CFA) was done considering these quantities of factors looking for the structure that makes the items fit together the best; the one that best represents the data and the existing relationships.

By looking at the Rotated Component Matrix for each attempt, factor loadings for each individual variable in the data set were used to interpret the meaning of the different factor groups. To be considered significant, the cutoff for the factor loading was 0.30-0.35; in addition discretion was used to decide. In the case of an item showing significance to several

[11] The sign "| |" stands for modular value.

factors, the one showing the highest factor loading was deemed to show a strong relationship, i.e. the dominant factor.

5.2.2 Structural equation modeling

After having defined the factors and understanding its relationship with the observed variables, a Structural Equation Modeling (SEM) in MPlus Version 7.2 (MUTHÉN and MUTHÉN, 1998-2012) was developed in order to investigate the hypothesized behavioral models' structure.

SEM was chosen because according to Jöreskog and Sörbom (2001) its methods can incorporate both unobserved (latent variables) and observed variables (factors' indicators), measurement errors in both dependent and independent variables, mutual causation, simultaneity (a variable can be both dependent and independent at the same time) and interdependency (between factors). Thus, this method allows investigating not only the relationship of variables but also the directions of influence.

Byrne (2012) stated that the term "Structural equation modeling" conveys two important aspects of the procedure: (a) a sequence of structural equations represents the causal processes under study, and (b) a clearer conceptualization of the theory under study is possible to be modeled pictorially with these structural relations.

Fornell and Larcker (1981), affirm that there is a relevant strength in this method that is its ability to bring together psychometric and econometric analyses in such a way that it is possible to take advantage of the best features of both. The econometric structural equation models formed clear incorporate the psychometrician's notion of unobserved variables (constructs) and measurement error in the estimation procedure.

Before starting the SEM, all the items related to each observed dependent variable that are not factor indicators needed to be managed and converted into a binary scale. In the model, the option "Categorical" was used in the command "Variable" aiming to specify which dependent variables are treated as binary or ordered categorical (ordinal) variables in the model and its estimation.

It was defined a maximum number of 10,000 iterations for the Quasi- Newton algorithm for continuous outcomes and the Output option "TECH4" was used in order to request estimated means, covariances, and correlations for the latent variables in the model (MUTHÉN and MUTHÉN, 1998-2012).

The goodness of fit was measured for each estimation model through the Root Mean Square Error of Approximation (RMSEA) and the Comparative fit index (CFI).

The explanations and criterions considered for both parameters are briefly described below:

a) RMSEA: expresses how well the model would fit the populations' covariance matrix (BYRNE, 1998 apud HOOPER, COUGHLAN and MULLEN, 2008). Kim and Bentler (2006) suggest a cutoff value close to 0.05 for RMSEA; values lower than it represents a good model. Maccallum, Browne and Sugawara (1996) say that a RMSEA equal to 0.01 represent an extremely good model and values in the range of 0.08 to 0.10 indicate mediocre fit.

b) CFI: compares the fit of a target model to the fit of an independent model – a model in which the variables are assumed to be uncorrelated. Kim and Bentler (2006), suggest that a CFI cutoff of 0.9 indicate close fit between the model and the data.

In this study, 4 sets of equations within the 2 parts of the SEM (measurement model and structural model) were used for each scenario (Brazil and Denmark):

a) Measurement equations: describe the relationships among observed variables and factors (Equation 4). Byrne (2012) says that it is a confirmatory factor analysis which focuses solely on the link between factors (unobserved variable) and their measured (observed) variables; the reason to be termed a measurement model.

$$I_{rn} = Z^{*}_{ln}\alpha_r + \upsilon_{rn} \quad and \quad \upsilon_n \sim N(0,\Sigma_\upsilon) \quad for\ r = 1,\ldots,R \qquad (4)$$

Where "I_{rn}" is the value of an indicator "r" of the latent construct "Z^{*}_{ln}" as perceived by individual "n", "Z^{*}_{ln}" is the value of latent construct "l" for individual "n", "α_r" is a parameter to be estimated and "υ_{rn}" is an error term. It was considered that R indicators translate into

writing R measurement equations and estimating a (R×1) vector α of parameters (i.e. one parameter is estimated for each equation).

In this step, the item set found be related to each factor in the *SPSS*® analysis was tested in MPlus Version 7.2 using the command "MODEL" and the option "BY" that cases the continuous latent variables to be "measured by" the indicators (regression equation).

After that, one by one, the factors with its related observed variables were modelled together. The RMSEA and CFI were checked for each estimation model.

b) First structural equations: describe the relationships between factors and observed variables that are not factor indicators (Equation 5).

$$Z^{*}_{ln} = \left(SC_{ln} + TH_{\ln} + PR_{\ln} + TI_{\ln}\right)\beta_{l} + \omega_{ln} \quad and \quad \omega_{n} \sim N\left(0, \Sigma_{\omega}\right) \quad for\ l = 1,\ldots,L \qquad (5)$$

Where "Z^{*}_{ln}" is the value of latent construct "l" for respondent "n", "SC_{ln}", "TH_{ln}", "PR_{ln}" and "TI_{ln}" are respectively a vector of the respondents socioeconomic characteristics, habitual use of car and bicycle, place of residence as a proxy for transit connectivity, accessibility, and abundance, and transit information search, "β_{l}" is a parameter to be estimated and "ω_{ln}" is an error term. It was considered L latent constructs translates into writing L structural equations and estimating a (M×L) matrix of β parameters (i.e. M parameters are estimated for each equation).

These equations were developed to link the latent attitudinal constructs to individual socioeconomic characteristics, travel habits, place of residence, and travel information sources. So, for each factor, each characteristic was tested one by one aiming to check that each ones were significantly related to the factors, further to the observed variables that explain them.

The command "MODEL" was used with the option "ON" that makes latent variables be "regressed on" the observed variables. To be significant, the value of the parameter estimate divided by the standard error (Est./S.E or Critical ratio) should have an absolute value greater than 1.29, considering the critical value for a two-tailed test at the 0.20 level. This statistical test is an approximately normally distributed quantity (z-score) in large samples.

After that, the structural equations were tested to verify if they are working well together (One by one), measuring the goodness of fit as the RMSEA and CFI.

c) Second structural equation: describe the relationships among habitual transit use and the factors (Equation 6). The habitual PT use was measured by the perceived frequency of PT use regardless of trip purposes and time-of-day, i.e. the term "habitual use" refers to a frequent use of the PT independently of the nature of the activity and the moment of using.

$$HTU^*_n = Z^*_{ln}\beta_y + \xi_n \quad and \quad \xi_n \sim N\left(0, \sigma^2_\xi\right) \qquad (6)$$

Where "HTU^*_n" is a vector of respondents' perceived habitual transit use, "Z^*_{ln}" is the value of latent construct "l" for respondent "n", "β_y" is a parameter to be estimated and "ξ_n" is an error term.

These equations are developed to relate the latent attitudinal constructs to habitual transit use patterns. Each hypothesis was tested one by one, using the command "MODEL" and the option "ON" in order to verify the correct relationship of variables and directions of influence related to habitual transit use.

To be significant, the Critical ratio should be an absolute value greater than 1.29, considering the critical value for a two-tailed test at the 0.20 level. This statistical test is an approximately normally distributed quantity (z-score) in large samples.

d) Third structural equation: describe the relationships among non-habitual transit use, habitual transit use and transit information search (Equation 7). It is important to highlight that the item related to the use of PT during the nighttime was used as a proxy measure for non-habitual transit use.

$$NHTU^*_n = \left(HTU^*_{bn} + TIS_{\ln}\right)\beta_z + \varsigma_n \quad and \quad \varsigma_n \sim N\left(0, \sigma^2_\varsigma\right) \qquad (7)$$

Where "NHTU^*_n" is a vector of respondents' perceived non-habitual transit use, "HTU^*_{ln}" is a vector of respondents' perceived habitual transit use, "TIS_{ln}" is a vector of transit information search possibilities (e.g., during night, to unfamiliar activities, to arrive on time etc.), "β_z" is a parameter to be estimated and "ς_n" is an error term.

Transit use during nighttime was used as a proxy measure for non-habitual transit use. The dependents variables, habitual transit use and non-habitual transit use (night) are ordinal and ranges from “never” to “always” on a 5-point Likert scale.

These equations are also developed to relate the latent attitudinal constructs to habitual transit use patterns. Each hypothesis was tested one by one, using the command “MODEL” and the option “ON” in order to verify the correct relationship of variables and directions of influence related to non-habitual transit use.

To be significant, the Critical ratio should be an absolute value greater than 1.29, considering the critical value for a two-tailed test at the 0.20 level. This statistical test is an approximately normally distributed quantity (z-score) in large samples.

The vector α of parameters of the measurement equations and the vectors β’s of parameters of the structural equations were estimated simultaneously by using Maximum Likelihood with Huber-White covariance adjustment (YUAN and BENTLER, 2000). Standard errors were calculated by adopting the White’s sandwich-based method that produces robust statistics in the presence of non-normality of the indicators and the categorical variables (WHITE, 1980). Alongside the traditional descriptive measure of chi-square test of absolute model fit, an additional descriptive goodness-of-fit measure was the Root Mean Square of Approximation (BROWNE and CUDECK, 1993).

As a result, according to Muthén and Muthén (1998-2012) the regression coefficients produced for the use of “BY” and “ON” statements using a weighted least squares estimator (WLSMV) and binary and ordered categorical observed dependent variables are probit regression coefficients.

6 RESULTS

6.1 SAMPLE CHARACTERISTICS

The survey yielded 1,195 responses, from which 1,123 were complete questionnaires from academics in Brazil and Denmark (93.97% completion rate).

Nearly 63.22% (710) of all respondents are from Brazil, being 426 from UFPE and 284 from UFRN, while the rest (36.78%) are from Denmark. After analyzing the samples collected in the three regions studied, it was found that there were no relevant distinctions or differences between Natal and Recife contexts, thus allowing to put them together. In order to make it easier to understand the results, the ones related to the Brazilian sample are highlighted blue and the only related to Danish sample are highlighted red.

Of all the Brazilian respondents, 69.01% live in the main cities (Recife and Natal), while the remainder lives in the Metropolitan Areas or others cities. Regarding the respondents in the Danish sample, 31.96% live in the main city, while the others reside in the Greater Copenhagen or other cities.

Table 5: Sample characteristics

VARIABLE	COUNTRY	CATEGORIES (%)					
Gender		Male	Female				
	BRAZIL	51.41	48.59				
	DENMARK	62.71	37.29				
Age		20 or less	21-25	26-30	31-35	36-40	Over 40
	BRAZIL	25.07	55.49	12.11	3.24	1.55	2.54
	DENMARK	15.74	59.08	17.43	5.33	1.45	0.97
Residential Arrangements		Alone	With child/ children	With roommates / friends	With parents	With partner/ Spouse	With partner/ spouse and child(ren)
	BRAZIL	6.48	0.42	10.7	71.97	7.18	3.24
	DENMARK	39.47	0.97	21.07	14.53	21.79	2.18
Mobile / internet availability		Yes. and use paid internet		Yes. and use free internet		No	
	BRAZIL	73.38		21.55		5.07	
	DENMARK	87.41		7.75		4.84	
Employment status		Only studying		Working and studying		Only working	
	BRAZIL	61.83		34.65		3.52	
	DENMARK	54.72		41.4		3.87	

In general, the majority of the respondents, when considering the entire sample (Brazil and Denmark), are male (55.6%), between 21-25 years (56.8%), live with parents (50.8%), are only studying (59.22%), have a mobile phone with GPS/navigation apps and use it with their own internet (78.54%). The main difference between countries found among those presented in Table 5 is the residential arrangements: in Brazil, 71.97% of people live with their parents, while in Denmark the majority, 39.47%, of people lives alone.

Table 6: Monthly expenses (total and with transport - %)

Total monthly expenses (BR)[12]	**0-193 USD**	**194-515 USD**	**516-1,288 USD**	**>1,288 USD**	**Not given**
	47.89	**36.34**	**7.32**	**1.69**	**6.76**
Total monthly expenses (DK)[9]	**0-380 USD**	**381-761 USD**	**762-1,522 USD**	**>1,522 USD**	**Not given**
	14.04	**34.14**	**43.83**	**5.57**	**2.42**
Monthly expenses - Transport (BR)[9]	**<25 USD**	**26-77 USD**	**78-128 USD**	**>128 USD**	**Not given**
	41.97	**44.93**	**8.31**	**2.68**	**2.11**
Monthly expenses – Transport (DK)[9]	**<15 USD**	**16-76 USD**	**77-152 USD**	**>152 USD**	**Not given**
	11.86	**39.47**	**43.10**	**4.36**	**1.21**

The total monthly expenses most significant in the Brazilian sample is 193 USD, at 47.89%, which includes rent, groceries and transport while over 515 USD is only 9.01% (See Table 6). For the Danish sample, the total monthly expense most significant is 761USD or less at 48.18% and more than 1,522USD for 5.57% of the respondents. When taking into consideration monthly expenses with transport, a total of 86.9% in Brazil and 51.33% in Denmark spend a maximum of about 77USD.

Table 7: Usual form of payment for public transport use

Payment for public transport (BR)	**Cash**	**Smartcard**			
	26.90	**73.10**			
Payment for public transport (DK)	**Cash**	**Smartcard**	**Phone app**	**Monthly card**	**Student card**
	2.91	**54.48**	**4.60**	**5.57**	**32.45**

Data on usage of the several payment methods for public transport shows (See Table 7) that the most used is the smartcard (VEM or RN card in Brazil and Rejsekort in Denmark). In both countries, this sort of payment gives the user some level of discount on the fare while

[12] Dollar Exchange Rate for 20 October 2015. Exchange Rate of 1.00USD = 3.88BRL /1.00USD = 6.57DKK

cash is the only method that does not see any discount/advantage. In Denmark payment with cash is used only by 2.91% of the respondents, while in Brazil this option is used by 26.90% of the respondents.

Table 8: Perceived travel mode availability (%)

Country	City	Bike at Home	Public Bike	Car/ Shared	Public Transport
BRAZIL	Recife	29.88	30.82	61.88	94.35
	Natal	31.58	- [13]	72.63	92.63
DENMARK	Copenhagen	90.07	9.69	29.54	94.92

When looking at how people perceive access to travel modes (see Table 8), access and use of a bicycle in Denmark is dominant, while in Brazil it is possible to notice a much higher percentage of those that have access and use of a car. This is a reflection of the public policy in Brazil that in the past decade encouraged and supported the purchase of vehicles, through credit facilities and long-term payments. While in Denmark the opposite stance was adopted as, since 1970, measures have been taken to turn the city as bicycle-friendly as possible.

Table 9: Use frequency of transport modes (%)

		Never	Rarely	Occasionally	Often	Always
Car (as a driver)	Brazil	45.21	10.70	10.70	12.82	20.56
	Denmark	37.05	31.72	19.37	7.51	4.36
Car (as a passenger)	Brazil	4.08	22.68	40.00	29.15	4.08
	Denmark	17.19	42.37	31.96	8.47	0.00
Public transport	Brazil	4.08	14.23	14.93	18.45	48.31
	Denmark	0.73	9.93	27.60	33.66	28.09
Bike/Walk	Brazil	22.68	29.44	26.34	16.20	5.35
	Denmark	2.91	7.02	11.86	38.50	39.71
Taxi	Brazil	34.79	41.27	20.56	3.10	0.28
	Denmark	64.89	31.48	3.39	0.24	0.00

Moreover, it was found that more than 90% have access to Public Transport (see Table 8) in each of the 3 cities/regions studied in this research and more than 60% use public transport

[13] There is no bicycle public system in Natal.

often or always (see Table 9) in both Brazil and Denmark, regardless the purpose of the trip and time-of-day. The data also shows the use of taxis, where the low usage can be explained by the fact that this mode of transportation is the most expensive, especially in Denmark, making it rarely or never used by those who are students.

People were also asked about the current use of public transport in relation to a few destination/activities (see Table 10 and Table 11). It is possible to notice that people in both countries use public transport when going to university and city center. Regarding latter, it is reasonable to say that this is the result of difficulty in finding parking spaces and/or restrictions existing in the area within the 3 cities/regions.

Table 10: Current public transport use for the following activities - Copenhagen (%)

		Never/ I don't do this activity	Rarely	Occasionally	Often	Always
Denmark	Going to the University	23.00	18.40	9.69	12.35	36.56
	Going to work	55.21	12.35	7.02	7.26	18.16
	Going to the city center	9.44	17.19	21.31	21.79	30.27
	Going to regular leisure activities	34.38	23.24	16.46	13.80	12.11
	Going out at night	13.56	17.68	19.85	20.10	28.81
	Going to new / unfamiliar places	9.69	16.22	30.02	27.85	16.22

Table 11: Current public transport use for the following activities – Recife and Natal (%)

		Never / I don't do this activity	Rarely	Occasionally	Often	Always
Brazil	Going to the University	13.66	14.79	9.01	11.27	51.27
	Going to work	57.04	7.32	5.63	5.49	24.51
	Going to the city center	13.66	13.94	16.48	11.83	44.08
	Going to regular leisure activities	16.90	17.75	19.44	19.15	26.76
	Going out at night	33.38	18.31	18.31	12.25	17.75
	Going to new / unfamiliar places	27.75	20.70	18.73	12.96	19.86

In Denmark, people are less likely to take public transport when going to leisure activities and in Brazil people are less likely to take public transport when going out at night.

6.2 SELF STATEMENT ABOUT THE PUBLIC TRANSPORT AND INFORMATION

Observing the perceived Level of service (LOS) in Brazil and Denmark, the differences between the scenarios begins to become more evident. As it can be seen in Table 12, perceptions about the current service in each country are quite the opposite of one another.

Table 12: Perceived level of service (%)

	BRAZIL	DENMARK
	Agree/ Strongly agree	Agree/ Strongly agree
Travel/waiting time are too long	**87.18**	**31.72**
There are good info services	**13.38**	**58.84**
Vehicles/stations are too crowded	**90.42**	**29.78**
The PT coverage is good	**16.48**	**62.71**
There often are service cancellations / delays	**63.38**	**30.27**
Public transport is expensive	**75.07**	**83.78**

The biggest share of people in Brazil agree or strongly agree that public transport has travel and waiting times that are too long, the information services are not good, the vehicles and stations are often too crowded, the public transport coverage is not good and there are often service cancellations and/or delays.

Despite this, a major share of people agrees that public transport is expensive: 83.78% in Denmark and 75.07% in Brazil (see Table 12). In Denmark the strong culture of everyday use of a bicycle (almost cost free) is one possible explanation for this evaluation. Although people judge the public transport as expensive, 47.46% of Brazilian respondents agree that is possible to save money by using public transport (see Table 13); i.e. even if it is considered expensive, the PT is far cheaper than the others options available in Brazil.

Moreover, the answers related to the perceived usefulness of the public transport system (see Table 13) also reveal that the use of the system is not associated to an option to neither save time (both countries) nor, at least, take advantage of this time to do things (Brazil) or save money (Denmark).

Table 13: Perceived usefulness of PT (%)

	BRAZIL	DENMARK
	Agree/ Strongly agree	Agree/ Strongly agree
Public transport allows me to go to my activities	**80.28**	**71.43**
Public transport allows me to go to new places	**58.31**	**77.97**
Public transport allows me to save time	**5.49**	**26.63**
Public transport allows me to save money	**47.46**	**14.77**
Public transport allows me to avoid driving	**51.83**	**50.12**
Public transport allows me to use the travelling time to do things	**28.45**	**40.68**

Regarding familiarity (see Table 14), the biggest share of respondents in both countries evaluate themselves as people who are familiar with the systems and are able to give information about line combinations to others when asked.

Table 14: Perceived familiarity with the system (%)

	BRAZIL	DENMARK
	Agree / Strongly agree	Agree / Strongly agree
I easily remember line combinations when I am asked	**61.27**	**63.20**
I usually remember the best route to arrive to my destination	**74.79**	**80.63**
I usually remember the public transport frequency of the lines I need	**60.99**	**51.82**
I usually remember which stop is the closest to my destination	**79.01**	**79.90**
I usually remember the travel time to arrive to my destination	**60.99**	**62.47**

Observing the numbers related to the security evaluation, the contrast of the scenarios in both countries is highlighted (see Table 15). People in Brazil affirm to be concerned about being robbed (94.08%) or harassed (58.87%) on public transport, about walking and waiting at night (98.03%) and with drunken passengers (67.46%). In Denmark the feeling of safety on public transport is relatively high. However, in both places, the condition associated with a higher concern about the use of public transport is when using the service at night (walking and waiting).

In Brazil, this perception by public, which sees public transport as insecure can be explained through the violence rates: according to Sindicato dos Trabalhadores em Transportes Rodoviários do Estado do Rio Grande do Norte - SINTRO/RN (2015 apud

TRIBUNA DO NORTE, 2015) only considering the first 5 months of 2015, there were about 200 registered cases of assault inside buses and in the first 15 days of December 2015 alone, 4 attacks were registered with constant thefts taking place at stops and bus terminals in Natal. In Recife, the Union of Road Workers (Sindicato dos Rodoviários de Pernambuco, 2015 apud TV JORNAL, 2015) stated that between January and November about 2,200 buses were attacked (number 88% higher than in 2014).

Table 15: Perceived security in PT (%)

	BRAZIL Agree/ Strongly agree	DENMARK Agree/ Strongly agree
I am concerned about being pickpocketed/robbed	**94.08**	**14.04**
I am concerned about being harassed	**58.87**	**10.17**
I am concerned about walking/waiting at night	**98.03**	**23.73**
I am concerned about drunk passengers	**67.46**	**21.07**

The analysis of the aspects related to social norms (see Table 16) revealed that the feeling of insecurity seems to be a consensus in Brazil, as well as the perception of the level of service. On the other hand only a small number of respondents in Denmark see public transport as unsafe. Moreover, the percentage of friends who use public transport is almost the same in both countries.

Table 16: Social norms (%)

	BRAZIL Agree / Strongly agree	DENMARK Agree / Strongly agree
Most of my friends use public transport	**66.76**	**66.34**
Most of my family members use public transport	**38.87**	**20.34**
My parents prefer that I do not take public transport	**32.68**	**5.33**
Most of my friends think that public transport is uncomfortable	**91.97**	**21.07**
Most of my friends think that public transport is unsafe	**94.79**	**2.66**
Most of my friends think that public transport is inefficient	**85.77**	**35.35**

As for information on public transport is perceived (see Table 17), the largest share of people in Brazil think that information is unreliable, inefficient, unclear, incomplete and difficult to find, whereas in Denmark the majority evaluates the quality of the information at

their disposal as reliable, efficient and easy to find. In both countries, the items evaluated worst were the ones related to delays and changes, and the clearness and completeness of the information.

Table 17: Perceived information quality (%)

	BRAZIL	DENMARK
	Agree/ Strongly agree	Agree/ Strongly agree
The travel time/waiting time information is reliable	**7.46**	**61.74**
The info about delays/changes is reliable	**6.34**	**42.86**
The info system provides efficient routes	**14.23**	**56.66**
The info is clear and complete	**7.32**	**46.25**
The information is easy to find	**11.69**	**61.74**

While still on the subject of information, in Recife and Natal, the 4 main reasons for information search are: the need to arrive on time (48.17%), going to new/unfamiliar places (42.96%), going to university (37.61%), and going to the city center (37.46%). In Copenhagen, the 4 main reasons for information search are: the need arrive on time (81.84%), going to new/unfamiliar places (64.89%), going out at night (44.31%), and going to the city center (38.98%) (See Table 18).

Table 18: Patterns of searching for PT information (%)

	BRAZIL	DENMARK
	Often / Always	Often / Always
Going to the University	**37.61**	**25.18**
Going to work	**21.13**	**15.25**
Going to the city center	**37.46**	**38.98**
Going to regular leisure activities	**34.65**	**25.67**
Going out at night	**30.56**	**44.31**
Going to new / unfamiliar places	**42.96**	**64.89**
When I need arrive on time	**48.17**	**81.84**

Moreover, when looking at the importance attributed to the different natures of information (see Table 19), in all places more than 90% of people agreed that information about departure/arrival times, fastest route and changes/delays are important or very important. Information regarding transfer between lines, and route options to arrive to new places is of secondary importance to the respondents.

Table 19: Importance to PT information (%)

	Brazil	Denmark
	Important / Very Important	Important / Very Important
How to transfer between lines	**85.63**	**71.91**
Route options to travel to new places	**87.46**	**73.85**
Departure/arrival time	**95.92**	**94.43**
Fastest route	**95.63**	**93.46**
Changes / delas	**94.79**	**93.22**

Looking at the current use of information sources (see Table 20), in Brazil the most used sources of PT information are: asking other passengers/public and/or transport personnel (89.01%), google maps (75.35%) and on-line information such as apps/internet (72.11%). On the other hand, the most used information sources in Copenhagen are: on-line information such as apps/internet (93.95%), real-time information in vehicles or stops (85.47%) and google maps (81.60%).

Table 20: Current use and importance of information sources (%)

	BRAZIL		DENMARK	
	Yes	Important / Very Important	Yes	Important / Very Important
Asking other passengers / public transport personnel	**89.01**	**88.17**	**35.35**	**21.07**
Using real-time information in vehicles or stops	**56.90**	**79.86**	**85.47**	**73.61**
Calling the public transport company	**7.18**	**26.62**	**2.18**	**6.54**
Using on-line information apps / internet	**72.11**	**88.31**	**93.95**	**90.31**
Using google maps	**75.35**	**80.99**	**81.60**	**67.80**

In both Recife and Natal, and in Copenhagen, most of the respondents agreed that using on-line information apps/internet, using google maps and using real-time information on vehicles or at stops is important or very important (see Table 20). Furthermore, in both countries just a minor share of people considers calling the public transport company important. To Brazilians, asking other passengers and/or public transport personnel is also important or very important (88.17%), while in Denmark just 21.07% consider this sort of information important.

Moreover, most of the respondents in Recife and Natal indicated that with better information on public transport (see Table 21), the use of the system would be much easier (92.54%), they could discover new possibilities to carry out their travels (88.73%), and they would use transit more frequently (58.87%).

Table 21: People beliefs related to improvements in PT information (%)

Statements		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Brazil	The use of the system would be much easier	0.85	1.55	5.07	37.89	54.65
	I would use more public transport	3.10	10.00	28.03	28.45	30.42
	I could discover new possibilities to carry out my travels	2.25	2.54	6.48	44.65	44.08

When asked about the intent of PT use in case of improvement of its information system (see Table 22), regardless of destination more than 45% said that they intend to use it either often or always and more than 70% answered that they intend to use it either often or always as the preferred form of transport to get to university and/or city center.

Table 22: Intended public transport use in case of an improvement in the information system - Brazil (%)

		Never/I don't do this activity	Rarely	Occasionally	Often	Always
Brazil	Going to the University	6.34	5.49	11.83	19.15	57.18
	Going to work	38.45	3.80	9.30	12.39	36.06
	Going to the city center	4.93	4.23	15.35	23.10	52.39
	Going to regular leisure activities	5.07	8.03	21.41	25.07	40.42
	Going out at night	17.61	14.23	20.14	15.35	32.68
	Going to new / unfamiliar places	11.27	10.99	20.28	21.13	36.34

Comparing the answers given in the beginning of the survey about the current use of PT (see Table 9) and those given at the end of the survey in a question that asked the intended frequency of public transport use in case of an improvement if the information system was to happen (see Table 22), it is possible to observe that there is a substantial willingness to

change behavior (see Table 23). The minimum increase observed was of 22.07%, related to commuting to University, and the higher was 75.11% and is related to going to unfamiliar/new places.

Table 23: Quantity of people who said use public transport always or often – currently and intended situations – Brazil

		Currently	Intended	Percentual variation
Brazil	**Going to the University**	**444**	**542**	**+ 22.07%**
	Going to work	**213**	**344**	**+ 61.50%**
	Going to the city center	**397**	**536**	**+ 35.01%**
	Going to regular leisure activities	**326**	**465**	**+ 42.64%**
	Going out at night	**213**	**341**	**+ 60.09%**
	Going to new / unfamiliar places	**233**	**408**	**+ 75.11%**

Thus, the potential of increasing public transport travels, considering the self-statement of the respondents is something concrete. Furthermore, to support this relationship and measure the other factors associated to public transport use, advanced analysis of the data was performed, which is described in the following sections.

6.3 FACTOR ANALYSIS

The factor analysis done in SPSS presented a Cronbach's alpha equal to 0.816 for the Danish sample and 0.791 for the Brazilian sample, indicating a good internal consistency (>0.7). Moreover, a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was found to be equal to 0.837 for the Brazilian sample and equal to 0.799 for the Danish sample (see Table 24), meaning that the factor analysis gave distinct and reliable factors (values close to 1).

Table 24: Measures of sampling adequacy

		BRAZIL	DENMARK
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.837	0.799
Bartlett's Test of Sphericity	Approx. Chi-Square	7106.394	4115.632
	Df	496	496
	Sig.	0.000	0.000

The results exhibited a Bartlett Test of Sphericity Sig (P value) equal to 0.000 for the Brazilian sample and equal to 0.000 for the Danish sample. Thus, the Bartlett's test is highly significant for these samples as $p < 0.001$ and the factor analysis is appropriate (See Table 24). Moreover, the anti-image correlation matrixes diagonals presented values > 0.6 in both cases.

The Scree Plots obtained in the factor analysis for each sample were analyzed and some factors (values close to the slope of the curves where the scree plot levels off) were tested (See Figure 92 and Figure 93).

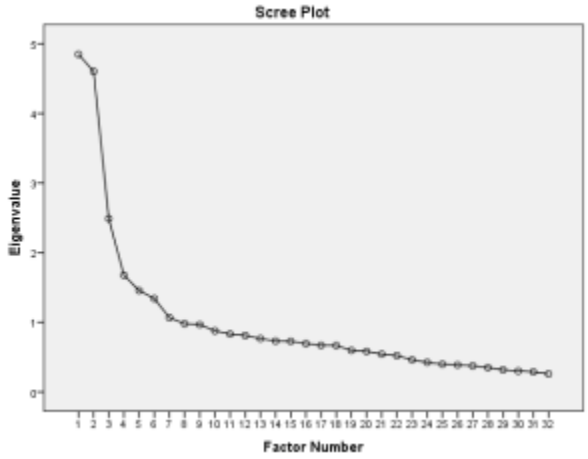

Figure 92: Brazil's scree Plot

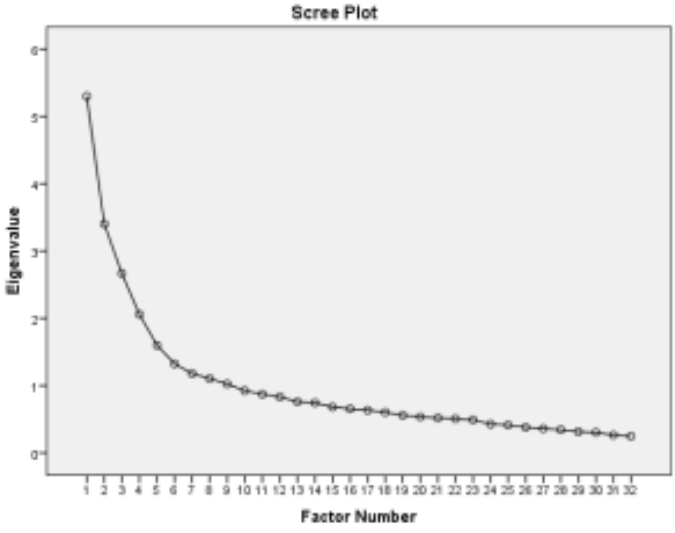

Figure 93: Denmark's scree plot

Considering the Rotated Factor Matrices and factor loadings obtained for each individual variable in the data set (cutoff > 0.30-0.35), a number of 6 factors associated with the PT use

were found to be the optimal for the Brazilian and Danish scenarios (7 different factors, considering both models), according to the meaning of the different factor groups using discretion to decide which should be retained.

The factor loadings indicate how each factor (F1 to F7) or latent variable is associated with the observed items used in the analysis. The factor loadings that fit better are presented in the Table 25 and Table 26, with dominant items marked in bold. The 7 ETAM factors related to the Brazilian and/or Danish scenarios, where the first five are common to both countries are:

F1 - Level of service: Variable that expresses people's perception about the operational conditions, comfort and price of public transport system;

F2 - Information quality: Variable that expresses people's perception of the quality of the current information available (reliability, clearness, completeness, easiness to find and efficiency);

F3 - Transit security: Variable that expresses feelings and concerns of people about the security perceived with the public transport use;

F4 - Transit familiarity: Variable that expresses a directed self-assessment of the individual's degree of familiarity in the use of public transport;

F5 - Transit usefulness: Variable that expresses the adequacy between people's individual needs and the current public transport service;

F6 - Transit convenience: Variable that expresses people's perception about public transport being suitable or opportune (e.g.: to save money, avoid driving and to use the travelling time to do things);

F7 - Pro-transit subjective norms: Variable that expresses the perceived encouragement by important others (family and friends) to use public transport.

Table 25: Rotated Factor Matrix – Recife and Natal

ITEM	F1	F2	F3	F4	F5	F6
The travel and waiting time is too long (R)[14]	**.453**	.109	.054	-.071	-.053	.216
There are good information services	.074	**.447**	.029	.027	.043	.050
The vehicles and stations are too crowded (R)	**.382**	.017	.161	-.104	-.130	.187
The public transport coverage is good	.190	.174	.077	.074	.018	.254
There often are service cancellations / delays (R)	.295	.203	-.031	-.129	-.098	.032
Public transport is expensive (R)	.189	.090	.141	-.147	-.282	.321
Public transport allows me to go to my activities	-.028	.087	.015	.325	**.632**	.099
Public transport allows me to go to new places	-.004	.148	-.080	.205	**.643**	.250
Public transport allows me to save time	.326	.197	-.035	.028	.142	.276
Public transport allows me to save money	.099	.103	.061	.045	.006	**.502**
Public transport allows me to avoid driving	.011	.032	.059	.015	.048	**.541**
Public transport allows me to use the travelling time to do things	.159	.119	.055	.030	.091	**.366**
I easily remember line combinations when I am asked	-.097	.042	.101	**.616**	.303	.029
I usually remember the best route to arrive to my destination	-.090	-.003	.047	**.721**	.273	-.027
I usually remember the public transport frequency of the lines I need	-.021	.056	-.053	**.690**	.214	-.039
I usually remember which stop is the closest to my destination	-.112	.109	-.015	**.768**	.188	.059
I usually remember the travel time to arrive to my destination	.021	.119	-.111	**.659**	.129	.102
The travel time/waiting time information is reliable	.254	**.602**	.009	.077	.032	.081
The information about delays/changes is reliable	.146	**.594**	-.059	-.043	.036	.109
The information system provides efficient routes	.079	**.763**	.008	.095	.031	.188
The information is clear and complete	.064	**.811**	.078	.084	.033	.088
The information is easy to find	.015	**.735**	.057	.105	.062	.027
I am concerned about being pickpocketed/robbed (R)	.298	.055	**.623**	.001	-.063	.061
I am concerned about being harassed (R)	.064	.014	**.687**	-.019	-.063	.182
I am concerned about walking/waiting at night (R)	.220	-.008	**.578**	.013	-.057	.024
I am concerned about drunk passengers (R)	.009	.031	**.629**	-.020	-.024	.053
Most of my friends use public transport	-.070	.005	-.141	.149	**.506**	.001
Most of my family members use public transport	-.099	.039	-.137	.167	**.521**	-.099
My parents prefer that I do not take public transport (R)	.075	.025	.117	.186	**.463**	.049
Most of my friends think that public transport is uncomfortable (R)	**.683**	.084	.217	-.034	-.009	.041
Most of my friends think that public transport is unsafe (R)	**.637**	.079	.376	-.058	-.016	-.017
Most of my friends think that public transport is inefficient (R)	**.613**	.152	.056	.010	.002	.106

[14] (R) means that the statement was reversed.

Table 26: Rotated Factor Matrix - Denmark

ITEM	F1	F2	F3	F4	F5	F7
The travel and waiting time is too long (R)	**.526**	.218	.046	.039	.100	.204
There are good information services	.127	**.507**	-.022	.060	-.020	.233
The vehicles and stations are too crowded (R)	.181	.285	.068	-.132	.018	.116
The public transport coverage is good	**.350**	.242	.040	.050	.139	.251
There often are service cancellations / delays (R)	**.531**	.232	.083	-.050	-.098	.044
Public transport is expensive (R)	**.320**	-.017	.093	-.033	.202	-.075
Public transport allows me to go to my activities	-.096	.145	-.062	.237	**.603**	.165
Public transport allows me to go to new places	-.086	.178	-.012	.184	**.570**	.188
Public transport allows me to save time	.383	.111	.003	-.003	**.466**	.295
Public transport allows me to save money	.173	-.089	.037	.017	**.520**	-.046
Public transport allows me to avoid driving	.064	-.061	-.044	.059	.331	.043
Public transport allows me to use the travelling time to do things	.223	.064	.036	-.011	.223	-.003
I easily remember line combinations when I am asked	-.051	.017	-.028	**.670**	.032	.051
I usually remember the best route to arrive to my destination	.011	.029	.010	**.850**	.022	-.014
I usually remember the public transport frequency of the lines I need	.023	-.050	.040	**.571**	.176	.002
I usually remember which stop is the closest to my destination	.007	.065	-.027	**.706**	.039	.024
I usually remember the travel time to arrive to my destination	-.003	.060	.004	**.653**	.148	.013
The travel time/waiting time information is reliable	.394	**.503**	.039	.095	-.013	.153
The information about delays/changes is reliable	.320	**.526**	.013	.015	-.047	.122
The information system provides efficient routes	.116	**.586**	.080	.014	.153	.027
The information is clear and complete	.100	**.798**	.093	.011	.082	.063
The information is easy to find	-.089	**.655**	.160	.092	.001	.107
I am concerned about being pickpocketed/robbed (R)	.085	.068	**.698**	.013	.024	.038
I am concerned about being harassed (R)	.054	.148	**.819**	-.071	-.005	.040
I am concerned about walking/waiting at night (R)	.219	.059	**.724**	.026	-.023	-.006
I am concerned about drunk passengers (R)	-.009	.014	**.705**	-.040	-.130	.033
Most of my friends use public transport	-.085	.176	.019	.167	.265	**.314**
Most of my family members use public transport	.051	.115	-.093	.054	.324	**.344**
My parents prefer that I do not take public transport (R)	-.052	.071	**.353**	.133	.134	.325
Most of my friends think that public transport is uncomfortable (R)	.162	.161	.137	-.004	.037	**.671**
Most of my friends think that public transport is unsafe (R)	-.021	.138	.451	.011	.006	**.497**
Most of my friends think that public transport is inefficient (R)	.252	.221	-.015	-.107	.190	**.620**

6.4 STRUCTURAL EQUATION MODEL ESTIMATION

Brazil and Denmark present a very similar model structure. Among the 7 factors found in total, 5 factors are common for both. The structural relations across the latent constructs based on the proposed framework are illustrated in Figure 94 for Copenhagen and Figure 95 for Recife and Natal. The values indicated in the arrows of both figures present the estimates obtained in the model that are characterized from Table 39 to Table 43.

Goodness-of-fit indices reveal that the models fit well, as the RMSEA was equal to 0.048 for the Brazilian sample and 0.058 for the Danish sample, which are well below the maximum accepted value of 0.08. The CFI for the Brazilian sample was 0.874 and for the Danish sample was 0.779. Loehlin (1998) suggested that the value of CFI of less than 0.9, but close to 0.9 is also attractive. The ratio between chi-square of model fit and degrees of freedom are 2.63 for Recife and Natal and 2.40 for Copenhagen, which are below the maximum value (Ullman, 1996).

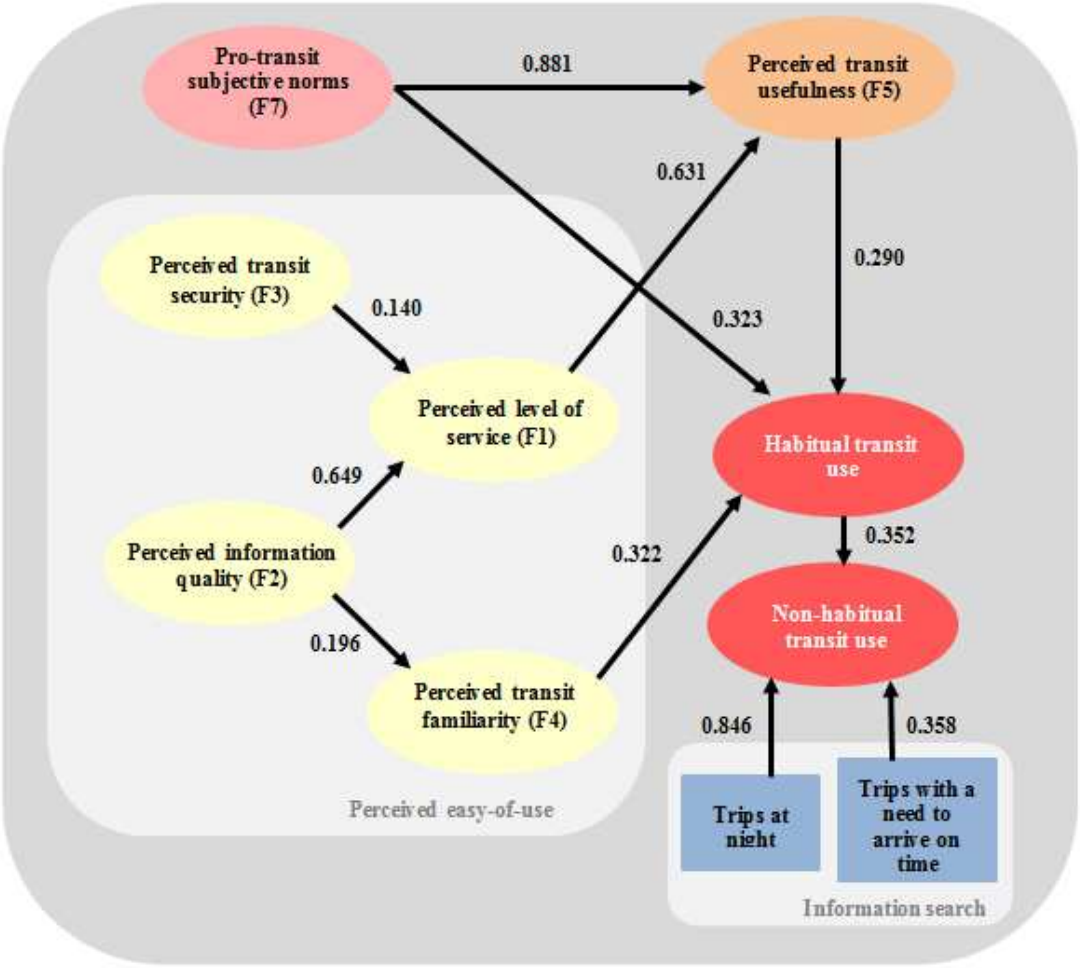

Figure 94: The structural relations in the behavioral framework for Copenhagen

In both, the relationships between transit use intentions and the underlying motivators and mediators are very similar, despite differences in transit provision. The public transport use is related to usefulness and familiarity, the usefulness is related to level of service and the level of service is related to security and information. Moreover, information is directly related with familiarity.

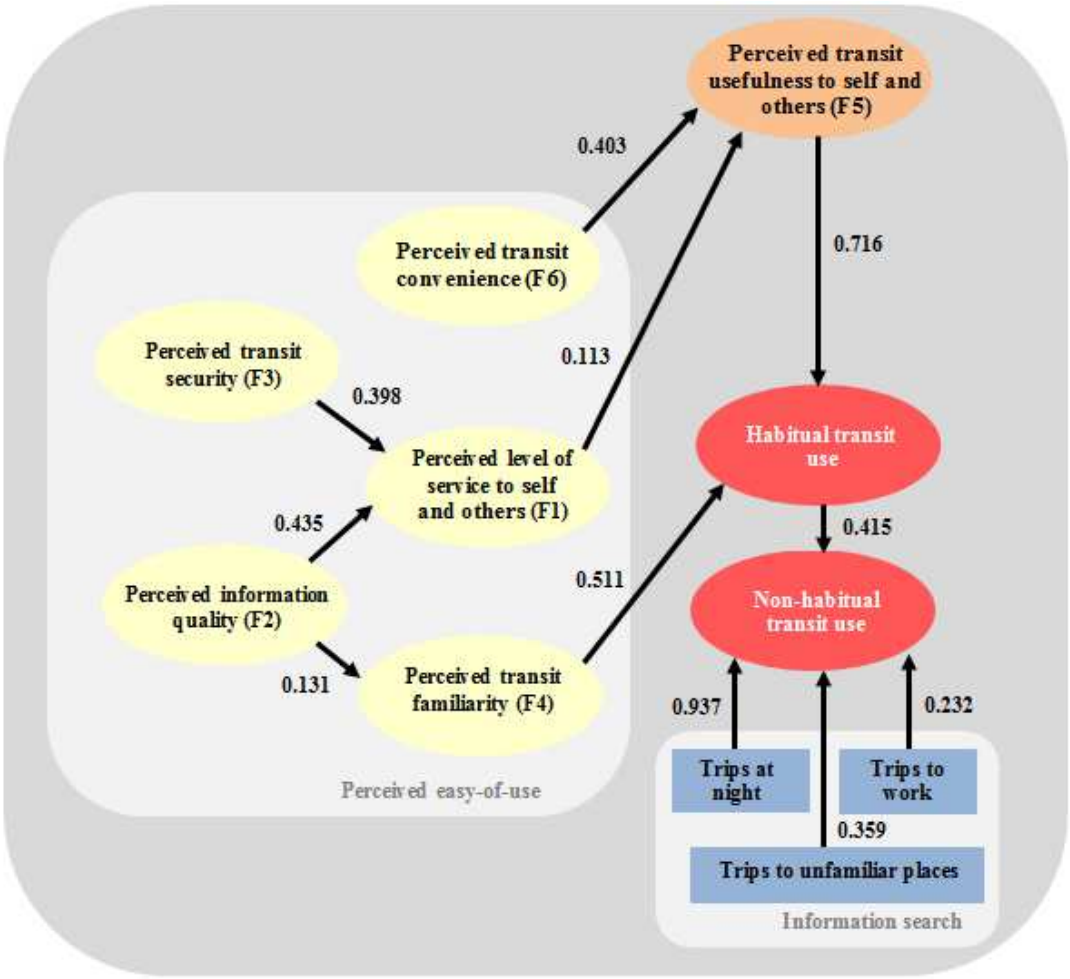

Figure 95: The structural relations in the behavioral framework for Recife and Natal

One difference is related to the perception of the system level of service and usefulness. In Copenhagen the ETAM follows its classical form, with a clear distinction between both the level of service and usefulness to one-self and the subjective norms, which represent the opinion of significant others. In Recife and Natal the level of service and usefulness of the system are perceived to self and others without a clear distinction.

Venkatesh and Davis (2000) refer to this effect of subjective norm on perceived usefulness and perceived level of service as the phenomenon of internalization, which is defined by Kelman (1958) as when the individual accepts the influence of people considered important (e.g. family, friends) in a way that he/she finishes integrating it to their existing values, internalizing it.

Another difference is associated to the relationships between the factors and the observed variables related to them (socioeconomic characteristics, habitual use of car and bicycle, place of residence, accessibility, and transit information search) in each country. The estimation results are presented in the following tables.

6.4.1 Structural equations model (latent variables – observed no explanatory variables)

The second column labeled Estimate presents the model estimated value for each parameter, the third column labeled C.R. (Critical Ratio) contains the values of the parameter estimate divided by the standard error and the fourth column labeled P-value gives the p-value for the z-score in the second column (Two-Tailed P-Value).

The first factor identified was the Level of Service. In Recife and Natal, this factor showed to be related to gender, method of payment, occupation status and place of residence; where men and people who study and work perceive the level of service worse, and people who pay in cash and live in Recife, Natal or RMN perceive the system better than others (see Table 27).

Table 27: Socio-economic characteristics linked to Level of service – Recife and Natal

LEVEL OF SERVICE (F1)			
Variable	**Estimate**	**C.R.**	**P-value**
Male	-0.347	-6.051	0.000
Pay with cash	0.109	1.795	0.073
Study and work	-0.092	-1.653	0.098
Lives in Recife	0.169	2.375	0.018
Lives in Natal	0.192	2.514	0.012
Lives in Natal Metropolitan Region	0.207	2.476	0.013

About the people who pay with cash, it is reasonable to affirm that these are people who do not use the system with much frequency and so it seems that the use of the system

determine the level of service's perception. If you use more, you perceive more the existing problems.

Table 28: Socio-economic characteristics linked to Level of service - Copenhagen

LEVEL OF SERVICE (F1)			
Variable	**Estimate**	**C.R.**	**P-value**
Male	0.151	1.702	0.089
Live with child/children	-0.720	-1.673	0.094

In Copenhagen, gender and residential arrangement are the observed variables associated to the level of service (see Table 28); where men and people who do not live with a child have a better impression of the public transport service. In general, people who have a child tend to have more concerns and special requirements to analyze the public transport service, what make it more difficult to fulfill all the needs of this group.

Regarding the second factor recognized, named "Information quality", in Recife and Natal (see Table 29) variables related to age, monthly expense with transport, source of information used, place where you live and access to bicycle were all found significant. Perceived higher information quality is negatively associated with asking other passengers or PT staff about PT info, while it is positively associated with real time information use.

Table 29: Socio-economic characteristics linked to Information quality – Recife and Natal

INFORMATION QUALITY (F2)			
Variable	**Estimate**	**C.R.**	**P-value**
Less than 18	0.286	2.620	0.009
High expense with transport	-0.317	-2.123	0.034
Ask people about PT information	-0.119	-2.033	0.042
Use real time information	0.099	2.392	0.017
Lives in Natal	-0.134	-2.177	0.029
Access to bicycle	0.059	1.701	0.089

In Copenhagen, we found that residential arrangements, access to bike and public transport systems, method of payment for PT and residence place are all relevant. It is realistic to say that people who live in Copenhagen have access to a denser network with information in more detail in the stations/stops (see Table 30). Moreover, people who have high access to

public bike, transit systems and pay with monthly card are considered people who tend to use PT more and so are more aware of how to gather information.

Table 30: Socio-economic characteristics linked to Information quality - Copenhagen

INFORMATION QUALITY (F2)			
Variable	**Estimate**	**C.R.**	**P-value**
Lives with roommate/friend	0.207	2.220	0.026
Access to bike sharing	0.301	1.676	0.094
Access to PT system	0.247	1.563	0.118
Pay with monthly card	0.229	1.645	0.100
Lives in Copenhagen	0.165	2.083	0.037

The third factor found to be relevant was “Security”. In Recife and Natal, people feel safer if they have access to a car and live in the Metropolitan Region of Natal (see Table 31). On the other hand, people who use real time information perceive low security. One possible explanation to this is that once the real time information is not available in bus stops, the only way to access it during the trip is using smartphones; due to a high perceived insecurity about being robbed in Brazil, people feel as if they are exposing themselves and so becoming more vulnerable to the risk of theft.

Table 31: Socio-economic characteristics linked to transit security – Recife and Natal

TRANSIT SECURITY (F3)			
Variable	**Estimate**	**C.R.**	**P-value**
Male	1.035	10.889	0.000
Lives in Natal Metropolitan Region	0.255	1.675	0.094
Access to car / car sharing	0.232	2.400	0.016
Use real time information	-0.235	-2.852	0.004

In Denmark, you feel less safe if you pay with a phone app (see

Table 32). Considering the same line of reasoning as presented for the Brazilian security analysis, it is possible to say that people who need to show their smartphone when taking public transport feel more vulnerable than those who do not. According to Denmark 2015 Crime and Safety Report, although not common practice, pickpockets and other minor criminals operate at tourist attractions, train stations, and on public buses (U.S. Department of State, 2015).

Table 32: Socio-economic characteristics linked to transit security - Copenhagen

TRANSIT SECURITY (F3)			
Variable	**Estimate**	**C.R.**	**P-value**
Male	0.224	2.450	0.014
Lives in Copenhagen	0.202	2.019	0.043
Access to bicycle	0.524	3.222	0.001
Pay with phone app	-0.385	-1.767	0.077

In both countries, men feel safer than women, but in Brazil, as expected, the gender has more importance, because the violence rates are higher and the fear of be harassment (women are more susceptible) is also higher for women (see more about perceived security in Table 15).

The forth factor recognized was “Familiarity”, in Recife and Natal (see table Table 33), people seem less familiar with the transit system if they are less than 18, have access to car, have high expense with transport, pay for public transport with cash and live in the main cities. On the other hand, people who use real time information perceive more familiarity with the PT system.

Table 33: Socio-economic characteristics linked to transit familiarity – Recife and Natal

TRANSIT FAMILIARITY (F4)			
Variable	**Estimate**	**C.R.**	**P-value**
Less than 18	-0.492	-3.926	0.000
Access to car / car sharing	-0.256	-3.608	0.000
Pay with cash	-0.572	-7.513	0.000
High expense with transport	-0.420	-1.861	0.063
Lives in Recife	-0.229	-2.628	0.009
Lives in Natal	-0.269	-2.740	0.006
Use real time information	0.112	1.780	0.075

In Denmark (see Table 34), if people pay for PT with a phone app, monthly card or student card, they feel more familiar with the system, which is reasonable because these methods of payment tend to be used for frequent users of the system.

Table 34: Socio-economic characteristics linked to transit familiarity - Copenhagen

TRANSIT FAMILIARITY (F4)			
Variable	**Estimate**	**C.R.**	**P-value**
Live with parentes	0.226	1.826	0.068
Live with partner and child	-1.197	-2.094	0.036
Pay with phone app	0.450	2.605	0.009
Pay with monthly card	0.630	4.119	0.000
Pay with student card	0.440	3.260	0.001

The fifth factor was "Usefulness" and the Brazilian respondents who have access to PT system and have low expense with transport perceived the public transport more useful than others (see Table 35). On the other hand, people who use their smartphone with paid internet, pay for PT with cash, live in Recife and have access to car judge the public transport as less useful.

Table 35: Socio-economic characteristics linked to transit usefulness – Recife and Natal

TRANSIT USEFULNESS (F5)			
Variable	**Estimate**	**C.R.**	**P-value**
Use GPS/paid internet	-0.290	-3.539	0.000
Access to PT system	0.459	2.948	0.003
Pay with cash	-0.590	-6.049	0.000
Low expense with transport	0.319	2.452	0.014
Lives in Recife	-0.254	-2.394	0.017
Access to car	-0.754	-8.729	0.000

In Denmark, people who use a car or have access to a bicycle consider transit less useful than others (see Table 36). This fact could be understood assuming that those people compare a trip by public transport to a door-to-door trip, as they have access to their private modes of transportation.

Table 36: Socio-economic characteristics linked to transit usefulness - Copenhagen

TRANSIT USEFULNESS (F5)			
Variable	**Estimate**	**C.R.**	**P-value**
Car use	-0.283	-2.254	0.024
Access to bicycle	-0.452	-2.883	0.004

The sixth factor discovered was “Convenience” and relates only to Brazil (see Table 37). People who live with parents or partner and pay with cash perceive less convenience than others. Also men, people who have access to a car and people who use real time information think that public transport is more convenient.

Table 37: Socio-economic characteristics linked to transit convenience - Recife and Natal

TRANSIT CONVENIENCE (F6)			
Variable	**Estimate**	**C.R.**	**P-value**
Male	0.194	3.025	0.002
Live with parentes	-0.133	-1.700	0.089
Live with partner	-0.219	-1.758	0.079
Pay with cash	-0.166	-2.179	0.029
Access to car	0.270	3.899	0.000
Use real time info	0.144	2.307	0.021

Knowing that this factor is highly linked with features as saving money and avoid driving, it is possible to understand why people who use a car to some extent think that public transport is more convenient.

The seventh and last factor identified was “Pro-transit subjective norms”, which is only related to the Danish sample in a clear distinction from others; in Brazil, the social norms are confused with the personal standards in the “Level of Service” and “Usefulness”.

People who live in Denmark and pay with a monthly card and people who have low to average expense with transport evaluate positively the subjective norms around them (see Table 38).

Table 38: Socio-economic characteristics linked to Pro-transit subjective norms - Copenhagen

PRO-TRANSIT SUBJECTIVE NORMS (F7)			
Variable	**Estimate**	**C.R.**	**P-value**
Pay with monthly card	0.440	3.316	0.001
Low expense with transport	0.206	1.851	0.064
Average expense with transport	0.218	1.766	0.077

6.4.2 Structural equations model (latent variables – habitual transit use)

The following results express the relation between the latent attitudinal constructs with each other and then with transit use in a habitual and a non-habitual pattern.

As shown in Table 39, the perceived information quality and the perceived security are positively and significantly related to the perceived Level of Service. As expected, in Copenhagen, where the transit system is relatively safe, the importance of the perceived information quality relative to security is higher compared to Brazil.

Table 39: Latent attributes linked to Brazil's and Denmark's level of service

LEVEL OF SERVICE (F1)						
	BRAZIL			DENMARK		
Variable	Estimate	C.R.	P-value	Estimate	C.R.	P- value
Transit security (F3)	0.398	11.175	0.000	0.140	3.031	0.002
Information quality (F2)	0.435	7.827	0.000	0.649	9.984	0.000

The perceived information quality is positively related to perceived familiarity with similar magnitude in both sources of information analyzed (see Table 40).

Table 40: Latent attributes linked to Brazil's and Denmark's Transit familiarity

TRANSIT FAMILIARITY (F4)						
	BRAZIL			DENMARK		
Variable	Estimate	C.R.	P-value	Estimate	C.R.	P- value
Information quality (F2)	0.131	2.176	0.030	0.196	3.198	0.001

In both the Brazilian and Danish sources of information, Level of service is found to be positively related to Transit usefulness (see Table 41). In Copenhagen, where the level of service is relatively higher, the importance of the level of service relative to usefulness is higher compared to Brazil.

Table 41: Latent attributes linked to Brazil's and Denmark's Transit usefulness

TRANSIT USEFULNESS (F5)						
	BRAZIL			DENMARK		
Variable	Estimate	C.R.	P-value	Estimate	C.R.	P- value
Level of service (F1)	0.113	1.592	0.111	0.631	7.923	0.000
Transit convenience (F6)	0.403	4.963	0.000	-	-	-
Pro-transit subjective norms (F7)	-	-	-	0.881	7.856	0.000

The Usefulness in Brazil showed to be also related to the perceived Transit convenience, or in other words, to the transit accommodation to the peoples' needs (e.g.: to save money, avoid driving). This was also the factor with higher loading in the contribution to the usefulness perception, what that means is that people in Brazil perceive the PT as useful more due to the convenience than due to their perception of level of service.

In Denmark, the "Pro-transit subjective norms" is the latent variable that most influence the perceived usefulness (see Table 42) or, in other words, the encouragement by important others (family and friends) to use public transport is the most significant factor related to the usefulness.

Table 42: Latent attributes linked to Brazil's and Denmark's Transit use

HABITUAL TRANSIT USE						
	BRAZIL			DENMARK		
Variable	Estimate	C.R.	P-value	Estimate	C.R.	P- value
Transit familiarity (F4)	0.511	8.962	0.000	0.322	4.372	0.000
Transit usefulness (F5)	0.716	13.776	0.000	0.290	2.742	0.006
Pro-transit subjective norms (F7)	-	-	-	0.323	2.300	0.021

Thus, Habitual transit use is found to be positively related to familiarity and usefulness, where usefulness has more significance in Recife and Natal than familiarity. Moreover, in Copenhagen, there is another factor that also influences directly the transit use: Pro-transit

subjective norms, which have almost the same impact as the familiarity, and both individually showed be more significant than usefulness in Denmark.

6.4.3 Structural equations model (latent variables – non - habitual transit use)

Finally, as shown in Table 43, non-habitual transit use is positively related to habitual transit use and information search, to accommodate to the specific travel needs of the journey, in both sources of information. In Recife and Natal, non-habitual transit use (at night) is related both to information search regarding go to work, to non-familiar places and out at night, while in Copenhagen it is associated with searching information regarding trips at night and information regarding to the need to arrive on time (See Figures 95 e 96).

Table 43: Latent constructs related to Brazil's and Denmark's perceived transit use at night

NON – HABITUAL TRANSIT USE						
	BRAZIL			DENMARK		
Variable	Estimate	C.R.	P-value	Estimate	C.R.	P- value
Transit use	0.415	11.839	0.000	0.352	7.401	0.000
Search PT info to go to work	0.232	2.032	0.042	-	-	-
Search PT info to go at night	0.937	7.063	0.000	0.846	7.192	0.000
Search PT info to go new/unfamiliar places	0.359	3.220	0.001	-	-	-
Search PT info when need to arrive on time	-	-	-	0.358	2.280	0.023

The Table 44 and the Table 45 present the estimated covariance matrix for the latent variables found in Brazilian and Danish sources of information.

Table 44: Estimated covariance matrix for the latent variables – Recife and Natal

	F1	F2	F3	F4	F5	F6
Level of service (F1)	0.296					
Information quality (F2)	0.094	0.231				
Transit security (F3)	0.318	-0.021	1.028			
Transit familiarity (F4)	-0.022	0.045	-0.057	0.664		
Transit usefulness (F5)	-0.017	0.013	0.000	0.194	0.973	
Transit convenience (F6)	0.005	0.002	0.055	0.001	0.103	0.311

Table 45: Estimated covariance matrix for the latent variables - Copenhagen

	F1	F2	F3	F4	F5	F7
Level of service (F1)	0.440					
Information quality (F2)	0.259	0.393				
Transit security (F3)	0.124	0.029	0.704			
Transit familiarity (F4)	0.074	0.079	-0.005	0.600		
Transit usefulness (F5)	0.268	0.155	0.029	0.064	0.586	
Pro-transit subjective norms (F7)	0.005	0.006	-0.001	0.015	0.199	0.217

7 CONCLUSIONS

This research focused on the role of information in public transport, mainly according young adults, exploring the relations between information provision and transit use for habitual and non-habitual (at night) travels. The sources of information analyzed (Brazil and Denmark) differ in the perceived LOS, information provision and information quality.

The contribution of this study to the body of knowledge consists of revealing the complex relationship between transit use frequency, perceived information quality, perceived level of service, perceived usefulness of the transit system, perceived difficulties to use the system (i.e., security, convenience), and perceived familiarity with the transit system.

The study shows the validity of the ETAM to explain transit use frequency and the importance of further extending the TAM with information provision quality and search according to the context of transport services, as it was exposed in the proposed behavioral framework. Results also show that Brazil and Denmark present a very similar behavioral model structure, despite the items that define each factor, the influence of each factor in each scenario and the socioeconomic characteristics related to each factor all varying according to the scenario.

For both countries, the perceived information quality was found to be directly and positively related to perceived LOS and familiarity with the transit system. The perceived security proved to be related to the perceived LOS also, but information quality was more significant than security in both Brazil and Denmark. This finding highlights the importance of information provision in PT use, especially in Brazilian context, where the information available in the infrastructure of the bus system is scarce.

Comparing Brazil and Denmark, the factor “security” showed to be more substantial in the Brazilian context, which was expected since in Copenhagen the transit system is relatively safer than Brazil. On the subject of familiarity, the intensity of the influence of information quality in this factor is similar in both Brazil and Denmark.

In both the Brazilian and Danish sources of information analyzed, the LOS was found to be positively related to transit usefulness, with the safeguard that in Copenhagen, where the

LOS is relatively higher, the importance of the LOS relative to usefulness is higher compared to Brazil.

Regarding usefulness, in Brazil this factor showed also to be influenced by the perceived transit convenience, or in other words, to the transit accommodation to the peoples' needs (e.g.: to save money, avoid driving). This factor has the higher loading in the contribution to the usefulness perception, meaning that people in Brazil perceives the public transport useful more due to the convenience than to their perception of level of service.

On the other hand, in Denmark, the "pro-transit subjective norms" is the latent variable that most influence the perceived usefulness, what means that the encouragement by important others (family and friends) to use public transport is the most significant factor related to the usefulness.

It is important to highlight that in Copenhagen the ETAM follows its classical form, with a clear distinction between both the level of service and usefulness to one-self and the pro-transit subjective norms. However, in Recife and Natal the level of service and usefulness of the system are perceived to self and others without a clear distinction, which can be a result of internalization of relevant others' opinions that become part of the individual's values.

Considering all these relations, in Recife and Natal, the habitual transit use is found to be positively related to familiarity and usefulness, where usefulness has more significance than familiarity. On the other hand, in Copenhagen, besides these two factors, pro-transit subjective norms also influences directly the transit use, which have almost the same impact as the familiarity (both individually showed to be more significant than usefulness in Denmark).

About the non-habitual transit use, this was found to be positively related to habitual transit use and information search in both Brazil and Denmark, being different in the kind of information searched in each case. In Recife and Natal, non-habitual transit use (at night) is related both to information search regarding going to work, to non-familiar places and out at night, while in Copenhagen it is associated with searching information regarding trips at night and information regarding to the need to arrive on time.

Regarding the hypotheses assumed in this thesis, they were tested both in the Brazilian and the Danish sources of information. It can be noticed through the observation of Table 39 that the first hypothesis was confirmed, as it is possible to evidence that the perceived information quality is positively and significantly related to the perceived Level of Service. Furthermore, the perceived information quality (see Table 40) was found to be positively related to the perceived familiarity with a similar magnitude in both sources of information analyzed, thus confirming the second hypothesis.

In addition, as presented in Table 29 to Table 38Table 33, the third hypothesis was only partially confirmed. The use of real time information is positively related to perceived information quality and transit familiarity, but is negatively associated with perceived transit security. These relationships between the use of real time information and the perceived transit security were found only in the Brazilian source of information.

A possible explanation to this is that once the real time information is not available in bus stops in the Brazilian cities analyzed, the only way to access it during the trip is using smartphones. Thus, due to a high perceived insecurity about being robbed in Brazil, people feel as if they are exposing themselves and so becoming more vulnerable to the risk of theft. Policy implications are possible positive outcome of investment in real-time information services on stops and terminals, and of supporting and encouraging initiatives aimed at offering real-time information.

The fourth hypothesis was confirmed as shown in Table 43. The non-habitual transit use is positively related to habitual transit use and information search in both sources of information analyzed.

Additionally, the respondents in Recife and Natal were asked about their beliefs associated to information improvements and indicated that better information provision would result in higher transit use intentions. In order to verify it, a cross-sectional analysis was also made and has confirmed these stated-preferences regarding transit use intentions with revealed-behavior.

Furthermore related to information in public transport, the samples collected in both Recife and Natal, and in Copenhagen, that were mainly composed of young people revealed

that the source most considered as important or very important was on-line information apps/internet to people in both countries. The policy implication that can be suggested from this finding is that compared to the high costs associated to public transport infrastructure and level of service improvements in terms of frequency, availability and reliability, bettering information quality could lead to an increase in transit ridership with relatively modest investments.

The sources of information (Brazilian and Danish) differ geographically, culturally and in terms of transit and information provision. However, many similarities were found regarding the information sources used, the reasons for searching information, the type of information sought, and the importance attributed to various information sources. Similar structural relations were found regarding the role of information as a motivator for transit use intentions.

The findings and the policy implications suggest transferability of the behavioral model framework proposed across regions with varying degrees of transit service and information provision, as long as an adequacy can be carried out considering the specific context, for example groups analyzed and specific socioeconomics items.

Since this study focused on the group of university students, it is recommended that future research examines samples that include travelers that have different characteristics to observe the validity of these relations through different ranges of the population. Furthermore, the application of this methodology over other countries and regions could be used to strengthen the evidences found. It is also strongly recommended that future research in this subject analyzes more and different items that could lead to different factors that also have relation with the perception of the easy-of-use and the usefulness of PT.

On the subject of information, there is a full variety of PT information to be explored and analyzed, for example in respect to preferences and desired approach. The ideal scope, updating status and location where the information is available can vary across regions, social and age groups, becoming necessary to be examined in order to better deliver the desired information in an efficient, clear and easy way.

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APPENDIX A – EXTENDED ABSTRACT IN PORTUGUESE

O PAPEL DA INFORMAÇÃO PARA ESTUDANTES DE GRADUAÇÃO E PÓS-GRADUAÇÃO NO BRASIL E NA DINAMARCA

1 INTRODUÇÃO

O estilo de vida dos jovens está mudando de um modelo tradicional enraizado e habitual para um mais dinâmico, onde nota-se a constante mudança de residência e de padrões de atividade, devido à necessidade de estudos, à competição no mercado de trabalho, a viagens de negócios, ao aumento no consumo de lazer e à globalização.

Quando combinado com a crescente complexidade e tamanho da cidade, este estilo de vida, que exige que as pessoas estejam em constante movimento em ambientes não familiares, gera uma grande demanda por informações sobre viagens. Desta forma, observa-se o aumento da importância da obtenção de informações pertinentes e confiáveis em um formato claro e eficiente que permita a realização de atividades, poupando tempo e dinheiro.

No entanto, a relação benefício-custo dos sistemas de informação de transporte público (TP) e o seu impacto sobre os padrões de viagem dos usuários e na mudança modal não é claro. Como resultado, há muitos operadores de TP que não fornecem informações, devido à crença de que os usuários de TP contam com a sua experiência e familiaridade com o sistema, com informações boca-a-boca, e com informações específicas do operador (IBRAEVA e FIGUEIRA DE SOUSA, 2014). Desta forma, compreender a relação entre os sistemas de informação e a utilização do TP pode apoiar os operadores em sua decisão de investir em sistemas de informação avançados.

Estudos recentes mostram a importância de buscar informações de TP para a realização de viagens habituais e de longa distância. Em uma pesquisa realizada com 200 participantes na China, 77% dos entrevistados afirmou que buscou informações de TP de uma a três vezes na semana anterior à pesquisa, e 77% disseram que gostariam de consultar informações de TP antes da viagem (HOU e CHEN, 2013).

Em uma pesquisa realizada em Bristol, respectivamente, 42% e 57% dos entrevistados afirmaram buscar informações sempre ou muito frequentemente para viagens de lazer e de negócios com distâncias superiores a 50 milhas dentro do Reino Unido, enquanto 57% afirmaram que obtiveram informações de TP para viagens não familiares (FARAG e LYONS, 2012).

Apesar da crescente acessibilidade à informação, não está claro se ela pode induzir a uma mudança modal para a utilização de TP (ABREVA e FIGUEIRA DE SOUSA, 2014). Por um lado, o uso de TP é considerado habitual e, consequentemente, menos sensível às informações, mas, por outro lado, o fato dos viajantes considerarem principalmente o tempo de viagem e o custo (NIELSEN, 2000, ANDERSEN *et al.*, 2014), mostra que as informações

são pertinentes mesmo quando o uso de TP é frequente e habitual (ŞIMŞEKOĞLU et al., 2015).

Até o momento, a investigação é escassa em relação ao uso de informações para o planejamento de viagens de TP, e a ligação entre a busca de informações de TP e a utilização do TP (FARAG e LYONS, 2012). Hou e Chen (2013) relatam que uma pesquisa revelou que 49,5% e 61,3% dos viajantes estavam dispostos a considerar a possibilidade de ajustar o seu horário de partida e o modo de transporte de acordo com informações pré-viagem. Brakewood et al. (2014) realizou uma pesquisa "antes e depois" para avaliar os impactos das informações de TP em tempo real em Tampa (Florida), e encontrou uma mudança significativa no tempo de espera e nos sentimentos associados com o tempo de espera, mas não na frequência de viagem ou no número de transferências.

Estes estudos fornecem informações sobre os estímulos externos (provisão de informação) e o resultado (número de passageiros), mas não fornecem uma estrutura comportamental do que está por trás do resultado. Nesse sentido, Farag e Lyons (2012) desenvolveram um quadro comportamental que explica o uso da informação em viagens de longa distância; onde a busca de informação está relacionada com atitudes e comportamentos, associando-se negativamente a viagens habituais e positivamente ao uso menos frequente.

O presente estudo sugere um quadro comportamental rigoroso quanto à relação entre a qualidade percebida da informação de viagem e o seu uso, a qualidade percebida do sistema de TP, o uso habitual do TP e a utilização não habitual do TP em viagens intra-metropolitanas.

2 ESTRUTURA DO MODELO

2.1 Estrutura comportamental

Esta dissertação observou o uso do TP a partir da perspectiva da aceitação tecnológica, de acordo com o Modelo Estendido de Aceitação Tecnológica - ETAM (VENKATESH e DAVIS, 2000), que se baseia na Teoria do Comportamento Planejado - TPB (AJZEN, 1991), estendendo o Modelo de Aceitação Tecnológica - TAM (DAVIS, 1989) através da consideração de normas subjetivas e da experiência com o produto, ou seja, a familiaridade. O ETAM foi estendido ainda mais neste estudo, a fim de explorar o papel da qualidade da informação na aceitação pelo usuário do serviço de transporte público urbano. A estrutura proposta do modelo está ilustrada na Figura 1.

O quadro proposto foi adaptado ao contexto do uso do TP, devido ao fato de que este é um produto sócio tecnológico complexo e dinâmico que requer aprendizagem contínua e atualização através de seus usuários. O ETAM original não considera explicitamente a provisão e a qualidade das informações e, a experiência do usuário, ou a familiaridade, não está relacionada com a facilidade de uso, mas apenas com a utilidade do produto. Por isso, alguns itens tiveram de ser acrescentados e/ou suas relações tiveram que ser adaptadas ao contexto do TP.

Visto que a informação é proporcionada como uma parte integrada do serviço de TP e é essencial para uma utilização eficiente desse sistema, esta não pode ser vista como um fator externo que leva à escolha inicial do produto, mas sim como um fator essencial para o uso eficiente e recorrente do sistema de TP. O mesmo é valido para a familiaridade.

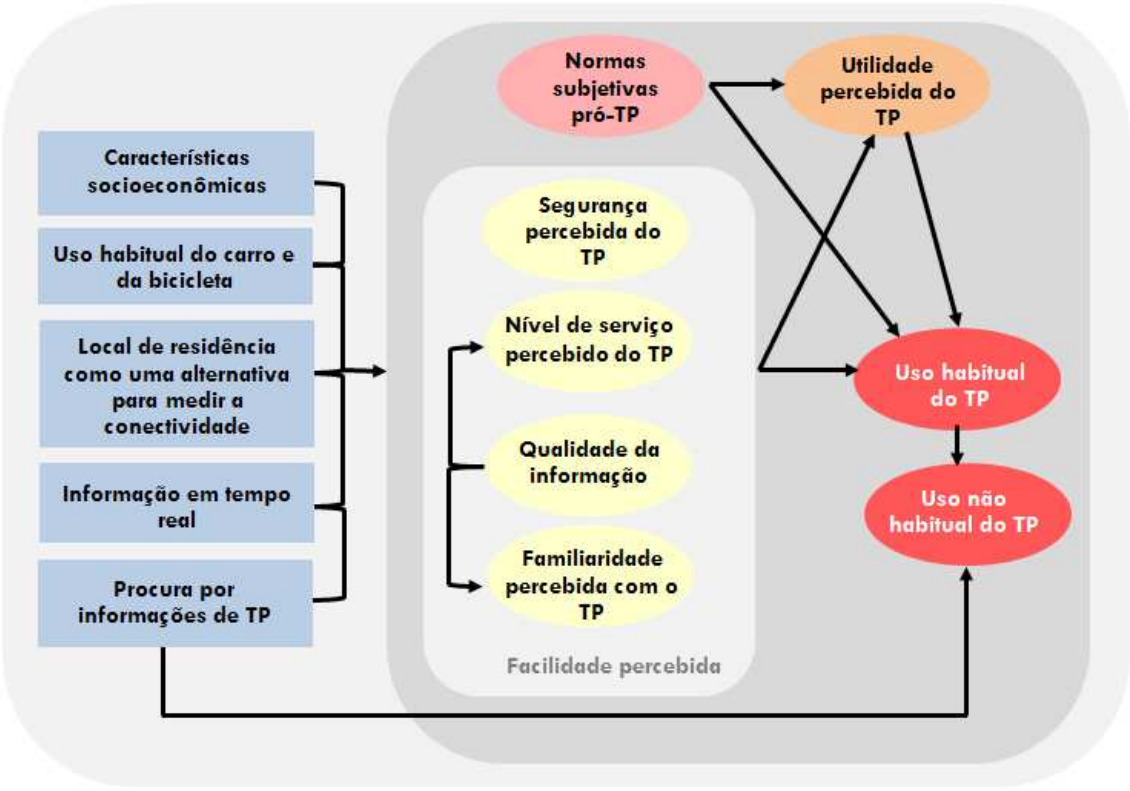


Figura 1: Proposta de modelo comportamental adaptado ao uso de TP

A estrutura comportamental proposta inclui a suposição de que a informação tem um papel adicional no aumento da percepção da familiaridade e do nível de serviço, que por sua vez afeta a facilidade de uso e a utilidade percebida do TP. A familiaridade é vista como uma facilitadora do uso do TP, pois reduz os esforços associados com a navegação e busca de informações (FARAG e LYONS, 2012; KAMGA et al, 2013). Portanto, a estrutura comportamental permite explorar as seguintes hipóteses:

H1: A qualidade percebida da informação está positivamente relacionada com um melhor nível de serviço percebido;

H2: A qualidade percebida da informação está positivamente relacionada com uma maior familiaridade percebida;

H3: A informação em tempo real está positivamente relacionada a uma maior percepção da qualidade da informação, familiaridade e segurança;

H4: O uso não habitual do transporte público está positivamente relacionado ao uso habitual e à procura de informações para acomodar as necessidades específicas das viagens em questão.

A utilização do TP foi medida por meio de duas construções: habituais e não habituais, que foram supostas estar relacionadas de forma diferente à necessidade de informação. Pode-se argumentar que o uso habitual de TP requer menos busca de informações do que as viagens não habituais (FARAG e LYONS, 2012).

A utilização habitual do TP foi medida através da frequência percebida de uso do TP, independentemente dos motivos de viagem e da hora do dia. A utilização do TP durante a noite foi usada como representante do uso não habitual do TP.

2.2 Modelo matemático

A estrutura do modelo comportamental hipotético foi investigada por meio da aplicação de um modelo de equações estruturais que contém quatro conjuntos de equações. O primeiro conjunto contém equações de medição (Eq. 1). O segundo conjunto (Eq. 2) liga os constructos latentes (fatores) às características socioeconômicas, ao uso habitual de carros e bicicletas, ao local de residência (usado como um representante da conectividade, acessibilidade e abundância do TP), e a busca de informações de TP, com ênfase em informação em tempo real. O terceiro conjunto (Eq. 3) relaciona os fatores com o uso habitual do TP. O quarto conjunto (Eq. 4) liga o uso não habitual do TP à utilização habitual de TP e à busca de informações de TP.

$$I_{rn} = Z^*_{ln}\alpha_r + \upsilon_{rn} \quad and \quad \upsilon_n \sim N\left(0, \Sigma_\upsilon\right) \quad for\ r = 1,\ldots,R \quad \text{(Eq. 1)}$$

$$Z^*_{ln} = \left(SC_{ln} + TH_{\ln} + PR_{\ln} + TI_{\ln}\right)\beta_l + \omega_{ln} \quad and \quad \omega_n \sim N\left(0, \Sigma_\omega\right) \quad for\ l = 1,\ldots,L \quad \text{(Eq. 2)}$$

$$HTU^*_n = Z^*_{ln}\beta_y + \xi_n \quad and \quad \xi_n \sim N\left(0, \sigma^2_\xi\right) \quad \text{(Eq. 3)}$$

$$NHTU^*_n = \left(HTU^*_{ln} + TIS_{\ln}\right)\beta_z + \varsigma_n \quad and \quad \varsigma_n \sim N\left(0, \sigma^2_\varsigma\right) \quad \text{(Eq. 4)}$$

onde I_{rn} é o valor de um indicador r da construção latente Z^*_{ln} de acordo com a percepção do respondente n, Z^*_{ln} é o valor da construção latente l para um respondente n. SC_{ln} , TH_{ln} , PR_{ln} e TI_{ln} são respectivamente o vetor das características socioeconômicas, dos padrões de viagem, do lugar de residência, e das fontes de informação de viagem utilizadas pelos respondentes (ex.: informação em tempo real, consultar outros passageiros). HTU^*_n é o vetor do uso habitual do TP percebido pelos respondentes, $NHTU^*_n$ é o vetor do uso não habitual do TP percebido pelos respondentes, e TIS_{ln} é o vetor das possibilidades de procura de informação no TP (ex.: durante a noite, para atividades não familiares, quando é necessário chegar em determinado horário, etc.). Foi considerado que os termos referentes aos erros ω_{ln} e υ_{rn} seguem uma distribuição normal com respectivas matriz de covariância Σ_ω, Σ_υ. Os termos referentes aos erros ξ_n e ς_n seguem uma distribuição normal com respectivas variâncias ξ e ς. Os parâmetros estimados foram α_r, β_l, β_y, e β_z.

Foram considerados R indicadores traduzidos em R equações de medição e estimando um vetor $(R\times 1)$ α *dos* parâmetros. Da mesma forma, considerando L construções latentes, foram escritas L equações estruturais, estimando uma matriz $(M\times L)$ de β parâmetros.

O modelo foi estimado por meio do software M-Plus. Os parâmetros foram estimados simultaneamente usando Máxima Verossimilhança com o ajuste de covariância Huber-White (YUAN e BENTLER, 2000). Os erros padrão foram calculados adotando o método baseado no tipo sanduíche de White que produz estatísticas robustas na presença de não normalidade nos indicadores e nas variáveis categóricas (WHITE, 1980).

3 FONTES DE INFORMAÇÃO

3.1 Recife e Natal, Brasil

Recife, a capital do Estado de Pernambuco, é o núcleo da oitava região metropolitana mais populosa do Brasil, que compreende 14 municípios e 4 milhões de habitantes, sendo mais de 1,5 milhões residentes em Recife. O sistema de transporte público (TP) da Região Metropolitana de Recife (RMR) é multimodal, incluindo ônibus, ônibus de trânsito rápido (Bus Rapid Transit - BRT), metro e Veículo Leve sobre Trilhos (VLT). O sistema de transporte é dividido em dois sistemas: o Sistema Estrutural Integrado (SEI) e o Sistema Complementar.

O SEI compreende 185 linhas de ônibus e 25 terminais integrados que conectam esse modo às linhas de BRT e ao metro. O sistema BRT é composto por 37 estações e oito linhas que transportam uma média diária de 110.000 passageiros. As três linhas de metro existentes possuem um total de 70,4 km, conectando 36 estações em cinco cidades da RMR e transportando uma média de 245.000 passageiros nos dias úteis. O sistema de tarifas de ônibus é baseado em cinco anéis, onde as tarifas variam de acordo com o anel onde a viagem é realizada. Existem tarifas reduzidas para estudantes e gratuidade para idosos (mais de 65 anos). Para uma única viagem de metro / LRT, a tarifa é de R$ 1,60 (US$ 0,41[15]). O sistema complementar abrange o resto da área metropolitana e não está fisicamente ou tarifariamente integrado com o SEI. Vale salientar que a RMR possui menos de 50 km de corredores de TP exclusivo, resultando em tempos de viagem longos devido à operação em tráfego misto.

Natal, a capital do Estado do Rio Grande do Estado e a nona cidade mais populosa do Brasil, abriga cerca de 800.000 habitantes e é o centro de uma área metropolitana que compreende doze municípios e 1,5 milhões de habitantes. O sistema de TP gerido pelo município de Natal é composto por ônibus e micro-ônibus: há 646 ônibus em operação, que transportam 530.000 passageiros por dia e a tarifa é de US$ 0,68[15]. A frota de 177 micro-ônibus geridos por operadores individuais é responsável por cerca de 50.000 passageiros por dia. Duas linhas de VLT, com um comprimento total de 56,2 km ligam 22 estações, em quatro municípios da Região Metropolitana (Natal, Parnamirim, Ceará Mirim e Extremoz). O serviço de VLT transporta 8.200 passageiros por dia, nos dias de semana, e a tarifa é de US$ 0,13[15]. Existem tarifas reduzidas para estudantes e gratuidade para idosos (mais de 65 anos). Os serviços de ônibus entre os núcleos urbanos metropolitanos e Natal são geridos pelo Estado do Rio Grande do Norte e dispõe de cerca de 250 ônibus e uma centena de micro-ônibus, transportando diariamente em torno de 175.000 passageiros.

[15] Considerando a taxa de conversão no dia 20 de Outubro de 2015: 1.00 USD = 3.88 BRL

Existem várias fontes de informação oferecidas pelos sistemas de TP em Recife e Natal. Nas duas cidades, as informações operacionais fornecidas nos ônibus são escassas e referem-se a nome e número da linha, preço da tarifa, direção (subúrbios ou centro da cidade) e pequena lista de principais lugares cobertos pela linha. As informações nas paradas de ônibus variam: alguns pontos de ônibus fornecem informações sobre as linhas que passam naquela parada, enquanto outras não estão sequer claramente identificadas como paradas. Em março de 2015, apenas 887 das 5.816 paradas de ônibus da RMR (15,3%) possuíam uma lista de linhas atendidas disponível. As cidades contam com websites oficiais das autoridades que oferecem informações sobre itinerários de linhas, paradas, horários e tarifas. O de Natal, contudo, não funciona há quase 6 anos. De acordo com o Grande Recife (2015), a cada mês o serviço telefônico de atendimento ao cliente recebe cerca de 8.000 chamadas, onde 70% delas estão relacionadas à obtenção de informações sobre itinerários de ônibus e vales eletrônicos. Para cobrir a necessidade de informações em tempo real, fontes de informação geradas por iniciativas privadas, como o app Citta Mobi (em Recife) têm surgido. As fontes independentes existentes atualmente são o Moovit app e o Google Maps.

3.2 Copenhagen, Dinamarca

A Grande Área de Copenhagen (GAC) possui uma população de cerca de 2 milhões de habitantes, distribuídos em 18 municípios que totalizam cerca de 3.000 Km². O planejamento e o desenvolvimento do sistema de TP na GAC seguem as diretrizes do "finger-plan", onde cinco cidades (Køge, Roskilde, Frederikssund, Hillerød e Helsingør) definem as direções a partir de Copenhagen para desenvolvimento dos "dedos" (corredores), que devem ser servidos por transporte e ligações rodoviárias. A rede de TP da GAC é composta por sete grandes modos: (i) metro, (ii) trens locais, (iii), trens suburbanos (S-train), (iv) trens regionais e interurbanos, (v) ônibus regulares, (vi) ônibus de alta frequência (A-bus), e (vii) ônibus suburbanos e expressos (S-bus e e-bus). O sistema transporta 220 milhões de passageiros por ano e inclui 448 linhas de ônibus e 13.500 paradas de ônibus.

O sistema de TP tem um sistema integrado de informação (Rejseplanen), que permite ao usuário procurar opções de TP a partir dos dados de partida ou de chegada, e oferece informações em tempo real. As informações fornecidas incluem tempos e percursos de caminhada, horários de partida, transferências, mapas, preço do bilhete, atrasos e mudanças no sistema. A informação pode ser acessada através de um aplicativo móvel e o sistema permite ainda a compra de bilhetes. O aplicativo é gratuito, e a informação é de acesso livre e, portanto, pode ser usada inclusive em produtos de terceiros, como por exemplo, Google Maps. Além disso, existe um aplicativo pago ("Bus næste"), que fornece informações sobre a posição em tempo real dos ônibus e a sua hora de chegada estimada para a parada de ônibus mais próxima. As informações em tempo real também são fornecidas em estações de trem e de metro e, em pontos de ônibus localizados no centro da cidade ou nos principais locais. No interior dos veículos, existe informação em tempo real sobre a localização atual do veículo, o seu destino e a próxima parada.

3.3 Dados e métodos

Um questionário foi desenvolvido (Ver apêndice D) para investigar as hipóteses definidas. Foram incluídas perguntas a respeito das características socioeconômicas, dos padrões de uso do TP, da familiaridade percebida com o TP, das normas sociais e dos padrões de busca e uso de informações de TP, bem como sobre a importância atribuída às várias fontes de informação.

As características socioeconômicas incluíram sexo, idade, moradia, acesso a telefone celular com internet, ocupação, acesso a opções de transporte, forma de pagamento pelo uso do TP, localização residencial e despesas mensais. Questões relacionadas aos padrões de uso do TP esclareceram a frequência de uso de cada modo de transporte e o modo de preferência de transporte para atividades obrigatórias e não obrigatórias. Os respondentes foram questionados também a respeito da sua experiência com o uso do TP, incluindo percepções sobre o nível de serviço, os serviços de informação, conforto, cobertura da rede, a confiabilidade do serviço, preço, utilidade e familiaridade com o sistema de TP. As perguntas sobre as normas sociais envolveram a atitude de familiares e amigos a respeito do nível de serviço e uso do TP. As afirmações relacionadas a algumas questões foram classificadas em uma escala de Likert de 5 pontos com suas opções variando de "discordo totalmente" à "concordo totalmente".

O questionário foi administrado em Inglês, Dinamarquês e Português, para estudantes das Universidades Federais de Pernambuco (UFPE) e do Rio Grande do Norte (UFRN), da Universidade Técnica da Dinamarca (DTU) e da Universidade de Copenhagen (KU) durante outubro de 2015 via internet. O tempo estimado para completar o questionário foi de cerca de 10 minutos e aos respondentes foi oferecida a chance de participar de um sorteio de 32 cartões-presente como um incentivo para a conclusão do questionário.

4 RESULTADOS

4.1 Características da amostra

No total, foram obtidos 1.123 questionários completos (63,2% do Brasil). A Tabela 1 apresenta as características da amostra. Os respondentes de Recife e Natal perceberam o nível de serviço e a qualidade das informações como inferiores em relação à Copenhagen. Em todas as fontes de informação estudadas, mais de 75% dos respondentes consideraram as tarifas de TP caras. Em Recife e Natal menos do que 15% avaliaram os serviços de informação como bons, em comparação com quase 60% em Copenhagen.

Em Recife e Natal, as três fontes de informação mais utilizadas são: perguntar a outros passageiros ou funcionários da empresa operadora (89,01%), Google Maps (75,35%) e informações on-line (72,11%). Em Copenhagen, as mais utilizadas são: informações on-line (93,95%), informações em tempo real nos veículos ou paradas (85,47%) e Google Maps (81,60%). Em ambas as fontes de dados, menos de 10% afirmou ligar para a empresa de transporte público para a obtenção de informações. Em Recife e Natal, perguntar aos passageiros ou a funcionários das operadoras foi considerado uma fonte importante de

informação por 88,71% das pessoas em comparação com 21,07% em Copenhagen. Em Recife e Natal, as 4 principais razões para a busca de informações escolhidas foram: necessidade de chegar dentro um determinado horário (48,17%), ir para lugares desconhecidos (42,96%), ir à universidade (37,61%), e ir ao centro da cidade (37,46%). Em Copenhague, os motivos foram: dentro um determinado horário (81,84%), ir para lugares desconhecidos (64,89%), sair à noite (44.31%) e ir para o centro da cidade (38,98%).

Nas duas fontes consultadas, mais de 90% das pessoas indicou que a informação sobre os tempos de partida/chegada, rota mais rápida e mudanças/atrasos são informações importantes. Em Recife e Natal 60% dos respondentes afirmaram que se o serviço de informação melhorasse, usariam o TP com uma frequência maior (58,87%).

VARIÁVEL	PAÍS	CATEGORIAS (%)					
Gênero		Homem	Mulher				
	BRASIL	51.41	48.59				
	DINAMARCA	62.71	37.29				
Idade		20 ou menos	21-25	26-30	31-35	36-40	Mais de 40
	BRASIL	25.07	55.49	12.11	3.24	1.55	2.54
	DINAMARCA	15.74	59.08	17.43	5.33	1.45	0.97
Moradia		Sozinho	Com criança	Com amigos	Com os pais	Com companheiro (a)	Com companheiro (a) e criança
	BRASIL	6.48	0.42	10.7	71.97	7.18	3.24
	DINAMARCA	39.47	0.97	21.07	14.53	21.79	2.18
Celular / uso de internet		Sim, com internet própria		Sim, utiliza com intenet grátis		Não	
	BRASIL	73.38		21.55		5.07	
	DINAMARCA	87.41		7.75		4.84	
Ocupação		Apenas estuda		Trabalha e estuda		Apenas trabalha	
	BRASIL	61.83		34.65		3.52	
	DINAMARCA	54.72		41.4		3.87	

Tabela 1: Características da amostra

4.2 Resultados da estimativa do modelo

As relações estruturais obtidas estão ilustradas nas Figuras 2a e 2b para Recife e Natal e para Copenhagen, respectivamente. Os resultados da estimação de cada fator (variável latente) estão apresentados nas tabelas de 33 a 44 (expostas na dissertação) para Recife e Natal (tabelas azuis) e Copenhagen (tabelas vermelhas), respectivamente. As estimativas que relacionam os fatores e os usos do transporte público podem ser encontradas nas tabelas 45 a 49 (expostas na dissertação).

A relação entre o qui-quadrado e os graus de liberdade foi de 2,63 para Recife e Natal e de 2,40 para Copenhagen, os quais estão abaixo do valor máximo (Ullman, 1996). Os RMSEA correspondentes foram 0,048 e 0,058, estando também abaixo dos valores máximos aceitos de 0,08 e 0,10. Os respectivos CFI obtidos foram 0,874 e 0,779, que são razoáveis de acordo com Loehlin (1998).

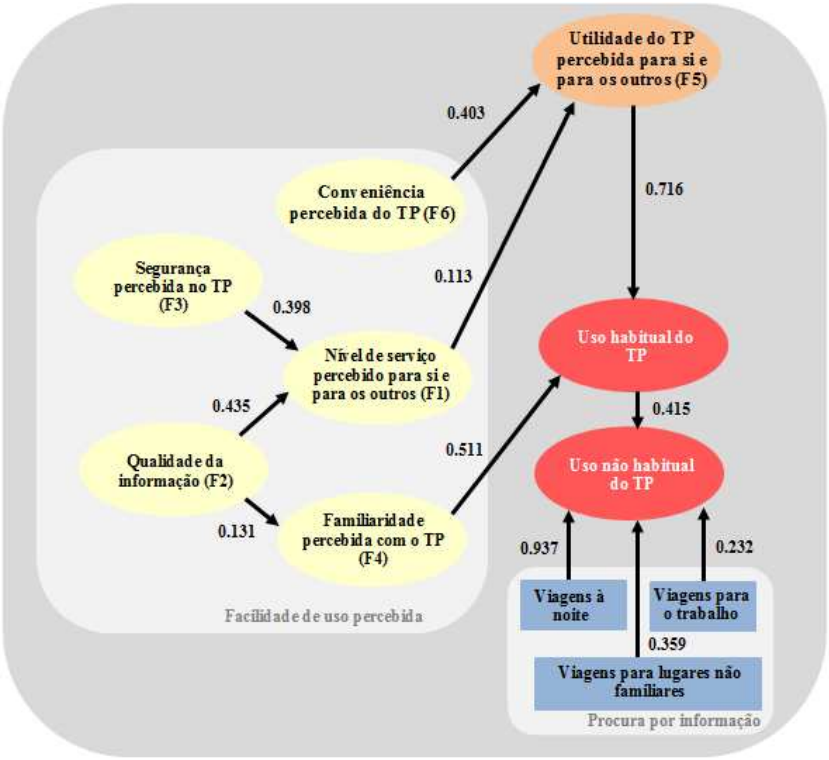


Figura 2a: Relações estruturais no quadro comportamental para Recife e Natal

As estruturas dos modelos das 2 fontes de dados estudadas é semelhante. Dentre os 7 fatores identificados, 5 são comuns. Uma diferença diz respeito à percepção do nível de serviço e da utilidade. Em Copenhagen, há uma clara distinção entre a utilidade e o nível de serviço percebidos do sistema para si mesmo e para os outros (normas subjetivas). Já em Recife e Natal, ambos são percebidos a si e aos outros sem uma distinção clara.

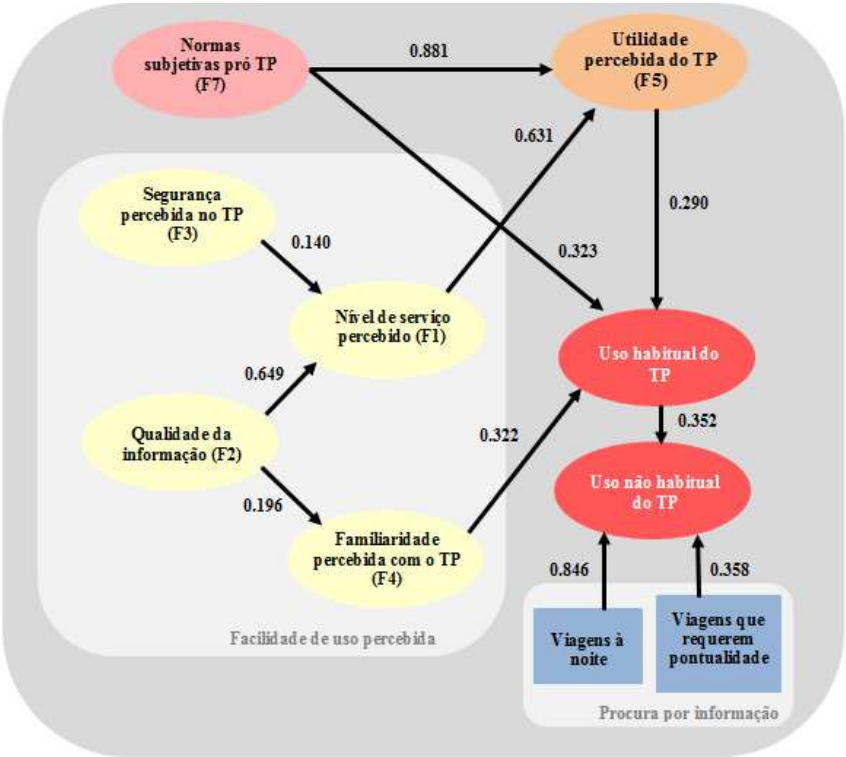


Figura 2b: Relações estruturais no quadro comportamental para Copenhagen

5 CONCLUSÕES

Este estudo explorou a relação entre o fornecimento de informações e o uso do TP de forma habitual e não habitual (à noite) para duas fontes de dados que diferem em relação à percepção do nível de serviço, da qualidade e da provisão de informações.

Os respondentes de Recife e Natal indicaram que uma melhor provisão de informação resultaria em intenções de uso do TP mais elevadas. Os resultados da análise transversal realizada confirmam essas preferências declaradas através do comportamento revelado em ambos os casos. A implicação política é que em comparação com os elevados custos de infraestrutura de TP e de melhorias no nível de serviço em termos de frequência, disponibilidade e confiabilidade, uma melhoria na qualidade da informação poderia levar a um aumento no número de passageiros no TP com investimentos relativamente modestos.

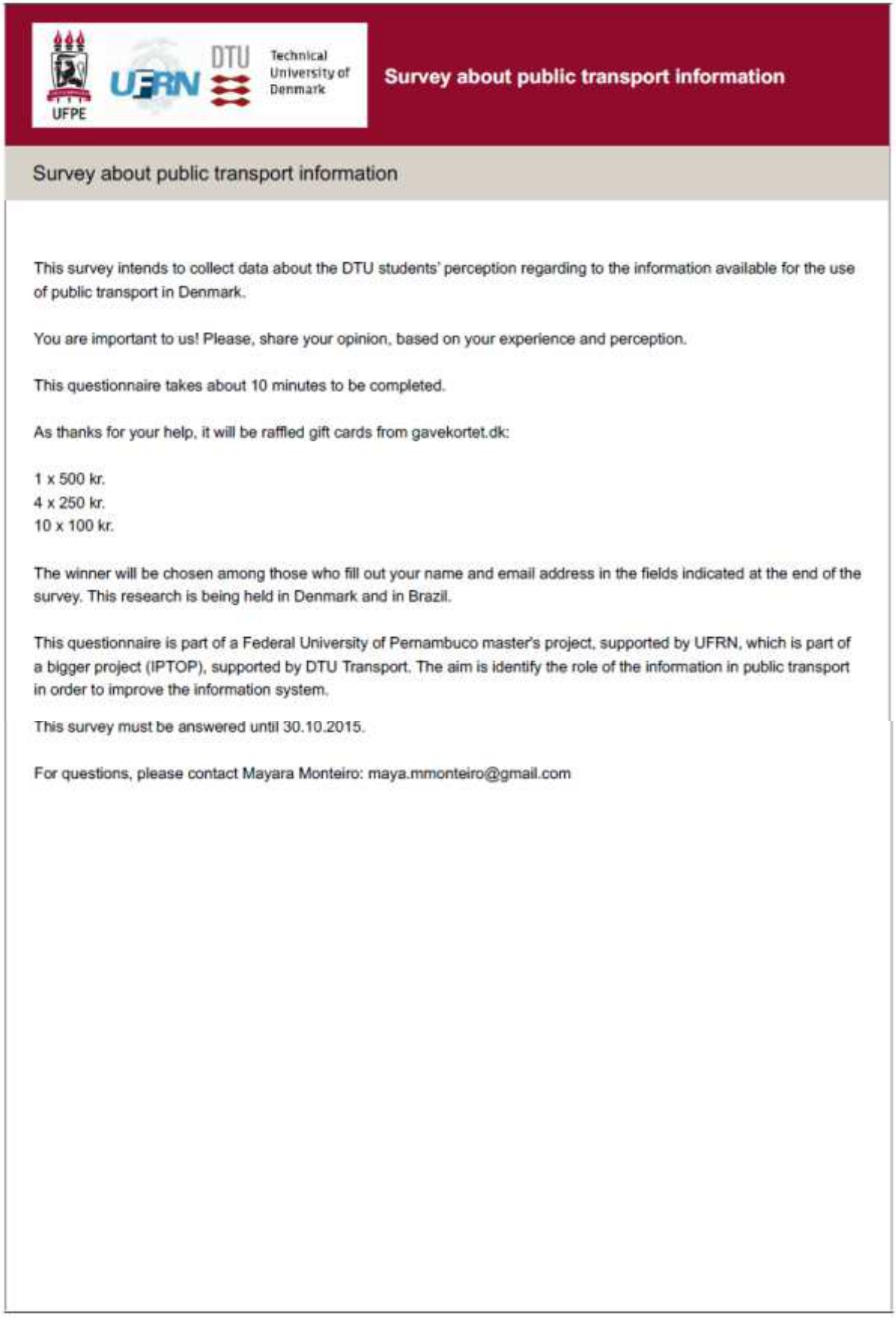
Como mostrado nas Figuras 2a e 2b, a qualidade percebida da informação é positiva e significativamente relacionada com o nível de serviço percebido, o que confirma a primeira hipótese. Nota-se que em Copenhague, onde o sistema de TP é relativamente mais seguro, a importância da qualidade percebida da informação em relação à segurança é maior que no Brasil. Foi encontrado também que a qualidade percebida da informação está positivamente relacionada com a familiaridade percebida, apresentando uma magnitude de impacto semelhante nos dois casos; confirmando a segunda hipótese.

Como apresentado nas tabelas 35 a 39 (expostas na dissertação), a terceira hipótese foi confirmada apenas parcialmente e apenas nas fontes de dados de Recife e Natal. O uso de informações em tempo real está positivamente relacionado com a qualidade da informação e a familiaridade, porém está associado negativamente com a segurança percebida no TP. Além disso, a percepção da qualidade da informação está negativamente associada com a obtenção de informação através da consulta de outros passageiros. As implicações políticas são possíveis resultados positivos do investimento em serviços de informação em tempo real, e apoio e incentivo às iniciativas destinadas a proporcionar informações em tempo real.

A respeito da utilização não habitual do TP, verificou-se que esta está positivamente relacionada com o uso habitual do TP e à busca de informações em ambos os casos, confirmando assim a quarta hipótese. Destaca-se que em Recife e Natal, o uso não habitual do TP durante a noite está relacionado à busca de informações sobre lugares não familiares, viagens ao trabalho e viagens durante a noite, enquanto em Copenhagen está associado com a busca informações sobre viagens durante a noite e informações sobre horários de chegada.

Por fim, é importante destacar que as duas fontes de dados diferem geograficamente, culturalmente e em termos de TP e de fornecimento de informações. No entanto, muitas semelhanças foram encontradas em relação às fontes de informação utilizadas, às razões para a busca de informações e o tipo de informações solicitadas, bem como as importâncias atribuídas às várias fontes de informação estudadas. As relações estruturais semelhantes que foram encontradas evidenciam o papel da informação como um motivador para as intenções de uso do TP. Os resultados e as implicações políticas sugerem transferência entre regiões com diferentes graus de nível de serviço do TP e de fornecimento de informações.

APPENDIX B - QUESTIONNAIRE: ENGLISH VERSION



UFPE UFRN DTU Technical University of Denmark

Survey about public transport information

Survey about public transport information

This survey intends to collect data about the DTU students' perception regarding to the information available for the use of public transport in Denmark.

You are important to us! Please, share your opinion, based on your experience and perception.

This questionnaire takes about 10 minutes to be completed.

As thanks for your help, it will be raffled gift cards from gavekortet.dk:

1 x 500 kr.
4 x 250 kr.
10 x 100 kr.

The winner will be chosen among those who fill out your name and email address in the fields indicated at the end of the survey. This research is being held in Denmark and in Brazil.

This questionnaire is part of a Federal University of Pernambuco master's project, supported by UFRN, which is part of a bigger project (IPTOP), supported by DTU Transport. The aim is identify the role of the information in public transport in order to improve the information system.

This survey must be answered until 30.10.2015.

For questions, please contact Mayara Monteiro: maya.mmonteiro@gmail.com

Survey about public transport information

A bit about yourself

* **1. What is your gender and age?**

	Gender	Age
Age and Gender		

* **2. What are your residential arrangements?**

- ◯ Alone
- ◯ With child/children
- ◯ With roommates/friends
- ◯ With parents
- ◯ With partner/spouse
- ◯ With partner/spouse and child/children

* **3. Do you have mobile phone with GPS/navigation apps?**

- ◯ Yes, and I usually use my paid WIFI and/or 3G internet connection
- ◯ Yes, and I usually use public/free WIFI networks
- ◯ No

* **4. What is your study/work status?**

- ◯ Only studying
- ◯ Working and studying
- ◯ Only working

* **5. Do you have access to the following travel options?**

	Yes	No
Bicycle at home	◯	◯
Bike-sharing (5-10 min. walk from home)	◯	◯
Car / shared car (with family, friends)	◯	◯
Bus / train / metro station (5-10 min. walk from home)	◯	◯

* **6. How do you usually pay for public transport?**

- ○ Cash to the driver / a single ticket
- ○ Rechargeable card (Rejsekort)
- ○ Phone app
- ○ Monthly card
- ○ Student card (Ungdomskort)

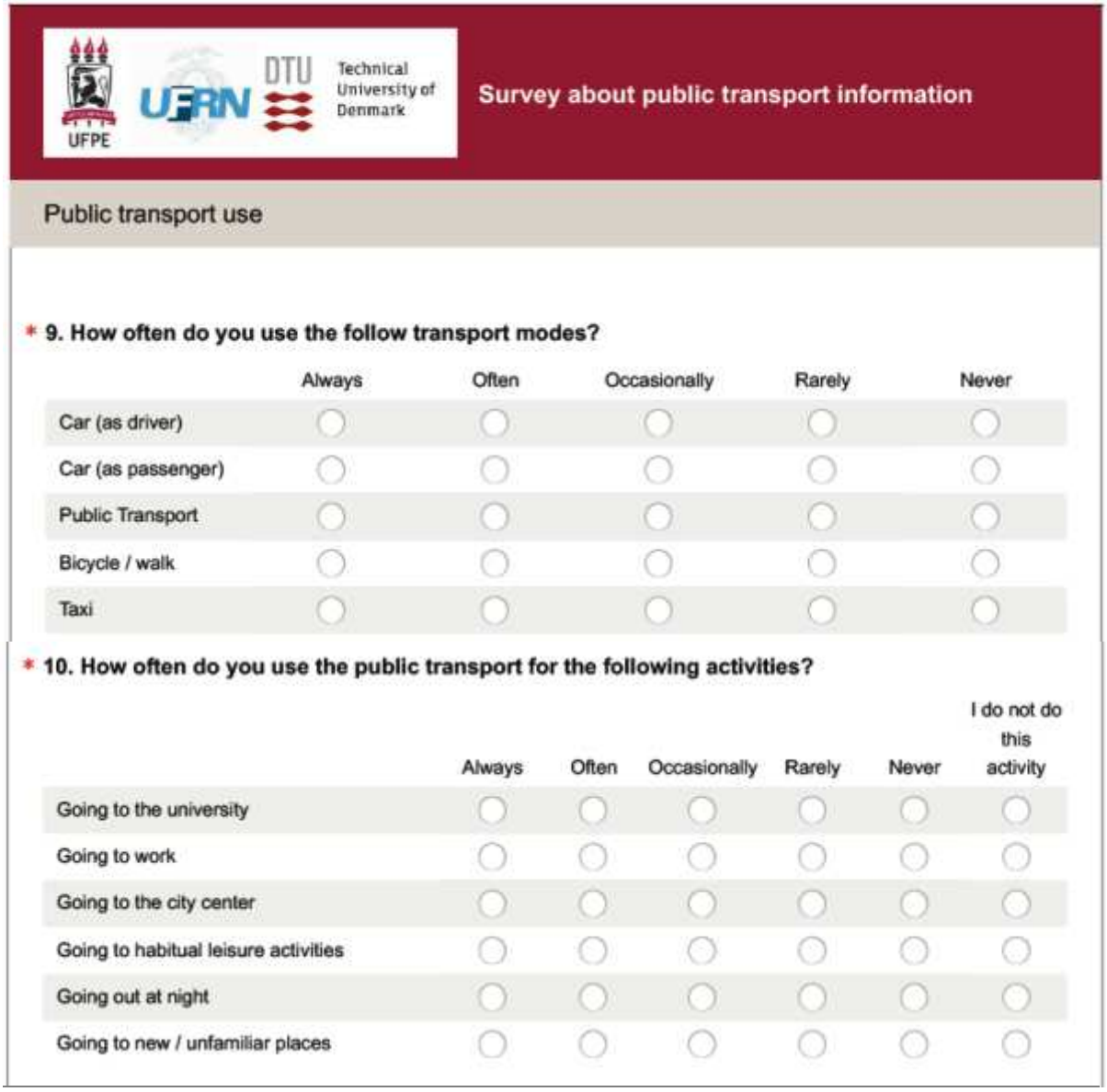
* **7. What are your monthly expenses?**

	Total (kr. - include rent, groceries, transport, etc.)	Transport (kr.)
Montly expenses		

* **8. Where is your residential location?**

Residence place	

P.s.: Please, enter in the following field the information do you have about your location if you answered "I don't know which one is"



UFPE UFRN DTU Technical University of Denmark

Survey about public transport information

Public transport use

* 9. How often do you use the follow transport modes?

	Always	Often	Occasionally	Rarely	Never
Car (as driver)	○	○	○	○	○
Car (as passenger)	○	○	○	○	○
Public Transport	○	○	○	○	○
Bicycle / walk	○	○	○	○	○
Taxi	○	○	○	○	○

* 10. How often do you use the public transport for the following activities?

	Always	Often	Occasionally	Rarely	Never	I do not do this activity
Going to the university	○	○	○	○	○	○
Going to work	○	○	○	○	○	○
Going to the city center	○	○	○	○	○	○
Going to habitual leisure activities	○	○	○	○	○	○
Going out at night	○	○	○	○	○	○
Going to new / unfamiliar places	○	○	○	○	○	○

Survey about public transport information

You experience with public transport

*** 11. What do you think about the general level of service in public transport for your purposes?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
The travel and waiting time is too long	○	○	○	○	○
There are good information services	○	○	○	○	○
The vehicles and stations are too crowded	○	○	○	○	○
The public transport coverage is good	○	○	○	○	○
There often are service cancellations / delays	○	○	○	○	○
Public transport is expensive	○	○	○	○	○

*** 12. Is the public transport system useful for you?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Public transport allows me to go to my activities	○	○	○	○	○
Public transport allows me to go to new places	○	○	○	○	○
Public transport allows me to save time	○	○	○	○	○
Public transport allows me to save money	○	○	○	○	○
Public transport allows me to avoid driving	○	○	○	○	○
Public transport allows me to use the travelling time to do things	○	○	○	○	○

*** 13. How familiar are you with the public transport in your area?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I easily remember line combinations when I am asked	○	○	○	○	○
I usually remember the best route to arrive to my destination	○	○	○	○	○
I usually remember the public transport frequency of the lines I need	○	○	○	○	○
I usually remember which stop is the closest to my destination	○	○	○	○	○
I usually remember the travel time to arrive to my destination	○	○	○	○	○

*** 14. What is your experience with public transport information?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
The travel time/waiting time information is reliable	○	○	○	○	○
The information about delays/changes is reliable	○	○	○	○	○
The information system provides efficient routes	○	○	○	○	○
The information is clear and complete	○	○	○	○	○
The information is easy to find	○	○	○	○	○

*** 15. What is your opinion about public transport security?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I am concerned about being pickpocketed/robbed	○	○	○	○	○
I am concerned about being harassed	○	○	○	○	○
I am concerned about walking/waiting at night	○	○	○	○	○
I am concerned about drunk passengers	○	○	○	○	○

UFPE UFRN DTU Technical University of Denmark

Survey about public transport information

Family and friends

*** 16. What do your friends and family think about public transport in your area?**

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Most of my friends use public transport	○	○	○	○	○
Most of my family members use public transport	○	○	○	○	○
My parents prefer that I do not take public transport	○	○	○	○	○
Most of my friends think that public transport is uncomfortable	○	○	○	○	○
Most of my friends think that public transport is unsafe	○	○	○	○	○
Most of my friends think that public transport is inefficient	○	○	○	○	○

Survey about public transport information

The importance of information in public transport

*** 17. How often do you search for information about public transport?**

	Always	Often	Occasionally	Rarely	Never
Going to the University	○	○	○	○	○
Going to work	○	○	○	○	○
Going to the city center	○	○	○	○	○
Going to regular leisure activities	○	○	○	○	○
Going out at night	○	○	○	○	○
Going to new / unfamiliar places	○	○	○	○	○
When I need arrive on time	○	○	○	○	○

*** 18. Which public transport information is important for you?**

	Very Important	Important	Neither Important or Unimportant	Unimportant	Very Unimportant
How to transfer between lines	○	○	○	○	○
Route options to travel to new places	○	○	○	○	○
Departure/arrival time	○	○	○	○	○
Fastest route	○	○	○	○	○
Changes / delays	○	○	○	○	○

*** 19. Do you use the following information sources? How important is for you to have them?**

	Use	Importance
Asking other passengers / public transport personel	⇕	⇕
Using real-time information in vehicles or stops	⇕	⇕
Calling the public transport company	⇕	⇕
Using on-line information apps / internet	⇕	⇕
Using google maps	⇕	⇕

APPENDIX C - QUESTIONNAIRE: DANISH VERSION

Undersøgelse vedrørende information i kollektiv transport

Undersøgelse vedrørende information i kollektiv transport

Denne undersøgelse har til hensigt at indsamle data om DTU-studerendes opfattelse af den information der stilles til rådighed til brug for rejser i den kollektive transport i Danmark.

Dine svar er vigtige for os! Vi vil sætte stor pris på at høre din mening, baseret på dine erfaringer og opfattelser.

Dette spørgeskema tager omkring 10 minutter at gennemføre.

Som tak for din hjælp, trækkes der lod om følgende gavekort til gavekortet.dk:

1 x 500 kr.
4 x 250 kr.
10 x 100 kr.

Vinderene vil blive valgt blandt dem, der udfylder navn og e-mail-adresse i de angivne felter i slutningen af undersøgelsen. Undersøgelsen bliver gennemført i både Danmark og i Brasilien.
Dette spørgeskema er en del af et kandidatprojekt ved Federal University of Pernambuco, støttet af UFRN, og er en del af et større forskningsprojekt (IPTOP), ledet af DTU Transport. Målet er at identificere hvilken rolle information spiller for kollektiv transport og derigennem forbedre informationssystemerne.

Undersøgelsen kan besvares indtil 30.10.2015.

For spørgsmål, kontakt venligst Mayara Monteiro: maya.mmonteiro@gmail.com

UFPE UFRN DTU Technical University of Denmark

Undersøgelse vedrørende information i kollektiv transport

Lidt om dig selv

*** 1. Hvad er dit køn og din alder?**

	Køn	Alder
Køn og alder		

*** 2. Hvad er din boligsituation?**

- Alene
- Alene med barn / børn
- Med bofæller / venner
- Med forældre
- Med partner / ægtefælle
- Med partner / ægtefælle og barn / børn

*** 3. Har du en mobiltelefon med GPS/navigation apps?**

- Ja, og jeg bruger normalt mit betalte WIFI og / eller 3G / 4G internetforbindelse
- Ja, og jeg bruger normalt offentlige / gratis WIFI netværk
- Nej

*** 4. Hvad er din arbejds-/uddannelsessituation?**

- Kun studerende
- Arbejde og studerende
- Kun arbejde

*** 5. Har du adgang til følgende rejsemuligheder?**

	Ja	Nej
Cykel ved hjemmet		
Delecykel (5-10 min. gang fra hjemmet)		
Bil / delebil (med familie, venner)		
Bus- / tog- / metrostation (5-10 min. gang fra hjemmet)		

* **6. Hvordan betaler du normalt for kollektiv transport?**

- ◯ Kontant til chauffør / købe billet
- ◯ Rejsekort
- ◯ App på mobiltelefon
- ◯ Månedskort
- ◯ Ungdomskort

* **7. Hvad er dine månedlige udgifter?**

	Total (kr. - inkl. husleje, indkøb, transport, osv.)	Transport (kr.)
Månedlige udgifter		

* **8. Hvor bor du?**

Område / kommune	

(Hvis "Ved ikke hvilken af ovenstående") Angiv venligst sted:

UFPE UFRN DTU Technical University of Denmark

Undersøgelse vedrørende information i kollektiv transport

Brug af kollektiv transport

* **9. Hvor ofte benytter du følgende transportmidler?**

	Altid	Ofte	Sommetider	Sjældent	Aldrig
Bil (som fører)	○	○	○	○	○
Bil (som passager)	○	○	○	○	○
Kollektiv transport	○	○	○	○	○
Cykel / gang	○	○	○	○	○
Taxi	○	○	○	○	○

* **10. Hvor ofte benytter du kollektiv transport til de følgende aktiviteter?**

	Altid	Ofte	Sommetider	Sjældent	Aldrig	Jeg udfører ikke denne aktivitet
Til universitetet	○	○	○	○	○	○
Til arbejde	○	○	○	○	○	○
Til København centrum	○	○	○	○	○	○
Til fritidsaktiviteter (jævnligt benyttede)	○	○	○	○	○	○
I byen om aftenen / natten	○	○	○	○	○	○
Til nye / fremmede steder	○	○	○	○	○	○

UFPE UFRN DTU Technical University of Denmark

Undersøgelse vedrørende information i kollektiv transport

Dine erfaringer med kollektiv transport

* **11. Hvad synes du om det generelle serviceniveau for den kollektive transport til dit brug?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
Rejsetiden og ventetiden er for lang	○	○	○	○	○
Der er gode informationssystemer	○	○	○	○	○
Køretøjerne og stationerne er overfyldte	○	○	○	○	○
Den kollektive transport dækker godt	○	○	○	○	○
Der er ofte aflysninger / forsinkelser	○	○	○	○	○
Kollektiv transport er dyrt	○	○	○	○	○

* **12. Er det kollektive transportsystem brugbart for dig?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
Kollektiv transport gør det muligt for mig at tage til mine aktiviteter	○	○	○	○	○
Kollektiv transport gør det muligt for mig at tage til nye steder	○	○	○	○	○
Kollektiv transport gør det muligt for mig at spare tid	○	○	○	○	○
Kollektiv transport gør det muligt for mig at spare penge	○	○	○	○	○
Kollektiv transport gør at jeg kan undgå selv at køre	○	○	○	○	○
Kollektiv transport gør at jeg kan bruge rejsetiden til at lave ting	○	○	○	○	○

*** 13. Hvor bekendt er du med den kollektive transport i dit område?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
Jeg kan normalt huske linjekombinationer når jeg bliver spurgt	○	○	○	○	○
Jeg kan normalt huske den bedste rute for at komme til min destination	○	○	○	○	○
Jeg kan normalt huske frekvensen på de linjer jeg har brug for	○	○	○	○	○
Jeg kan normalt huske hvilket stop der er tættest på min destination	○	○	○	○	○
Jeg kan normalt huske rejsetiden til min destination	○	○	○	○	○

*** 14. Hvad er dine erfaringer med kollektiv transport information?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
Information om rejsetid / ventetid er pålidelig	○	○	○	○	○
Information om forsinkelser / ændringer er pålidelig	○	○	○	○	○
Informationssystemet foreslår effektive ruter	○	○	○	○	○
Informationen er præcis og komplet	○	○	○	○	○
Informationen er let at finde	○	○	○	○	○

*** 15. Hvad er din holdning til sikkerheden i kollektiv transport?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
Jeg er bekymret for risikoen for lommetyveri / røveri	○	○	○	○	○
Jeg er bekymret for risikoen for at blive chikaneret	○	○	○	○	○
Jeg er bekymret for risikoen ved at gå / vente om aftenen / natten	○	○	○	○	○
Jeg er bekymret for fulde passagerer	○	○	○	○	○

UFPE UFRN DTU Technical University of Denmark

Undersøgelse vedrørende information i kollektiv transport

Familie og venner

* **16. Hvad synes din familie og dine venner om kollektiv transport i dit område?**

	Meget uenig	Uenig	Hverken uenig eller enig	Enig	Meget enig
De fleste af mine venner benytter kollektiv transport	○	○	○	○	○
De fleste af mine familiemedlemmer benytter kollektiv transport	○	○	○	○	○
Mine forældre foretrækker at jeg ikke benytter kollektiv transport	○	○	○	○	○
De fleste af mine venner synes at kollektiv transport er ukomfortabel	○	○	○	○	○
De fleste af mine venner synes at kollektiv transport er utrygt	○	○	○	○	○
De fleste af mine venner synes at kollektiv transport er ineffektivt	○	○	○	○	○

UFPE UFRN DTU Technical University of Denmark

Undersøgelse vedrørende information i kollektiv transport

Informations betydning for kollektiv transport

*** 17. Hvor ofte søger du efter information om kollektiv transport?**

	Altid	Ofte	Sommetider	Sjældent	Aldrig	Jeg udfører ikke denne aktivitet
For ture til universitetet	○	○	○	○	○	○
For ture til arbejde	○	○	○	○	○	○
For ture til Københavns centrum	○	○	○	○	○	○
For ture til fritidsaktiviteter	○	○	○	○	○	○
For ture i byen om aftenen	○	○	○	○	○	○
For ture til nye steder	○	○	○	○	○	○
Når det er vigtigt for mig at ankomme til tiden	○	○	○	○	○	○

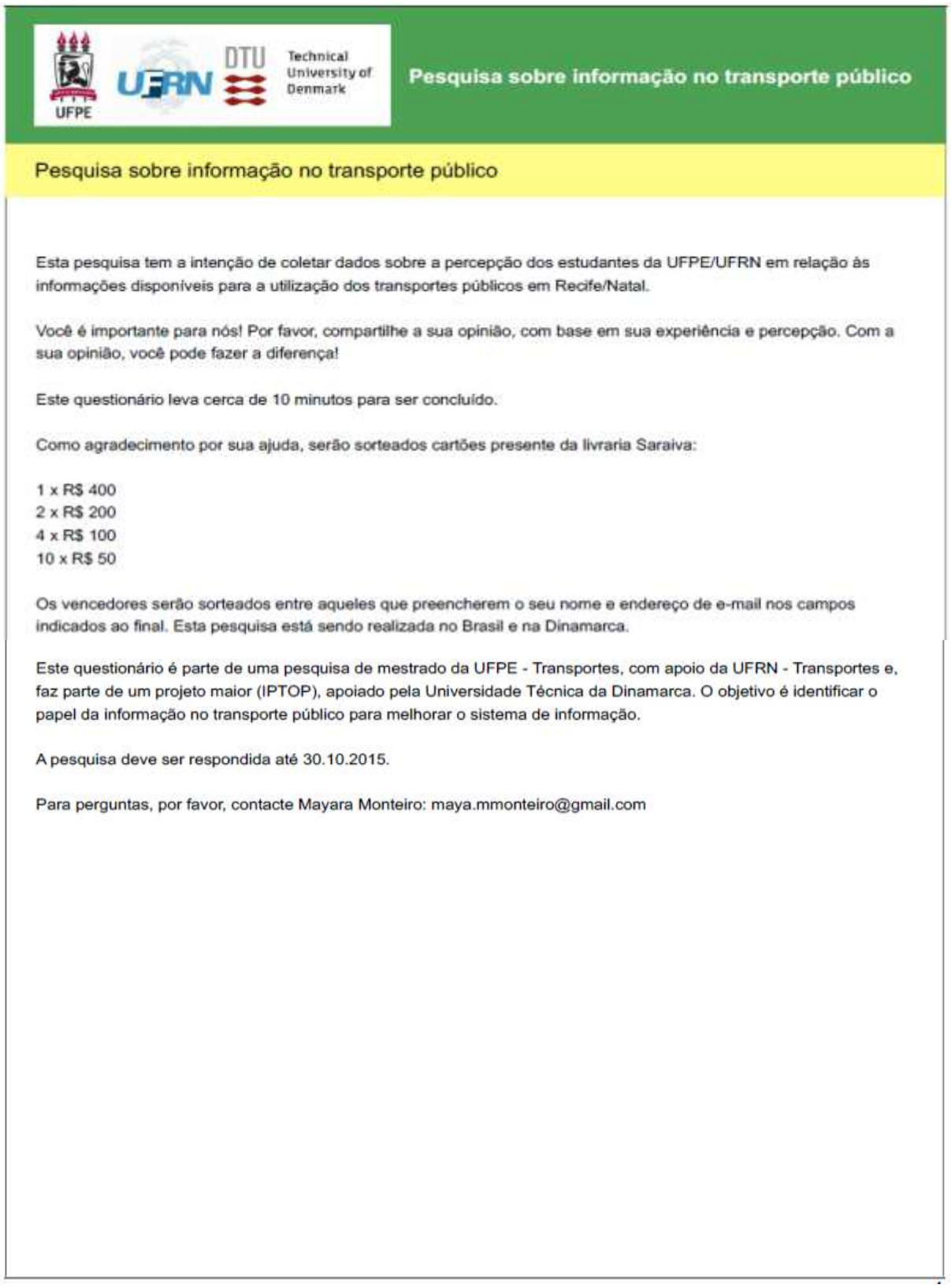
*** 18. Hvilken information i kollektiv transport er vigtig for dig?**

	Meget uvæsentligt	Uvæsentligt	Hverken uvæsentligt eller væsentligt	Væsentligt	Meget væsentligt
Hvordan man skifter mellem to linjer	○	○	○	○	○
Valgmuligheder for ruter ved rejser til nye steder	○	○	○	○	○
Afgangs- / ankomsttider	○	○	○	○	○
Hurtigste rute	○	○	○	○	○
Ændringer / forsinkelser	○	○	○	○	○

*** 19. Benytter du følgende informationskilder? Hvor vigtigt er det for dig at have dem?**

	Bruger	Vigtighed
Spørge andre passagerer / medarbejdere i den kollektive transport	⇕	⇕
Benytte realtidsinformation i køretøjer eller ved station / stop	⇕	⇕
Ringe til den kollektive transport virksomhed	⇕	⇕
Benytte on-line information via apps / internet	⇕	⇕
Benytte Google maps	⇕	⇕

APPENDIX D - QUESTIONNAIRE: PORTUGUESE VERSION[16]



Pesquisa sobre informação no transporte público

Pesquisa sobre informação no transporte público

Esta pesquisa tem a intenção de coletar dados sobre a percepção dos estudantes da UFPE/UFRN em relação às informações disponíveis para a utilização dos transportes públicos em Recife/Natal.

Você é importante para nós! Por favor, compartilhe a sua opinião, com base em sua experiência e percepção. Com a sua opinião, você pode fazer a diferença!

Este questionário leva cerca de 10 minutos para ser concluído.

Como agradecimento por sua ajuda, serão sorteados cartões presente da livraria Saraiva:

1 x R$ 400
2 x R$ 200
4 x R$ 100
10 x R$ 50

Os vencedores serão sorteados entre aqueles que preencherem o seu nome e endereço de e-mail nos campos indicados ao final. Esta pesquisa está sendo realizada no Brasil e na Dinamarca.

Este questionário é parte de uma pesquisa de mestrado da UFPE - Transportes, com apoio da UFRN - Transportes e, faz parte de um projeto maior (IPTOP), apoiado pela Universidade Técnica da Dinamarca. O objetivo é identificar o papel da informação no transporte público para melhorar o sistema de informação.

A pesquisa deve ser respondida até 30.10.2015.

Para perguntas, por favor, contacte Mayara Monteiro: maya.mmonteiro@gmail.com

[16] It needs to be clarified that the respondents were automatically redirected to question 9 or 10, according to the answer given in the question 8 and the same is true for questions from 11 to 20 that were accessed by the respondents according the answer given in question 9 or 10.

Pesquisa sobre informação no transporte público

Um pouco sobre você

* **1. Qual o seu gênero e idade?**

	Gênero	Idade
Idade e Gênero		

* **2. Com quem você mora?**

- ◯ Sozinho
- ◯ Com criança(s)
- ◯ Com colegas de quarto/amigos
- ◯ Com os pais
- ◯ Com namorado(a)/cônjuge
- ◯ Com namorado(a)/cônjuge e criança(s)

* **3. Você possui celular com GPS/aplicativos com mapas?**

- ◯ Sim, e eu geralmente uso minha rede de internet paga ou 3G
- ◯ Sim, e eu geralmente uso redes de internet públicas/de graça
- ◯ Não

* **4. Qual é o seu status de estudo/trabalho?**

- ◯ Apenas estudando
- ◯ Trabalhando e estudando
- ◯ Apenas trabalhando

* **5. Você tem acesso aos seguintes modos de transporte?**

	Sim	Não
Bicicleta em casa	◯	◯
Bicicleta pública compartilhada (5-10 min. caminhando a partir de casa)	◯	◯
Carro / carro compartilhado (com família, amigos)	◯	◯
Ônibus / estação de metrô (5-10 min. caminhando a partir de casa)	◯	◯

* **6. Como você geralmente paga pelo transporte público?**

- ◯ Em dinheiro para o cobrador
- ◯ Smartcard (Recife: VEM / Natal: NATALCard, RN card)

* **7. Qual é sua média de gasto mensal?**

	Total (R$ - incluindo aluguel, alimentação, transporte, etc.)	Transporte (R$)
Gasto mensal		

Pesquisa sobre informação no transporte público

* **8. Qual o seu estado?**

- ◯ Pernambuco
- ◯ Rio Grande do Norte

* **9. Onde você mora?**

- ◯ Abreu e Lima
- ◯ Araçoiaba
- ◯ Cabo de Santo Agostinho
- ◯ Camaragibe
- ◯ Igarassu
- ◯ Ilha de itamaracá
- ◯ Ipojuca
- ◯ Itapissuma
- ◯ Jaboatão dos Guararapes
- ◯ Moreno
- ◯ Olinda
- ◯ Paulista
- ◯ Recife
- ◯ São Lourenço da Mata
- ◯ Fora da região metropolitana de Recife

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Pesquisa sobre informação no transporte público

* **10. Onde você mora?**

- ◯ Ceará-Mirim
- ◯ Extremoz
- ◯ Ielmo Marinho
- ◯ Macaíba
- ◯ Maxaranguape
- ◯ Monte Alegre
- ◯ Natal
- ◯ Nísia Floresta
- ◯ Parnamirim
- ◯ São Gonçalo do Amarante
- ◯ São José de Mipibu
- ◯ Vera Cruz
- ◯ Fora da região metropolitana de Natal


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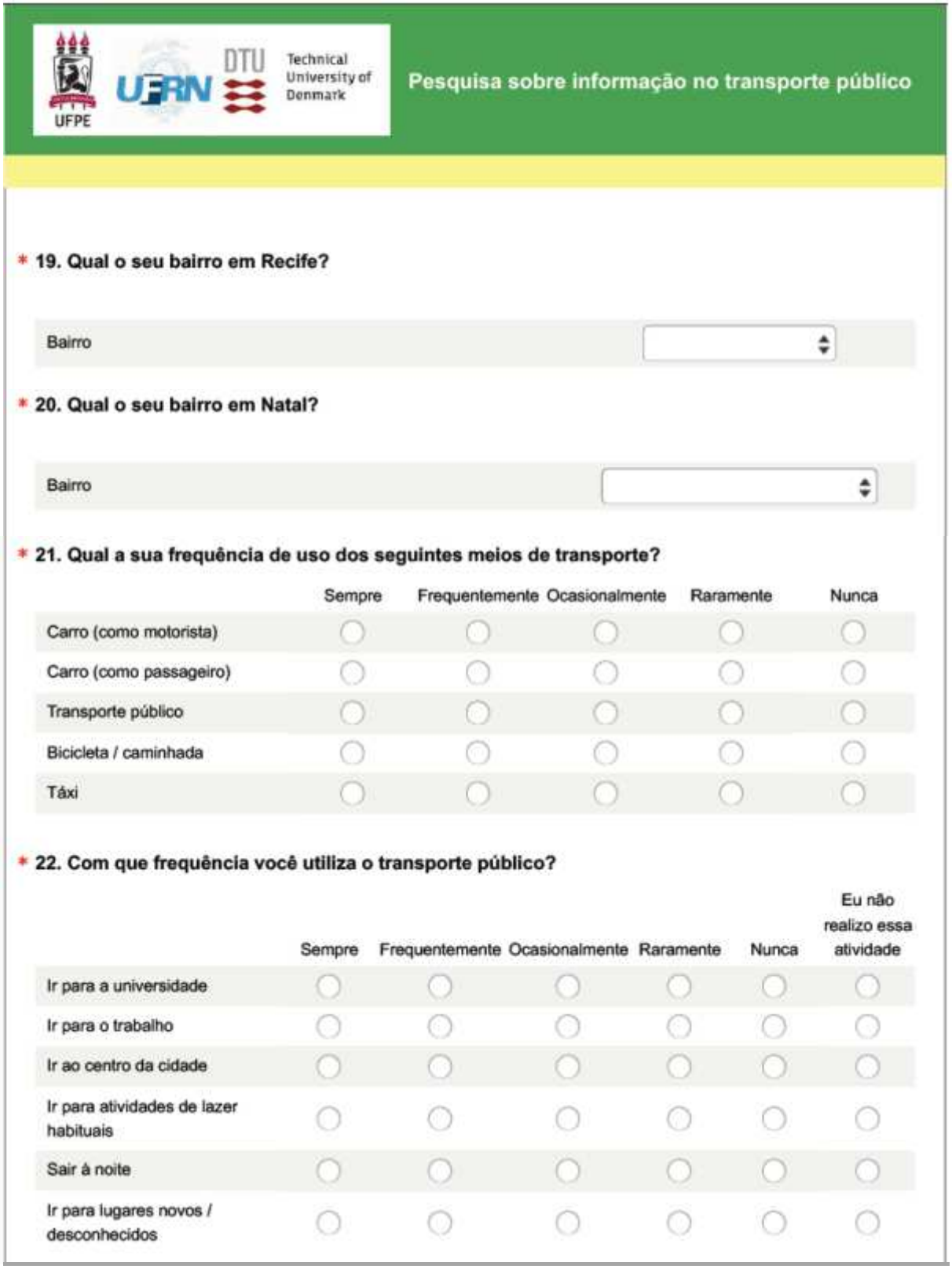
Pesquisa sobre informação no transporte público
* 11. Qual o seu bairro em Abreu e Lima?
Bairro
* 12. Qual o seu bairro no Cabo de Santo Agostinho?
Bairro
* 13. Qual o seu bairro em Camaragibe?
Bairro
* 14. Qual o seu bairro em Igarassu?
Bairro
* 15. Qual o seu bairro em Itapissuma?
Bairro
* 16. Qual o seu bairro em Jaboatão dos Guararapes?
Bairro
* 17. Qual o seu bairro em Olinda?
Bairro
* 18. Qual o seu bairro em Paulista?
Bairro



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Pesquisa sobre informação no transporte público

* **19. Qual o seu bairro em Recife?**

Bairro

* **20. Qual o seu bairro em Natal?**

Bairro

* **21. Qual a sua frequência de uso dos seguintes meios de transporte?**

	Sempre	Frequentemente	Ocasionalmente	Raramente	Nunca
Carro (como motorista)	○	○	○	○	○
Carro (como passageiro)	○	○	○	○	○
Transporte público	○	○	○	○	○
Bicicleta / caminhada	○	○	○	○	○
Táxi	○	○	○	○	○

* **22. Com que frequência você utiliza o transporte público?**

	Sempre	Frequentemente	Ocasionalmente	Raramente	Nunca	Eu não realizo essa atividade
Ir para a universidade	○	○	○	○	○	○
Ir para o trabalho	○	○	○	○	○	○
Ir ao centro da cidade	○	○	○	○	○	○
Ir para atividades de lazer habituais	○	○	○	○	○	○
Sair à noite	○	○	○	○	○	○
Ir para lugares novos / desconhecidos	○	○	○	○	○	○

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Pesquisa sobre informação no transporte público

Sua experiência com o transporte público

* **23. O que você pensa sobre o nível geral de serviço do transporte público que você utiliza?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
Os tempos de viagem e de espera são muito longos	○	○	○	○	○
Existem bons serviços de informação	○	○	○	○	○
Os veículos e estações são muito lotados	○	○	○	○	○
A cobertura do transporte público é boa	○	○	○	○	○
Frequentemente acontecem cancelamentos / atrasos nas viagens	○	○	○	○	○
As tarifas de transporte público são caras	○	○	○	○	○

* **24. O transporte público é útil para você?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
O transporte público me permite ir aos locais das minhas atividades	○	○	○	○	○
O transporte público me permite ir a novos lugares	○	○	○	○	○
O transporte público me permite economizar tempo	○	○	○	○	○
O transporte público me permite economizar dinheiro	○	○	○	○	○
O transporte público me permite evitar dirigir	○	○	○	○	○
O transporte público me permite aproveitar o tempo de viagem para fazer coisas (ex.:ler, estudar)	○	○	○	○	○

*** 25. Quão familiar você é com o transporte público da sua área?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
Eu facilmente lembro as combinações de linhas quando eu sou perguntado	○	○	○	○	○
Eu geralmente lembro a melhor rota para chegar ao meu destino	○	○	○	○	○
Eu geralmente lembro a frequência das linhas de transporte público que eu preciso	○	○	○	○	○
Eu geralmente lembro qual é a parada/estação mais próxima do meu destino	○	○	○	○	○
Eu geralmente lembro o tempo de viagem para chegar ao meu destino	○	○	○	○	○

*** 26. Qual a sua experiência com informações no transporte público?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
Os tempos de viagem e de espera informados são confiáveis	○	○	○	○	○
As informações sobre cancelamentos/alterações são confiáveis	○	○	○	○	○
O sistema de informações fornece rotas eficientes	○	○	○	○	○
A informação é clara e completa	○	○	○	○	○
A informação é fácil de ser encontrada	○	○	○	○	○

*** 27. Qual a sua opinião a respeito da segurança no transporte público?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
Eu fico preocupado(a) em ser furtado(a)/roubado(a)	○	○	○	○	○
Eu me preocupo em ser assediado(a)	○	○	○	○	○
Eu me preocupo em andar/esperar à noite	○	○	○	○	○
Eu me preocupo com passageiros bêbados	○	○	○	○	○

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Pesquisa sobre informação no transporte público

Família e amigos

* **28. O que os seus amigos e a sua família pensam a respeito do transporte público na sua região?**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
A maioria dos meus amigos usam transporte público	○	○	○	○	○
A maior parte da minha família usa transporte público	○	○	○	○	○
Meus pais preferem que eu não use transporte público	○	○	○	○	○
A maioria dos meus amigos acha o transporte público desconfortável	○	○	○	○	○
A maioria dos meus amigos acha o transporte público inseguro	○	○	○	○	○
A maioria dos meus amigos acha o transporte público ineficiente	○	○	○	○	○

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Pesquisa sobre informação no transporte público

A importância da informação no transporte público

* **29. Com que frequência você procura por informação sobre o transporte público?**

	Sempre	Frequentemente	Ocasionalmente	Raramente	Nunca
Ir para a universidade	○	○	○	○	○
Ir para o trabalho	○	○	○	○	○
Ir ao centro da cidade	○	○	○	○	○
Ir para atividades de lazer habituais	○	○	○	○	○
Sair à noite	○	○	○	○	○
Ir para lugares novos / desconhecidos	○	○	○	○	○
Quando eu preciso chegar na hora certa	○	○	○	○	○

*** 30. Quais das seguintes informações de transporte público são importantes para você?**

	Muito importante	Importante	Nem importante nem sem importância	Sem importância	Muito sem importância
Como realizar transferência entre linhas	○	○	○	○	○
Opções de rotas para viajar para novos lugares	○	○	○	○	○
Horário de partida/chegada	○	○	○	○	○
Rota mais rápida	○	○	○	○	○
Alterações / atrasos	○	○	○	○	○

*** 31. Você usa as seguintes fontes de informação? Quão importante é para você tê-las?**

	Uso	Importância
Perguntar a outros passageiros/empregados do transporte		
Usar as informações em tempo real nos veículos/paradas/estações		
Ligar para a companhia de transporte público		
Usar aplicativos de informação on-line / apps		
Usar google maps		

*** 32. Se houvessem mais informações de transporte público disponíveis:**

	Discordo totalmente	Discordo	Nem discordo nem concordo	Concordo	Concordo totalmente
A utilização do sistema seria muito mais fácil	○	○	○	○	○
Eu usaria mais o transporte público	○	○	○	○	○
Eu poderia descobrir novas possiblidades para realizar minhas viagens	○	○	○	○	○

*** 33. Com que frequência você utilizaria o transporte público se houvesse melhoria no sistema de informação?**

	Sempre	Frequentemente	Ocasionalmente	Raramente	Nunca	Eu não realizo essa atividade
Ir para a universidade	○	○	○	○	○	○
Ir para o trabalho	○	○	○	○	○	○
Ir ao centro da cidade	○	○	○	○	○	○
Ir para atividades de lazer habituais	○	○	○	○	○	○
Sair à noite	○	○	○	○	○	○
Ir para lugares novos / desconhecidos	○	○	○	○	○	○