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Factors influencing metropolitan public transport integration in Florianópolis, Brazil – a Delphi study

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc in Transport and City Planning at University College London: I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

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Abstract

Integration is addressed in most transport policy documents, understood as a means to achieve greater transport sustainability. Still, comprehensive analyses of integrated transport experiences in literature are scarce. This dissertation falls within this research gap context, exploring the attempts of public transport integration in Florianópolis Metropolitan Region.

A Delphi survey was designed to assess policymakers and stakeholders' perceptions through three successive questionnaires, focusing on the investigation of factors influencing transport integration pursuit. The method distinguishes operational and broader strategic integration aspects, combining the identification of barriers and supporting measures for short-term implementation with the long-term objectives linked with a desirable urban mobility future.

Findings evidenced major agreements over existing vision, targets, policies and plans, which are believed to be leading to a desirable future. This vision involves improved conditions for sustainable transport modes over the private car and a more balanced distribution of services, housing and employment within the metropolitan area. The management of public transport is perceived to play a crucial role in achieving the desired vision, with respondents placing high importance in governance improvement. Within the long-term objectives, participants valued transport and land-use integration higher than environmental concerns. Barriers and measures were identified, shortlisted and ranked by the participants. Among the barriers, institutional structures and lack of resources are also constantly mentioned in the literature, while legal and political constraints appear to be context-specific. A set of measures is identified to overcome such barriers. These consist of infrastructure provision aspects, institutional changes and greater commitment from the political realm and general population.

1. Introduction

A four-mile distance between place of residence and university, both located in the same city. Whereas this could generally result in an effortless public transport journey, this is not the case observed in São José and other cities in conurbation with Florianópolis. Due to the absence of fare integration and the lack of direct bus routes, one must take a bus to Florianópolis city centre terminal and from there use another service to return to the city of origin, only then reaching its destination, resulting in a commute three times longer than necessary.

This daily struggle reported by a student (NSC TV, 2018) is an example of the transport inequalities caused by the absence of integration. Similar or worse situations are experienced by many of the 150,000 daily public transport users who often needlessly travel to the region's most congested area solely to transfer between bus services.

Integration has been long advocated in transport policy (Stead, 2010, Preston, 2012) and understood as one of the most critical requirements to shift mode choice (Givoni and Banister, 2010). Still, a common debate in practice is to determine until what point integration is required since its often mistakenly treated as an aim itself (May et al., 2006, Stead, 2010) and valued more than anything else (van de Velde, 2005).

Considering the context of major Brazilian cities, where continuous car-oriented policies and practices have led to reduced public transport use (Vasconcellos, 2018), there is a consensus among policymakers that a major strategy for transitioning towards more sustainable urban mobility is to effectively integrate public transport services within metropolitan areas, as well as to integrate transport and land-use policies (da Silva et al., 2008).

In Florianópolis Metropolitan Region, transport integration efforts intensified in 2014, with the creation of a metropolitan authority and the development of an integrated metropolitan public transport plan (SANTA CATARINA, 2014, Neto, 2019). However, after years of discussions and negotiations, transport integration still struggles to see the light of day. In consideration of this regional context and the perceived importance of integration in transport policy, this research aims to investigate how to more effectively move towards metropolitan public transport integration, identifying the main factors influencing its pursuit.

The dissertation is organised as follows: Chapter 2 presents a critical review of the literature on transport integration, exploring its meaning, dimensions, and barriers experienced in practice. Chapter

3 introduces mobility policies and conditions at national and regional levels, subsequently presenting Florianópolis Metropolitan Region integration plan. Chapter 4 explains the Delphi technique, exploring the survey design and application. Chapter 5 highlights the main findings of the research, reflecting on consulted literature. Finally, the conclusions of the study are drawn in chapter 6, demonstrating contributions to the literature and practice implications.

2. Literature review

2.1 The meaning of integration in transport policy and practice

The term 'integration' has a long tradition in transport policy, where it has continuously been used and advocated but poorly defined (Potter and Skinner, 2000, May et al.,2006). Integration as a concept can therefore remain intangible for policymakers: with overall consensus of its importance, but a limited understanding of what exactly it represents or how to achieve it (Stead, 2010). Preston (2010) additionally points out the difficulties in presenting evidence of integrated transport policies benefits.

Recognizing the complexity within the concept, authors usually define it as being multistage. These include a four-stage scalar (Potter and Skinner, 2000), the concept of integration ladder (Hull, 2005), and Stead's (2010) five forms of integration, building on Eggenberger and Partidário (2000).

A more concise definition is found in NEA et al. (2003, p.5), where transport integration is described as: *"The organizational process through which the planning and delivery of elements of the transport system are brought together, across modes, sectors, operators and institutions, with the aim of increasing net social benefits"*. While considering the links between diverse elements, this definition ignores the relevance of transport in increasing environmental benefits, as noted by Anderton (2010).

A clear distinction is observed in the literature between integration of public transport (PT) at the operational level, which addresses aspects of information, ticketing and fare, network, services, and physical connectivity (Abrate et al., 2009, Saliara, 2014); and transport integration at the strategic level, which encompasses the integration of different transport modes, the links between transport and land-use (and also other policy sectors such as education, health and environment), and the institutional integration within and across local, regional and national government sectors (May et al., 2006, Givoni and Banister, 2010).

While this dissertation focuses on the integration of public transport services, it seeks to encompass strategic aspects such as integration across policy sectors and institutions. Therefore,

building on May et al. (2006) and Preston (2010) theoretical definitions, integration is addressed here in the following dimensions:

1. Operational public transport integration;
2. Integration between different transport modes;
3. Integration across institutions; and
4. Policy integration – transport with land-use and other policy sectors

2.2 Dimensions of transport integration

2.2.1 Operational public transport integration

Integration can be distinguished in operational and strategic levels, with the first concerning the integration of fares, information and services (May et al., 2006, Preston, 2010). Most of the literature tends to focus on how the introduction of integration features in public transport affects its patronage. In the case of Madrid, Matas (2004) attributes fare and networking integration as the causes of a 40% patronage increase between 1986 and 2004. Abrate et al. (2009) explored the effects of integrated tariff systems in Italian cities, noticing patronage increases in short and long runs. Buehler (2011) recognizes the integration of PT services as a critical factor explaining the disparity of sustainable mobility mode share in Germany and the United States.

While such arguments are useful for demonstrating the attractiveness of integration, much rarer are the studies that go beyond patronage analysis, analysing policymakers and users' perceptions of policy changes. In the metropolitan area of Haifa, in Israel, Sharaby and Shiftan (2012) noticed an increase in free transfers after fare integration, with users feeling free to choose among more route options. Hidalgo and King (2014) relied on official data and interviews with stakeholders to compare the experiences of Bogotá and Cali in transforming fragmented public transport services into citywide integrated ones, describing planning, implementation and operational aspects.

A handful of studies additionally confront the perceptions of policymakers with transport users. Chowdhury et al. (2018) used surveys and semi-structured interviews to compare the most valued aspects of integration in Auckland. They concluded that both groups value network integration the most, while also perceiving fare integration as critical. On the other hand, users placed high importance to integrated timed transfers, which was not recognized important by policymakers. Kash and Hidalgo (2014) confronted the perspectives of local transport professionals with PT users in Bogotá. Increased

vehicle occupancy represented a clear mismatch, understood as a quality reduction by users, and as an efficiency gain by transport planners.

2.2.2 Integration between transport modes

Integrated multimodal transport systems seek to increase the attractiveness of public transport, in order to make it a viable alternative to the private car (Ibrahim, 2003). Luk and Olszewski (2003) highlight that since the transport system evolves according to population increase and settlement distribution, integrating different services requires a strategic effort amongst different agencies and operators.

In this regard, an essential element is to facilitate travellers' routes with transfers, providing reliability, accessibility, speed and synchronization (Chowdhury and Ceder, 2016). Achieving "seamless" transfers, however, is a common challenge when integrating multiple transport modes, since users perceive the need to transfer as a negative aspect of public transport trips (Guo and Wilson, 2004).

2.2.3 Integration across institutions

Integrated transport systems require cooperation between institutions to address issues such as fare policy, contracts, performance monitoring and funding (Paget-Seekins et al., 2015). However, as highlighted by Givoni and Banister (2010), the growth of the transport system led to an exacerbated specialization, with institutions focusing on specifics networks or single transport modes, resulting in the concept of the whole journey being forgotten. Consequently, transport decision-making is typically fragmented across diverse institutions and service providers (Cervero, 2001). Institutional fragmentation is even more evident in the case of city-regions or metropolitan areas (Hull, 2010), in which boundary issues represent challenges for achieving coordination and integration (Vasconcellos, 2018).

Numerous studies explore conditions in which coordination across institutions and municipalities was achieved. Despite context specificities, a common recommendation is to adopt a more centralized governance model, with high autonomy and professionalization (Sager, 2005) and tight control of networks, pricing, information and quality of service (Zembri, 2010). Centralization is understood to make decisions more liable and binding across different stakeholders, with professionalization (and separation from the political realm) increasing the acceptance of projects developed by public servants (Sager, 2005). While it is possible to develop integrated transport strategies and projects in the context of split institutional responsibilities, these are likely to be less effective (Marsden and May, 2006) and

harder to achieve, since more actors must be engaged, thus increasing transaction costs (Feitelson and Gamlieli, 2010).

2.2.4 Policy integration

The relationship between built environment and travel behaviour, as well as the importance of integrating land-use and transport policies, is well stressed by existing literature (e.g. Banister and Hickman, 2006, Cao et al., 2009, Ewing and Cervero, 2010). In practice, however, quite often a mismatch can be observed, with land-use patterns being influenced by local decisions which rarely shape into a coherent vision of the future. As argued by Cervero (2001), some impediments in integrating transport and land-use policy lie in the very nature of institutions, since land development decisions are made locally, while transport impacts are felt regionally. Balance employment opportunities with housing, provide essential uses within the neighbourhood, plan permeable street networks, and raise density levels around public transport nodes are some of the fundamental principles to enhance this integration, encouraging sustainable travel (Hickman et al., 2010).

Additionally, there is an increasing recognition of transport as a multidisciplinary field, directly related to other policy sectors such as health, environment and education (Gwilliam, 2002). However, in many countries, these are perceived as lacking effectiveness since there is no structure to manage relationships between sectors (Stead, 2010). Decision-making is therefore based on the contribution to economic growth rather than environmental or health objectives. Transport is perceived to be dominant over the environment sector, resulting in narrow considerations for such aspects in practice (Stead, 2008).

2.3 Barriers to transport integration

Despite the recognition that many barriers prevent turning integrated transport policy into practice (Givoni and Banister, 2010), research on identifying such impediments is scarce, with a predominance of theoretical definitions of transport integration (Potter and Skinner, 2000, Stead, 2010) over the exploration of case studies. Barriers can be described as forces that reduce the potential of a measure or even make its implementation impossible, and for the case of sustainable transport can be categorized in physical, legal, institutional, financial, political, side effects, and social and cultural (Banister, 2004, May et al., 2005).

Market forces are very often acknowledged as crucial barriers to achieving operational public transport integration (Ardila, 2008, Potter, 2010, Paget-Seekins et al., 2015). In many countries,

economic deregulation facilitated market entry in the transport sector (Banister and Button, 1991), which although may enhanced economic efficiency, resulted in negative externalities, such as inadequate accessibility, pollution, congestion, poor public transport standards and safety issues (Vasconcellos, 2001, Flores Dewey, 2013). In informal regimes, coordination of PT services is excruciating difficult (Cervero, 2001), with private operators uninterested in investing in better vehicles or rationalizing supply, but rather in increasing frequencies and fares (Fernandez and Muñoz, 2007).

There is a strong case for better government regulation to address such shortcomings (Estache and Gómez-Lobo, 2005), with evidence demonstrating that intervention and regulation can do better than the market (Button, 2004). Nevertheless, this view is contested both by existing local operators that resist to increasing control of operations, environmental standards and working conditions (Paget-Seekins et al., 2015), and by influent organizations (e.g. World Bank) that encourage cities to rely on the private sector for providing transport facilities and services (Gwilliam, 2002).

In the context of integrating PT among several operators, existing contracts can represent a barrier for fare integration, resulting in difficulties to launch the bidding process (Hidalgo and King, 2014). In a more strategic perspective, Nello-Deakin (2015) investigated the barriers hindering the effectiveness of a metropolitan authority in integrating public transport in Tarragona, Spain. Such barriers consisted of institutional settings (unclear role of the authority and unsuitable tendering model), political issues (lack of leadership and disregard of users' needs), resources (economic crisis and power imbalances between government and municipality), the legal split between urban and interurban lines and the popular apathy towards PT.

2.4 Conceptual approach

Integration can be distinguished in different dimensions, as evidenced in section 2.2. To continuously enhance integration, these dimensions should be incorporated into the long-term objectives of the transport system. However, initially conceiving and implementing integrated transport systems requires overcoming several barriers, some of them presented in section 2.3. As such, an analysis of the factors influencing the quest for integration should distinguish these aspects. Figure 1 presents the conceptual approach employed in this dissertation.

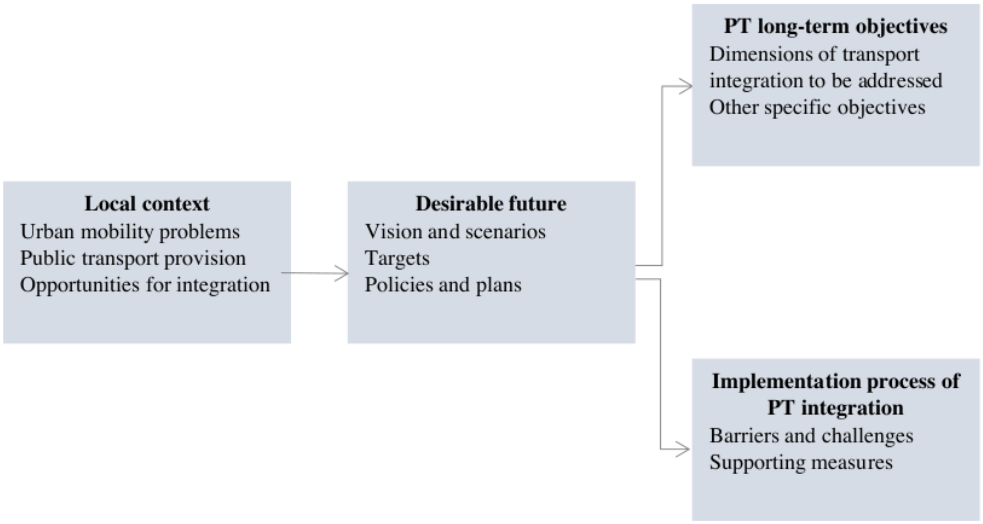

Figure 1: Conceptual approach diagram

The operationalisation of the research is explained in detail in section 4.3.

2.5 Observed research gaps

While the pursuit of integrated transport planning and practice presents itself as of critical importance, most research has concentrated on looking at this aspect in isolation, treating it as an end itself. This leads to a rather narrow framing of integrated transport, which can be observed by the vast literature that explores patronage successes and the lack of more thorough analyses of integrative measures' social costs and benefits (van de Velde, 2005). Integration, therefore, needs to be recognized as a means to achieve more sustainable transport (Givoni and Banister, 2010) and fulfil different policy sectors goals (Stead, 2010, May et al., 2006).

Additionally, studies that encompass strategic dimensions tend to focus either on excessively theoretical definitions (e.g. Potter and Skinner, 2000, Hull, 2005) or descriptions of practical applications. The latter ones usually rely almost solely on secondary data and policy document analysis (e.g. Potter, 2010, Preston, 2012), not providing in-depth analyses of case studies.

Exploratory research on transport integration experiences usually employs interviews with policymakers as the primary data collection method (e.g. Kash and Hidalgo, 2014, Chowdhury et al., 2018). While interviews enable to gather a deep understanding of the specific context, typically there is no exchange of information between the interviewees, restricting consensus-building and prioritization.

Finally, case studies concentrate on monocentric urban agglomerations (e.g. Ibrahim, 2003, Hidalgo and King, 2014), rather than metropolitan regions (e.g. Nello-Deakin, 2015). This constitutes an important dearth of research since metropolitan areas tend to have more fragmented institutional governance settings, thus imposing additional challenges for transport integration.

The research gaps mentioned above have provided motivation and shaped the design of the research, which seeks to investigate the factors influencing the quest for transport integration in the case of Florianópolis Metropolitan Region.

3. Urban mobility in Florianópolis Metropolitan Region and its transport integration plan

3.1 Urban mobility conditions and policies in Brazil

While transport can support social and economic development, for most Latin American cities, growth patterns and trends are not sustainable. High motorisation rates and decreases in active and public transport trips are widely noticed, being further evident in Brazilian medium and large cities (Hidalgo and Huizenga, 2013). In Brazil, differently from most countries in Latin America that promoted public transport deregulation (Cervero, 2000, Flores Dewey, 2013), bus services are typically provided by medium and large enterprises with fixed routes, schedules and fares established in contracts. However, as argued by Vasconcellos (2001), this formalisation not necessarily results in proper integration, with conflicting relations between government, operators and users. In cities in conurbation, where typically each municipality has its own PT service, overlapping of routes results in higher mileage and fleet, leading to higher fares (Gomide, 2006).

As a response to inequalities, the Federal Government, through the Ministry of Cities, launched a series of policy guidelines to redefine urban development in Brazilian cities. Transport policy transitioned from focusing solely on road infrastructure to encompass social, economic and environmental dimensions (Vasconcellos et al., 2011). The national urban mobility policy gained legal force in 2012, establishing the priority of public and active transport over individual motorised transport, and obligating municipalities to elaborate urban mobility plans. The law additionally sets basic guidelines for public participation and regulation of PT services (BRASIL, 2012).

The sanction of the Metropolis Statute introduced governance guidelines in integrating common interest services, such as transport (BRASIL, 2015). However, even with the existence of metropolitan

authorities, very often plans and projects are blocked by disagreeing city councils, a reflection of the concentration of powers in federal, state and municipal levels (Vasconcellos, 2018).

3.2 The context of Florianópolis Metropolitan Region

The city of Florianópolis is the capital of Santa Catarina, one of the states in south Brazil (Figure 2). With most of its territory consisting in an island close to the mainland, Florianópolis initially developed independently from its surroundings (Peluso Júnior, 1991). The construction of a bridge in 1926 and extensive highways investments in the 1960s and 1970s transformed transport and land-use patterns, with the gradual disappearance of water transport and the emergence of conurbation with the cities of São José, Biguaçu and Palhoça (Sugai, 2015). Currently, the formal metropolitan region encompasses nine municipalities (SANTA CATARINA, 2014) and more than one million residents (IBGE, 2019). Interdependence relations are evident, with Florianópolis concentrating most of jobs and services, and developments in the metropolitan region consisting mostly in new housing facilities (Cocco, 2016).

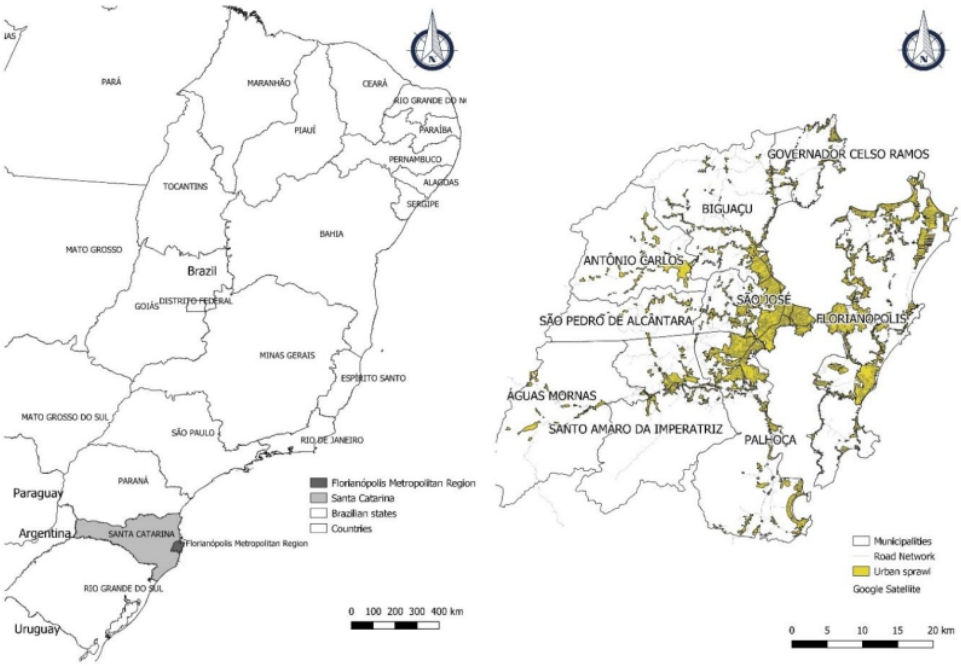

Figure 2: Florianópolis Metropolitan Region location (left) and overview (right).
Source: data from IBGE (2019), OSM (2019) and PMF (2019).

Citizens regularly refer to urban mobility as the vital issue in the region (Borges, 2014, Silva, 2019), especially those that must travel from the mainland to the island to access services or go to work. Car dependence is higher than any other major metropolitan region in Brazil, with 48% of trips made by private motorised vehicles, and 26% accounting for both public and active transport (PLAMUS, 2015). The absence of public transport infrastructure, coupled with inadequate conditions for walking and cycling, and the predominance of single-use, low-density and sprawled developments are some of the conditioning factors behind this unsustainable mode share (ICES, 2015).

In the early 2000s, investments in developing an integrated PT system only englobed Florianópolis (Barbosa et al., 2017) and not the metropolitan region. Currently, six different public transport providers are operating in Florianópolis Metropolitan Region. Of the nine municipalities, only Florianópolis has a formal system. The remaining eight cities have the legal obligation to regularise public transport (Alves, 2018), but companies still operate with emergency contracts or no contract at all, dividing the region into "accorded" catchment areas which are typically explored by a single provider. Although fares vary according to service type (intra or intercity), there is no fare integration between different providers (SETUF, 2019). Figure 2 shows public transport routes in the central areas of Florianópolis, Biguaçu, Palhoça and São José.

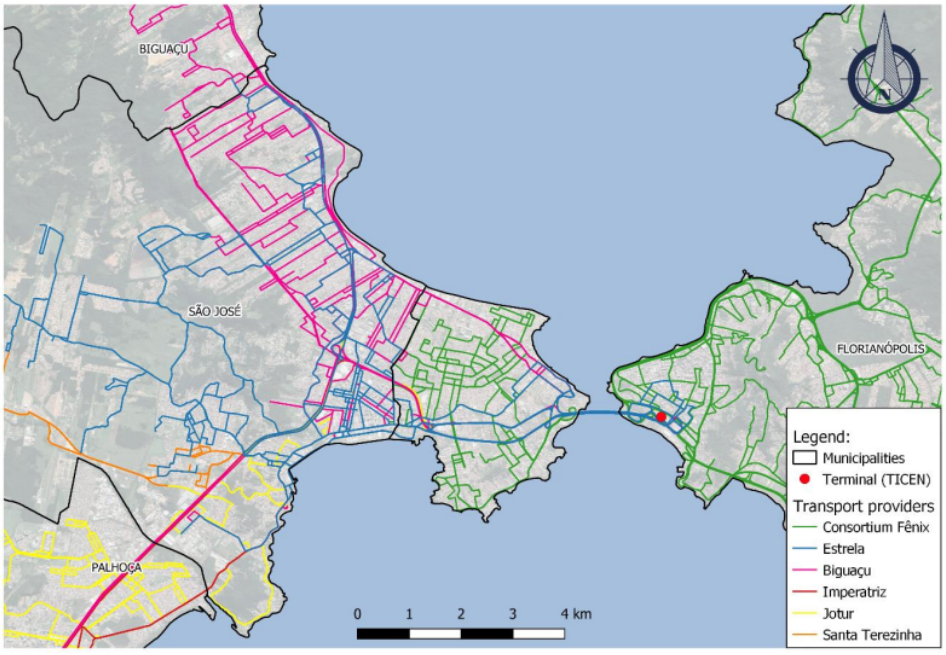

Figure 3: Public transport routes in the core of Florianópolis Metropolitan Region.
Source: data from PLAMUS (2015) and IBGE (2019)

While municipalities in Brazil typically have inadequate control over public transport operation (da Silva et al., 2008), this is aggravated in Florianópolis Metropolitan Region due to informality. Frequencies and routes are altered in negotiations between public institutions and private providers, but since data regarding passengers, mileage and fleet is heavily protected, policymakers lack the necessary information to ground fundamental decisions. Private companies are unsure about how long they will operate, and as a consequence, are resistant to improve fleet standards and service quality.

With the exception of Florianópolis, 70% of the 150,000 daily public trips consist in inter-city public transport services (SUDERF, 2018). The superposition of municipal with inter-city routes "forces" the population to opt for the costliest option since the latter usually has higher frequencies (Souza et al., 2017). This arguably results in implications in accessing essential services, jobs and other activities. In Florianópolis city centre, surveys with inter-city PT users revealed striking walking distances to destinations (790 meters in average, with 21% over 1.2kilometers) as a direct consequence of the lack of fare integration (Carvalho et al., 2017).

3.3 The public transport integration plan

In light of its mobility conditions and the legal framework established by the national policies, Florianópolis Metropolitan Region was one of the first in Brazil to approve a sustainable urban mobility plan, 'PLAMUS', launched in 2015. One of the main strategies is to implement an integrated inter-city public transport system with BRT corridors and bus lanes, managed by a central metropolitan agency (PLAMUS, 2015). Consequently, 'SUDERF', a metropolitan institution linked with the state government, was created to handle functions of common interest between municipalities, with public transport as the top priority (SANTA CATARINA, 2014).

A public transport plan for eight of the municipalities (with the exception of the city of Florianópolis, which already has a public transport contract in effect) has being developed and discussed since 2016, with the project still lacking legal approval and further detailing (Neto, 2019). In addition to a new set of routes, timetables and fleet standards, a new governance model will be introduced, consisting of an associated-management structure, with an executive committee (with representatives of the municipalities and SUDERF) as deliberative technical body, and a transport council (formed by civil society, operators and representatives of the State and City institutions) as an advisory body (SUDERF, 2018).

Reasons for such a lengthy process are multifold. While public integration was expected to take place when introducing BRT corridors (G1 SC, 2016), financial constraints led to the failure of a public-private partnership model. At the same time, the informal situation of contracts (Alves, 2018) pushed for operational PT integration before infrastructure implementation. Nevertheless, legal, political and institutional barriers prevent the implementation of the integration plan: after three years of discussion, a state law enabling SUDERF to manage public transport was approved, but only four municipalities ratified this agreement with local laws (Gadotti, 2019).

4. Method

As previously stated, the research aim is to investigate the factors influencing the pursuit of integration in Florianópolis Metropolitan Region. Given the limited research that employs in-depth analysis and consensus-building techniques, as evidenced in Chapter 2, this dissertation uses the Delphi technique as its primary method. The research aim can be derived in four research questions:

1. Are existing policies and plans aligned with a desirable future urban mobility vision for Florianópolis Metropolitan Region;
2. In what ways can public transport integration contribute to a desirable future for the region;
3. What are the main barriers that hinder metropolitan public transport integration;
4. In the regional context, which measures could support public transport integration taking place;

4.1 The Delphi method

The Delphi technique was developed in the 1950s (Dalkey and Helmer, 1963) and since then has been used in a wide range of fields as a method for achieving convergence of opinion with experts concerning a specific topic (Schmidt,1997). Hsu and Sandford (2007, p.1) describe it as being *"a group communication process that aims at conducting detailed examinations and discussions of a specific issue for the purpose of goal setting, policy investigation, or predicting the occurrence of future events"*.

Four key characteristics are constant in Delphi surveys, namely anonymity, iteration, controlled feedback and statistical group response (Rowe and Wright, 2001). Participants should be knowledgeable on the subject and have diverse backgrounds (Turoff, 1970). Anonymity is guaranteed by the moderator, reducing the effect of dominant individuals (Dalkey, 1972). Delphi is performed through multiple rounds, with judgments summarized by the researcher and provided as feedback after each round. This process enables social learning and changes in opinions and judgements (Dunn, 2014). Group responses are presented either numeric, with measures of central tendency (median, mean) and

dispersion (interquartile range, standard deviation, variance), or graphically, with histograms and frequency charts (Heiko, 2012)

Some possible shortcomings and weaknesses are inherent to the process of conducting a Delphi study. Due to its time-consuming nature, there is a potential for low response rates (Hsu and Sandford, 2007). An expert panel without sufficient knowledge will generate generic rather than specific information (Vernon, 2009, Linstone, 2002). The main critique of Delphi, however, is focused on the potential of manipulating opinions (Linstone and Turoff, 2002), if the researcher introduces his views and lead the experiment through the feedback process. Witkin and Altschuld (1995) also argue that the research design itself incurs in a subtle pressure to conform with group opinions.

4.2 Delphi in transport policy and practice

A growing number of authors in transport literature have been employing Delphi as a scenario development technique (Melander, 2018). Shiftan et al. (2003) assessed the desirability and probability of a range of policy measures to build one expected and one desirable transport scenario for Tel-Aviv Metropolitan Area. Schuckmann et al. (2012) analysed factors influencing the future development of transport infrastructure on a global level. In New Zealand, Stephenson et al. (2014, 2018) have employed four survey rounds with transport experts to identify interventions leading to sustainable mobility. Studies occasionally rely on additional methods for constructing future scenarios. A combination of Delphi and backcasting was employed to investigate the future of electric mobility in Germany (Zimmermann et al., 2012) and to conduct a participatory transport visioning in Andalusia (Soria-Lara and Banister, 2017). Varho and Tapio (2013) combined Delphi with cluster and qualitative content analysis to identify changes needed to reduce transport-related CO^2 emissions in Finland.

A less explored research area is to investigate aspects influencing specific transport policies. Feuerstein et al. (2018) identified factors that impact European long-distance passenger rail transport competition. For the Italian context, Cafiso et al. (2013) used Delphi questionnaires to evaluate managers' perceptions of critical bus transport safety aspects. In the case of metropolitan public transport, Hirschhorn et al. (2018), asked experts to prioritize its most important operational and organizational features. For the latter category, integration emerged as the central element, with policy, multimodal, institutional (concerning jurisdiction) and operational dimensions highly ranked.

4.3 Delphi application for Florianópolis Metropolitan Region

4.3.1 Selection of participants

Defining the relevant expertise and the desired knowledge are vital criteria when building a Delphi panel of participants (Stephenson et al., 2018, Hirschhorn, 2019). Individuals were sought based on their interaction with the process of integrating public transport in the metropolitan region, being identified through existing publications and the author's professional contacts. This initial sample of experts was contacted and encouraged to provide recommendations of other professionals to participate in the survey, in a snowball sampling approach. Concerning expertise, the study incorporated a diversity of professional roles, such as (i) academia, (ii) city government, (iii) state government, (iv) federal government, and (v) consultancy/private sector. In terms of knowledge, to incorporate multiple views, professionals with different academic backgrounds were invited, including (i) urban planning, (ii) transport planning, (iii) administration, (iv) engineering, (v) architecture, (vi) law, and (vii) journalism. Appendix A presents an expert matrix with detailed panel information.

An electronic link to the first questionnaire sent to 50 participants resulted in 37 full responses. For the second questionnaire, the invitation and feedback report ensured 32 responses. Twenty-nine participants completed the third and final Delphi round. The response rates for the questionnaires are very positive, especially considering the time-demanding nature of Delphi surveys. This can be attributed to the current local relevance of the topic, where public transport integration is expected to be on the verge of implementation. Another possible factor for low dropouts was the feedback process, with responses analysed and presented back to the participants just a few days after the completion of each questionnaire.

4.3.2 Survey design

The Delphi survey consisted of three subsequent rounds of questionnaires, which were entirely carried out with *Opinio*, a UCL web-based survey platform. This included not only the questionnaires but invitations, reminders and feedback reports. Figure 4 provides a schematic representation of the three survey rounds, with a brief description of each block and type of questions. The colours of the question blocks represent the research questions (RQs) posed by the dissertation. Questionnaires are presented in appendices B, C and D. After each round, participants received a feedback report containing aggregated results. In rounds 1 and 2, the feedback report accompanied the invitation for the subsequent questionnaire.

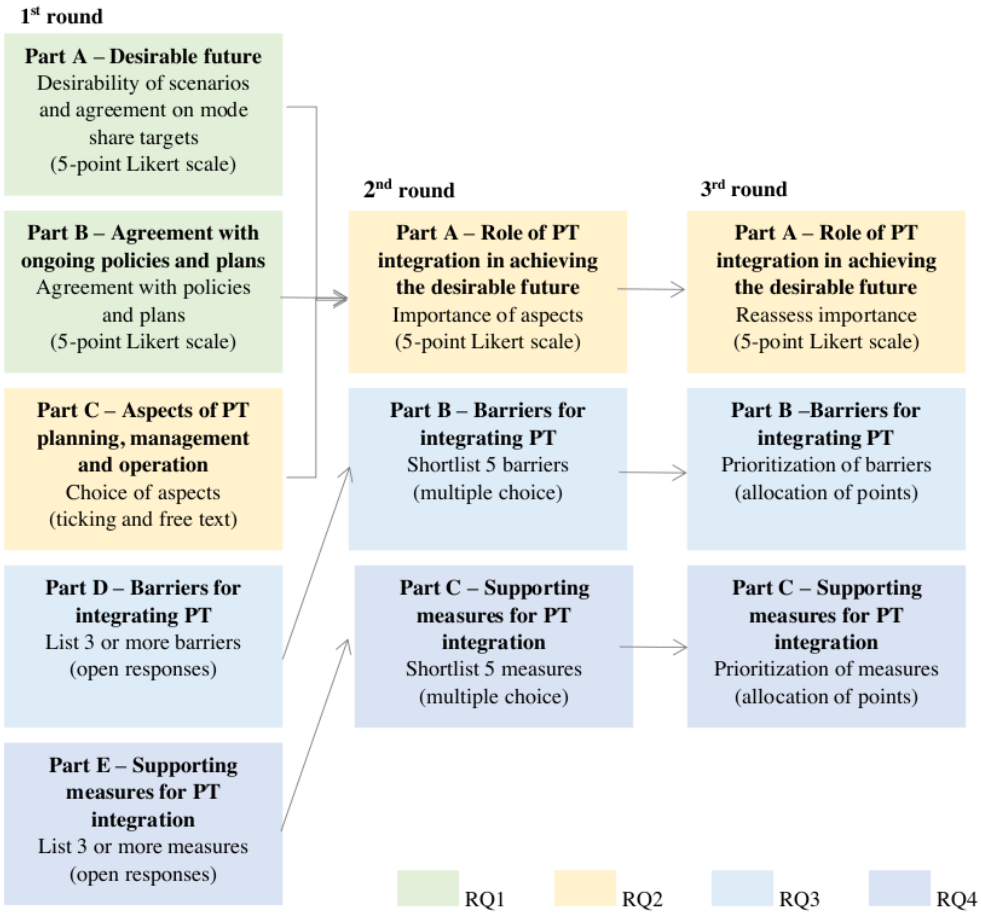

Figure 4: Schematic representation of the Delphi survey design

The first round started with the assessment of a desirable urban mobility future, considering the year of 2044. Scenarios developed by regional plans (ICES, 2015, PLAMUS, 2015) were broken into components and presented as statements, with the participants assessing their desirability in a five-point Likert scale. The design of this question followed the procedure adopted in other transport scenario development studies, where the desirability of each statement is assessed considering a twenty-five to thirty-year horizon (e.g. Shiftan et al., 2003, Schuckmann et al.,2012 Zimmermann et al.,2012). The year 2044 was chosen to match the time horizon considered in PLAMUS (2015). In the sequence, participants were presented with a mode-share target and asked to state their desirability and agreement. 'Part B' briefly described the aims of the national urban mobility policy, the metropolitan statute and the sustainable urban mobility plan for Florianópolis Metropolitan region, asking participants to state their agreement with the policies and plans. Parts 'A' and 'B' of the first questionnaire are directly

related to the first research question of this dissertation, assessing the alignment between the current policies and plans with the desired future.

'Part C' presented participants with a brief description of the public transport integration plan and a list of PT aspects that would likely suffer alterations if the plan was approved. Those concerned planning, management and operation, being identified in general public transport literature (White, 2016, Ceder, 2016) and context-specific news and presentations (SUDERF, 2018, OMU-UFSC, 2019). Respondents were asked to tick pre-listed aspects and invited to include additional items. In the second round of the survey, these aspects were converted into objectives, with participants being asked to rate the perceived importance of addressing those objectives for achieving the desired future in the region, relating to the second research question of the dissertation. A desirable future statement, consisting in the agreed long-term vision, targets, policies and plans was presented to the participants. PT objectives that did not achieve consensus in the second round of the survey were reassessed in the third and final questionnaire, in a consensus-building procedure (Soria-Lara and Banister, 2017, Feuerstein et al., 2018).

The identification of the main barriers and measures to achieve public transport integration consisted of a ranking-type Delphi exercise (Paré et al., 2013). Parts 'D' and 'E' asked individuals to list and describe at least three barriers and three measures, in a brainstorming process. This gives experts the freedom to include items perceived as being essential or within their chosen interest. In parts 'B' and 'C' of the second round, by eliminating redundancy, single inventories were consolidated, from which the participants should select just the most essential items. This narrowing down of alternatives seeks to limit the number of items for ranking, the third and final phase. Ranking consisted in a fixed-sum question, with participants required to distribute a given number of points among items. This method enables parametric statistics analyses (Hirschhorn, 2019), fitting research questions three and four.

4.3.3 Ethical considerations

While the research employed in this dissertation involves successive interaction with participants to assess their opinions, a key characteristic of Delphi surveys is the guarantee of anonymity, resulting in low ethical risks. Additionally, a detailed information sheet was sent to the invitees prior to their participation in the study. Feedback reports contained only aggregated and anonymised statistical data, with no personal information disclosed. Appendix E presents a completed risk assessment form.

5. Findings and discussion

5.1 Desirable urban mobility future and agreements on current policies and plans

In 2015, a sustainable action plan (ICES, 2015) and urban mobility plan (PLAMUS, 2015) were launched, as briefly mentioned in chapter 3. A document analysis of the plans' technical reports reveals strong integration between transport and land-use, with future scenarios relying on more compact and dense urbanization, and priority for active and public transport, which is consistent with general recommendations of recent literature (Banister, 2008, Hickman et al., 2010). However, besides assessing technical consistency, ensuring policymakers and stakeholders commitment is crucial to improve the implementation of public policies and plans (Howlett, 2019).

The first research question posed by this dissertation sought to assess if current policies and plans for Florianópolis Metropolitan Region are leading to a desirable future. While existing plans have developed future scenarios in order to propose future interventions for the region, it was previously unknown to the researcher if these were perceived desirable by the Delphi panellists. Therefore, the first step consisted in identifying a shared vision, with scenario components inserted as statements for the year of 2044, with participants asked to rate their desirability, as shown in Figure 5.

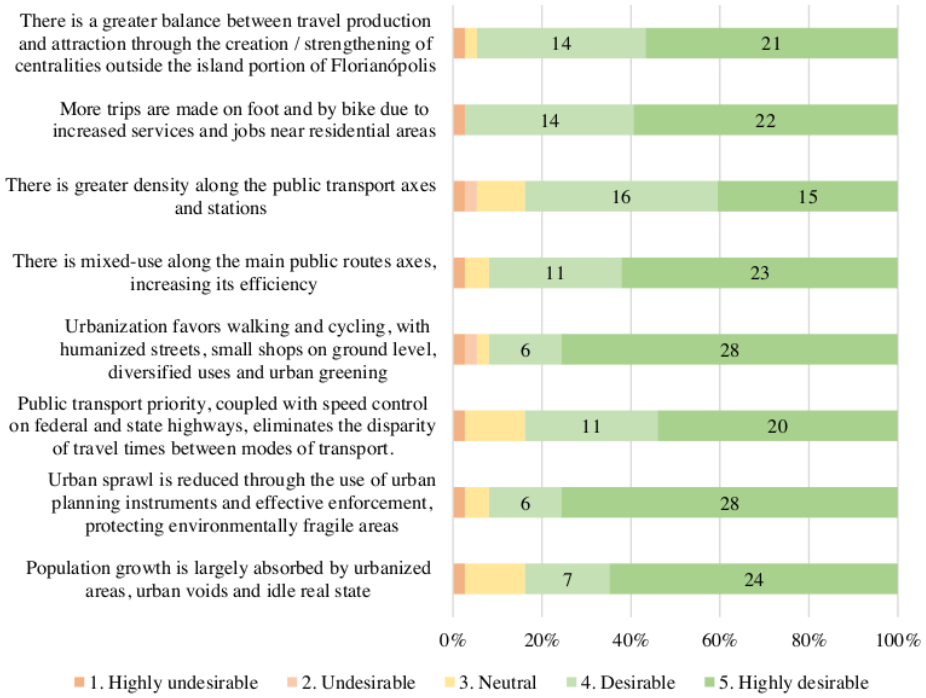

Figure 5: Desirability of scenario statements by 2044.

All the eight vision components were ranked as being desirable (rankings 4 and 5) by most of the participants, with the number of responses ranging from 31 to 36 (83.8% to 97.3%). The existence of higher density along PT axes and stations is the item with the lowest "highly desirable" scores, with 15 (40.5%) responses, while the favouring of active transport and the reduction of urban sprawl lead the score in this criterion, with 28 (75.7%) responses.

Scenarios developed in PLAMUS (2015) estimate a mode shift from cars and motorcycles (65% of motorized trips in 2014 to 52% in 2044) to buses (35% of motorized trips in 2014 to 48% in 2044). Figure 6 presents the Delphi participants' desirability towards this mode shift and agreement with the target.

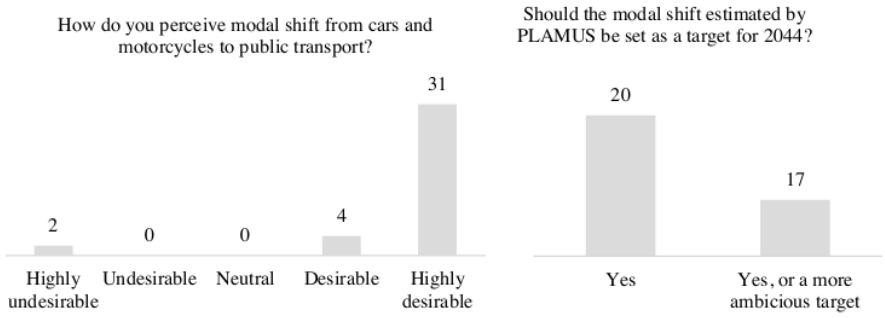

Figure 6: Perceptions of mode shift and mode share target.

The majority of Delphi panellists perceived modal shift from cars and motorcycles to public transport as highly desirable by 2044, with 31 (83.8%) responses. Although two respondents perceived this modal shift as highly undesirable, all participants agreed with the mode share target (or a more ambitious one) in the following question. Participants were then asked to indicate their agreement to current policies and plans, as indicated in Figure 7. In the case of national policies, they should consider the applicability in the regional context.

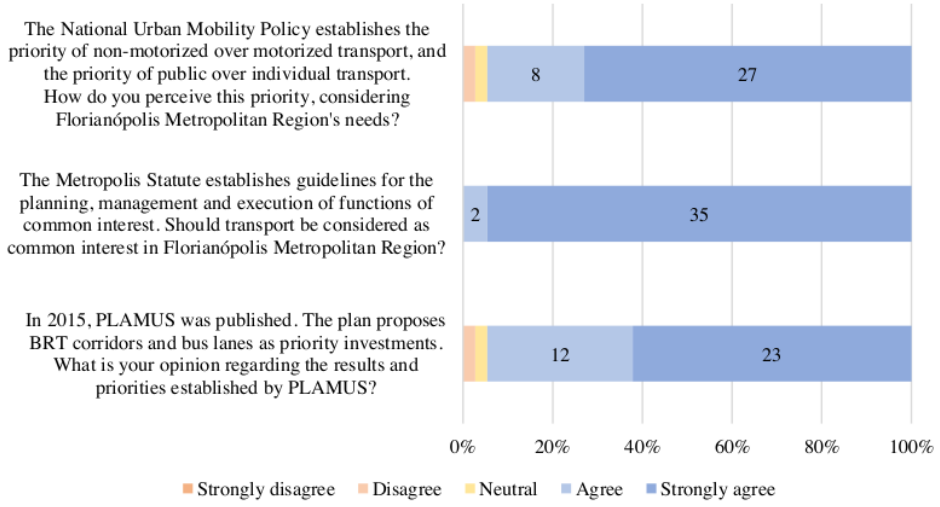

Figure 7: Agreement with ongoing policies and plans.

A high level of agreement with the ongoing policies and plans can be observed among the Delphi panel. Only one out of 37 participants disagreed with the priorities established by the National Urban Mobility Policy and PLAMUS. In addition, it's worth emphasizing the consensus achieved with the second question, with 35 (94.6%) "strongly agree" responses, which seems to reinforce the institutional

fragmentation of metropolitan regions (Vasconcellos, 2018) and the perception of urban mobility as the primary problem in Florianópolis Metropolitan Region (Borges, 2014, Silva, 2019).

The Delphi survey evidenced that, according to the panel's perception, current plans and policies can lead and are aligned with a desirable future urban mobility for Florianópolis Metropolitan Region. High levels of desirability were found for every scenario statement and agreements with mode share targets and ongoing policies were observed.

5.2 Role of public transport integration in achieving the desirable future

The second research question posed by this dissertation consists in identifying how public transport integration can contribute to a desirable future in Florianópolis Metropolitan Region. Participants were required to rate the importance of addressing PT objectives concerning its planning, management and operation. In the first round of the survey, respondents were asked to identify aspects that would likely be altered if public transport integration takes place, by gathering free-text contributions and pre-listing aspects mentioned by transport literature and context-specific material. These contributions were converted in objectives in the second questionnaire, with participants solicited to rank the importance of each objective considering the desirable future statement generated in the first round (see Appendix B).

Different measures of consensus are employed in Delphi surveys. For five-point Likert scale questions, typical definitions consist in a given rate of positive responses, such as higher than 65% to 80% (Putnam et al., 1995, Soria-Lara and Banister, 2017), or interquartile range (IQR) values equal or inferior to one (Raskin, 1994, Rayens and Hahn, 2000). Consensus was defined as 80% or higher positive responses (rankings four and five) with a given objective. Where consensus could not be achieved, objectives were reassessed in the third questionnaire. Figure 8 presents the percentage of positive responses for each objective, grouped by clusters.

Consensus was achieved in 25 of the 32 PT objectives. Statistical measures of central tendency and dispersion indicate a strong convergence of opinions among participants in the second round (Appendix F). Seven items that received less than 80% positive responses were selected to be reassessed in the third round. Table 1 compares the percentage of positive responses (% pos.), mean, median, standard deviation (S) and variance (v^2) for the reassessed objectives.

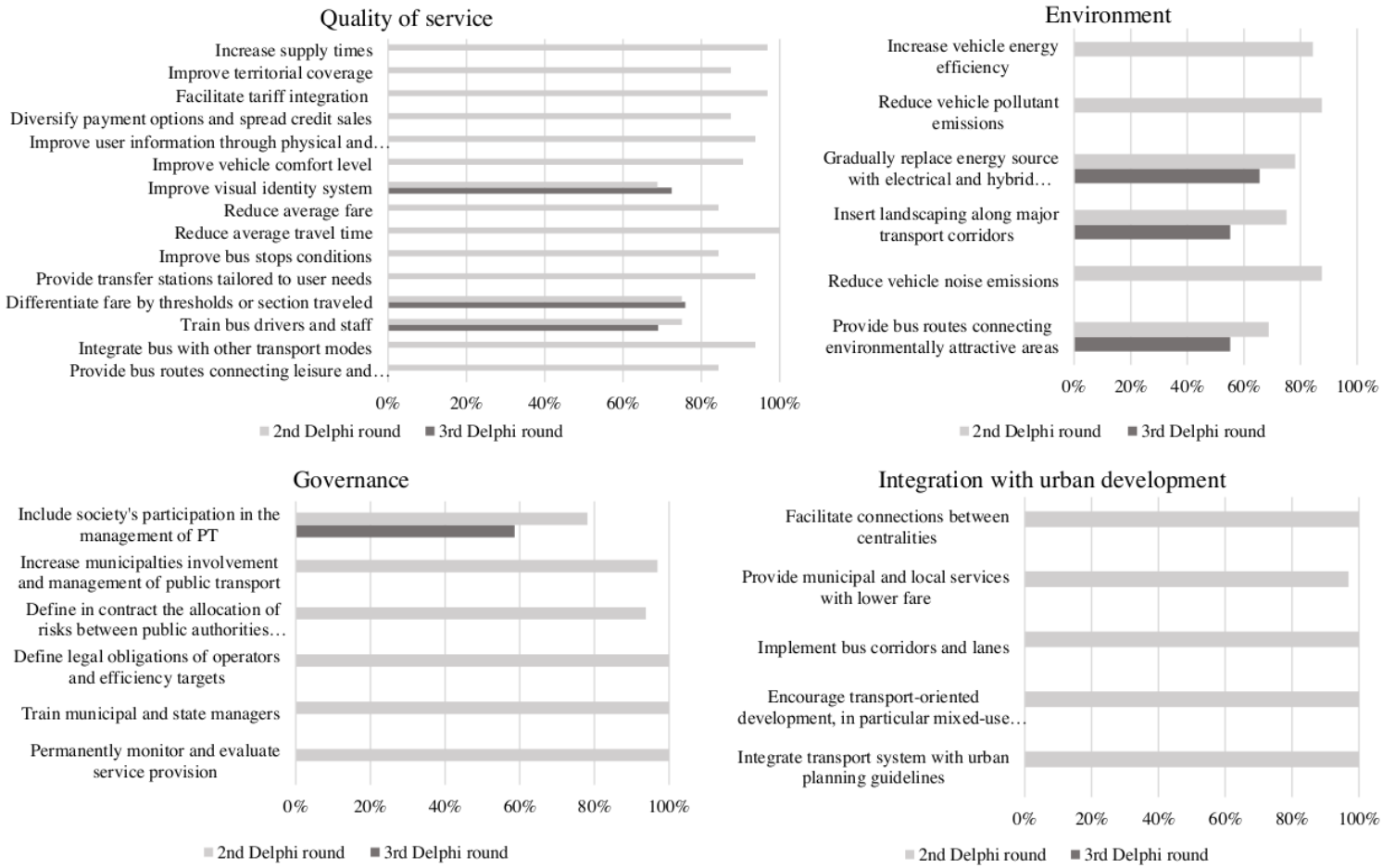

Figure 8: Percentage of positive responses for PT objectives, rounds 2 and 3.

The ‘quality of service’ cluster encompasses objectives mainly related to operational PT integration. Facilitating tariff integration is one of the highest-ranked among all objectives. Network integration aspects are spread among several objectives, such as travel time reduction, increased supply and adequate transfer stations, which also presented high percentage of positive responses. These findings are coherent with the literature that places fare and network as the most important aspects of operational PT integration (Sharaby and Shiftan, 2012, Chowdhury et al., 2018). User information and the improvement of visual identity are examples of information integration. This latter objective only had 69% positive responses in the second round, with a slight increase (72%) when reassessed in the third questionnaire. This lower perceived importance of information, when compared to fare and networking integration, corresponds to the findings of Chowdhury et al. (2018). In a more strategic level, integration of bus with other transport modes was perceived as highly important (94%).

From the governance cluster, objectives concerning legal aspects, training of public servants, service monitoring and municipalities’ involvement received highly positive responses. Increasing participation of society in the management of public transport, however, received 78% of positive responses. When reassessed in the third Delphi round, this rate dropped to 59%, with a slight increase in dispersion. This represents a source of concern since it indicates a technocratic tendency among experts and policymakers, whose judgements can differ significantly from users’ actual needs (Kash and Hidalgo, 2014, Chowdhury et al., 2018). In contrast, increased public participation is preconized by national policies and the proposed governance model in Florianópolis Metropolitan Region (SUDERF, 2018).

Five objectives concern different forms of transport and urban development integration, with all perceived as highly important by respondents. This is consistent with previous findings from Da Silva et al. (2008), where policymakers recognized transport and spatial planning integration as a crucial strategy for increasing PT attractiveness in Florianópolis. Implementing PT infrastructure, facilitating connections between centralities, encouraging mixed-use densification and following urban planning guidelines are all objectives related to the development of a strategic transport network, a key component of land-use and transport integration (Hickman et al., 2010).

Concerning PT and environment, three of the six environment-related objectives received less than 80% positive responses, being reassessed in the third round and suffering significant rating decreases, as shown in Table 1. By comparing results among clusters, it can be inferred that integration between transport and land-use is perceived as more highly valued than the environment for achieving the desired future. This reflects Stead’s (2008) argument that narrow considerations for this integration are given in practice.

Table 1: Panel's perceived importance of reassessed PT objectives, rounds 2 and 3

Aspect	Round 2					Round 3				
	% pos.	Mean	Median	S	v^2	% pos.	Mean	Median	S	v^2
Improve visual identity system	69%	3.72	4	0.72	0.51	72%	3.69	4	0.65	0.42
Differentiate fare by thresholds or section travelled	75%	3.91	4	0.80	0.65	76%	3.97	4	1.03	1.07
Train bus drivers and staff	75%	3.91	4	0.80	0.65	69%	3.93	4	0.83	0.68
Include society's participation in the management of PT	78%	3.91	4	0.76	0.58	59%	3.69	4	0.83	0.70
Gradually replace energy source with electrical and hybrid alternatives	78%	4.06	4	0.79	0.62	66%	3.79	4	0.76	0.58
Insert landscaping along major transport corridors	75%	3.88	4	0.86	0.73	55%	3.55	4	0.89	0.80
Provide bus routes connecting environmentally attractive areas	69%	3.75	4	0.75	0.56	55%	3.59	4	0.85	0.73

Additional consensus could not be reached on any of the reassessed objectives. The variance and standard deviation decreased slightly for objectives concerning the visual identity of PT and the use of alternative energy sources, which indicates a convergence of opinions among the participants. However, for the remaining reassessed objectives, dispersion increased, which contradicts recent Delphi applications in transport literature (Soria-Lara and Banister, 2017, Feuerstein et al., 2018).

Based on the responses obtained in the third round, some critical reflections can be drawn. The increased values for standard deviation and variance are indicative that establishing 80% positive responses as a measure for consensus proved inadequate. Whereas a lower percentage of positive responses could have been adopted, consensus could alternatively be measured by analysing central tendency or dispersion values, such as the median or IQR (see Appendix F). All 32 objectives have median values equal to 4 or 5, which represents that most participants perceive these as being either important or highly important. Similarly, IQR would represent achieving wide-spread consensus in the second round, since values for all objectives are equal or inferior to one.

The majority of PT objectives included were perceived essential by the participants. Perhaps a more comprehensive and diverse list of aspects should have been included in the first questionnaire, as

to identify a more explicit prioritization. Alternatively, ranking-type questions could have been introduced to distinguish priorities.

5.3 Brainstorming, narrowing down and ranking of barriers and measures

With the two final research questions, this dissertation proposed to identify the main barriers hindering public transport integration in Florianópolis Metropolitan Region and the measures to overcome them. This implied a need for prioritization, which led to the design of a ranking-type exercise, performed throughout the three Delphi rounds.

In the first questionnaire, the panel was asked to list and describe at least three barriers that perceivably hinder PT integration, as well as three measures that could support integration taking place in the region. This brainstorming phase generated 120 inputs for existing barriers and 106 for supporting measures. Responses were consolidated into single lists by removing duplicates (Paré et al., 2013) and grouping similar inputs (Schmidt, 1997). Final inventories were comprised of 42 barriers and 34 measures.

The second Delphi round asked respondents to shortlist five barriers and measures among those previously listed. This limitation was introduced to emphasize prioritization and reduce respondents' fatigue (Hirschhorn, 2019). Considering that shortlists should include at least 10% of the inventory (Schmidt, 1997), the limit of five items was set for both barriers and supporting measures. Due to inventories' length, items were presented in a random order to avoid any bias. Table 2 present the list of barriers and measures with the highest percentage of votes obtained in round 2. Inventories and shortlisting percentages are found in Appendix G and Appendix H.

Table 2: Top shortlisted barriers and measures in round 2

Barriers	**%**
Low availability of resources to fund public transport infrastructure	25%
Low awareness of society regarding public transport importance	25%
Fear of loss of political power at municipal level	22%
Deficient metropolitan institutional structure	22%
Political decision-making, regardless of technical aspects	22%
Legal needs of approving a law and subsequent inter-federative agreements to enable the bidding of the new system	22%
Difficulty in maintaining permanent and qualified technical teams to consolidate the integration project	22%
Lack of public transport promotion policies	22%
Lack of understanding about the importance of public transport for urban development	19%
Possibility of non-adherence of municipalities in the project, harming integration	19%
Measures	**%**
Implement BRT corridors and bus lanes	44%
Institutionally, technically and financially strengthen SUDERF or the equivalent metropolitan agency	44%
Prioritize urban mobility on the region's political agenda	31%
Implement integration terminals (São José, Biguaçu, Palhoça)	31%
Allocate specific resources for public transport (e.g. state fund)	28%
Develop the Integrated Urban Development Plan, articulating different sectoral policies	28%
Implement an inter-federative governance model as foreseen in the Metropolis Statute, expanding political integration between Mayors and empowering organized civil society	25%
Commit political will and efforts in the implementation of public transport improvements	22%
Create greater engagement between State and Municipalities to promote consensus, placing metropolitan interest above individual ones	22%
Promote improvements in public transport (e.g. large supply, better vehicles) to attract more users	22%

A tie in the number of responses for the top selected alternatives would result in a final list with eight barriers and six measures. Due to the proximity of the percentages among alternatives, the final shortlist was increased to include the top ten most selected barriers and measures. In the final questionnaire, participants were required to distribute a total of 100 points among the ten shortlisted items. This fixed-sum ranking was chosen due to its more robust statistical analysis possibilities (Hirschhorn, 2019). Items were again presented in a random order to avoid bias.

Ratings for barriers and measures are summarized in Table 3 and Table 4. Ranking (Rank) is based on the average points (Avg. Points) received by each item. Standard deviation (S) and mode represent dispersion and central tendency. The highest single score attributed by a participant (High) and the percentage of respondents that allocated zero points to an item (Zeros) are also exhibited. ‘Rank2’ represents the shortlisting percentages obtained in the second questionnaire.

Table 3: Prioritization of barriers in round 3

Barriers	Avg. Points	S	High	Mode	Zeros	Rank	Rank2
Low availability of resources to fund public transport infrastructure	14.18	7.97	30	20	7%	1	1
Lack of public transport promotion policies	13.52	9.12	50	10	3%	2	3
Political decision-making, regardless of technical aspects	12.26	6.94	30	5	7%	3	3
Deficient metropolitan institutional structure	11.56	6.65	30	10	7%	4	3
Difficulty in maintaining permanent and qualified technical teams to consolidate the integration project	10.85	8.90	50	5	7%	5	3
Low awareness of society regarding public transport importance	9.88	5.67	20	5	14%	6	1
Legal needs of approving a law and subsequent inter-federative agreements to enable the bidding of the new system	9.11	5.22	20	5	7%	7	3
Fear of loss of political power at municipal level	8.85	5.23	20	10	14%	8	3
Lack of understanding about the importance of public transport for urban development	8.19	6.05	30	5	10%	9	9
Possibility of non-adherence of municipalities in the project, harming integration	8.15	4.78	20	5	17%	10	9

The lack of resources to fund PT infrastructure received the highest number of points (14.18) among shortlisted barriers and presented the highest mode (20). The unavailability of resources is a common cause of implementation delays, as argued by Banister (2004) and evidenced by Hidalgo and King (2014). In Florianópolis Metropolitan Region, the implementation of PT infrastructure was set to occur in parallel with transport integration (PLAMUS, 2015). In practice, however, financial constraints delayed investments (G1 SC, 2016), "forcing" operational integration to take place without the planned infrastructure. The fact that Delphi panellists perceive this as the most critical barrier evidence the need of addressing this issue in practice. Infrastructure investments are also ranked among the top measures that could support PT integration, as shown in Table 4.

Throughout this dissertation, it is argued that the fragmented institutional setting reflects in transport inequalities in Florianópolis Metropolitan Region. In the Delphi survey, respondents also express such perception, when placing the lack of public transport promotion policies, the deficient metropolitan institutional structure and the difficulty in consolidating the integration project among the five highest-ranked barriers. The latter two aspects particularly relate to the findings of Nello-Deakin (2015), who identified power imbalances within the metropolitan authority as a direct consequence of its institutional structure. Since its creation in 2014, SUDERF has been struggling to design an integrated system, being demobilized and restructured according to political cycles (Silva, 2018, Neto, 2019).

Political aspects permeate the implementation of integrated transport projects (Estache and Gómez-Lobo, 2005, Hidalgo and King, 2014, Vasconcellos, 2018) and this is also evidenced by respondents, with the disregard of technical aspects in the decision-making receiving the third-highest number of points (12.26) among shortlisted barriers. The eminence of PT integration leads to the fear of losing political power (8th-ranked barrier) by municipalities since planning and operation would be primarily the responsibility of a centralized metropolitan agency. This fear, however, is likely to be ungrounded, since most municipalities have inadequate control over public transport (da Silva et al., 2008) regardless of being part of a metropolitan region. A possible way to overcome this political barrier is to adequately address the division of rights and responsibilities the proposed associate-management governance model.

The two legal barriers mentioned are directly related. As explained in Chapter 3, the lack of powers for metropolitan authorities in the Brazilian Constitution led to the approval of the Metropolis Statute (BRASIL, 2015). If public transport is to be coordinated by a metropolitan agency, a state law must be approved, with inter-federative agreements between the agency and the municipalities made before launching the bidding process (7th-ranked barrier). For that reason, if one of these agreements is not reached, integration can only occur partially, not encompassing all municipalities (10th-ranked barrier). These findings corroborate with Vasconcellos' (2018) argument that such legal/institutional structure is a major constraint for achieving metropolitan public transport integration.

Social and cultural barriers are among those highly-ranked by the Delphi panellists. These refer to the low awareness and understanding of PT importance in general (6th place) and its relation to urban development (9th place). This is contrary to transport literature, in which low social acceptability is mostly reported when trying to implement 'push' measures (Banister, 2004), with public transport provision and operations understood to be generally free of cultural barriers (May et al., 2005).

A notable absence among the top-rated items is the opposing market force exerted by existing operators, which is often referred as one of the main barriers in turning fragmented PT services into integrated systems (Ardila, 2008, Paget-Seekins et al., 2015). Nevertheless, this barrier received significant responses (16%) in round 2, almost making to the ranking phase (see Appendix G).

Table 4: Prioritization of measures in round 3

Measures	Avg. Points	S	High	Mode	Zeros	Rank	Rank2
Implement BRT corridors and bus lanes	19.69	13.36	50	10	0%	1	1
Institutionally, technically and financially strengthen SUDERF or the equivalent metropolitan body	12.48	10.31	60	10	7%	2	1
Promote improvements in public transport (e.g. large supply, better vehicles) to attract more users	11.00	4.60	20	10	10%	3	8
Implement integration terminals (São José, Biguaçu, Palhoça)	10.54	5.23	20	5	10%	4	3
Create greater engagement between State and Municipalities to promote consensus, placing metropolitan interest above individual ones	10.36	5.82	25	5	17%	5	8
Allocate specific resources for public transport (e.g. state fund)	9.74	4.54	20	10	10%	6	5
Commit political will and efforts in the implementation of public transport improvements	9.59	6.00	30	5	7%	7	8
Prioritize urban mobility on the region's political agenda	9.48	4.86	20	10	17%	8	3
Implement an inter-federative governance model as foreseen in the Metropolis Statute, expanding political integration between Mayors and empowering organized civil society	8.41	4.02	20	5	7%	9	7
Develop the Integrated Urban Development Plan, articulating different sectoral policies	7.48	3.44	20	5	14%	10	5

The ranking of the measures reinforces the importance given to infrastructure, with the implementation of BRT corridors and bus lanes receiving 57,8% more points than the second highest-ranked item. While presenting highly dispersed opinions (only barrier or measure with standard deviation higher than 11), the item did not receive any zeros by the participants, which is an indicator of its perceived importance. Additionally, the implementation of transport hubs in the region received the fourth-highest number of points. This emphasis in infrastructure-related aspects may be directly associated with the urgent need of improving PT in Florianópolis Metropolitan Region, an area with more than one million inhabitants but still without public transport priority measures.

The strengthening of SUDERF, the metropolitan agency, is the second-highest ranked measure. Higher individual scores (‘High’) seem to explain the dispersion (S=10.31) in opinions. This rating indicates panel’s agreement with a more centralized and overarching transport governance model, as advocated by Sager (2005) and Marsden and May (2006). Nevertheless, respondents also seem to believe that it is necessary to further improve this model (9th ranked measure), in order to achieve higher policy integration and public participation, in the moulds of the Metropolis Statute (BRASIL, 2015).

Participants of the Delphi panel seem to be in favour of a transport paradigm shift, introducing transport improvements to attract more users, possibly as a way to increase public support. This is evidenced in the measures ranked in third and sixth places, consisting of providing ample supply and better vehicles, as well as allocating resources for PT through a state fund or similar mechanism. Such perceptions can be interpreted as critiques to the public transport integration plan, designed without public subsidies and primarily based on existing supply levels (SUDERF, 2018).

The remaining measures in the "top ten" consist of actions and decisions of political nature. According to the participants, there is the need to prioritize urban mobility on the political agenda, commit efforts in the implementation of improvements, enhance engagement between State and Municipalities, and place metropolitan interests above individual ones. Assuming that political acceptability is driven by public opinion (Banister, 2008), there is a necessity to build sufficient public support if integration is to be implemented. Actively involving PT users and creating awareness with the general public seem necessary to achieve this change.

The development of an integrated urban development plan is, with a high consensus among the panel, the least important among the "top 10", with the lowest standard deviation (3.44) and high percentage of 'zeros' (14%). Since developing this plan is crucial for strategic integration, the low score (7.48) evidences respondents' preference in focusing on operational integration aspects in the short run.

6. Conclusions

Even though integration has been a central theme in transport policy for two decades, there is a dearth of success stories in practice (Givoni and Banister, 2010), which can represent the difficulty in understanding the concept (Preston, 2010). Case studies are often limited by a narrow framing of operational aspects, particularly patronage analysis (e.g. Matas, 2004, Abrate et al., 2009). This research explored operational integration dimensions in combination with a broader visioning exercise and wider strategic aspects, thus representing a contribution to existing literature.

The dissertation additionally explored the barriers and measures hindering implementation, considering metropolitan instead of city-wide integration, an under-researched topic (Nello-Deakin, 2015). For doing so, it employed Delphi surveys to collect, combine and reassess opinions, an in-depth study that deviates from the mainstream approach of assessing transport integration through secondary data (e.g. Potter, 2010, Preston, 2012).

In transport literature, Delphi has typically been applied either in future scenario development or to investigate factors influencing specific policies or projects. This research employed an innovative Delphi survey, linking visioning, long-term public transport objectives and short-term influencing factors.

While the method sought to fulfil observed knowledge gaps, using Delphi questionnaires to build consensus among participants, pre-structured questions restricted the received inputs, representing a significant limitation. In future research applications, this framework could be expanded to include interviews, which are likely to result in more creative and detailed opinions (Soria-Lara and Banister, 2017), providing complementary findings.

It is necessary to emphasize that survey results represent solely experts and stakeholders' opinions, a limitation imposed by the very design of the Delphi technique. As previously stated, priorities among policymakers and users can substantially differ (Chowdhury et al., 2018), and therefore identifying this vision dissonance is essential if both societal and public administration goals are to be achieved in practice (Kash and Hidalgo, 2014). Future research can address this gap by employing surveys with public transport users, focus groups, community meetings or other methods to verify the eventual differences in perceptions.

Considering these limitations, Delphi proved successful in investigating the factors influencing transport integration in Florianópolis Metropolitan Region, incorporating diverse professional backgrounds and including representants from academia, the private sector and all three tiers of government.

The interactive assessment of opinions enabled prioritization and consensus-building. A major finding was that despite such diversity among the panel, a common desired future was immediately identified, with agreement on vision, targets, policies and plans. This desirable future involves better conditions for public and active transport, more equitable distribution of services and greater control of the urbanisation process. Equally significant is the common perception that current policies and plans are aligned with such vision.

When assessing the importance of long-term public transport objectives, a high degree of consensus was identified in the majority of items. Levels of positive responses indicate that panellists greatly value land-use and transport integration over environmental aspects. Great importance was also placed in governance improvement, an aspect also highlighted when ranking the most necessary supporting measures.

Major barriers hindering metropolitan public transport integration identified by the research consist of resources, institutional, political, legal and socio-cultural constraints. Lack of resources to fund PT infrastructure, deficient metropolitan institutional setting and absence of public transport promotion policies are commonly observed in other contexts (Nello-Deakin, 2015, Hidalgo and King, 2014), while the importance given to social and cultural barriers contradicts the consulted literature (Banister, 2004, May et al., 2005). Due to its unique specificities, legal barriers can be understood as being more applicable to the Brazilian context.

Transport integration appears to be a vital policy for Florianópolis Metropolitan Region, one that can reduce inequalities experienced by PT users (Souza et al., 2017, Carvalho et al., 2017) and car usage levels (PLAMUS, 2015). Conversely, low society awareness of public transport importance was ranked as a major barrier, evidencing a mismatch that should be addressed in practice. While the integrated PT plan was discussed with municipalities and subjected to public consultation (Redação ND, 2017), further public participation mechanisms could be implemented to build public support and overcome social, cultural and political barriers.

Over the last few years, with the creation of a metropolitan authority and the development of an integrated transport plan, considerable efforts have already been promoted in the attempt of integrating transport in Florianópolis Metropolitan Region. Findings from this study indicate that additional ones are required to overcome immediate barriers to implementation and continuously improve the transport system in the long-term. There are, however, reasons to be hopeful in a transition towards more sustainable mobility. It is fair to state that the region experiences a particularly favourable context, where there is agreement over a desirable future, with policies and plans reflecting that vision. If public servants, politicians, the private sector and the general population jointly recognizes transport integration as a priority, there is potential to turn the region into a successful case study in Brazil and Latin America. More importantly, if integration is effectively addressed, some of the transport inequalities faced by the population, as presented at the beginning of this dissertation, can cease to exist.

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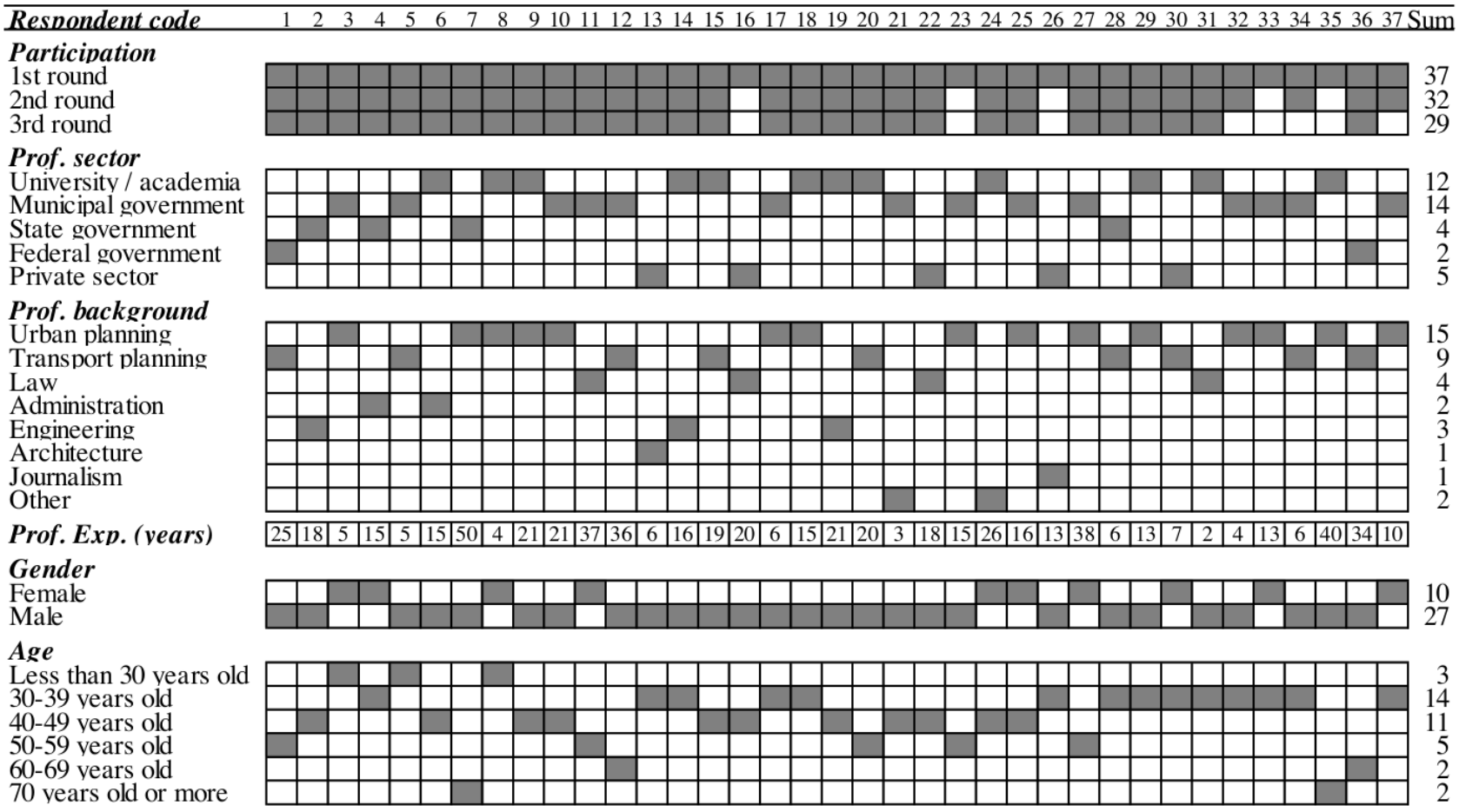
Appendix A – Panel Matrix



Respondent code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Sum
Participation																																							
1st round	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	□	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	37
2nd round	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	□	■	■	■	■	■	■	□	■	■	□	■	■	■	■	■	■	□	■	□	■	■	32
3rd round	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	□	■	■	■	■	■	■	□	■	■	□	■	■	■	■	■	□	□	□	□	■	□	29
Prof. sector																																						
University / academia	□	□	□	□	□	■	□	■	■	□	□	□	□	■	■	□	□	■	■	■	□	□	□	■	□	□	□	■	□	■	□	□	□	■	□	□	12
Municipal government	□	□	■	□	■	□	□	□	□	■	■	■	□	□	□	□	■	□	□	□	■	□	■	□	■	□	■	□	□	□	□	■	■	■	□	□	■	14
State government	□	■	□	■	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	4
Federal government	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	2
Private sector	□	□	□	□	□	□	□	□	□	□	□	■	□	□	■	□	□	□	□	□	■	□	□	□	■	□	□	■	□	□	■	□	□	□	□	□	□	5
Prof. background																																						
Urban planning	□	□	■	□	□	□	■	■	■	■	□	□	□	□	□	□	■	■	□	□	□	□	■	□	■	□	■	□	■	□	□	■	■	□	■	□	■	15
Transport planning	■	□	□	□	■	□	□	□	□	□	■	□	□	□	■	□	□	□	□	■	□	□	□	□	□	□	□	■	□	■	□	□	■	□	■	□	□	9
Law	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	■	□	□	□	□	□	■	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	4
Administration	□	□	□	■	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	2
Engineering	□	■	□	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	3
Architecture	□	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	1
Journalism	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	1
Other	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	2
Prof. Exp. (years)	25	18	5	15	5	15	50	4	21	21	37	36	6	16	19	20	6	15	21	20	3	18	15	26	16	13	38	6	13	7	2	4	13	6	40	34	10	
Gender																																						
Female	□	□	■	■	□	□	□	■	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	■	■	□	■	□	□	■	□	□	■	□	□	□	■	10
Male	■	■	□	□	■	■	■	□	■	■	□	■	■	■	■	■	■	■	■	■	■	■	■	□	□	■	□	■	■	□	■	■	□	■	■	■	□	27
Age																																						
Less than 30 years old	□	□	■	□	■	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	3
30-39 years old	□	□	□	■	□	□	□	□	□	□	□	■	■	□	□	■	■	□	□	□	□	□	□	□	□	■	□	■	■	■	■	■	■	■	□	□	■	14
40-49 years old	□	■	□	□	□	■	□	□	■	■	□	□	□	□	■	■	□	□	■	□	■	■	□	■	■	□	□	□	□	□	□	□	□	□	□	□	□	11
50-59 years old	■	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	■	□	□	■	□	□	□	■	□	□	□	□	□	□	□	□	□	□	5
60-69 years old	□	□	□	□	□	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	2
70 years old or more	□	□	□	□	□	□	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□	□	2

Appendix B – First round of Delphi survey

* This survey was conducted in Portuguese language. The original version can be found in: https://bit.ly/2ZDlINa

This research is part of a dissertation for the master's degree in 'Transport and City Planning' at University College London (UCL), with the main objective to identify barriers hindering public transport integration in the Florianópolis metropolitan area, and the main measures that could support its implementation.
A more detailed description of the research is here: https://tiny.cc/09cx8y

This questionnaire has an approximate duration of ten (10) minutes and will remain open for responses until July 9, at 19:30h. Thank you for your participation!

Personal information

Q1: Age range:

Check the box that corresponds to your age:

◯ < 30 years ◯ 30-39 years ◯ 40-49 years ◯ 50-59 years ◯ 60-69 years ◯ >= 70 years

Q2: With which genre do you identify the most?

◯ Masculine ◯ Feminine ◯ I do not wish to declare ◯ Other

If you have chosen "other", please specify:

Q3: Which field correspond to your professional activity?

◯ Transport planning ◯ Urban planning ◯ Architecture
◯ Engineering ◯ Law ◯ Journalism
◯ Administration ◯ Geography ◯ Other

If you have chosen "other", please specify:

Q4: Select the sector related to your professional experience:

◯ University/academia ◯ Municipal government ◯ State government
◯ Federal government ◯ Consultancy/private sector ◯ Other

If you have chosen "other", please specify:

Q5: For how long (in years) are you professionally active?

Part A – Desirable urban mobility future in Florianópolis Metropolitan Region

This block aims to assess the desirable urban mobility future in the long term, presenting scenarios and targets from the Florianópolis Sustainable Action Plan (ICES) and Florianópolis Metropolitan Region Sustainable Urban Mobility Plan (PLAMUS).

Q6: Scenario components for Florianópolis Metropolitan Region are presented below, considering the horizon of 2044. Indicate the desirability of each of the following.

	1 Highly undesirable	2 Undesirable	3 Neutral	4 Desirable	5 Highly desirable
There is a greater balance between travel production and attraction through the creation/strengthening of centralities outside the island portion of Florianópolis	○	○	○	○	○
More trips are made on foot and by bike due to increased services and jobs near residential areas	○	○	○	○	○
There is greater density along public transport axes and stations	○	○	○	○	○
There is mixed use along the main public transport axes, increasing its efficiency.	○	○	○	○	○

Urbanisation favours walking and cycling, with humanized streets, small shops on ground level, diversified uses and urban greening	○	○	○	○	○
Public transport priority, coupled with speed control on federal and state highways, eliminates the disparity of travel times between transport modes	○	○	○	○	○
Urban sprawl is reduced through the use of urban planning instruments and effective enforcement, protecting environment fragile areas	○	○	○	○	○
Population growth is largely absorbed by urbanized areas, urban voids and idle real state	○	○	○	○	○

In 2014, 48% of trips in Florianópolis Metropolitan Region were made by cars and motorcycles, with equal 26% made by public transport and active transport (walking and cycling).

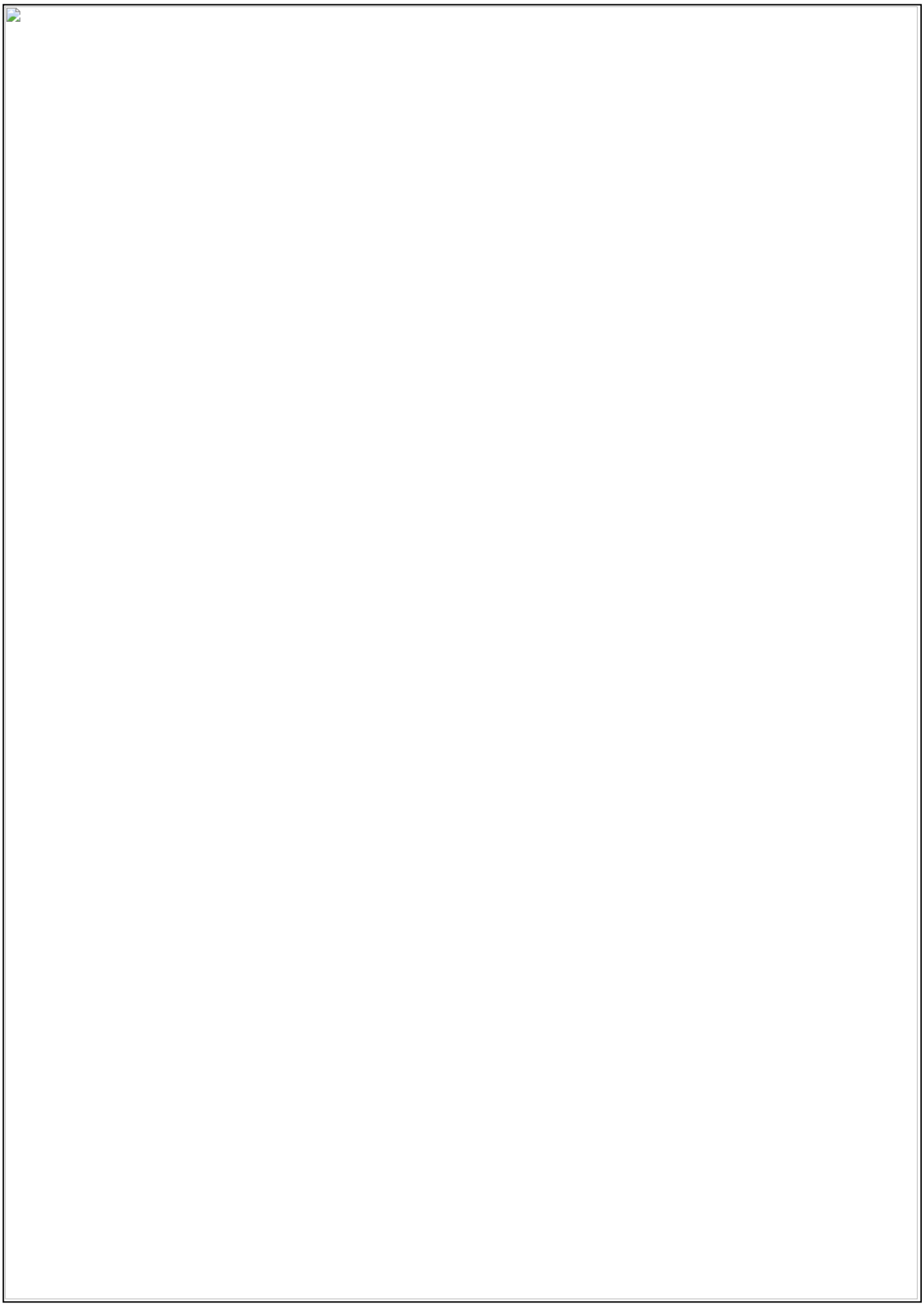
When formulating an oriented development scenario, with land use changes and implementation of BRT corridors and bus lanes, PLAMUS estimates a growth in the use of public transport (from motorized trips in 2014 to 48% in 2044) and a consequent reduction in the use of individual motorised transport (from 65% in 2014 to 52% in 2044).

Q7: According to your future vision for the Florianópolis Metropolitan region, how do you perceive modal shift from individual motorised transport to public transport?

○ Highly undesirable ○ Undesirable ○ Neutral ○ Desirable ○ Highly desirable

Q8: According to your future vision for the Florianópolis Metropolitan region, give your opinion if the modal shift estimated by PLAMUS should be established as a goal to be achieved by the year 2044.

○ No, the estimate is not desirable.
○ Neutral
○ Yes, or a more ambitious target
○ No, the estimate is too ambitious
○ Yes



Q13: Governance

- ☐ Society participation in the management of the system
- ☐ Municipalities involvement in the management of the system
- ☐ Contracts: risk allocation and incentives
- ☐ Regulatory framework: legal obligations and efficiency targets
- ☐ Technical capacity of municipal and state managers
- ☐ Other:

If you have chosen "other", please specify:

Q14: Environment

- ☐ Fleet energy efficiency
- ☐ Fleet pollutant emissions
- ☐ Other:

If you have chosen "other", please specify:

Q15: Integration with urban development

- ☐ Connectivity across centralities
- ☐ Local and municipal services with lower fare
- ☐ Implementation of bus corridors and bus lanes
- ☐ Encourage transport-oriented development
- ☐ Other:

If you have chosen "other", please specify:

Parts D and E – Barriers and measures to achieve PT integration

Q16: List and describe at least three barriers that, in your perception, hinder the quest for PT integration in Florianópolis Metropolitan Region.

Q17: List and describe at least three measures* that, in your perception, could support PT integration in Florianópolis Metropolitan Region.

***Measures can encompass policies, investments, institutional changes, specific projects and key decisions.**

Appendix C – Second round of Delphi survey

* This survey was conducted in Portuguese language. The original version can be found in: https://bit.ly/2ZHJIi4

Thank you for taking part in the second round of the survey. The report with the results of the first round is available in this link: http://tiny.cc/e2us9y

Part A – Role of PT integration in achieving the desirable future

The following phrases denote the future vision, targets and agreement with ongoing policies and plans, according to participants' responses in the first questionnaire:

Long-term vision: In 2044, the strengthening of centralities in the mainland of Florianópolis Metropolitan Region provides greater balance between travel production and attraction. The proximity of services and households, coupled with other urban improvements, provides good conditions for travels on foot and by bicycles. Public transport becomes attractive and efficient due to the diversity of uses along corridors and priority along main highways and avenues. Environment-fragile areas are effectively protected, with population growth being absorbed by existing urbanized areas.

Target: Increase public transport trips and reduce travel by individual motorised transport. In 2044, public transport trips should grow from 35% to at least 48%.

Agreement with policies and plans: Public transport priority over individual transport should be applied in the region, with transport understood as a common interest function. Investments and actions established by PLAMUS should be implemented.

In the following questions, indicate the importance, in your perception, of addressing the following PT objectives in achieving the desirable future in Florianópolis Metropolitan Region.

Q1: Quality of service

	1 Not important	2 Little importance	3 Neutral	4 Important	5 Very important
Increase supply times	○	○	○	○	○
Improve territorial coverage	○	○	○	○	○
Facilitate tariff integration	○	○	○	○	○
Diversify payment options and spread credit sales	○	○	○	○	○
Improve user information through physical and digital media	○	○	○	○	○
Improve vehicle comfort levels	○	○	○	○	○
Improve bus stops conditions	○	○	○	○	○
Improve visual identity system	○	○	○	○	○
Reduce average fare	○	○	○	○	○
Reduce average travel time	○	○	○	○	○
Provide transfer stations tailored to user needs	○	○	○	○	○
Differentiate fare by thresholds or section travelled	○	○	○	○	○
Train bus drivers and staff	○	○	○	○	○
Integrate bus with other transport modes	○	○	○	○	○
Provide bus routes connecting leisure and cultural areas	○	○	○	○	○

Q2: Governance

	1 Not important	2 Little importance	3 Neutral	4 Important	5 Very important
Include society's participation in the management of PT	○	○	○	○	○
Increase municipalities involvement and management of PT	○	○	○	○	○
Define in contract the allocation of risks between public authorities and operators	○	○	○	○	○
Define legal obligations of operators and efficiency targets	○	○	○	○	○
Train municipal and state managers	○	○	○	○	○
Permanently monitor and evaluate service provision	○	○	○	○	○

Q3: Environment

	1 Not important	2 Little importance	3 Neutral	4 Important	5 Very important
Increase vehicle energy efficiency	○	○	○	○	○
Reduce vehicle pollutant emissions	○	○	○	○	○
Gradually replace energy source with electrical and hybrid alternatives	○	○	○	○	○
Insert landscaping along major transport corridors	○	○	○	○	○
Reduce vehicle noise emissions	○	○	○	○	○
Provide bus routes connecting environmentally attractive areas	○	○	○	○	○

Q4: Integration with urban development

	1 Not important	2 Little importance	3 Neutral	4 Important	5 Very important
Facilitate connections between centralities	○	○	○	○	○
Provide municipal and local services with lower fare	○	○	○	○	○
Implement bus corridors and lanes	○	○	○	○	○
Encourage transport-oriented development, in particular mixed-use densification	○	○	○	○	○
Integrate transport system with urban planning guidelines	○	○	○	○	○

Part B – Barriers for integrating PT

Q5: The following list contains barriers for metropolitan public integration in the region, according to what was mentioned by participants in the first questionnaire. Select five barriers that, in your perception, exert greater interference in the pursuit of integration.

☐ Lack of political will, articulation and leadership by municipal and state managers

☐ Opposite private interests, in particular of current operators

☐ Low availability of resources to fund public transport infrastructure

☐ Difficulty in offering good public transport to low density, poorly-connected and single-function areas

☐ Legal needs of approving a law and subsequent inter-federative agreements to enable the bidding of the new system

☐ Public opinion focused on solutions relevant to the use of individual transport

☐ Low participation and integration of bodies involved (eg mayors, councilors, legislature, operators)

- [ ] Current contract for public transport in Florianópolis, hindering their participation in the integrated system
- [ ] Lack of physical space for the implementation of BRT lanes, bus lanes, cycle paths and cycle lanes
- [ ] Fear of loss of political power at municipal level
- [ ] Reconcile municipal and state government interests
- [ ] Difficult to afford the purchase of land and cost of integration terminals
- [ ] Deficient institutional metropolitan structure
- [ ] Low awareness of society regarding public transport infrastructure
- [ ] Difficulty in maintaining permanent and qualified technical teams to consolidate the integration project
- [ ] Lack of technical capacity to implement, operate and maintain the system
- [ ] Lack of political interest due to the proximity of municipal elections in 2020
- [ ] Resistance to the unknown and lack of boldness by managers and companies
- [ ] High concentration and pendularity of trips in the region
- [ ] Compliance to individual interests without an integral view of urban and transport for the region
- [ ] Low understanding of the municipalities on the associated management model proposed
- [ ] Definitions of tariff policy, bidding and routes
- [ ] Lack of understanding about the importance of public transport for urban development
- [ ] Lack of leadership and State Government political interest in SUDERF
- [ ] Overlapping competences between involved institutions
- [ ] Need to change urbanization / land use model
- [ ] Low public engagement and participation in the design of the system
- [ ] Commissioned roles according to political interests with few technical capacity
- [ ] Corruption
- [ ] Political decision-making, regardless of technical aspects
- [ ] Disagreement on the overlap of intercity lines with municipal ones in Florianópolis

- ☐ Political misinformation regarding the importance of public and active transport actions
- ☐ Demobilization of SUDERF during the process
- ☐ Lack of multimodality studies
- ☐ Lack of public transport promotion policies
- ☐ Lack of urban planning institutes
- ☐ Contrary influences of the labour union
- ☐ Insistence on not relying on subsidies, making it difficult to offer a high-quality system
- ☐ Transport planning based on minimum supply, disregarding induced demand
- ☐ Possibility of non-adherence of municipalities in the project, harming integration
- ☐ Disregard for actual user needs
- ☐ Conflicting views regarding the need for bus prioritization after additional traffic lane implementation of "Via Expressa" (major highway connecting Florianópolis with the region)

Part C – Supporting measures for PT integration

Q6: The following list contains measures that could support public transport integration in Florianópolis Metropolitan region, according to what was mentioned by participants in the first questionnaire. Select the five measures that you perceive as being the most important.

- ☐ Implement BRT corridors and bus lanes
- ☐ Institutionally, technically and financially strengthen SUDERF or the equivalent metropolitan agency
- ☐ Establish management council and consolidate associated management structure
- ☐ Allocate specific resources for public transport (e.g. state fund)
- ☐ Mobilize and inform the popullation to demand metropolitan integration and other improvements in public transportation
- ☐ Develop the Integrated Urban Development Plan, articulating different sectoral policies
- ☐ Promote media communication about the importance of transport investments
- ☐ Commit political will and efforts in the implementation of public transport improvements

- [ ] Introduce subsidies to make the fare more attractive to the user
- [ ] Prioritize urban mobility on the region's political agenda
- [ ] Reallocate resources among federative entities
- [ ] Strengthen involved agencies (eg mobility departments) with technical staff
- [ ] Create greater engagement between State and Municipalities to promote consensus, placing metropolitan interest above individual ones
- [ ] Adopt transport demand management tools such as disincentives and externalities charging
- [ ] Create structure of urban mobility discussions with community, managers and operators
- [ ] Encourage municipal managers by informing them of the advantages of integrating public transport
- [ ] Implement instruments to reorganize land use and urbanization
- [ ] Implement fare integration mechanisms
- [ ] Implement integration terminals (São José, Biguaçu, Palhoça)
- [ ] Initiate integration with alternative system using existing terminals
- [ ] Promote improvements in public transport (eg large supply, better vehicles) to attract more users
- [ ] Conduct audits on existing transport systems
- [ ] Consolidate and maintain technical staff to conduct further studies
- [ ] Demystify the viability of other modes, reinforcing the viability of buses
- [ ] Discuss metropolitan integration in committee at legislative assembly
- [ ] Study feasibility of other transport modes
- [ ] Implement an inter-federative governance model as foreseen in the Metropolis Statute, expanding political integration between Mayors and empowering organized civil society
- [ ] Provide public transport tax incentives
- [ ] Inquire about political-institutional power relations in the municipalities
- [ ] Promote fare integration with other transport modes

- [ ] Obey road system foreseen in City Plans
- [ ] Pressure from population and control agencies in demanding an integrated bidding process
- [ ] Give priority to public transport on "Via Expressa"
- [ ] Resume public-private partnership model to fund public transport infrastructure

Appendix D – Third round of Delphi survey

* This survey was conducted in Portuguese language. The original version can be found in: https://bit.ly/34fR003

Thank you for taking part in the final questionnaire. The feedback report with the results of the second round is available in this link: http://tiny.cc/ilgnaz

Part A – Role of PT integration in achieving the desirable future

Q1: The following list contains the items that didn't achieve consensus (% of positive responses less than 80%) in the previous questionnaire. Reassess the level of importance of the following items in achieving the desirable future in Florianópolis Metropolitan Region.

	1 Not important	2 Little importance	3 Neutral	4 Important	5 Very important
Improve visual identity system	○	○	○	○	○
Diferentiate fare by thresholds or section travelled	○	○	○	○	○
Train drivers and staff	○	○	○	○	○
Include society's participation in the management of PT	○	○	○	○	○
Gradually replace energy source with electric and hybrid alternatives	○	○	○	○	○
Insert landscaping along major transport corridors	○	○	○	○	○
Provide bus routes connecting environmentally attractive areas	○	○	○	○	○

Part B – Barriers for integrating PT

Q2: The ten barriers below were shortlisted by the participants as exerting the major interferences in the quest for public transport integration. Among those, distribute a total of hundred (100) points, as to prioritise the most relevant items, according to your perception.

Low availability of resources to fund public transport infrastructure	
Low awareness of society regarding public transport importance	
Fear of loss of political power at municipal level	
Deficient metropolitan institutional structure	
Political decision-making, regardless of technical aspects	
Legal needs of approving a law and subsequent inter-federative agreements to enable the bidding of the new system	
Difficulty in maintaining permanent and qualified technical teams to consolidate the integration project	
Lack of public transport promotion policies	
Lack of understanding about the importance of public transport for urban development	
Possibility of non-adherence of municipalities in the project, harming integration	

Part C – Supporting measures for PT integration

Q3: The ten measures below were shortlisted by the participants as being with the highest potential of supporting public transport integration. Among those, distribute a total of hundred (100) points, as to prioritise the most relevant items, according to your perception.

Implement BRT corridor and bus lanes	
Institutionally, technically and financially strengthen SUDERF or the equivalent metropolitan body	
Prioritize urban mobility on the region's political agenda	
Implement integration terminals (São José, Biguaçu, Palhoça)	
Allocate specific resources for public transport (eg state fund)	
Develop an Integrated Urban Development Plan for the region, articulating different sectoral policies	
Implement an inter-federative governance model as foreseen in the Metropolis Statute, expanding political integration between Mayors and empowering organized civil society	

Commit political will and efforts in the implementation of public transport improvements	
Create greater engagement between State and Municipalities to promote consensus, placing metropolitan interest above individual ones	
Promote improvements in public transport (e.g. large supply, better vehicles) to attract more users	

Appendix E – Risk assessment form

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

UCL

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form
http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION - BARTLETT SCHOOL OF PLANNING / MSC TRANSPORT AND CITY PLANNING
LOCATION(S) - LONDON, UNITED KINGDOM.
PERSONS COVERED BY THE RISK ASSESSMENT - Guilherme Furtado Carvalho

BRIEF DESCRIPTION OF FIELDWORK – No fieldwork will be conducted. The research method comprises of desk research and Delphi surveys, which will be submitted to respondents through a web application.

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ? No specific risk related to the environment. The researcher is already used to the environment of London.

CONTROL MEASURES — **Indicate which procedures are in place to control the identified risk**

- ☐ work abroad incorporates Foreign Office advice
- ☐ participants have been trained and given all necessary information
- ☐ only accredited centres are used for rural field work
- ☐ participants will wear appropriate clothing and footwear for the specified environment
- ☐ trained leaders accompany the trip
- ☐ refuge is available
- ☐ work in outside organisations is subject to their having satisfactory H&S procedures in place
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

None.

EMERGENCIES — **Where emergencies may arise use space below to identify and assess any risks**

e.g. fire, accidents

Examples of risk: loss of property, loss of life

None emergency identified.

CONTROL MEASURES — **Indicate which procedures are in place to control the identified risk**

- ☐ participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
- ☐ fire fighting equipment is carried on the trip and participants know how to use it
- ☐ contact numbers for emergency services are known to all participants
- ☐ participants have means of contacting emergency services
- ☐ participants have been trained and given all necessary information
- ☐ a plan for rescue has been formulated, all parties understand the procedure
- ☐ the plan for rescue /emergency has a reciprocal element
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Do not apply.

FIELDWORK 1 May 2019

EQUIPMENT	Is equipment used?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any Risks
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangement for equipment is followed
☐	participants have been provided with any necessary equipment appropriate for the work
☐	all equipment has been inspected, before issue, by a competent person
☐	all users have been advised of correct use
☐	special equipment is only issued to persons trained in its use by a competent person
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	Is lone working a possibility?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any Risks
e.g. alone or in isolation lone interviews.	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? No specific risks that arise from the research that will be conducted.

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ an appropriate number of trained first-aiders and first aid kits are present on the field trip
- ☐ all participants have had the necessary inoculations/ carry appropriate prophylactics
- ☐ participants have been advised of the physical demands of the trip and are deemed to be physically suited
- ☐ participants have been adequate advice on harmful plants, animals and substances they may encounter
- ☐ participants who require medication have advised the leader of this and carry sufficient medication for their needs
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

Do not apply.

TRANSPORT	**Will transport be Required**	**NO**	**X**	**Move to next hazard**
		YES		**Use space below to identify and assess any risks**
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ only public transport will be used
- ☐ the vehicle will be hired from a reputable supplier
- ☐ transport must be properly maintained in compliance with relevant national regulations
- ☐ drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
- ☐ drivers have been trained and hold the appropriate licence
- ☐ there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
- ☐ sufficient spare parts carried to meet foreseeable emergencies
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	**Will people be dealing with public**	**YES**	**If 'No' move to next hazard If 'Yes' use space below to identify and assess any Risks**
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low? The risk is low, since surveys are anonymized and conducted through web application.		

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ all participants are trained in interviewing techniques
- ☐ interviews are contracted out to a third party
- ☐ advice and support from local groups has been sought
- ☐ participants do not wear clothes that might cause offence or attract unwanted attention
- ☐ interviews are conducted at neutral locations or where neither party could be at risk
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

The participants will be informed of the purpose of the study and none personal information will be disclosed.

WORKING ON OR NEAR WATER	**Will people work on or near water?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any Risks**
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ lone working on or near water will not be allowed
- ☐ coastguard information is understood; all work takes place outside those times when tides could prove a threat
- ☐ all participants are competent swimmers
- ☐ participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
- ☐ boat is operated by a competent person
- ☐ all boats are equipped with an alternative means of propulsion e.g. oars
- ☐ participants have received any appropriate inoculations
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any Risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES **Indicate which procedures are in place to control the identified risk**

- ☐ the departmental written Arrangement for MH is followed
- ☐ the supervisor has attended a MH risk assessment course
- ☐ all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- ☐ all persons performing MH tasks are adequately trained
- ☐ equipment components will be assembled on site
- ☐ any MH task outside the competence of staff will be done by contractors
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any Risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES — Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangements for dealing with hazardous substances and waste are followed
- ☐ all participants are given information, training and protective equipment for hazardous substances they may encounter
- ☐ participants who have allergies have advised the leader of this and carry sufficient medication for their needs
- ☐ waste is disposed of in a responsible manner
- ☐ suitable containers are provided for hazardous waste
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	NO	If 'No' move to next section If 'Yes' use space below to identify and assess any Risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES — Give details of control measures in place to control the identified risks

Have you identified any risks that are not adequately controlled?			
	NO	X	Move to Declaration
	YES		Use space below to identify the risk and what action was taken

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? ☐

If yes, please state your Project ID Number ☐

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION — The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

- [X] I the undersigned have assessed the activity and associated risks and declare that there is no significant residual Risk
- [ ] I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR: Robin Hickman

**** SUPERVISOR APPROVAL TO BE CONFIRMED VIA E-MAIL ****

Appendix F – Importance of PT objectives, round 2 results

Cluster	Objective	% pos.	Mean	Median	S	v²	IQR
QS	Increase supply times	97%	4.50	5	0.56	0.31	1
QS	Improve territorial coverage	88%	4.34	4	0.69	0.48	1
QS	Facilitate tariff integration	97%	4.66	5	0.54	0.29	1
QS	Diversify payment options and spread credit sales	88%	4.22	4	0.65	0.42	1
QS	Improve user information through physical and digital media	94%	4.34	4	0.59	0.35	1
QS	Improve vehicle comfort level	91%	4.25	4	0.61	0.38	1
QS	Improve visual identity system	69%	3.72	4	0.72	0.51	1
QS	Reduce average fare	84%	4.25	4	0.71	0.50	1
QS	Reduce average travel time	100%	4.94	5	0.24	0.06	0
QS	Improve bus stops conditions	84%	4.03	4	0.59	0.34	0
QS	Provide transfer stations tailored to user needs	94%	4.47	5	0.61	0.37	1
QS	Differentiate fare by thresholds or section travelled	75%	3.91	4	0.80	0.65	0.25
QS	Train bus drivers and staff	75%	3.91	4	0.80	0.65	0.25
QS	Integrate bus with other transport modes	94%	4.53	5	0.61	0.37	1
QS	Provide bus routes connecting leisure and cultural areas	84%	4.03	4	0.77	0.59	0.25
G	Include society's participation in the management of PT	78%	3.91	4	0.76	0.58	0
G	Increase municipalities involvement and management of public transport	97%	4.63	5	0.54	0.30	1
G	Define in contract the allocation of risks between public authorities and operators	94%	4.41	4	0.61	0.37	1
G	Define legal obligations of operators and efficiency targets	100%	4.78	5	0.41	0.17	0
G	Train municipal and state managers	100%	4.75	5	0.43	0.19	0.25
G	Permanently monitor and evaluate service provision	100%	4.91	5	0.29	0.08	0
E	Increase vehicle energy efficiency	84%	4.13	4	0.74	0.55	1
E	Reduce vehicle pollutant emissions	88%	4.22	4	0.74	0.55	1
E	Gradually replace energy source with electrical and hybrid alternatives	78%	4.06	4	0.79	0.62	1
E	Insert landscaping along major transport corridors	75%	3.88	4	0.86	0.73	0.25
E	Reduce vehicle noise emissions	88%	4.03	4	0.73	0.53	0
E	Provide bus routes connecting environmentally attractive areas	69%	3.75	4	0.75	0.56	1
UD	Facilitate connections between centralities	100%	4.81	5	0.39	0.15	0
UD	Provide municipal and local services with lower fare	97%	4.44	4	0.56	0.31	1
UD	Implement bus corridors and lanes	100%	4.94	5	0.24	0.06	0
UD	Encourage transport-oriented development, in particular mixed-use densification	100%	4.66	5	0.47	0.23	1
UD	Integrate transport system with urban planning guidelines	100%	4.78	5	0.41	0.17	0

QS = Quality of service, G= governance, E= environment, UD = Integration with urban development

Appendix G – Narrowing down of barriers, round 2

Barriers	%
Low availability of resources to fund public transport infrastructure	25%
Low awareness of society regarding public transport importance	25%
Fear of loss of political power at municipal level	22%
Deficient metropolitan institutional structure	22%
Political decision-making, regardless of technical aspects	22%
Legal needs of approving a law and subsequent inter-federative agreements to enable the bidding of the new system	22%
Difficulty in maintaining permanent and qualified technical teams to consolidate the integration project	22%
Lack of public transport incentives policies	22%
Lack of understanding about the importance of public transport for urban development	19%
Possibility of non-adherence of municipalities in the project, harming integration	19%
Lack of political will, articulation and leadership by municipal and state managers	16%
Opposite private interests, in particular of current operators	16%
Lack of physical space for the implementation of BRT lanes, bus lanes, cycle paths and cycle lanes	16%
Compliance to individual interests without an integral view of urban and transport for the region	16%
Overlapping competences between involved institutions	16%
Demobilization of SUDERF during the process	16%
Difficult to afford the purchase of land and cost of integration terminals	13%
Resistance to the unknown and lack of boldness by managers and companies	13%
High concentration and pendularity of trips in the region	13%
Lack of leadership and State Government political interest in SUDERF	13%
Commissioned roles according to political interests with few technical capacity	13%
Public opinion focused on solutions relevant to the use of individual transport	13%
Current contract for public transport in Florianópolis, hindering their participation in the integrated system	13%
Low public engagement and participation in the design of the system	9%
Corruption	9%
Transport planning based on minimum supply, disregarding induced demand	9%
Low participation and integration of bodies involved (e.g. mayors, councillors, legislature, operators)	6%
Reconcile municipal and state government interests	6%
Lack of technical capacity to implement, operate and maintain the system.	6%
Lack of political interest due to the proximity of municipal elections in 2020	6%
Low understanding of the municipalities on the associated management model proposed	6%
Need to change urbanization / land use model	6%
Disagreement on the overlap of intercity lines with municipal ones in Florianópolis	6%
Insistence on not relying on subsidies, making it difficult to offer a high-quality system	6%
Conflicting views regarding the need for bus prioritization after additional traffic lane implementation of "Via Expressa" (major highway connecting Florianópolis with the region)	6%
Difficulty in offering good public transport to low density, poorly connected and single-function areas	3%
Definitions of tariff policy, bidding and routes	3%
Political misinformation regarding the importance of public and active transport actions	3%
Lack of multimodality studies	3%
Lack of urban planning institutes	3%
Contrary influences of the labour union	0%
Little attention to actual user demand	0%

Appendix H – Narrowing down of measures, round 2

Measures	%
Implement BRT corridors and bus lanes	44%
Institutionally, technically and financially strengthen SUDERF or the equivalent metropolitan agency	44%
Prioritize urban mobility on the region's political agenda	31%
Implement integration terminals (São José, Biguaçu, Palhoça)	31%
Allocate specific resources for public transport (e.g. state fund)	28%
Develop the Integrated Urban Development Plan, articulating different sectoral policies	28%
Implement an inter-federative governance model as foreseen in the Metropolis Statute, expanding political integration between Mayors and empowering organized civil society	25%
Commit political will and efforts in the implementation of public transport improvements	22%
Create greater engagement between State and Municipalities to promote consensus, placing metropolitan interest above individual ones	22%
Promote improvements in public transport (e.g. large supply, better vehicles) to attract more users	22%
Implement instruments to reorganize land use and urbanization	19%
Implement fare integration mechanisms	19%
Introduce subsidies to make the fare more attractive to the user	16%
Promote fare integration with other transport modes	16%
Give priority to public transport on "Via Expressa"	16%
Strengthen involved agencies (e.g. mobility departments) with technical staff	13%
Provide public transport tax incentives	9%
Resume public-private partnership model to fund public transport infrastructure	9%
Adopt transport demand management tools such as disincentives and externalities charging	9%
Consolidate and maintain technical staff to conduct further studies	9%
Demystify the viability of other modes, reinforcing the viability of buses	9%
Establish management council and consolidate associated management structure	6%
Mobilize and inform the population to demand metropolitan integration and other improvements in public transportation	6%
Reallocate resources among federative entities	6%
Initiate integration with alternative system using existing terminals	6%
Discuss metropolitan integration in committee at legislative assembly	6%
Study feasibility of other transport modes	6%
Pressure from population and control agencies in demanding an integrated bidding process	6%
Create structure of urban mobility discussions with community, managers and operators	3%
Encourage municipal managers by informing them of the advantages of integrating public transport	3%
Conduct audits on existing transport systems	3%
Inquire about political-institutional power relations in the municipalities	3%
Obey road system foreseen in City Plans	3%
Promote media communication about the importance of transport investments	0%