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## Article

# Experiences of innovation in public services for sustainable urban mobility

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## Research Article

## Experiences of innovation in public services for sustainable urban mobility

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## ABSTRACT

The article aims to analyze non-motorized transport initiatives by adopting the innovation-in-services approach based on multi-agents. We selected ten cases in the municipality of Sao Paulo, Brazil. Our findings identified innovations in the local context in the treatment of infrastructure for active mobility. These public services were introduced in a participatory process and a collective re-appropriation of urban space. Innovation is based on techniques and competences. The projects promote an expansion of the competences of service providers related to interactions with civil society, resulting in an integral perspective on the uses, local dynamics and behavioral issues of the users themselves. Service provider techniques are temporary and permanent intervention methodologies, and methodologies for project impact evaluation. These techniques are associated with tactical urbanism for temporary urban interventions. User techniques were identified to apply the propensity score-matching method, which aims to evaluate the impacts of an instance of intervention through the comparison of groups in addition to technical inspections and local interviews. The relationship management generated relational and organizational competences for civil society organizations. Therefore, public services for non-motorized transportation have a great deal of potential to shape innovations, following transformations intended for a sustainable urban mobility paradigm.

## 1. Introduction

In recent years, numerous studies have increasingly connected the two concepts of smart cities and sustainable cities, due to their interconnections and similar objectives (Ahvenniemi et al., 2017; Walletzky & Štěpánek, 2019; Caputo, Walletzky, & Štěpánek, 2019; Monfaredzadeh & Krueger, 2015). Nonetheless, there are many definitions of smart cities and, in many of them, this reflection on sustainability is not consensual (Meijer & Bolívar, 2016; Haarstad, 2017; Ahvenniemi et al., 2017). In summary, Meijer and Bolívar (2016) analysis shows that contemporary debates about smart city governance differ in their emphasis on smart technology, smart people or smart collaboration as the defining features of smart cities. In the same vein, according to Ahvenniemi (2017), there are two main streams in the smart city debate: a) an ICT and technology-oriented current, and 2) a people-oriented current. Within these currents, there are a number of dimensions addressed that range from the efficiency and technological advancement of the city's hard infrastructure (which includes transportation) through to infrastructure that focuses on people – that infrastructure in relation to social and human capital, knowledge, inclusion, participation, social innovation, and equity. Finally, the approaches and types of initiatives, in

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top-down and bottom-up modes (Ahvenniemi et al., 2017), are also contemplated. In our study, we propose to use the people-oriented stream and the bottom-up initiatives.

Given that achieving sustainability is a major challenge for modern cities, there is a need to better understand the relationship between smart city and sustainable city concepts. This achievement is also directly linked to the participation of society in influential choices relating to development and decision-making, also strengthening the legitimacy of urban governance (Monfaredzadeh & Krueger, 2015; Meijer & Bolívar, 2016). One important step in the direction of sustainable cities is the promotion of sustainable urban mobility, considered a big challenge in speedily urbanizing developing cities and generating severe health, economic, social and environmental issues. In addition, sustainable urban mobility encompasses a central role in the future of sustainable cities (Banister, 2008; 2011; Pojani & Stead, 2015; Larranaga et al., 2019; Zannat et al., 2020). The issue may best be solved through adequate mobility policies, programs and plans, using appropriate diagnostics, which require a broad knowledge of the population's travel patterns.

Mobility patterns depend especially upon urban forms and on the socioeconomic and cultural attributes of urban dwellers. Understanding the relationships between people; the use and occupation of land; the distribution of activities over territories; and the accessibility of different services, urban forms, functions and their connections; is a crucial factor toward achieving a sustainable city that uses and distributes its resources efficiently and equitably (Ahvenniemi et al., 2017; Haarstad, 2017). Within the context of mega-cities in developing countries, one of the central issues to address is sustainable urban expansion (Zhao, 2010), and we argue that this requires measures with a dual approach: of infrastructure and public services.

The Brazilian population made 65.3 billion trips in 2016 (ANTP, 2018). Walking and cycling accounted for the majority (43%), followed by individual motorized transport (cars and motorcycles, 29%) and public transport (28%). Therefore, a majority of Brazilians utilizes active and/or public modes of transport (ANTP, 2017).

More recently, the National Policy on Urban Mobility (NPUM) has defined guidelines that give priority to non-motorized forms of transport and to the collective public transport service. This is the first national law that addresses the issue of mobility with a more comprehensive approach, from a perspective of equity, sustainability and participation of society (ANTP, 2017). It achieves this through collegiate bodies, ombudsmen in those institutions responsible for the management of the NPUM, public hearings and consultations, and systematic procedures for communication – all aiming at evaluating user satisfaction, and improving public accountability (Brazil, 2012). However, despite the ambitious strategies outlined by the NPUM, positive results will rely on an interaction involving different bodies, institutions and individuals. In order to see effective transformation in urban mobility, a political effort to promote the integration of transport modes (Zannat et al., 2020) and improve governance processes will be essential (Lima et al., 2020).

The NPUM (Brazil, 2012) introduced as a principle the “priority of non-motorized forms of transport over motorized and collective public transport services over individual motorized transportation” and “mitigation of the environmental, social and economic costs of movements of people and cargo throughout the city” (Brazil, 2012, Section II, Art. 6°, II). When analyzing the Brazilian regulatory framework at different government levels, it is clear that the priority for active mobility is guaranteed; however, there are few tools available to provide practical results in the qualification of active mobility networks connected to collective public transport. In this manner, we argue that the relationship between sustainable urban mobility and active transport sets up huge challenges for public service provision.

Active mobility (non-motorized transport) is defined as travel on foot, by bicycle, by wheelchair, or through any other means of transport that is achieved using human propulsion. In addition to contributing to environmental improvement, it offers a series of physical, emotional and social welfare benefits (Shi, 2019). When combined with public transport in large cities, active commuting is also a strategy for combating some of humanity's great challenges related to the environment, especially with regard to climate change, and air and noise pollution. Thus, active mobility plays a fundamental role in achieving sustainable urban mobility (Appolloni et al., 2019; Pojani & Stead, 2015; Larranaga et al., 2019).

Walking is the main form of transport that connects the population to all other means of transport, and precisely because walking is, in general, evaluated as an auxiliary to other modes of transport, it is often underestimated in the simulation or planning of transport systems. If pedestrians are users of public transport – every journey begins and ends on foot (Appolloni et al., 2019), then it is necessary to ensure safe routes for access to that public transport. They are also users of the public road space; thus, areas near to public transport stations have a high flow of pedestrians, which emphasizes the importance of public services in the provision of qualified sidewalks or pavements for users, according to demand. Cyclists must also have guaranteed access to road space and public transport, so it is essential to plan cycling services aligned with public transport, provided with well-connected cycling routes.

Despite the importance of active mobility in Brazil and other emerging/developing countries, the infrastructure and services related to non-motorized transport are neglected in policymaking, leading to poor infrastructure and characteristics of services. We suggest that the introduction of services for the requalification of urban space, connecting active mobility and public transport, is associated with favorable conditions for walking and cycling, and the innovation-in-public-services approach can contribute toward a better understanding of this phenomenon.

Non-technological innovations – organizational, relational, and social, among others (Djellal & Gallouj, 2013; Desmarchelier et al., 2019) – play a relevant role in innovation in public service. Also, demographic contextual variables must be considered to analyze innovation in public service, taking into account, beyond the social aspects, the cultural, educational, political circumstances that they are embedded (Demircioglu, 2020).

This study employs a broad perspective to explain innovation in services, providing a global framework, taking into account technological and non-technological innovations and considering all agents involved in the service. The paper focuses on the following research questions: What are the factors that support the innovation in active mobility services - new, improved or modified? How do the stakeholders involved, in the multi-agent context that the initiatives studied are embedded, act in the process of acquiring and using the competences and techniques required for service innovation? The proposed analysis applies the characteristics-based model,



representing an innovation in terms of service characteristics, and adopting it as a multi-agent approach (Windrum & Garcia-Goñi, 2008; Gallouj & Weinstein, 1997).

### 1.1. Theoretical approach

Studies on the logic of services bring a new perspective, related to the satisfaction of the specific desires, skills, knowledge and capabilities of agents (public, private and users) as an instrument to develop more efficient, effective and appropriate solutions. The adoption of a service logic considers that several stakeholders are committed to creating value, together with the search for sustainability. In this direction, a new logic is proposed where it is possible to go beyond the traditional view, with a more comprehensive perspective, better adapted to understand the logic and dynamics of socio-environmental evolutions. Along these lines, frameworks emerge that present collaborative approaches, focusing on the ways in which actors interact and enable systems in which the satisfaction of actors links to collective satisfaction (Polese et al., 2018). In line with this innovation-in-services perspective, it is key that new service-based solutions attain the sustainable development goals (SDG) of Agenda 2030 (Cruz et al., 2017; Calabrese et al., 2018a; 2018b).

Innovation commonly links to urban issues through ‘smart cities.’ This definition is based on communication technologies for the transformation and improvement of availability and quality of infrastructure and services, reducing the gap between government and citizens (e-democracy, e-government/digital government), and between the standards of organization, learning, and management of infrastructures for all actors, with sustainable development as a background (Lima et al., 2020; Ahvenniemi et al., 2017; Haarstad, 2017). The definition of smart cities focused on technological aspects has been criticized by several researchers (Caputo, Wallezky, & Štěpánek, 2019; Ahvenniemi et al., 2017; Haarstad, 2017; Monfaredzadeh & Krueger, 2015), since the concept of smart cities is rather broad and describes various perspectives (environmental, social and economic). However, precisely because of this broad perspective, there is no agreement about the principles that ought to be considered in order to develop smarter and sustainable cities (Guedes et al., 2018; Polese et al., 2018).

From the social and organizational perspective of the term, it is considered that a ‘smart city’ is a human one, and the focus of attention is on the specific domain of the city as a complex of shared resources, knowledge, skills and capabilities, which act to build paths and collaborative conditions for collective satisfaction, not only providing quality of life but also encompassing participation in city planning, establishing a transparent and democratic governance model, with accountability. In this sense, it may be said out that the people involved and their knowledge bases (Monfaredzadeh & Krueger, 2015; Haarstad, 2017; Caputo, Wallezky, & Štěpánek, 2019) provide smart solutions. The ecological perspective, on the other hand, focuses on reducing GHG emissions, increasing green spaces, and polycentric planning and development.

Thus, beyond technological aspects, the people and needs communities are contemplated and recognized – communities that use data and information technology to achieve more efficient services, monitor and optimize existing infrastructures, and increase collaboration between different actors, in both private and public sectors (Ahvenniemi et al., 2017; Haarstad, 2017).

These perspectives stem from an intention to improve citizen quality of life, generating impacts not only restricted to environmental sustainability targets but also to wellbeing. This in turn is linked to sustainable urban mobility, the promotion of active mobility, and the connection of these transport modes to the use of public transport – in line with the Stockholm Declaration (UN, 2020). In this context, ‘smart’ and ‘sustainable’ must be strongly connected, both being targets of the same paradigm shift (Lyons, 2018; Polese et al., 2018).

In the same vein, the incorporation of a broader innovation approach is required for exploring opportunities of innovation in services that address sustainable urban mobility issues, including strategies for innovation itself. This topic is a major driver of innovation and confirms that its influences, far beyond the traditional concept of competitiveness, also include environmental and social problems (Stare, 2013; Cruz et al., 2017). It is a complex, multiform, systemic and often conflicting issue (Djellal & Gallouj, 2013). We cannot then resolve it through a single actor: innovation in services, by definition, bases itself on interactions between different actors (Polese et al., 2018; Stare, 2013).

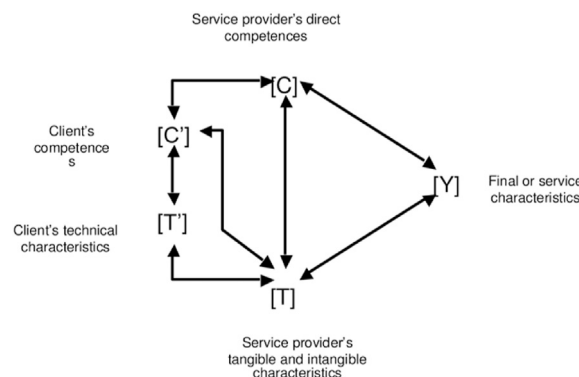


Fig. 1. The product as a conjunction of vectors of characteristics and competences (characteristics-based approach).

Source: Djellal et al. (2013).



Authors have shown that the challenges are even greater within contexts of developing and emerging economies, in a situation substantially marked by a bias towards technological innovation (Stare, 2013; Cruz & Paulino, 2019). In emerging economies, public services demand innovation not only in terms of efficiency gains, but also in terms of transparency and responsiveness to their users' needs (Mohnen & Stare, 2013; Cruz et al., 2017; Cruz & Paulino, 2019).

The theoretical approach of innovation in services used in this paper, in accordance to Gallouj and Weinstein (1997), proposes that a service can be defined as, and composed of, the mobilization of internal or external competences, and internal or external techniques (tangible or intangible), to produce the final characteristics of the product (goods or services) (Gallouj & Weinstein, 1997; Gallouj, 2002; Gallouj & Savona, 2010). More recently, Djellal et al. (2013) have added vectors to the model in order to better integrate the different agents, especially in the cases studied, where the users are considered as associations of civil society that represent interests in the issue of active mobility (Fig. 01).

The quality of a good or service is the result of a set of competences held by providers/producers and users. The competences of service providers divide into back office competences and user-facing competences – or competences that are required in the interaction with users (Windrum & Garcia-Goni, 2008; Clausen et al., 2020). Network-based innovations are a particular configuration of organizational innovation, reflecting the idea that the constitution of the network alone can already be considered as the main purpose of innovation (Djellal et al., 2013). However, in order to act within this new conformation, it also requires the development of competences in the public sector aimed at extending its organizational boundaries, and aimed also at adopting some of the practices and cultural characteristics of its collaborative partners. These changes imply the need to develop a different composition of communication, coordination, and governance.

We then explored these sets of obtained data in order to identify the following topics: project descriptions; changes in services before and after implementation of initiatives; participation of stakeholders; stakeholders involved; development of new technologies and methodologies relevant to active mobility; technical training; new competences and techniques acquired; and environmental improvements.

## 1.2. Research context

With a view to bridging the contextualized gap in the previous topics, the present paper aims to analyze active transport experiences in the city of Sao Paulo by adopting the innovation-in-services approach, based on multi-agents (Djellal et al., 2013). The aforementioned megacity is the largest in Brazil and one of the first in the country to implement interventions focused on active transport. The city

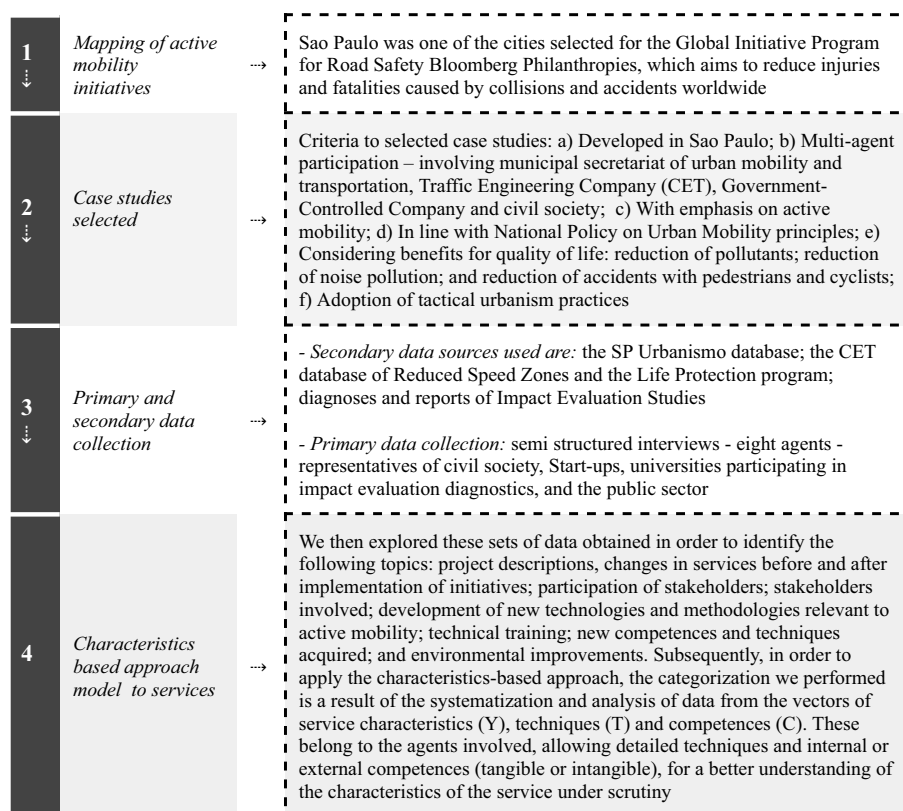


Fig. 2. Research methodology steps.

Source: the authors.



has about 12.5 million inhabitants (IBGE, 2019) and 9.1 million cars, bikes, buses and trucks, which means 7.3 motor vehicles for every 10 inhabitants (Detran, 2019). In Sao Paulo, despite taking only 30% of passengers, cars are responsible for 73% of GHG emissions (IEMA, 2017). In addition to pollutant gas emissions, the excessive and poorly planned use of private motorized transport also over occupies urban space on the roads and in parking spaces, causing degradation to the quality of urban vitality (Barczak & Duarte, 2012). While the individual motorized transport fleet continues to increase, investments in the improvement of urban mobility services – especially in high-capacity public transport – are still insufficient to meet the demand for travel in the city and its metropolitan region.

Since 2011, Sao Paulo has been implementing road safety policies and projects through various programs. We selected ten cases in the city, relating to four initiatives, below.

1. *Reduced Speed Zones*: aims to improve road safety for vulnerable users, pedestrians and cyclists, reducing injuries and improving environmental quality; a perimeter is defined where the maximum speed allowed is 40 km/h.
2. *Complete Streets*: aims for the equitable distribution of space, which should ideally provide security and comfort to every person, of any age, using every means of transportation.
3. *Public Space Activation*: aims to improve the social, environmental and economic functionality of public spaces, considering the issues connected to active mobility to be fundamental.
4. *Safe Routes to School*: aims to reduce the risk of injury and death in children near schools on the outskirts of the city.

The ten cases aim to improve road safety conditions, non-motorized transport, and access to public transport, and possibly may be able to contribute to the reduction of noise levels, improvement of air quality and reduction of GHG emissions. The remainder of this paper follows this sequence: Section 2 focuses on the methodology used, Section 3 displays the results, and finally, our conclusions appear in Section 4.

## 2. Methodology

For the data collection, the research methodology is spatiotemporally restricted to Sao Paulo within a period from 2015 (due to the Sao Paulo Mobility Plan) until Nov 2019. It bases itself on four steps (see Fig. 2).

Firstly, we mapped out the initiatives in Sao Paulo (Table 1).

According to the criteria, the 10 selected initiatives are (Table 2):

In the context addressed, the stakeholders were City Hall, represented by the Municipal Secretariat for Mobility and Transport; the Traffic Engineering Company, CET; and civil society related to the selected cases.

The secondary data sources used were the SP Urbanism database; the CET database of Reduced Speed Zones and the Life Protection program; diagnoses and reports of Impact Evaluation Studies; and reports from Nacto, Metropole 1:1, Cidade Ativa and ITDP.

**Table 1**

Mapping of initiatives in the city of Sao Paulo.

<i>Public Space Activation</i> – Centro Aberto program	Implementation	Location	Tactical urbanism
Sao Joao Ave. and Largo Paissandu	Oct/2014	Center	Yes
Largo Sao Francisco, and Ouvidor Pacheco and Silva Square	Oct/2014	Center	Yes
Largo Sao Bento	Sep/16	Center	Yes
Galvao Bueno St.	Nov/16	Center	Yes
Largo General Osorio	Dec/16	Center	Yes
<i>Reduced Speed Zone</i> program	Implementation	Location	Tactical urbanism
Bela Vista	Apr/2016	Center	No
City center – 1st Phase	Oct/2013	Center	No
City center – 2nd Phase	Dec/2014	Center	No
Consolação	Jun/2015	Center	No
Lapa – 1st Phase	Sep/2014	West	No
Lapa – 2nd Phase	Mar/2015	West	No
Santana	Sep/2014	North	Yes
Moema – 1st Phase	Nov/2014	South	No
Moema – 2nd Phase	Nov/2014	South	No
Penha	Dec/2014	East	No
Bras	Feb/2015	East	No
Sao Miguel Paulista	Sep/2015	East	Yes
Caminhar Pinheiros	Nov/2018	West	Yes
<i>Complete Street</i> program	Implementation	Location	Tactical urbanism
Joel Carlos Borges	Sep/2017	South	Yes
<i>Safe Routes to School</i> program	Implementation	Location	Tactical urbanism
Jose Bonifacio	May/2018	East	Yes
Jardim Nakamura		Jun/2019 South	Yes

Source: the authors.



**Table 2**

Initiatives and clarifications for selection.

Type	Initiative	Clarification
Activation of Public Spaces	Centro Aberto Program: 05 initiatives	Pioneering experiment in the application of tactical urbanism practices in Sao Paulo
Reduced Speed Zone	Santana	Experiment evolved from temporary to permanent intervention step
Reduced Speed Zone	Sao Miguel Paulista	Incident in street with the highest number of pedestrian deaths in the city
Reduced Speed Zone	Caminhar Pinheiros	Experiment led to the permanent reduction of local speed limits
Complete Street	Joel Carlos Borges	Unique Complete Street initiative for the city
Safe Route to School	José Bonifácio	Unique Safe Route to School initiative with data available for public access

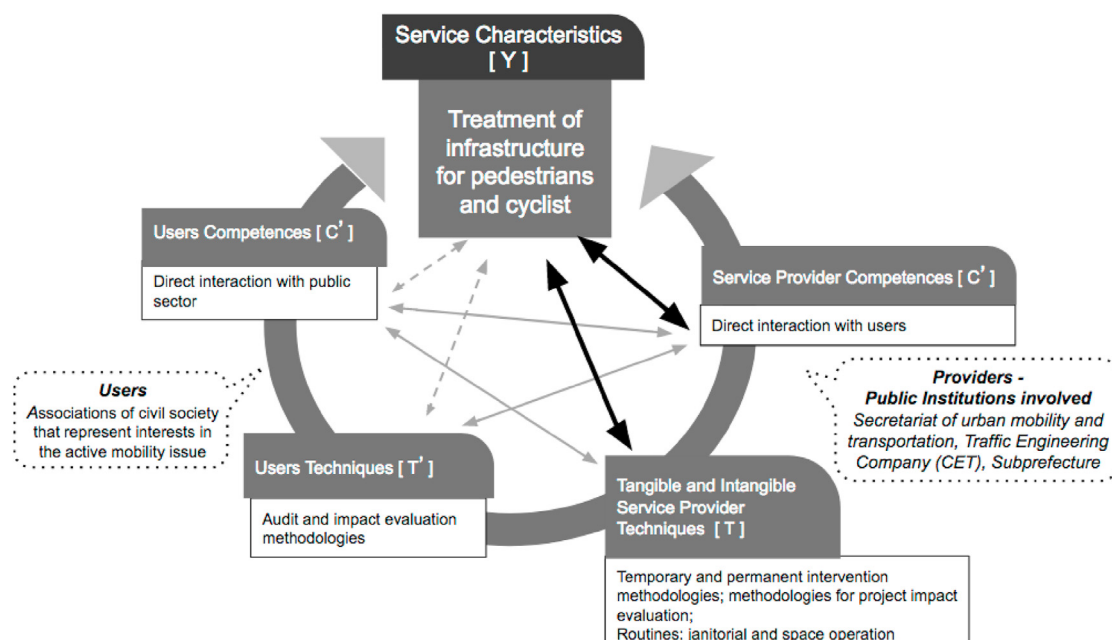
Source: the authors.

Essentially, the reports on interventions (2005–2019) provide information about workshops, engagement with stakeholders, post-intervention impact evaluation, design of interventions, and materials used (in-event, temporary and permanent actions). For the primary data collection, eight agents were asked to complete semi-structured interviews: representatives of civil society (WRI, ITDP and Bloomberg), Start-ups (Urb-i), universities participating in impact evaluation diagnostics (FGV and LabMob/UFRJ), and the public sector (Secretariat of Urban Mobility). The semi-structured questionnaires were filled out by face-to-face interviews conducted with the key actors. The average time for each interview was 90 min. In addition to the questionnaires, the interviewees provided project-related materials (field reports, images, impact evaluations, results of field interviews with users and local community). Subsequently, in order to apply the characteristics-based approach, the categorization performed is a result of the systematization and analysis of data from the vectors of service characteristics (Y), techniques (T) and competences (C).

### 3. Interpreting the characteristics of innovation in active mobility services

Relationship management linked to the analysis of the influence of actors that compose the city as a social group is considered as a potential driver for more intelligent and sustainable cities (Guedes et al., 2018; Ahvenniemi et al., 2017; Haarstad, 2017). When it comes to innovation in services provided by the public sector, as in the case of urban mobility services, efforts must be made to understand the relationship between service provider and service user. In the context of developing and emerging economies, in a situation substantially marked by information asymmetry, lack of accountability, transparency and responsiveness to user needs, the challenges are even greater; for example, negotiating conditions, responsibilities, empowerment, and linkages between agents from different sectors all vary widely (Polese et al., 2018). In this manner, in the adapted model, we propose an alternative representation of the arrows of each agent to the service vector, which demonstrates what happens in practice – until now the incidence of users and the public sector in the service vector has occurred unevenly.

Fig. 3 shows the characteristics of public services, in the cases studied, using the characteristics-based model for the interpretation of innovation in services adapted to the cases studied. In this adaptation – beyond the differentiation of arrows – users appear as the

**Fig. 3.** The characteristics-based approach model – adapted to the cases studied.

Source: the authors.



associations of civil society that represent interests in the active mobility issue, the providers as the public Institutions involved in the initiatives – Secretariat of Urban Mobility and Transportation, Traffic Engineering Company (CET), and Sub-prefectures.

Innovation in services is explained as an outcome of competences and techniques of service providers and users (Gallouj & Weinstein, 1997; Windrum & Garcia-Goni, 2008; Gallouj & Savona, 2010; Desmarchelier et al., 2019). Service provider competences (C) and users (C') relate to knowledge (theoretical and practical) and routines, which may be scientific, technical, operational or relational. The (T) service provider techniques and (T') users refer to tangible (computers, machinery, equipment, and other infrastructure items) or intangible (mathematical methods, working methods) techniques (Gallouj & Weinstein, 1997; Gallouj, 2002; Gallouj & Savona, 2010). The vectors, in our research context, are summarized in Table 3 below.

#### a) The service characteristics vector (Y) of active mobility

Innovation in the local context is presented in the service characteristics vector (Y). We identified the introduction of new features in public services of infrastructure treatments for pedestrians and cyclists. These aimed at the maintenance and re-qualification of infrastructure for walking, cycling and integration with public transport, covering the following aspects: sidewalks; crossings; accessibility; horizontal and vertical signaling in public spaces; traffic light systems suitable for non-motorized transport; and traffic moderation. In order to generate an improvement in the level of service quality, the initiatives studied sought to increase safety and comfort for pedestrians by reducing speed, redesigning and expanding sidewalks, and in the case of the Centro Aberto Program, connecting with bike paths. From this program, we additionally verified the possibility of improving the environmental quality of public spaces with a comfortable environment and low noise levels, positively affecting length of permanence and the manner in which people use the city, giving priority to the circulation of public transport users, pedestrians, and cyclists (cyclists restricted to the Centro Aberto program) (SMUL, 2015; 2017a; 2017b; 2017c; 2017d; 2017e).

The planning and development of public policies is considered as a potential driver to transform the city into a more intelligent and sustainable place (Guedes et al., 2018; Ahvenniemi et al., 2017; Haarstad, 2017; Caputo, Walletzky, & Štěpánek, 2019), taking into account multimodal transport (individual and collective), and prioritizing active modes of transport over motorized and collective modes over individual. Advances in the regulatory framework explicitly point to a contribution toward: sustainable development; equity in citizens' access to collective public transport; equity in the use of public spaces for circulation, roads and public areas; the prioritizing of non-motorized modes of transport over motorized and collective public transport over individual; the reduction of environmental, social and economic impacts of movement of people and cargo within urban spaces; encouragement of scientific and technological development; and the use of renewable and less-polluting energy, amongst others. Fig. 4 shows the integration of the active mobility initiatives studied in the recent regulatory framework for urban mobility.

By analyzing Fig. 4 it is possible to establish the relationship that the more local (municipal) the public policy, the greater its social

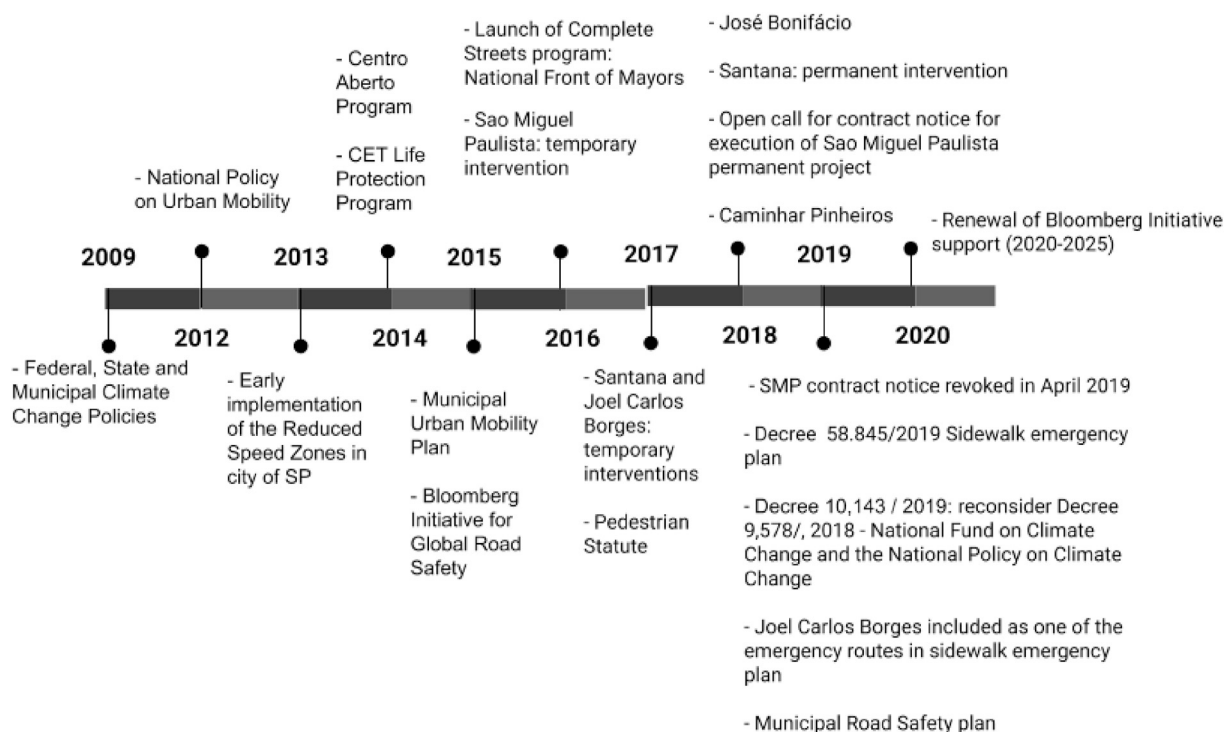


Fig. 4. Timeline for initiatives and regulatory frameworks.  
Source: the authors.



**Table 3**

Service providers and users – technique (T) and competence (C) vectors.

	Competences (C)	Techniques (T)
<b>Service provider</b>	<ul style="list-style-type: none"> <li>- Articulation and engagement process: the development of training workshops and collection of ideas</li> <li>- Direct interaction with users: interaction channels are opened; this may contribute to an exchange of heterogeneous information and tacit and non-tacit knowledge.</li> <li>- Development of training workshops and collection of ideas.</li> <li>- Interactions were more complete, including a greater diversity of agents in cases where there was a space for training, discussion and exchange of experiences led by civil society, with government support</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction of tactical urbanism practices: short-term and low-cost interventions aim to promote grassroots restructuring, in a participatory approach, towards the re-appropriation of urban spaces by their own users</li> <li>- Methodologies for project impact evaluation: projects go beyond the CET ‘business as usual’ approach (volumetric counts, signaling and road operation). With regard to the counting method, CET traditionally performs pedestrian and vehicular volumetric counts. <i>Ex-ante</i> and <i>ex-post</i> interviews occur in temporary and permanent interventions in order to evaluate user perceptions regarding the redesign of road geometry, safety and comfort, interference in user displacements, and economic impacts on the local market</li> </ul>
<b>Users</b>	<p><b>Competences (C’)</b></p> <ul style="list-style-type: none"> <li>- Direct interaction with the public sector: the protagonism of civil society, related to the cases studied, is highlighted through working together to develop the temporary intervention project; through analysis, along with municipal bodies, of those sites that might receive temporary intervention; and holding workshops with the community (general users)</li> </ul>	<p><b>Techniques (T’)</b></p> <ul style="list-style-type: none"> <li>- Audit: gather data through local interviews, perform technical inspections with measurements of flows of people, permanence activities, road safety, waste management issues, furniture, and project perceptions. This survey tool also permits user engagement, thus rendering quantitative and qualitative information on local public life accessible.</li> <li>- Impact evaluation methodologies: propensity score-matching method, which aims to evaluate the impacts of an intervention through the comparison of groups. The group that receives the intervention (factual) and the group that remains unchanged (counterfactual)</li> </ul>

Source: the authors.



**Table 4**

BIGRS selected cities: temporal urban design strategies.

Country	City	Temporal urban design strategies	Year of implementation
Ghana	Accra	Lapaz intersection	2018
Ethiopia	Addis Ababa	Le Gare	2016
Indonesia	Bandung	Cikudapateuh intersection	2019
Thailand	Bangkok	Asoke Montri; Yaowarat; Silom	2017
Colombia	Bogota	Plazoleta Plaza and Calle 80 programs, among others	2016
Vietnam	Ho Chi Minh City	–	–
India	Mumbai	Mithchowki intersection	2017
Brazil	Sao Paulo	Jose Bonifacio	2018
Brazil	Sao Paulo	Jardim Nakamura	2019
Brazil	Sao Paulo	Penha	2019
Brazil	Sao Paulo	Caminhar Pinheiros	2019
Brazil	Sao Paulo	São Miguel Paulista	2016
Brazil	Sao Paulo	Santana	2018
Brazil	Sao Paulo	Joel Carlos Borges	2017
Brazil	Sao Paulo	Centro Aberto Program	2015
Brazil	Fortaleza	Zone 30 of Rodolfo Teófilo; Dragão do Mar	2018
China	Shanghai	Nanjing road, Huangpu district	2016

Source: the authors.

influence and participation. We can highlight concrete examples, such as the municipal Urban Mobility Plan, the Pedestrian Statute, creation of the walking mobility thematic chamber at the municipal council, as well as the active mobility initiatives studied, developed through cooperation agreements with City Hall. The evolution of the regulatory framework is relatively recent, additionally opening up opportunities for innovation in pedestrian mobility public services (service characteristics). The competence and technique vectors of stakeholders appear in the upcoming topics.

#### b) Service provider competences vector (*C*)

The *service provider competences (C)* highlighted are fundamentally the result of direct interactions between public agencies and civil society organizations. Once interaction channels are opened, this can contribute to an exchange of heterogeneous information, and tacit and non-tacit knowledge (Djellal & Gallouj, 2013; Desmarchelier et al., 2019). In order to make the adoption of tactical urban practices feasible, in the cases studied, the development of new competences followed the implementation of projects. Windrum and Garcia-Goñi

**Table 5**

Characterization of cases with tactical urbanism techniques.

Case	Historical	Urban Mobility Services	Tactical Urbanism Interventions
<b>Centro Aberto Program</b>	Implementation: 2014 Temporary and permanent interventions: from Oct. 2014 to Dec. 2016	Metro station and a bus terminal. There are also cycle lanes, bicycle sharing system, bike racks and pedestrian zones	Installations of wooden decks with different permanent activities; removal of parking spaces; pedestrian tracks; extension of sidewalks and interfaces with bicycle lanes; free Wi-Fi; public toilets; new pedestrian lanes; improvement of public lighting
<b>Santana</b>	Implementation: 2014 Temporary intervention: 2017 Permanent intervention: 2018	A metro station and a bus terminal. In total, there are 87 bus lines running on almost every surrounding street. There are also three sections of cycle paths	Micro-roundabout; reduction of corner radii; sidewalk extension; narrowing of traffic/moving lane
<b>Sao Miguel Paulista</b>	Implementation: 2015 Temporary intervention: 2016 Permanent intervention: has not occurred	A train station and more than 50 municipal bus lines passing through the surroundings	Sidewalk extensions; mini plazas; narrowing of traffic/moving lane; crosswalk
<b>Joel Carlos Borges</b>	Implementation, temporary and permanent interventions: 2017	A train station and municipal bus lines passing through the surroundings	Sidewalk extensions; narrow traffic/moving lane; maximum speed reduced to 20 km/h
<b>Caminhar Pinheiros</b>	Implementation and temporary intervention: 2018 Permanent intervention: has not occurred	A metro station and part of the street with a cycle lane and bicycle sharing system; proximity to a bus lane	Rotating parking spaces painted to be transformed into new areas for pedestrian circulation; maximum speed reduced from 50 km/h to 40 km/h during the temporary intervention (and remained as a permanent measure)
<b>Jose Bonifacio</b>	Implementation and temporary intervention: May 2018 Permanent intervention: Sep. 2018	Municipal bus lines passing through the surroundings	Micro-roundabout; offset curb extensions/chicane; sidewalk extensions; narrow traffic/moving lane; new crosswalk; maximum speed was reduced from 40 km/h to 30 km/h during the temporary intervention (and remained after, as a permanent measure)

Source: the authors.



**Table 6**

The stakeholder engagement process.

Initiatives		Activation of Public Space	Reduced Speed Zone			Complete Street	Safe Route to School
Stakeholder engagement process		Centro Aberto Program	Sao Miguel Paulista	Santana	Caminhar Pinheiros	Joel Carlos Borges	Jose Bonifacio
Meeting/Workshop (year of event)		2013	2016	2017	2019	–	2018
Protagonism		Public Sector	Civil Society	Civil Society	Civil Society	Civil Society	Public Sector
Supported by		Public Sector	Public Sector	Public Sector	Public Sector	Public Sector	Civil Society
Engagement process		Workshop	Open meeting and workshop	Open meeting	Public Hearing	Data collection in loco, in 2017	Data collection at schools and Open meeting, in 2018
Actors/ Participants	Civil society	X	X	x	x	–	x
	Merchants	–	X	x	x	–	–
	Local users/ visitors	–	X	x	x	–	–
	Residents	–	X	x	x	–	x
	Experts/ technicians	X	X	x	x	–	x

Source: the authors.

(2008), Gallouj and Savona (2010) and Desmarchelier et al. (2019) have emphasized the importance of innovation in services for various links and feedback among the public and private sectors, and users. The development of training workshops and collection of ideas, in some cases, and the attempt to establish new communication channels with users of temporary interventions, in all cases, propose to test the transformation of public spaces and to collect data about the perception of users related to proposed projects (Mohnen & Stare, 2013; Cruz et al., 2017). Workshops were coordinated by civil society organizations, with public sector support, with the exception of Centro Aberto, Caminhar Pinheiros, Joel Carlos Borges and Jose Bonifacio. The Centro Aberto was coordinated and supported by the public sector; in Caminhar Pinheiros, Jose Carlos Borges, and Jose Bonifacio – where there was no specific workshop/meeting to discuss the initiatives – we consider that the query conducted after the intervention, in contrast to the other projects, created a more abrasive acceptance process. At Jose Bonifacio, despite the presence of civil society organizations, a greater role was played by the public sector in the articulation and engagement process. In the case of Caminhar Pinheiros, there occurred a debate about the initiative at a Public Hearing (Pinheiros Regional Government) only after the intervention, making the process of acceptance and transformation more attritional in comparison to the other case studies.

### c) Service provider techniques (T)

The *service provider techniques (T)* relate to the introduction of tactical urbanism practices, methodologies for project impact evaluation; and routines: janitorial and space operation.

Tactical urbanism allows us to test places for different uses; subsequently, these places may receive permanent intervention. These short-term and low cost interventions aim to promote grassroots restructuring, in a participatory approach, towards the re-appropriation of urban spaces by their own users, in line also with the broad view of innovation in services, which extends potential forms of participation toward specific actors. This, for example, could comprise the participation of NGOs and civil society in decision-making, consultation and other involvement processes (Gallouj & Savona, 2010; Cruz et al., 2017a, 2017b).

Over the last few decades, the use of temporal urban design strategies (tactical urbanism) has been on the rise in the larger cities of developing countries. The municipality of Sao Paulo is a city of this type, and it is important to understand how tactical urbanism manifests in each local context. The Bloomberg Initiative for Global Road Safety (BIGRS), launched in 2015, seeks to improve road safety in ten cities around the world (Accra, Addis Ababa, Bandung, Bangkok, Bogota, Fortaleza, Ho Chi Minh City, Mumbai, Sao Paulo, and Shanghai), using temporal urban design strategies to achieve its goals (Table 4).

Tactical urbanism interventions encompass small-scale and short-term urban projects, meant to inspire long-term transformation with the purpose of recovering urban spaces, mainly through the engagement with, and participation of, civil society (Lydon & Garcia, 2015; Cloutier et al., 2018). Cloutier et al. (2018) show that communities want to engage and collaborate with the transformation of the urban environment, legitimating a certain amount of interference with public spaces with a view to improving their quality. A collaborative rather than confrontational approach, through spaces for citizen participation and engagement, it aims to contribute towards building bridges between a society and its city. This procedure aims to promote and improve efficiency and sustainability in the supply of public services, since it can prime these services toward their users' needs (Polese et al., 2018; Gallouj & Savona, 2010). In general, tactical urbanism organizes itself into observational stages of current uses – behavioral observation of users and space dynamics – contemplating measurements and counts of traffic, pedestrians and cyclists.

Service provider techniques are also a methodology for project impact evaluation and routines: janitorial and space operations. The projects exceed the CET 'business as usual' approach (volumetric counts, signaling and road operation). With regard to the counting method, CET traditionally performs pedestrian and vehicular volumetric counts.

In the cases studied, the applied urban reading methodology directs towards the collection and analysis of data from the shape of



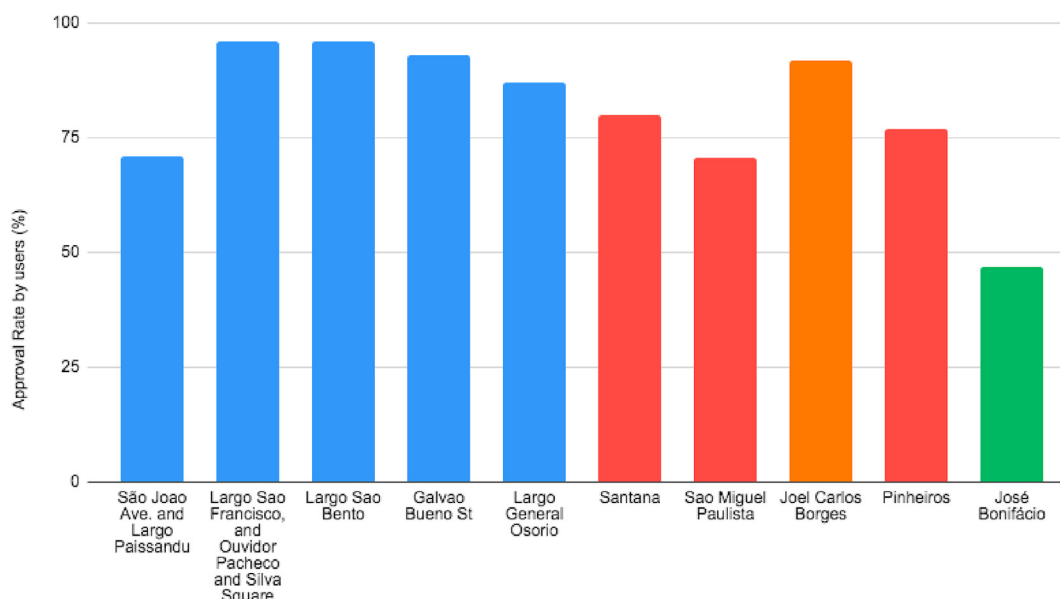


Fig. 5. User approval rates (%) for initiatives.

Source: the authors.

public spaces and the way in which people use them. The methodology thus goes beyond the quantitative scope, also performing geometric surveys; mapping of permanence activities; and behavioral observations, such as crossings made inside and outside the pedestrian range, or pedestrians leaving the sidewalk at bottlenecks. In addition, *ex-ante* and *ex-post* interviews occur in temporary and permanent interventions in order to evaluate user perceptions regarding the redesign of road geometry, safety and comfort, interference in user displacements and economic impacts on the local market. The urban reading method thus allows a systemic view of the place (Gehl, 2010), ensuring that the main aspects that need to be reformed, adapted or constructed are identified and analyzed, and also enhanced by tactical urbanism techniques.

With regard to the practical knowledge of service providers (T), and specifically for the Centro Aberto program, due to the program's characteristic fixed elements and other elements that change according to users, a specific activity was developed of janitorial and space operation that also involves maintenance and conservation, ensuring that the place and its equipment are clean and well maintained. In relation to routines, the monitoring work, besides providing information about the Program, encompasses the operations of provision, use, and loan guidance of portable furniture. This dynamic may change or introduce new procedures, affecting routines, processes and operations.

#### d) Users competences (C')

*User competences (C')* (represented by civil society organizations) are related to interactions established with the public sector. From the criteria adopted, we selected the following cases: a Reduced Speed Zone (Sao Miguel Paulista and Santana), and a Complete Street (Joel Carlos Borges). The cases (Tables 5 and 6) show the multi-agent perspective and key stakeholders involved in the initiatives, as well as how the participation of civil society and the surrounding community occurred in each case.

In the cases studied, associations of civil society that represent interests in the active mobility issue play an important role in shaping the model, based on characteristics for the interpretation of innovation in services. The protagonism of civil society, related to the cases studied, is highlighted by working together to develop the temporary intervention project; analyzing, along with municipal bodies, those sites that might receive temporary intervention; and holding workshops with the community (general users).

In general, it was reported that the relationship between the parties involved was complex, and at times, attritional, which is a common and challenging issue in groups encompassing different actors, who occasionally may seem to disagree. This relationship management generated relational and organizational competences for the proponent organizations (Djellal & Gallouj, 2013; Gallouj & Savona, 2010).

The experience gained through these interventions resulted in a closer relationship with CET-SP technicians, increasing the engagement and understanding of organizational mandates and the recognition of the technical capacity of the teams involved, which can be observed, in particular, in the Jose Bonifacio case. However, even with the indications, it is not a consensus among users that new relational or organizational competences were developed. It is also highlighted that the proponent organizational teams have less operational experience than CET, and during the implementation of temporary intervention, they were able to strengthen their technical and operational capacities (Gallouj & Weinstein, 1997) with CET-SP technicians, responsible for the projects' implementation. The multi-agent service model endorses the development of mutuality and synergies among the actors, each with particular goals and



competences (Windrum & Garcia-Goñi, 2008; Gallouj & Savona, 2010; Polese et al., 2018). The interventions were also an opportune time to increase the documentation of the processes (images and research), which must be consistent.

Specifically, for each initiative, the interactions carried out by civil society and the surrounding community occurred as follows (Table 6).

From an analysis of Table 6, it is verifiable that interactions were more complete – including having a greater diversity of agents in cases where there was space for training, discussion and exchange of experiences led by civil society – with government support.

Workshops were held with the goal of raising awareness of problems and potentials in the initiative's region, taking into account a heterogeneity of participants and ensuring that everyone was involved in the debate. The presence of experts and technicians was called upon to collaborate with the urban requalification project and road safety, identifying priorities and demands for the local surroundings around intervention points. Efforts of engagement from residents of, and visitors to, the neighborhoods also aimed to broaden understanding of road safety, urban design and traffic calming. In Caminhar Pinheiros, Jose Carlos Borges and Jose Bonifacio, where there occurred no specific workshop/meeting to discuss the initiatives, and/or that did not consider a great variety of stakeholders, in contrast to other projects, we consider that queries conducted after the intervention created a more abrasive acceptance process.

Caminhar Pinheiros was discussed at the Participative Council of Pinheiros and debated at a public hearing in the Pinheiros Regional Government, and discussions with merchants and residents highlighted that there was no consensus on maintaining the extended sidewalk lanes with furniture on the road. In Joel Carlos Borges, the idea of holding workshops with the community arose in 2017, before the implementation of a temporary project, with the purpose of informing the population about said intervention and collecting suggestions. The project went ahead without clear communication with the local population. Questionnaires were applied in November 2017, having the goal of investigating perceptions and evaluations from street traders and local users on the impact of the Complete Street project; as a complement, it had the aim of investigating the transportation and consumption habits of people accessing the street. In Jose Bonifacio, questionnaires were applied at state schools, by the public sector, in 2018, supported by ITDP Brazil, the Bloomberg Initiative, and NACTO. There is still a need, however, to provide a participatory workshop within the community surrounding the Jose Bonifacio housing complex, to identify suggestions for changes to occur at the site. Despite the presence of civil society organizations that also supported other cases selected for the research, it is noteworthy that in Jose Bonifacio there was a greater role of the public sector in this process, regarding the engagement and the use of tactical urbanism as a testing step for the project.

As a result of interactions conducted by civil society and the surrounding community, and regarding the approval rates of users (%) with regard to the initiatives, see Fig. 5 below.<sup>1</sup>

According to Fig. 5, even in cases where there was not a satisfactory engagement process, largely, the inhabitants agreed with the proposal for withdrawing a circulation range of cars, with a view to broadening sidewalks, and with interventions to create more bike lanes, and reduce local speed limits. This gives indications of a significant demand for public services aligned to more comfortable, more pleasing, and safer spaces for walking and cycling.

#### e) User Techniques (T')

*User techniques (T')* are related to audits performing technical inspections and impact evaluation methodologies. The audits perform technical inspections with measurements of flows of people, permanence activities, road safety, waste management issues, furniture, and project perceptions. They gathered data through local interviews, with the local population and frequenters from further afield. Through these interviews, it was possible to identify different dynamics for the particular space in question, focused on how users occupy it and how they behave at different times, or days of the week. This surveying tool also permits user engagement, thus rendering quantitative and qualitative information accessible regarding local public life. Mainly for Joel Carlos Borges, Caminhar Pinheiros and Jose Bonifacio, where there were no specific workshops/meetings to discuss the initiatives, questionnaires were also applied to investigate the transportation and consumption habits of people accessing the street, and perceptions and evaluations of street traders, surrounding community and local users on the impact of the initiatives. Reinforcing this, and mainly in emerging economies, services demand innovation in terms of efficiency gains, but also in terms of transparency and responsiveness to user/citizen needs (Mohnen & Stare, 2013; Cruz et al., 2017).

User techniques also affect evaluation methodologies. A strategy that involves the construction of pilot projects, and only afterward, a consolidation of the initiative as a new solution proposal, demands data collection to support the solutions to be implemented, and also to carry out *ex-ante* and *ex-post* evaluations. *Ex ante* data collection can support the identification of changes needed and may document the reasons for the required changes. Additionally, after implementation, data collection can evaluate the effects of changes, point out required adaptations and/or other changes, as well as validate success and experience gained from the project, and it may in any case lead to permanent changes. In the cases of Sao Miguel Paulista and Joel Carlos Borges streets, a propensity score matching method was applied, which aims to evaluate the impacts of an intervention through the comparison of groups: the group which receives the intervention (factual) and the group that remains unchanged (counterfactual) (FGV, 2017a, 2017b; Labmob & WRI, 2018). This method seeks to increase study credibility by strengthening the idea of attribution of obtained results to the intervention itself and not to other factors. With the exception of Caminhar Pinheiros, within the other initiatives, there was no evaluation of propensity score matching, but interviews and *ex-ante* and *ex-post* data collection took place.

Finally, analysis of innovation in public services in the cases studied points out the principles of the NPUM, and in a larger scope, SDG

<sup>1</sup> The colors represent each of the initiatives studied: Blue - Centro Aberto Program; Red - Reduced Speed Zones; Orange - Complete Street; and Green - Safe Route to School.



11: Sustainable Cities and Communities. The principles of NPUM – and the Urban Mobility Plan of SP – has directed the choices made in order to establish the prioritization of active modes of transport over motorized, and of collective modes over individual, as well as the adoption of traffic calming measures. Regarding SDG 11, we highlight the promotion of new perspectives for managing urban spaces, which also stimulates decision-making in favor of a sustainable urban mobility system.

#### 4. Discussions and conclusions

We explored experiences of active mobility in Sao Paulo, Brazil, using the innovation-in-services perspective, and selected ten case studies that focused on the improvement of road safety conditions, non-motorized transport and access to public transport. Also included was the multimodal/intermodal perspective, in accordance with NPUM: the Centro Aberto Program of Public Space Activation; the Sao Miguel Paulista, Santana and Caminhar Pinheiros Reduced Speed Zones; the Joel Carlos Borges Complete Street; and the Jose Bonifacio Safe Route to School. The innovations were anchored in the competences and techniques of providers and users. The application of the characteristics-based approach to services (Gallouj & Weinstein, 1997; Windrum & Garcia-Goñi, 2008), and adapted to the studied context, demonstrated that innovation in services (Y) provided by the public sector occurred in the introduction of new methods for the treatment of infrastructure for pedestrians, aiming at the maintenance and re-qualification of infrastructure for walking, cycling and integration with public transport. The improvement of urban mobility, which responds to those needs evidenced by society, requires services that result in new ways for people to occupy the city road space. It is about not only expanding, but also creating and requalifying services for active mobility. It shows the relevance of paying attention to forms of non-technological innovation, and that the deliberate structuring of innovation networks does not necessarily support innovative processes and results verified in the local context.

Users are considered as civil society organizations that represent interests in the active mobility issue. Through the work of third sector organizations, we also highlighted the role of volunteers and collectives in the creation and introduction of innovative solutions for active mobility in the local context, which meet social needs based on the inclusion of pedestrians as a priority in the use of urban road space. The organizations draw attention to the interests of the individual citizen and use their experiences to interact with the public service provider (City Hall) in the identification of areas for intervention and in the establishment of evidence bases on the effectiveness of techniques used for the requalification of road space.

Regarding new service provider competences and techniques, the projects contributed to the development of competences (C) related to various interactions with civil society, giving it a systemic perspective on the uses, local dynamics and behavioral issues of users. Service provider techniques are temporary and permanent intervention methodologies, and methodologies for project impact evaluation. Methodologies for urban interventions, affecting the evaluation and enlargement of the urban reading methodology scope, are beyond pedestrian and vehicular volumetric counts. These techniques are associated with tactical urbanism as a technique (T) for temporary urban interventions. Under the domain of tactical urbanism, some impediments arise: political, planning practice, and citizenship. In short, the political barrier relates to a lack of funding, compliance with the NPUM, political will, non-partisanship of actions, and long-term vision. Planning practice can move towards more effective and regular approval and participation of society and may have an influence on evaluation. Furthermore, new routines of direct service providers (T) was noted, specifically for the Centro Aberto program, due to the development of janitorial and space operations that also involved maintenance and conservation. This dynamic can change or introduce new procedures, affecting routines, processes and operations.

User techniques (T') were identified, for Sao Miguel Paulista and Joel Carlos Borges, to apply the propensity score-matching method, which aims to evaluate the impacts of an instance of intervention through the comparison of groups. User techniques (T') were also related to technical inspections and local interviews. The relationship management generated relational and organizational competences for the proponent organizations (C'). The experiences gained through the interventions resulted in a closer relationship with Traffic Engineering Company (CET)-SP technicians, increasing engagement and understanding of the organizations' mandates, and recognition of the technical capacity of the teams involved. In addition, we highlight a strengthening of the technical and operational capacity of proponent organizations, with regard to the implementation of projects.

From the theoretical background studied, it is concluded that smart cities are the result of a combination of physical structure, local knowledge, and human capabilities aimed at the production and provision of public services. This combination may be identified in the framework used, from the multi-agent configuration presented.

Regarding the practical implications/implications for policy makers, it is recommended to seek the consolidation and expansion of the projects analyzed, supporting the interventions (temporary and permanent) established that change the road priority, allocating more appropriate portions of urban space to the most vulnerable users, making the locations more attractive for active mobility and access to public transportation, improving air quality and reducing greenhouse gas emissions. In general, there was some political resistance to implement projects aimed at prioritizing active mobility, both within the government and among part of the population, especially when it comes to changes that require taking space away from the car (especially parking spaces) or significant speed reductions. Sometimes this resistance stems from fear of the unknown, and tactical urbanism collaborates to break this resistance, allowing the experience and experimentation of the space on a temporary basis - the redesign can be removed or adjusted if the result is not positive. The importance of transforming tactical urbanism into public policy is also highlighted, with a replicable and scalable character, identifying the potential of these pilot projects, for experimentation, evaluation, and conducting any necessary corrections that are identified during the test phase, but without forgetting the important objective of approving new types of permanent interventions. In this sense, some barriers are highlighted: related to the lack of public funding, compliance with the National Policy of Urban Mobility and Municipal Plans of Urban Mobility, political will, non-partisan actions and long-term vision.

In this study, the environmental dimension is limited to two aspects – namely, noise and air pollution, based on the assumption that



enhanced non-motorized mobility associated with collective public transport may possibly bring greater environmental comfort due to a reduction in both air and noise pollution. However, further studies along these lines need to be carried out, expanding the data and proposals of indicators on sustainable urban mobility, with validation and weighting by multi-agent and local participation, seeking to better portray vulnerabilities and local priorities. Another limitation refers to data collection, since the materials and data available for analysis consider only a portion of the population that uses the public space. In this sense, even the civil society organizations involved in the process, quantitatively and qualitatively, cannot be considered representatives of local society/users in general. Several questions remain that should be addressed by future research, since the projects are still relatively recent and are limited to particular spatio-temporal boundaries. Also, it would be interesting to deepen the dialogue between social innovation and innovation in services, with a focus on sustainability and the 2030 Agenda. In order to understand social innovation, spearheaded by third sector organizations, involving the co-creation of new services/products, shaped by interactions between key stakeholders. Co-creation in social innovation is a recent study and still needs to be investigated in greater depth, highlighting socio environmental issues. Finally, a maturation of results from the projects studied is still also necessary, as well as a deepening of the analysis of projects of a similar nature in other urban and social contexts.

## Conflicts of interest

The authors declare no conflicts of interest.

## Declaration of competing interest

The authors declares that there is no conflict of interest.

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