The City Lab Joinville in southern Brazil: an innovative approach for addressing sustainability in the mobility sector

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Abstract

The city of Joinville in the south of Brazil is known for its future-oriented policies and efforts towards becoming a smart city. In this context, a so-called "Mobility City Lab" was implemented in a joint effort between the local administration, the GIZ (Deutsche Gesellschaft für International Zusammenarbeit), the Fraunhofer Institute for Industrial Engineering (IAO) and the University of Stuttgart.
The City Lab Methodology has been developed in 2012 by the innovation network "Morgenstadt / City of the Future", which is a collaboration platform led by the Fraunhofer Society where research, industry and cities come together to design and implement solutions for the city of the future. The City Lab approach is a holistic analytical framework that helps to create individual sustainability strategies for cities that build on digital innovations, clean technologies and a broad stakeholder dialogue. The goal in Joinville was to help this city to become a model in Brazil for innovative mobility concepts and create a precedent in Latin America on how intelligent growth and sustainable urban development can be initiated in an emerging economy.
The methodology applied is comprised of four main steps (preparation, desktop research and analysis, onsite assessment, and results). The analysis of strategic documents and expert interviews with local actors allowed for the assessment of the local mobility system. This was completed by the analysis of indicators and action fields, which indicated an immediate need for improving the public transport, highlighted the lack of intermodality, a strong private car culture and a general discontent of users with the public transport services offered. 25 project ideas, tailored to Joinville´s unique needs and opportunities, were developed in the process and results compiled in a roadmap as a guideline for transforming the mobility in the city. The proposed projects are combined with the already ongoing and planned activities in Joinville and aim to further strengthen its position within Brazil and make it a lighthouse city within Latin America.
This paper will describe the research phases and the relevant results of the analysis. It aims to give an insight on the process implementation in the municipality and how the co-creation process is carried out and a key to the successful implementation of the project. Finally, it will reveal some of the activities that have been initiated after the city lab and the impact that it has had on the transformation of Joinville and its citizens.

Introduction

Today cities in Brazil, are struggling with the consequences of the ongoing challenges that come with urbanization: traffic, air pollution, increased waste production, etc. Besides, the absence of dialogues between private and public sector leads to bad investments and a missing blueprint for sustainable urban development. In Brazil, 86% of the population live in cities. The number of registered passenger cars has ascended by 138.6% (Observatório das Metrópoles 2018) in the last ten years and the tendency shows a steady growth rate. Public transport services are considered inadequate; long waiting times, overcrowded buses and collapses after rainfalls are not an exception. Innovative mobility concepts and technologies for the planning and implementation of sustainable urban systems are in great demand not only to face diverse challenges of the urbanized world but also to open up important future markets for companies and cities.
Joinville with 577,077 inhabitants it is the most populous municipality of the state of Santa Catarina and the 37th of the country. Important to mention, there are less than 300 cities in Brazil with population more than 100.000 inhabitants. Thus, Joinville can be a replication example for them. It has a population density of 457.58 inhabitants per square kilometer and is the third largest city in the South Region of Brazil. The city has a high HDI (human development index) - (0.809) holding 21st national position among Brazilian municipalities. Moreover, Joinville has the largest GDP (Gross Domestic Product) of the state of Santa Catarina – EUR 11 553,54 (BRL 44 303,65) per capita and produces 18.9 percent (fiscal value added) of the global gross domestic product of the state. (Instituto Brasileiro de Geografia e Estatística (IBGE) 2010;2014;2017)

This city is also known for its future oriented policies and efforts towards becoming a smart city. In February of 2016 the so-called project *Join.Valle* was launched, with the aim of co-creating the city of the future, improving, at the same time, its citizens' quality of life. The program has three main working areas: to create a creative ecosystem in Joinville, to develop an open platform and standard to facilitate the generation of new smart applications while democratizing Internet access, and promote a dialogue between the public sector, private initiatives, and universities.
In this context, the Morgenstadt Initiative in a strategic cooperation with the GIZ co-designed a project for supporting the city of Joinville in the development of a comprehensive roadmap for a sustainable urban mobility. All projects designed during the City Lab have been tailored to the Joinville's unique needs and are meant to support the city in addressing its specific challenges in the area of mobility.

The Morgenstadt City Lab approach and process

The basis for the in-depth analysis of Joinville was the Morgenstadt assessment framework for sustainable urban development. The model was developed by Fraunhofer IAO back in 2012 together with the University of Stuttgart within the innovation network „Morgenstadt: City Insights". It is built on three dimensions of the urban system that need to be addressed to ensure sustainable urban development: urban leadership, socio-economic strategies, technologies, and infrastructure. It applies a standardized data assessment that helps to evaluate the status quo and to identify key challenges and opportunities. A mixture of quantitative benchmarks and qualitative data ensures that an objective performance profile of the city can be generated (Fraunhofer IAO 2017). The assessment tool includes two levels of the analysis: performance indicators and action fields.
The framework had been developed by analyzing six lighthouse cities (e.g. New York, Copenhagen, Tokyo, Freiburg) and after has been successfully applied in various cities in Europe such as Prague (Czech Republic), Berlin (Germany), Lisbon (Portugal), Sabadell (Spain), etc. Hence, it can be said that the stated indicators and action fields refer to highly developed cities with rather advanced infrastructures and technologies. Therefore, the Morgenstadt approach had to be "topicalized" in the preparation phase. Two aspects need to be highlighted in the adaptation process: on the one hand, the focus of the City Lab in Joinville was set on mobility and therefore, a selection of relevant indicators and action fields was done; on the other hand, there was a need for their adaptation with regards to the local conditions. Indicators and action fields were re-defined based on the regional standards and values, wherever this information was available. Also, the existing framework was adapted to the local context based upon experiences made within the Urban Nexus Project (GIZ funded project in which Fraunhofer IAO adopted the Morgenstadt Framework for the analysis of ten Asian cities e.g. Ulaan Baator, Dan Nang, Chiangmai etc.) and upon an evaluation of Brazilian regulations on cities and urban development. In addition to the mentioned benchmarks, it was helpful to compare the values of the indicators with numbers and averages for other Brazilian regions and cities similar to Joinville. In addition, cities in Brazil like Fortaleza were identified during the interviews as "good practice" and used as a reference in certain mobility aspects for Joinville.

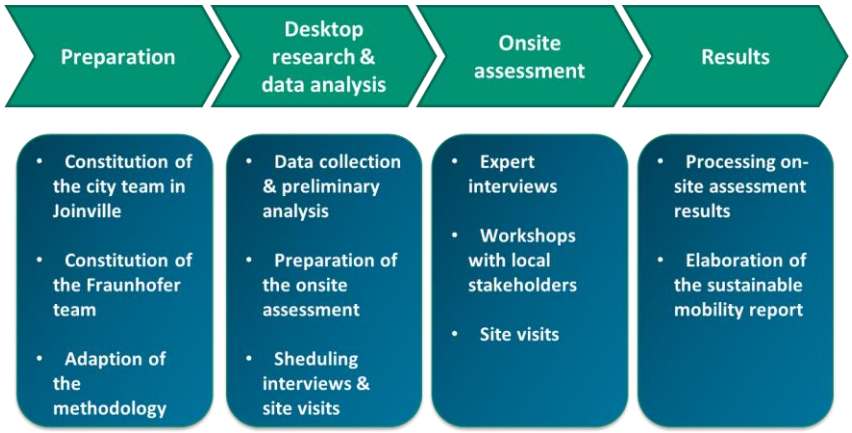

Figure 1: Structure of the Mobility City Lab process in Joinville (Padilla et al. 2017, 2017)

The City Lab process was divided into four different steps. The preparation phase comprised the constitution of the local team and the Fraunhofer assessment team. The Fraunhofer team was formed by the City Lab leader, the mobility expert and two research assistant. The Joinville support team was composed of two employees of the Secretary of Urban Planning and Sustainable Development (SEPUD) of the city. Besides a GIZ representative

supported the assessment throughout all phases. The adaptation of the methodology described above was also carried out principally during this phase.
The second phase consisted of the analysis of strategic documents and the initial data collection relevant to mobility. The actor landscape in the field of mobility was scanned and analyzed, which helped to identify interview partners for the on-site assessment. The selection of the interview partners is a crucial step and has to be done carefully to ensure that all strategic stakeholders from all relevant departments and institutions are represented and involved in the co-creation process.
The third phase was the on-site assessment. During the one and a half weeks of the in-situ analysis, 20 interviews with 35 interviewees, and 2 innovation workshops were carried out. Additionally, 4 site visits were organized so that the assessment team could gain a better understanding of the problematics and opportunities in the city. Main bus stations were visited (e.g. central station, station ITAUM and station Vera Cruz) as well as the main points for traffic blockages in the city center and the facilities of the private bus operator BUSSCAR.
Further research on best practices to the co-designed project ideas was done during the fourth phase to complement the information on the co-created project ideas. In addition, some research was done on possible partners for an eventual future implementation. The design of the strategic roadmap, as well as the finalization of the official report, comprised the last steps of the city lab.

Joinville mobility profile
Strategic plans provided by the local administration such as the mobility plan released in 2015 and a public transport user´s satisfaction research was studied and an exhaustive web research was carried to complement the analysis of the indicators and action fields collected. This information formed the basis of the elaborated sustainability profile of Joinville summarized below.
Private motor vehicles: being the most used mode of transport in the city (41.15%) (Fundação Instituto de Pesquisa e Planejamento para o Desenvolvimento Sustentável de Joinville 2010), it is also the main cause of congestion in the main streets, particularly in the city center. The municipality does not have specific regulations in place or incentives for establishing limitations to the use of private cars. Contrary, the existing taxation system is rather designed to promote the use of cars. According to the study, the total fleet in the city increased by 32% if compared with the year 2010 (33% increase in private cars) and the number of persons per licensed vehicle decreased from 3,14 to 1,50 which poses a certain pressure on the infrastructure (Prefeitura Municipal de Joinville 2017).
Public transport: the public transport system in Joinville consists of buses. The system is organized around ten "integration stations" (*Estações de Integração*) and the different of bus stops throughout the city. Two private companies are offering public transportation services with the total fleet of around 347 busses, from which approximately 296 buses are designed with an accessible low-floor frame (Passebus 2017). The city has already implemented 21,4 kilometers of bus-only preferred lanes, which are considered by its new mobility plan as a small number for a city of its size. In addition, it has been acknowledged that 20% of the fleet is still not accessible for everyone (including persons with disabilities) (Presidência da República, Casa Civil 2004).
Delivery of mobility services: public buses' users were interviewed on a range of questions on public service satisfaction, alternatives, and preferences. In terms of general satisfaction, 63% of customers showed some degree of dissatisfaction with the bus stops' comfort, 61% with the public transport's costs, and 45% with the exposure to noise and pollution (WRI Brasil Cidades Sustentáveis 2014). In terms of the services provided, 66% of the users surveyed expressed some degree of dissatisfaction with the service availability during the weekends, while 56% complained about the bus frequency, and 51% with the service availability during the evening (WRI Brasil Cidades Sustentáveis 2014). When customers were asked about the waiting time, 58% said that they were unsatisfied or very unsatisfied with this aspect. Related to the ticket costs, 27% answered that they were very unsatisfied, and 46% just unsatisfied (WRI Brasil Cidades Sustentáveis 2014).
Walking and cycling: The Mobility Plan states that walking must be prioritized as the main mobility alternative. Therefore, the city wants to guarantee that walking is both attractive and safe and that there are no major obstacles or threats to pedestrians. However, there are extremely high taxes for bike purchasing vs cars, as more than 70% of the bike price are taxes. A survey by the Institute of Research and Planning for Sustainable Development of Joinville shows that most of its citizens (66.25%) find it difficult to use the sidewalks due to a lack of them or because they were defective (Fundação Instituto de Pesquisa e Planejamento para o Desenvolvimento Sustentável de Joinville 2010). As for the cycling, the city counts with 125 kilometers of bike lanes, which are planned to be expanded to 730 kilometers by 2025 (Fundação Instituto de Pesquisa e Planejamento para o Desenvolvimento Sustentável de Joinville 2015). Additionally, from the 58.03% of the people that do not usually ride a bicycle, 17.97% do not do that because they find it dangerous and 22.5% answered that the reason is that they do not have one; from the 41.97% of the people that usually ride a bicycle,

46.72% do not use bicycle lanes, as they do not exist (97.45%) (Fundação Instituto de Pesquisa e Planejamento para o Desenvolvimento Sustentável de Joinville 2010).

Analysis of indicators

The in-depth analysis of the mobility system was carried out using the *Morgenstadt* assessment framework for sustainable urban development and was structured in two levels of analysis, namely indicators and action fields. The indicator assessment is focused on the following question: What is the sustainable performance of the city today? The 46 collected indicators cover different aspects concerning mobility. It should be emphasized that the inclusion of diverse indicators is an important step that allows a more accurate evaluation of the entire system. Thus, such sectors as urban structure, energy, environment, society, economy and ICT were also assessed. The results in detail are presented in this section.

Indicator	Indicator scope	Value Joinville	Green	Yellow	Red
Modal split in % of total traffic	share of traffic by pedestrian	23,11%	> 40%	20% - 40%	<20%
	share of traffic by bicycle	11,13%	> 25%	5% - 25%	< 5%
	share of traffic by public transport	24,60%	> 65%	50 -65%	<50%
	share of traffic by personal vehicles (cars, motorcycles,etc)	41,15%	< 15%	15% - 40%	>40%
Level of motorisation in passenger vehicles per 1000 city inhabitant	The ratio between the total number of passenger motorized vehicles (incl. cars & taxis) within the urban agglomeration and the population.	434	< 300	300 - 400	> 400

Table 1. Extract of indicator assessment (Padilla et al. 2017)

In comparison to other southern states in Brazil, public transportation usage is low. For instance, the share of public transport in the southern region is 46,3%, while in Joinville it is only 22% of the total (M. Pochmann 2011). In contrast, the share of private motorized transport is 41,15%, that makes its level slightly lower than average in the south region (44,1%), but higher than average in Brazil (36,5%) (M. Pochmann 2011). Motorization level in the city is above the Brazilian average: 249 passenger vehicles per 1.000 inhabitants in 2016 (Instituto Brasileiro de Geografia e Estatística (IBGE) 2013). However, if compared to the average European level of motorization (EU-28), the value of Joinville (in 2016) was about 50% lower than the average of Europe in the year 2015 (498 passenger vehicles per 1.000 inhabitants) (European Commision 2015).

The bicycle traffic share was estimated to be around 11%, while the average in the region is 2% (M. Pochmann 2011). This is when compared to the share of bicycles in the European cities such as Cologne (2008) and Helsinki (2013) where it ranges between 11-13% (Österreichische Gesellschaft für Politikberatung und Politikentwicklung (OGPP) 2016), quite high. However this percentage includes rural areas with fewer alternative transport modes. The 125 kilometers of cycle path is quite low for a city of its size, but Joinville is, as mentioned above, planning to increase this number to 730 by 2025, which will certainly promote cycling in the city. Regarding exclusive bus lanes, the existing 27 kilometers are comparatively low for the city of such extent. The length of the existing ones is in its majority inadequate and they are often not continuous (Padilla et al. 2017).

In respect to logistics, almost 100% of transported freight goods within Joinville are shipped by road. Since over-sea transport is not so relevant by the local industry, rail and water freight transport modes do not really take place (Padilla et al. 2017). The same dynamic can be seen on Brazil's interstate level where road freight transport share is 61,1% (Padilla et al. 2017). Thus, comparison to the inner-city logistics is feasible, because it is largely road limited.

As to electric mobility, these kind of technologies are nowadays not just a trend, but a valuable solution to the many challenges posed by the ongoing urbanization around the world. Thus, in the transformation of the transport to a non-fossil fuel based system, electro mobility is of high importance. The market of electric vehicles is still emerging and even In spite of this, the European Union, electric passenger vehicles represent only 1,2% of all new cars sold in 2015 (Nils-Viktor Sorge 2017) and in Joinville electric mobility still needs to be rolled out

as there are only a few electric vehicles registrations so far. However, during the assessment, the interviewed universities showed great interest in starting projects around the electrification of their fleets. This can be certainly a starting point for the transition.
With regards to the traffic induced delays, Joinville´s loss of time in congestion is with 23,5 hours/year per capita is far below similar-sized cities in Brazil as Feira de Santana (32,9 hours) but above others like Cuiabá (20,7 hours). Within Brazil, Joinville is on place 15 (out of 54). Sao Paulo, with 77 hours, occupies the first place (INRIX 2017).
Information on environmental indicators such as carbon dioxide emissions and fine dust pollution is not being collected and could not be found at the time of the study. Hence, it would be important to invest in this type of data collection for further analysis and project planning in the mobility sector.
Recapitulating, when compared to the other Brazilian cities, Joinville is a relatively good developed city. Nevertheless, spatial aspects must be taken into consideration in terms of structure and space planning, not only to improve mobility in general but also to prevent more congestion and other side effects of urbanization in the future. Taking into account that 11,94% of the city´s urban area is occupied by traffic, while around 32% is undeveloped city area, it is imperative to define patterns for the future development of the city in a way that it is aligned with the mobility plan and promotes a sustainable transport system. Finally, in terms of population density, Joinville with 2.705 inhabitants per square kilometer in the urban center is a relatively low populated city; especially when compared to cities like Recife, which have 7.133 inhabitants and Curitiba is 4.062 inhabitants per square kilometer. (INRIX 2017)

Action fields analysis

The action field analysis indicates how the city is currently addressing sustainability through concrete activities and development plans. As far as the Joinville City Lab's field of interest is mobility sector, as for the indicators, this assessment was done, after selecting and adapting the action fields from the *Morgenstadt* framework that are relevant to mobility. These were then classified in the following sub aspects: intermodality, e-mobility, public transport, sharing systems, traffic management and parking, pedestrian and cycling, and mobility management.

Action field intermodality	**YES**	**NO**	**PLANNED**
Does the city implement mobility hubs to combine several modes of transportation (bus, bycicls, sharing vehicles, charging stations etc.)?		X	
Has the city implemented park&ride slots around public transport nodes?		X	
Action field e-mobility	**YES**	**NO**	**PLANNED**
Are there specific "free parking slots" in the public space reserved for electric vehicles?		X	
Action field public transport	**YES**	**NO**	**PLANNED**
Do buses and trams have own priority lines?	X		
Action field sharing systems	**YES**	**NO**	**PLANNED**
Does the city provide parking spaces for shared vehicles?		X	
Does the city implement car sharing in the city?		X	
Action field road traffic management and parking	**YES**	**NO**	**PLANNED**
Is the city undertaking a systematic process of decreasing the number of car parks in the city?	X		
Action field pedestrian and cycling	**YES**	**NO**	**PLANNED**
Does the city expand pedestrian-activities in the public space (e.g. pedestrian zones etc.)?	no information		
Action field mobility management	**YES**	**NO**	**PLANNED**
Does the city collect and utilize real time data to optimize the traffic system (eg user data to understand mobility behavior and artifact based data)?			X

Table 2. Extract of action field assessment (Padilla et al. 2017)

At the moment of the study, there was almost no infrastructure related to intermodality and sharing systems. However, the city has the intention to slowly introduce it in the coming years. During the interviews, intermodality was recognized as a very important aspect to be promoted within the mobility system by several of the stakeholders. The city plans, and municipal activities are rather focused on the action fields "pedestrian & cycling" and "public transport". This was also reflected during the interviews, where different stakeholders addressed the issue of how to design the system in order to promote walking and cycling in the city and improve the offered public transport. In this sense, the municipality is taking essential steps as extending the existing cycling lanes and removing the gaps within the cycling network. Furthermore, it is planned to build bike sharing stations in strategic points as bus terminals, Likewise secure parking for bicycles is planned since this was identified as a crucial factor for motivating the population to use their bike as a mode of transport. (Padilla et al. 2017)

In terms of promoting public transport, the municipality is working on plans of „decentralization" of the service with the aim of making the service more efficient. Regarding passenger comfort, the necessity of transforming the bus stations into more attractive meeting points for the people has been recognized. Concerning this field, the city's Mobility Plan has already identified some ambitious goals: to achieve 100% fewer emissions in bus transport. Besides, the service has to improve in terms of comfort by renewing the fleet, providing real-time information to the citizens regarding the arrival time of the bus. Here, the installation of onboard GPS was planned for 2018. The universal fee was also identified during the assessment as one of the weak points of the current system. This regards the proposal of revision of the system and the replacement of it by a zone tariff system was suggested as detailed in the following section.

In general, the interviewees showed great receptiveness and openness to mobility concepts proposed during the study such as express bus lanes or the new zoning system mentioned above or investments in infrastructure for bicycles. The assessment of the action fields showed that one of the main limitations are the high investment costs. This refers especially to the rehabilitation of the existing transport infrastructure like roads and bus stations but also to the purchase of new vehicles as well as to the implementation of new technologies. (Padilla et al. 2017).

A comprehensive SWOT analysis was carried out the *Morgenstadt* methodology was adapted to the local context. In the case of the Joinville City Lab identification of strengths, weaknesses, threats but especially opportunities resulted in the condensed SWOT analysis. This was the basis for the co-developing of the project ideas during the on-site assessment. In the course of the discussions with local stakeholders, further relevant information was gathered and generated. The information was clustered into four categories: governance, public transport, non-motorized transport and motorized transport. This data, on the one hand, was a summary of the status quo in Joinville in terms of mobility and on the other hand, was the reason and justification for the project ideas presented in the next chapter.

Opportunities for transforming the mobility in Joinville

During the one and half weeks of on-site assessment, a total of 25 project ideas were developed together with the interviewees and during the internal working sessions of the local and the City Lab assessment team. The projects tackle all of the relevant aspects for transforming the mobility in Joinville: smart governance, socio-economic development, intermodality, e-mobility, and technical aspects as the restructuring of the tariff system. The most diverse strategic stakeholders from the public sector as well as research institutes and citizens organizations participated in the process. The Secretary of Urban Planning and GIZ organized diverse interviews with representatives of the different departments within the city administration but also with bus companies, cyclist associations, regional administrations, energy providers, environmental consultants and German companies such as Bosch, BMW and the start-up Station-i of the Zuweso GmbH. The assessment was conducted in a way that promoted productive discussions and the co-creation of solutions for facing the mobility challenges in the city.

The innovation workshop organized on the first of November had the aim of presenting, verifying, discussing and further develop the ideas for smart city projects and measures that were generated and shaped during the on-site assessment 23-31 Oct. Given the limited time available on the innovation workshop (four hours), the following ten out of the 25 project ideas were selected by city representatives and the City Lab team, to be presented and discussed in detail during the co-creation session:

Park & Ride Stations: Well equipped and multimodal big parking lots for cars and bicycles around urban bus terminals (mainly in the south), so that citizens can park their vehicles in these places safely, also offering various services such as washing, mechanics, etc. The creation of well-equipped and attractive park & ride stations complemented with express bus lines can promote the use of public transport.

Mobility Hub: The city has identified the need to transform the bus stations into more livable meeting points, with additional services and offering intermodality services such as car sharing, bicycle sharing, car and bicycle repair stations, lockers, etc. The use of these additional services should become possible by updating the existing "Ideal" transport card.

Last mile delivery with e-trucks and e-bike: Last kilometer distribution with e-vehicles and e-bikes can reduce the noise and pollution in the city centre; E-trucks are suitable for the short stop-and-start urban delivery routes while e-bikes can be used specially for post services and delivery of food. The municipality proposes to identify empty public properties located in the center, which can be rented out to the logistic companies and after transformed into cross-docking centers, etc.

Public train line "South-North": there are only six trips per day for freight transport using the rail infrastructure that goes through the city. This existing infrastructure can be used for public transportation as well. Currently in plans, is a new train line to run from Guaramirim and Araquari in the southern part that should be connected and integrated to the park & ride station proposed in the Itaum district, in order to connect passengers with the train.

Co-creation online platform*:* It is an innovation contest to develop solutions to the problems presented by the citizens. Citizens are invited to identify the pressing problems around mobility in Joinville. Via a voting system, citizens can select the most "important" problems from their perspective. A challenge for the creation of ideas and proposals to solve them is organized and best proposals are selected and receive initial funding for their implementation.

Bike sharing & safe parking: Attractive and safe parking infrastructure for bicycles can be implemented in different strategic locations as the proposed park & ride stations and the mobility hubs. For electric bicycles, the parking infrastructure would need charging points or lockers for the accumulator. Additional services as a bike-repair shop can be also offered in bigger bicycle-parking infrastructures.

***Open Data platform*:** A platform that any institution of the city can feed to collect all different kind of information regarding mobility, e.g. public transport companies, sensors, telecommunication companies, citizens. This information needs to be collected in a common platform and be available to the public.

Establishment of a "Low emission area": Establishment of a green area in the city center as an environmental (green) zone and introduce traffic restrictions based on the class of vehicles the city would like to exclude. Vehicles with high emissions will be excluded or pay more than others. The zone is delimited by special signs and could be controlled by cameras in combination with air pollution measurement.

Restructuring of the tariff system: Joinville has a unique tariff system. The tariff system can be restructured using zones. Clearly organized fare systems are easy to understand by passengers and can reduce ticket prices, particularly for short distances and thus promote public transport. Monthly tickets with a reduced rate per trip or different rates, depending on the total number of trips (more trips results into the lower price) should be as well introduced.

City Green certificate: The city can implement and issue a "sustainability" or "green" seal to encourage companies to promote the use of alternative transportation modes among their employees. Examples: changing rooms so that employees who use the bicycle can get ready before work starts or provision of bicycles at no cost to employees.

Further project ideas make up the 25-project catalogue: Ride-sharing and real-time information applications, e-Buses for public transportation, soft regulations for promoting high occupancy in private cars, car sharing, the introduction of e-vehicles in the Municipal and University fleet and others.

The way forward

Joinville is known in Brazil for its future-oriented policies and efforts towards becoming a smart city. Projects as the co-creation platform *Join.Valle* was launched*,* with the aim of involving citizens in the design of their city of the future and improving their quality of life.

Another initiative aligned with this objective is the "*Mobility Observatory*" (Observatório de Mobilidade) but it is needed to extend this existing group with additional stakeholders and institutionalize it to ensure its influence and efficacy. The suggested *action-group* could be created, to connect representatives of the city administration, the regional government, public transport, logistic companies, start-ups, the universities, cyclist associations, the, financial institutions and others. The purpose of the group is to define an "implementation agency" that will ensure the implementation of jointly developed projects such as those described above.

The PlanMOB is the most important guideline document regarding mobility in Joinville. When the assessment was carried out, the documents were being revised. It was suggested to use the opportunity to evaluate the possibility of incorporating the City Lab results into the updated version, which was due to be approved and released in 2018. Process like this one, would ensure the political commitment to the implementation and give

it a legal character. The creation of the Mobility Action Group, would enhance the coordination of all actors and facilitate the implementation of the projects. It could be managed and coordinated by SEPUD, the Secretary which accompanied the entire City Lab process.

From the City Profile above, it can be derived that Joinville needs an overarching approach to address urgent mobility challenges. One of the main problems is undoubtedly the absence of alternative modes of transport to promote intermodality and decrease the dependency on the private car. On the other hand, the public transport needs to be improved to increase the user satisfaction and enhance the user experience. A stand-alone solution might not have a considerable impact, but a coherent set of measures can.

In this context, the introduction of smart policies is regarded as crucial to effectively promote the transition to more environmentally friendly modes of transport, increase awareness and as an incentive for the implementation of the measures outlined above. In this sense, the establishment of a low emission zone in combination with financial incentives for electric vehicles and the use of bikes was proposed for Joinville. The emission of a green certificate to companies and institutions promoting the use of green transport modes among their workers can serve as a complement to promote the transition.

During the City Lab, a big potential for realizing last mile logistic projects was identified: the union of transporters showed great interest in outsourcing last mile deliveries to be done with e-bikes and small e-cars. For this, micro hubs need to be identified and equipped. For the implementation of this project, an initial screening of needs and implementation options has to be carried out. This would involve a preliminary data collection and assessment to gather information regarding the volume of shipments, the service provider structure, the receiver structure, the topography of the city, the share of heavy transport in traffic, etc.

The graphic below represents an overview of the projects developed and the approach proposed. As described above, the governance aspect is regarded as the basis for guaranteeing the sustainability of the implementation. In the technology and infrastructure layer, the solutions are presented without a specific order for it. In general, they can be all implemented in parallel and are considered to complement each other.

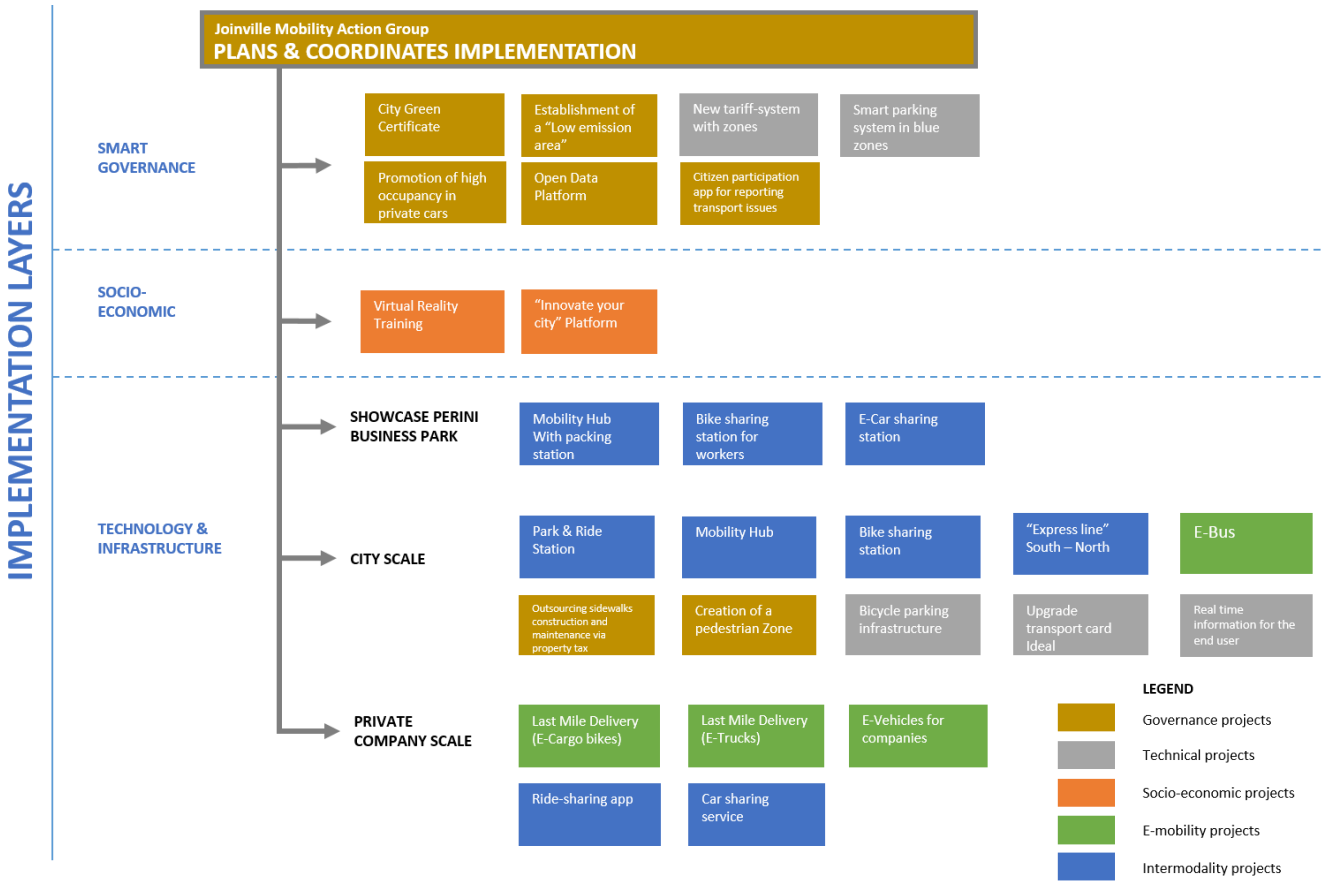

Figure 2. Joinville City Lab roadmap (Padilla et al. 2017)

Conclusions and outlook

Mobility is unquestionably one of the main concerns of the city administration. It is not only one of the main source of pollution but also very expensive and accounts for huge amounts of energy consumption. Today, cities are completely dependent on mobility dynamics and processes. When a city is striving to transform itself into a smart and sustainable city, mobility is inevitably one of the aspects that need to be mastered. Mobility is a very complex topic and has to be treated as such. It is imperative to know how to best use the available knowledge and the existing technology to shape the future-oriented mobility of tomorrow.

The city lab process awakened great interest by all stakeholders on working towards the implementation of the projects and collaborating in their development and financing. This window of opportunity must be used to create synergies and initiate the rollout. In this effort, Joinville has initiated several activities in 2018. The creation of an open data platform smart mobility has already started and will receive support for the investment in greater hardware infrastructure from a private initiative. Regarding last mile delivery, the city has launched a contest for elaborating business plans and is planning to implement a pilot project. Likewise, a pilot project on bike sharing and safe parking are planning. Here the city is working with start-ups and companies active in the sector as Scipopulis bus dashboard, Chica dockless bikes and others.

During the City Lab process, the city has realized the importance of data. Therefore, the current focus is on the expansion of its database to be able to better assess the feasibility of the projects. Data is considered to be crucial for implementing measures towards the creation of an intermodal transportation system and the integration of different transport modes. Finally, innovation is being driven through pilot projects and prototyping.

Joinville is a city with countless opportunities to become a lighthouse for smart cities in Brazil and the region. Several initiatives have been taken to use them and innovate the urban environment. The City Lab was one of them and managed to bring the right people together, gather the scattered information and created a momentum that the city is well managing to keep and use. The ongoing activities in the city around mobility prove that the Morgenstadt approach is a powerful tool to co-create, build synergies and start action when driven by motivated people willing to transform their city and a strong political will.

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