

A Work Project, presented as part of the requirements for the Award of a Master's degree in
Management from the Nova School of Business and Economics.

DIAGNOSE OF THE SMART CITY CONCEPT, PROJECT SCOPE DEFINITION AND
IMPLEMENTATION OF MOBILITY AS A SERVICE IN LISBON

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Abstract

Cities are under pressure as their importance as economic and populational centers grows. Smart Cities answer these urban challenges, improving well-being, productivity, competitiveness, and innovation, as high returns to all stakeholders spur investment in digital technologies. This project assesses Lisbon, rated 75th smartest city worldwide, in the dimensions of governance and mobility, finding that integration is one of Lisbon's biggest mobility challenges, although the market of Mobility as a Service is growing, and companies are developing solutions to support public entities used by the municipality. Therefore, Lisbon should implement an app based on the one developed by the market leader.

Keywords: Market Research, Smart City, Urban challenges, Mobility as a Service,

Integration

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Chapter 1 - Diagnose of the Smart City concept and project scope definition



1.1 – Complication Analysis

Why is it important to focus on cities?

What are the main problems cities are facing?

How will the environment of cities be in the future?

What is the possible solution to mitigate the outcomes of these challenges?

- Literature Review



1.2 – Smart City Definition

How can a Smart City be described?

What are the different layers of a Smart City, and which problems can it solve?

What are the dimensions of a smart city strategy?

What is the baseline point for a city to become “smart”?

- Literature Review



1.3 – Market Overview

How can we define the dynamics of the Smart Cities market?

Are companies already established in the market?

What is the current market value and how is it expected to grow?

What benefits can the implementation of Smart City measures bring to the economy?

- Literature Review



1.4 – Scope Definition

How is Lisbon performing worldwide as a Smart City?

What are Lisbon’s major weaknesses as a Smart City?

Why should Lisbon be considered a focus of the analysis?

What dimensions of the Smart City project should be analyzed in the case of Lisbon?

- Literature Review
- IMD ranking analysis

Key takeaways of Chapter 1, the diagnosis of a Smart City and project scope definition

?

1.1 – Complication Analysis, presenting the urban challenges for the future

Why are cities important?

Cities generate 60% of the world's GDP



Why are cities under pressure?

Urban population is growing, reaching 9.7 Bn citizens by 2050



What challenges are being faced?

Environmental, social and resource-based challenges

Smart Cities can be a solution to tackle the current challenges cities are facing



1.2 – Smart City Definition, understanding the dimensions of a smart city

A smart city is composed of ICT's, to collect and analyze data to find efficient and affordable solutions to urban challenges

Government

Health
& Safety

Education

Mobility

Environment
& Energy

Digitalization



1.3 – Market overview of Smart Cities, analyzing the market dynamics

Suppliers

Tech
Companies



Governments

Demand

Citizens



Businesses

Market evaluated in 393 Bn, in 2019, and set to grow at a rate of 13,4%, until 2030

Market
leaders



Smart Cities increase well-being, productivity, competitiveness, and innovation

1
2
3

1.4 – Scope Definition, analyzing the ranking and focusing on Lisbon's governance and mobility dimensions

Lisbon ranks 75th
in the IMD Smart City Ranking



The capital of Portugal, with a population of 500 000 citizens and 1M travelers per day, is set to receive investment



Lisbon scores worse in the ranking:
Mobility | Governance

Scope

Lisbon's governance and mobility dimensions, with a higher focus on mobility

Chapter 2 - Evaluation of the smart governance dimension, from challenges and best practices to recommendations



2.1 – Smart Governance Overview

What is the methodology used in the Smart Governance chapter?

Why is Smart Governance relevant and how is it growing?

How, according to the IMD Smart City Ranking, does Lisbon rank in Smart Governance against benchmark cities?

What governance challenges is Lisbon facing and how will they be addressed?

- Literature Review
- IMD ranking analysis



2.2 – Transparency

Challenge: Why is corruption a problem in Lisbon?

Best practices: How are best-practice cities mitigating corruption practices?

Recommendation: What should the Lisbon Municipality do to increase transparency?

- Expert Interviews
- Benchmarking
- Survey
- Literature Review



2.3 – Participatory Governance

Challenge: Why is shared-decision making a problem in Lisbon?

Best practices: How are best-practice cities implementing new digital civic participation channels?

Recommendation: What should the Lisbon Municipality do to incorporate and promote civic participation?

- Expert Interviews
- Benchmarking
- Survey
- Literature Review



2.4 – Digitalization

Challenge: Is digitalization used to leverage transparency and participatory governance?

Best practices: How are best-practice cities investing in digitalization?

Recommendation: How should the Lisbon Municipality address digitalization?

- Expert Interviews
- Benchmarking
- Survey
- Literature Review

Key takeaways of Chapter 2



2.1 Smart Governance Overview

Lisbon major Governance challenges:

1

Corruption



2.2 Transparency

Citizens see **government representatives** as being easily **corrupted** and have **low trust levels** in **public institutions**

City agencies and **digital platforms** to increase transparency in the public administration

Implement an E-Procurement platform

Challenge

Best Practices

Recommendation

2

Shared-decision making



2.3 Participatory Governance

There is a **low level of shared decision making**, due to low participation rates and participatory budget constraints

Digital tools to empower and understand citizens opinions

Develop digital shared-decision making initiatives



2.4 Digitalization

Digitalization benefits companies, municipalities, and citizens, that must face **challenges** arising from it

Challenge & Best Practices

Recommendation

Digital transformation plans to promote effective interactions with citizens and efficient services

Stage 1: Digital transformation focused on citizens

Stage 2: Digital transformation focused on services

Chapter 3 - Evaluation of the Smart Mobility dimension, from challenges and best practices to recommendations

	3.1 – Smart Mobility Overview What is the methodology used in the Smart Mobility chapter? How is Smart Mobility relevant? How, according to the IMD Smart City Ranking, does Lisbon rank in Smart Mobility against benchmark cities? What mobility challenges is Lisbon facing and how will they be addressed?	• Literature Review • IMD ranking analysis
	3.2 – Individual Mobility Challenge: Why is traffic congestion a problem in Lisbon? Challenge: Why is parking availability a problem in Lisbon? Market & best practices: How is the market behaving to reduce traffic congestion and parking inefficiencies? Recommendations: What solutions can be used to reduce traffic congestion and improve smart parking in Lisbon?	• Literature Review • Expert Interviews • Benchmarking • Survey
	3.3 – Shared Mobility Challenge: Why is public transportation not satisfactory in Lisbon? Challenge: Why are mobility-sharing apps not reducing traffic congestion in Lisbon? Market & best practices: How is the market for shared mobility behaving to improve the two services? Recommendations: What solutions can be used to improve the services of public transportation and mobility-sharing apps?	• Literature Review • Expert Interviews • Benchmarking • Survey
	3.4 - Mobility Administration Best practices: How is the use of more sustainable modes of transportation being incentivized? Best practices: How are individual and shared mobility being financed? Recommendations: How can Lisbon incentivize citizens to use public transports? Recommendations: How can Lisbon finance sustainable mobility investments?	• Literature Review • Expert Interviews • Benchmarking • Survey

Key takeaways of Chapter 3



3.1 Smart Mobility Overview

Lisbon major Governance challenges:

1 Traffic Congestion

2 Parking Solutions

3 Public Transportation

4 Mobility Sharing Apps



3.2 Individual Mobility

570 000 cars circulate every day

Demand for parking exceeds supply

Tech-driven traffic solutions

Data analytics, e-payment, sensors, and cameras

Implementation of Congestion Charging

Incorporation of Sensors and App-guidance

Challenges

Market & Best Practices

Recommendation



3.3 Shared Mobility

Consumer satisfaction below average

Apps are not being used enough

Cloud and traffic management

Bike-sharing will grow significantly
Promotion of car-sharing

Contactless Payment System
Real-Time Demand Tracking

Car-Sharing app for corporations
Development of Bike infrastructure



3.4 Mobility Administration

Sustainable modes of transportation can be incentivized ...

A Gamified system, where citizens can gain rewards by using shared-mobility options

Best Practices

Recommendation

... and financed by the public budget or public-private partnerships

Green bonds to finance sustainable mobility investments

Chapter 4 - Implementation of Mobility as a Service in Lisbon



4.1 – From Smart Mobility to Mobility as a Service

What is the future challenge in urban mobility?

Why should we focus on Mobility as a Service?

How can we define Mobility as a Service?

What are the different integration levels of Mobility as a Service?

- Literature Review
- Expert Interviews



4.2 – Mobility as a Service Market

What is the current market value?

What is the market potential?

What are the market dynamics?

What is the current leader company in the MaaS market?

- Literature Review
- Benchmarking



4.3 – Best Practice Analysis

What is Whim?

What are Whim's main characteristics?

How does Whim attract customers?

- Literature Review
- Benchmarking



4.4 – Recommendation for Mobility as a Service in Lisbon

How will the customer journey in Lisbon look like?

How will the ecosystem be composed?

What conditions must be ensured for the implementation of a MaaS service?

What would be the impact of a MaaS service in Lisbon?

- Literature Review
- Expert Interviews
- Benchmarking

Key takeaways of Chapter 4, the Implementation of Mobility as a Service in Lisbon



4.1 – From Smart Mobility to Mobility as a Service, understanding how MaaS can solve the integration challenge

According to the different interviewees, the **major challenge for the future of mobility** is the **integration** of the several transport modes

Mobility as a Service (MaaS) is the **integration** of various forms of **transportation services** into a **single service**, on-demand. It offers **added value** through a **single application** providing **access to mobility**, with a **single payment channel**



4.2 – Mobility as a Service Market, analyzing the market dynamics

The US/Europe/China market grows at a CAGR of 25%, reaching 1 400 Bn Us Dollars by 2030

Companies and Public Players invest in the integration of services



MaaS Global is the market leader, founder of the Whim app



4.3 – Best Practice Analysis, analyzing the mechanisms of a MaaS service



The “1st MaaS solution commercially available” tries to **beat the service level** of a car

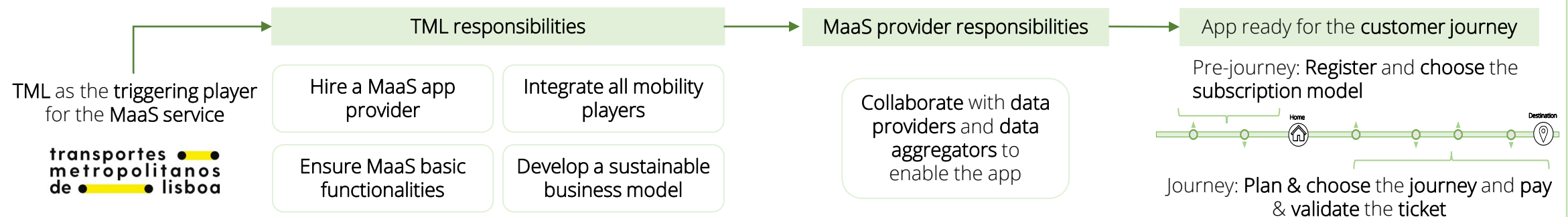
Plan a multimodal route

Use electronic tickets
(individual or subscription model)

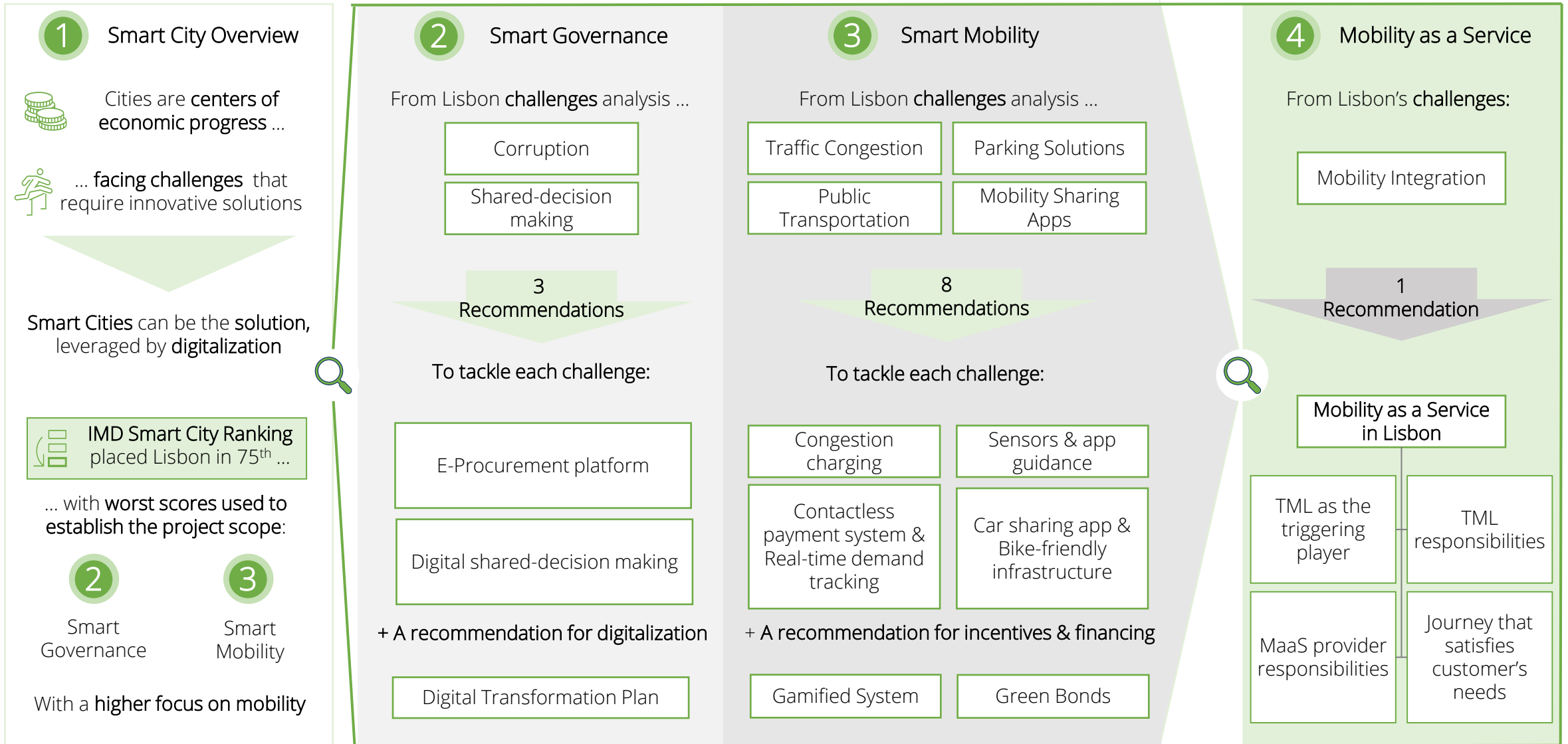
Payment via the app



4.4 – Recommendation for Mobility as a Service in Lisbon



From understanding Smart Cities to analyzing Smart Governance and Smart Mobility in Lisbon and concluding with a MaaS recommendation to the city



Project Overview



1

Smart City Overview

Diagnose of the Smart City concept and project scope definition

slide 2-8

- 1.1 – Complication Analysis
- 1.2 – Smart City Definition
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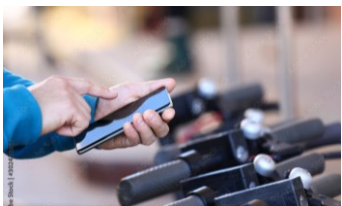
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Smart Governance

Evaluation of the Smart Governance dimension from challenges to recommendations

slide 9-20

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Smart Mobility

Evaluation of the Smart Mobility dimension from challenges to recommendations

slide 21-40

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4

Mobility as a Service

Implementation of Mobility as a Service in Lisbon

slide 41-48

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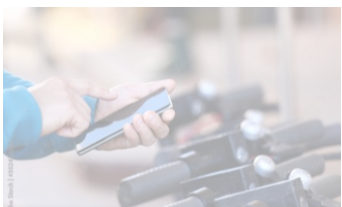
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In the next few years, cities' growth will pose challenges that require innovative solutions

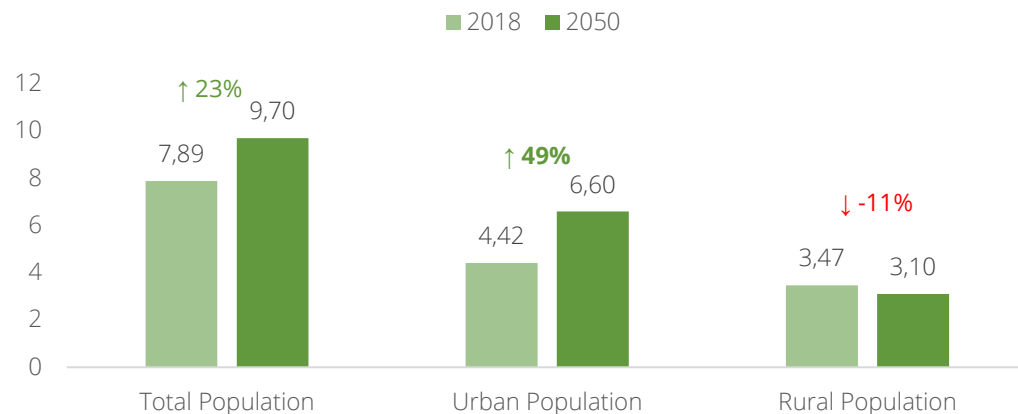
Cities are centers of economic progress, concentrating 60% of Global GDP



Urban Population will be 68% of the world's population by 2050

In 2018, the world's total population amounted to 8 billion. In 2050, the total population will reach 9.7 billion, with an urban population of 68% ⁽¹⁾

Urban Population is expected to grow by 49% until 2050 (in billion) ⁽¹⁾



Cities face many environmental, social and resource-based challenges



80%

World's food consumption in cities ⁽⁶⁾



75%

Primary energy sources are consumed in cities ⁽⁷⁾



2.01 Billion tones

Solid waste generated in 2016 in cities ⁽⁸⁾



91%

Urban citizens face poor air quality ⁽⁹⁾



+ 60% of greenhouse gas emissions produced by cities that only cover 2% of the land ⁽¹⁰⁾

Cities cannot grow as they previously did, and the adoption of Smart City solutions can tackle the growth most relevant challenges

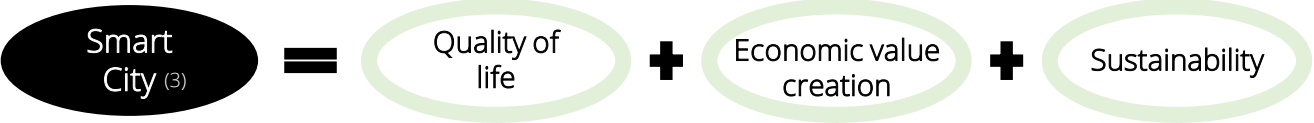


Smart Cities tackle urban challenges by adding digital intelligence to the urban world

A Smart City ...

Framework composed of **technologies** to **collect** and **analyze data** used to **manage city infrastructure** and to find **efficient** and **affordable solutions** to urban challenges ⁽¹⁾

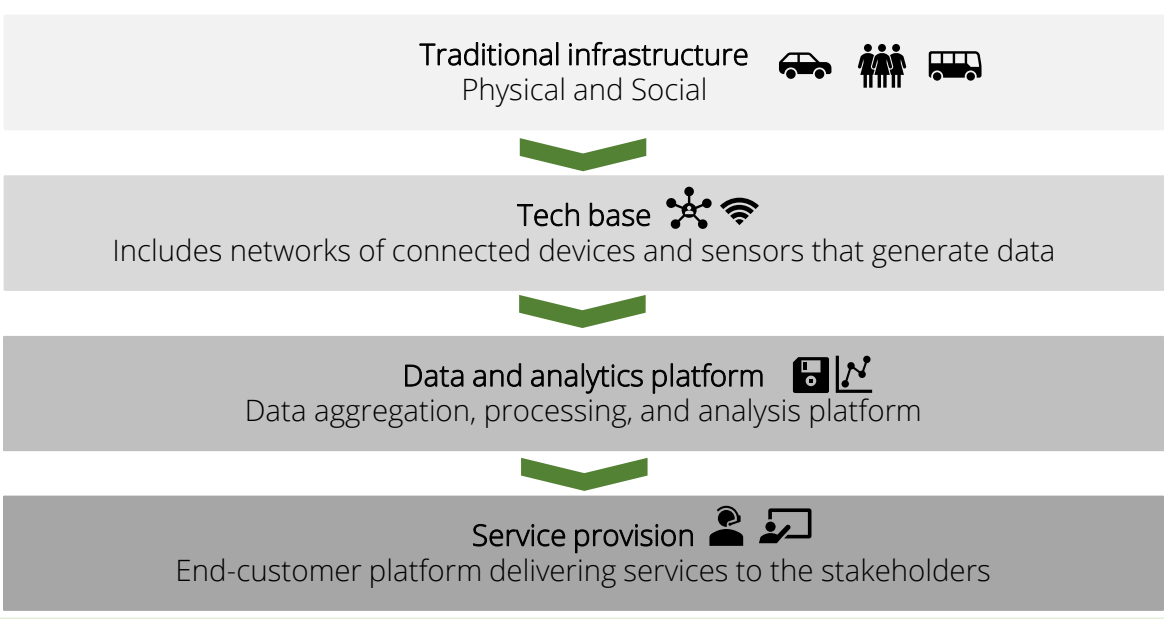
There are different **stakeholders** involved in a **collaborative process**: ⁽²⁾  **Government**  **Business**  **Citizens**



... leverages technology to help solve urban problems

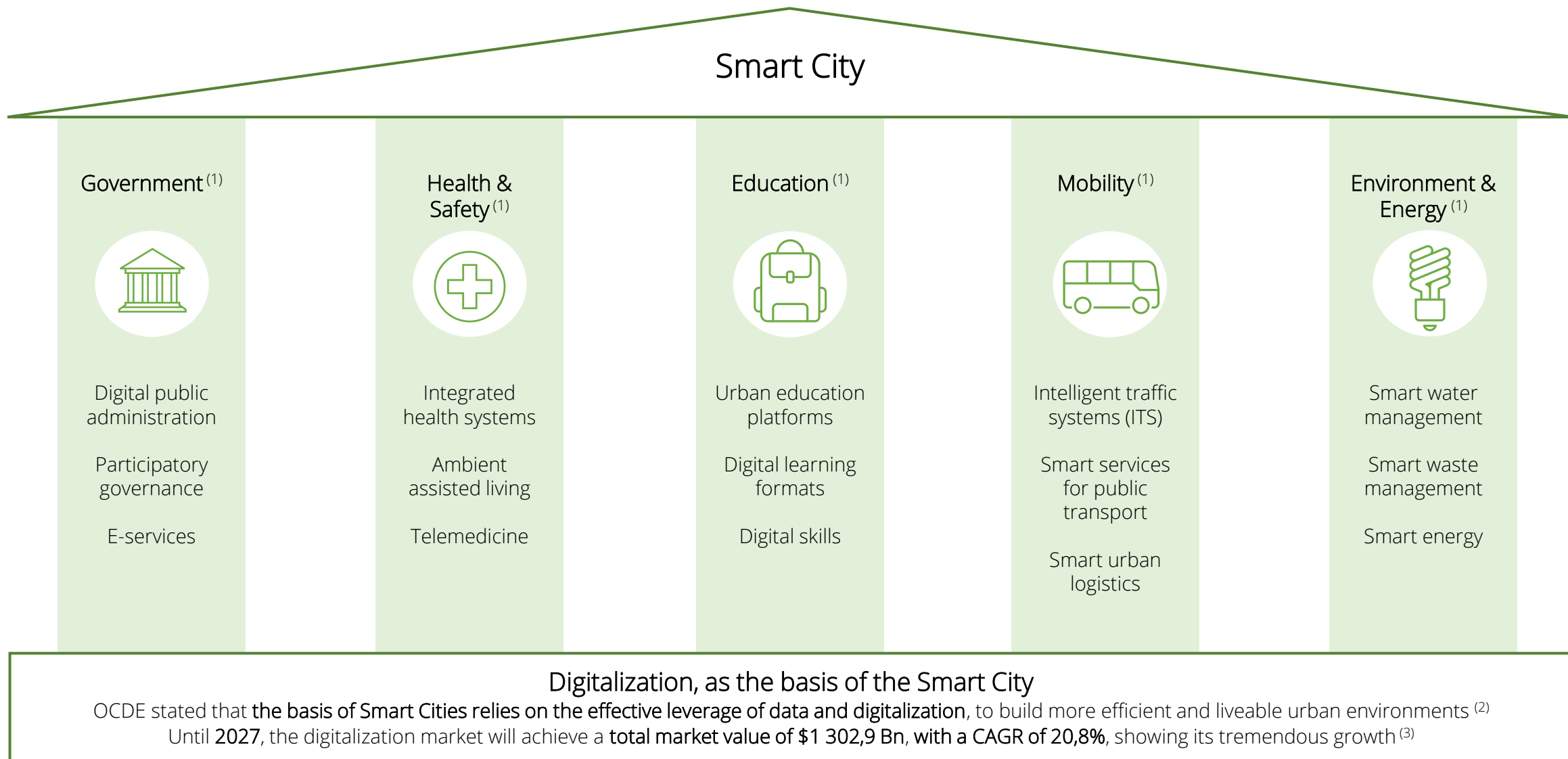
Quality of life 	Self-sustaining energy grids, greener spaces, a reasonable commute, ... ⁽³⁾
Economic Value Creation 	Produces new revenue streams and cost efficiencies , creating capital for new Smart City investments and attracting businesses, citizens, tourists, and skilled labor ⁽⁶⁾
Sustainability 	Improves quality of life and generate economic value for upcoming generations ⁽³⁾

The layers illustrate how technology is applied to the urban world ^{(4) (5)}





Smart Cities have 5 comprehensive dimensions leveraged by digitalization





The market for Smart Cities is expected to grow at a fast pace with companies providing innovative solutions to cities

The Smart City market has leading tech companies providing innovative solutions to governments, citizens, and businesses ⁽¹⁾

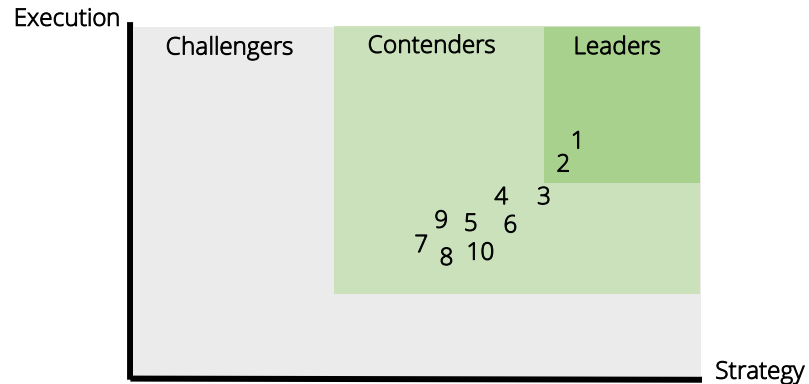


Many of the biggest tech companies are investing in Smart City solutions, with Cisco and IBM being the current market leaders

The top 10 companies behind the Smart City market are ⁽³⁾:

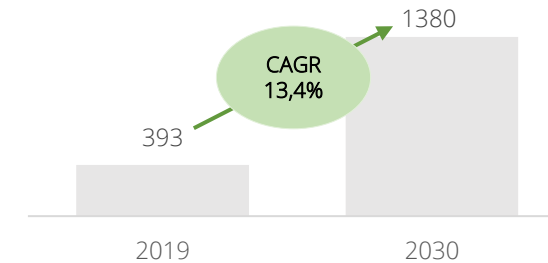
- | | | | | |
|-------------|------------------------|---------------|------------|---------------|
| 1. CISCO | 2. IBM | 3. Microsoft | 4. HUAWEI | 5. SIEMENS |
| 6. HITACHI | 7. Schneider Electric | 8. TOSHIBA | 9. ORACLE | 10. ERICSSON |

Cisco and IBM being the market leaders, excel in terms of execution (financial performance) and market strategy ⁽⁴⁾

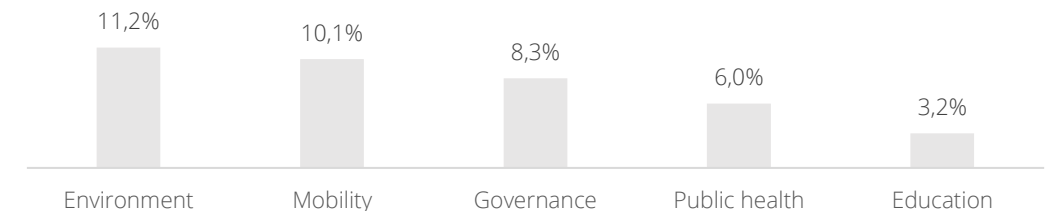


The market will have a CAGR of 13,4% until 2030, with cities investing in new technologies due to high returns

The market revenue CAGR is estimated to be 13,4% until 2030 ⁽⁵⁾



The returns on investment (ROI) for Governments are high in all Smart City dimensions ⁽⁶⁾



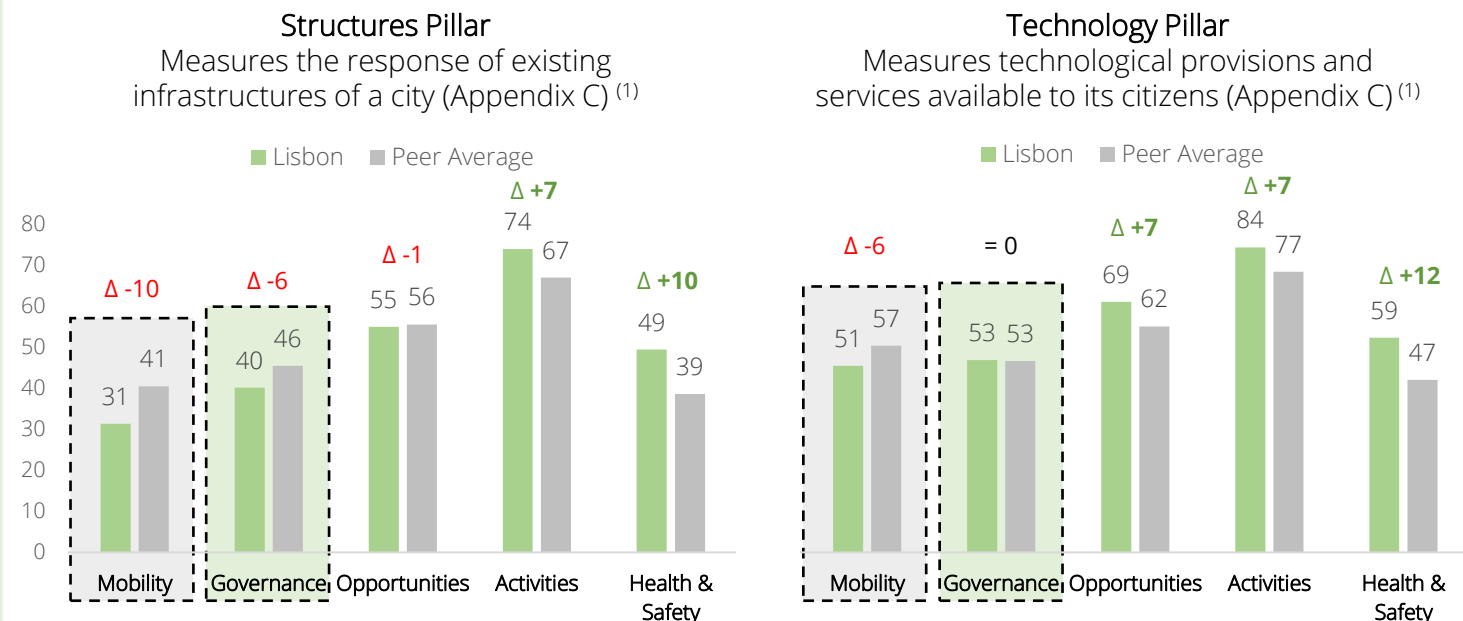


The Institute for Management Development (IMD) rated Lisbon in the 75th position of its ranking, with the worst deviation from the peer average scores in Governance and Mobility

Lisbon ranks 75 out 109 in the IMD Ranking ⁽¹⁾

City	Smart City Ranking 2020	Changes from 2019
Singapore	1	→ 0
Helsinki	2	↑ 6
Zurich	3	↓ -1
Auckland	4	↑ 2
Oslo	5	↓ -2
Copenhagen	6	↓ -1
Geneva	7	↓ -3
Taipei	8	↓ -1
Amsterdam	9	↑ 2
New York	10	↑ 28
Munich	11	new
Washington	12	↑ 19
Dusseldorf	13	↓ -3
Brisbane	14	↑ 13
London	15	↑ 5
Stockholm	16	↑ 9
Manchester	17	new
...		
Milan	74	↓ -52
Lisbon	75	↑ 1
Bratislava	76	↑ 8
...		
Nairobi	108	↓ -8
Lagos	109	↓ -7

Lisbon worst scores, including in relation to the peer average, are in Governance and Mobility, according to IMD's Smart City Ranking



120 Lisbon's citizens surveyed chose 6 priority areas for the city related to mobility and governance (Appendix C):

Mobility

- Road Congestion
- Public Transports
- Air Pollution

Governance

- Affordable Housing
- Corruption
- Unemployment



The focus of the research will be Lisbon, considering the dimensions of Smart Governance and Smart Mobility

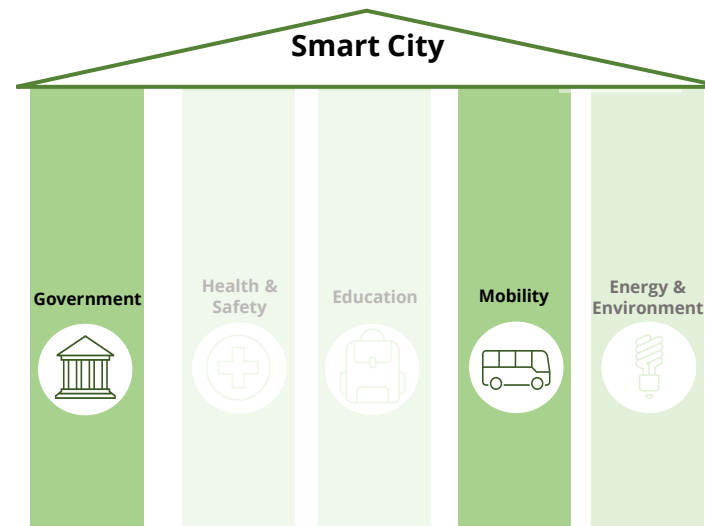
The municipality of Lisbon will be studied ...



- Capital of Portugal ⁽¹⁾
- 500 000 citizens in 2017 ⁽¹⁾
- Pressured due to the 1M people and 370 000 cars that enter each day ⁽¹⁾
- High financial support from the EU – “Plano de Recuperação e Resiliência” ⁽²⁾

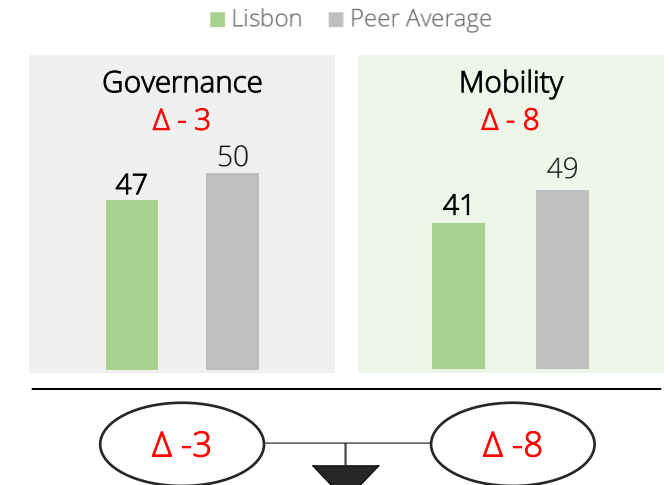
... considering Smart Governance and Smart Mobility ...

- Low scores in the IMD ranking ⁽³⁾
- Lisbon's citizens top priorities ⁽³⁾



... with a higher focus on the mobility dimension where the gap is bigger

Average of Structural and Technological Pillars ⁽³⁾



Difference between Lisbon and the peer average is higher for mobility than governance



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Mobility as a Service

Implementation of Mobility as a Service in Lisbon

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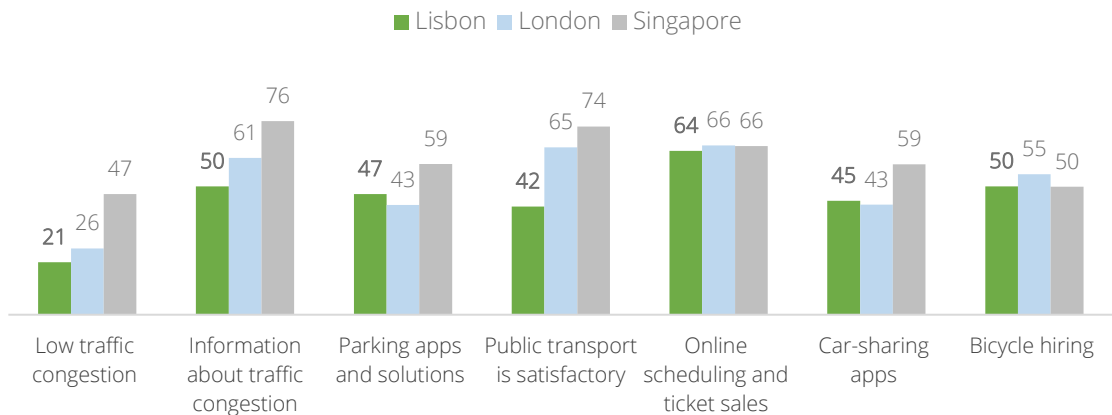
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According to several conducted interviews, the integration of the different modes of transportation is Lisbon's major future mobility challenge

In Chapter 3, Lisbon's current mobility challenges, identified from the ranking, were addressed through several recommendations

- Lisbon's mobility scores from the IMD Smart City Ranking were analyzed:⁽¹⁾

According to the IMD, Lisbon, Singapore, and London scores in all the Mobility Domains ⁽¹⁾



leading to 4 challenges ...

- 1

Road Congestion
- 2

Parking Solutions
- 3

Public Transportation
- 4

Mobility Sharing Apps

Then, several recommendations were made to mitigate the challenges

In Chapter 4, Lisbon's challenge of mobility integration, identified through the conducted interviews, will be addressed

- Interviewees mentioned the future of mobility as the major mobility challenge:⁽²⁾

Interview Quote:
“... integration ... one of the biggest challenges in Lisbon” – Bernardo Sousa, Portugal Digital ⁽²⁾

Interview Quote:
“... The interest for integration exists ...” – Helena Martins, CML ⁽²⁾

Interview Quote:
“...one ticket for several different transport modes...” – João Castro, Nova SBE ⁽²⁾

Interview Quote:
“...aggregation and integration of information...” – Pedro Pereira, Metro ⁽²⁾

Interview Quote:
“... You must integrate it with the different mobility services...” – Diogo Santos, Deloitte ⁽²⁾

leading to 1 future challenge...

Mobility Integration

Therefore, a recommendation will be made, addressing Mobility Integration

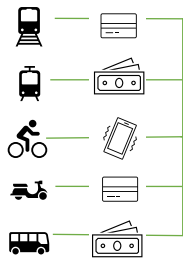
Mobility as a Service, implemented at different levels, can be the solution for the mobility integration challenge

Mobility as a service (MaaS) is the integration of different transportation modes into a single platform, with a unique payment channel

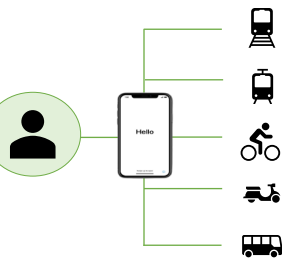
How can Lisbon integrate its different mobility options?

Mobility as a Service (MaaS) is the integration of various forms of transportation services into a single service, on-demand. It offers added value through a single application providing access to mobility, with a single payment channel ⁽¹⁾

Current model ⁽²⁾



MaaS model ⁽²⁾



Today – One vehicle for trip purpose ⁽³⁾



Integrated in one service

2030 – A solution for each specific purpose ⁽³⁾



MaaS services have 4 levels of integration with an increasing capability to plan journeys, provide e-tickets, subscription plans, and incentives ⁽⁴⁾

Level 1

+ Journey planning

Main Players:



Level 2

+ Journey planning + E-ticketing

Main Players:



Level 3

+ Journey planning + E-ticketing
+ Subscription plan

Main Players:



Level 4

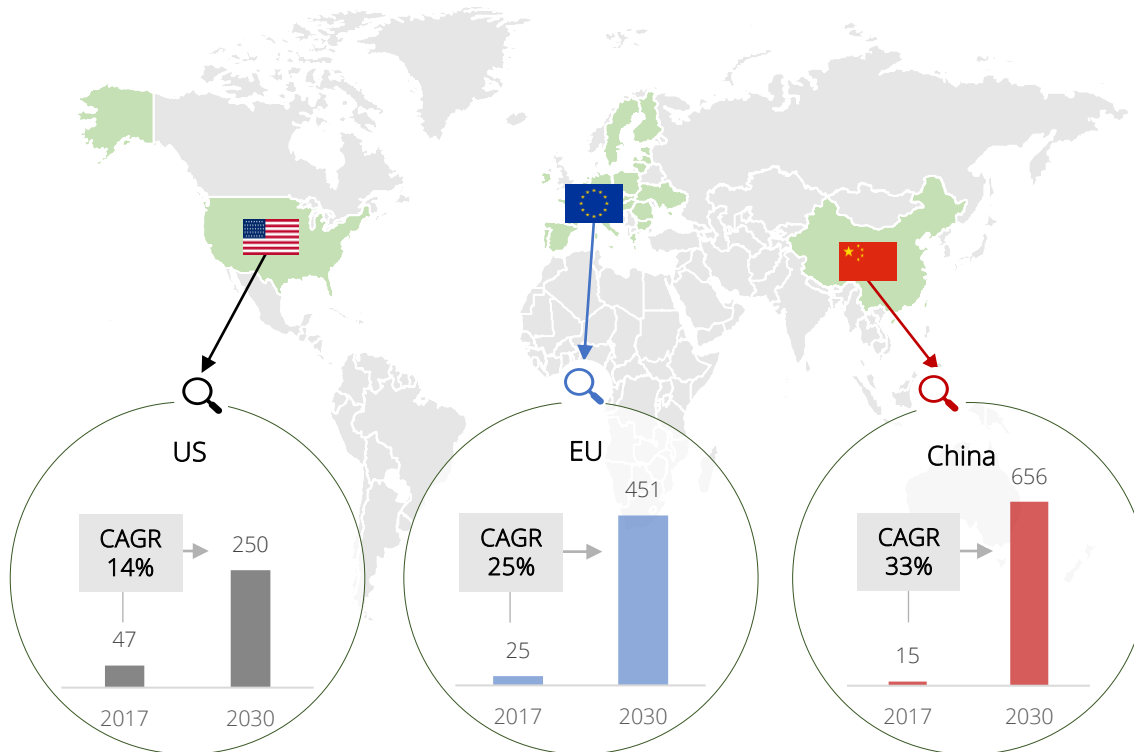
+ Journey planning + E-ticketing
+ Subscription plan + Incentives

No level 4 MaaS company still exists

The Mobility as a Service market is forecasted to grow at a high rate, with the private sector being the main provider of solutions in this area, supported by public entities

The MaaS market grows at a CAGR of 25% with the US, EU, and China being the regions with higher market development

The US/EU/China markets, in revenue, are expected to grow at a combined CAGR of 25% from 2017 to 2030, reaching 1,400 Bn Us Dollars ⁽¹⁾



MaaS market has already companies investing in the aggregation and integration of services, with the help of public players



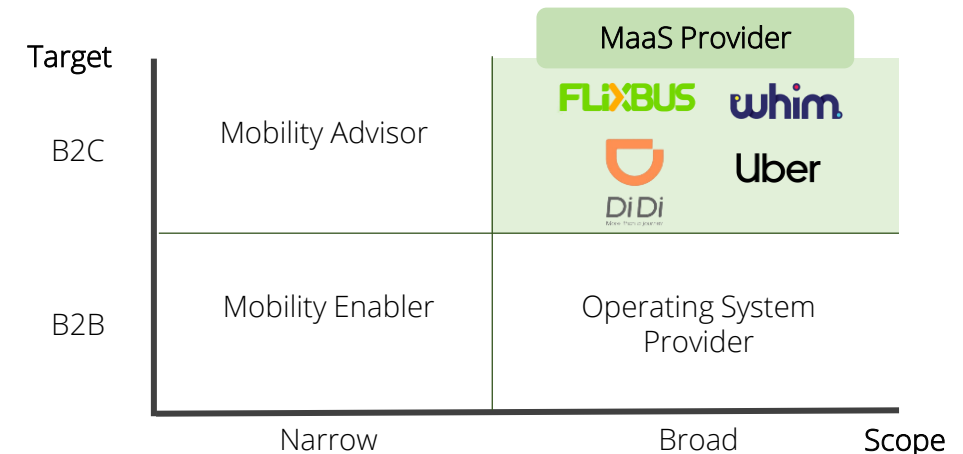
The company MaaS Global is MaaS market leader

maas
GLOBAL

Founder of the Whim App, the world's first true MaaS operator ⁽³⁾



- In the mobility market, a MaaS provider is placed in different phases of the consumer journey: ⁽²⁾



Whim, the reference for MaaS apps, captures customers by integrating all transportation modes and allowing for journey planning, e-ticketing, and online payments

Whim users build a multimodal route and pay for it all on the app, allowing for convenience and adaptability to the individual needs

- Interconnects public and private transportation - bus; train; metro; tram; ferry; taxi; car; bike and e-scooter share ⁽²⁾⁽³⁾ - within a single app and single payment channel ⁽¹⁾

Characteristics that attract customers due to the recognition of individual needs:

End to end trip planning ⁽⁴⁾

Users select their preferred mode of transportation or the combination ⁽³⁾

Multimodal route: ⁽⁵⁾

Pohjois-Haaga, 00400 Helsinki

46 min

ABC

11:48

🚲

Cycle 1,5 km / 5 min

11:59

🚌

Bus 721

Kuusikkotie

2 stops

Sumatrantie

12:12

🚶

Walk 139m / 2 min

12:18

🚇

Metro

Intiankatu

11 stops

Eliel Saarisen tie

12:33

🚶

whim

Electronic ticketing ⁽⁴⁾

Users purchase tickets individually or use the active ticket via the app ⁽³⁾

Active ticket- Subscription plans available: ⁽⁶⁾

Whim to Go	Pay as you go
HSL 30-day season ticket	€62,7/month
Whim Plus	€2,99 per 30 days
Whim Unlimited	€600 /month

The access to more transport modes, minutes, and kilometers increases as the price increases

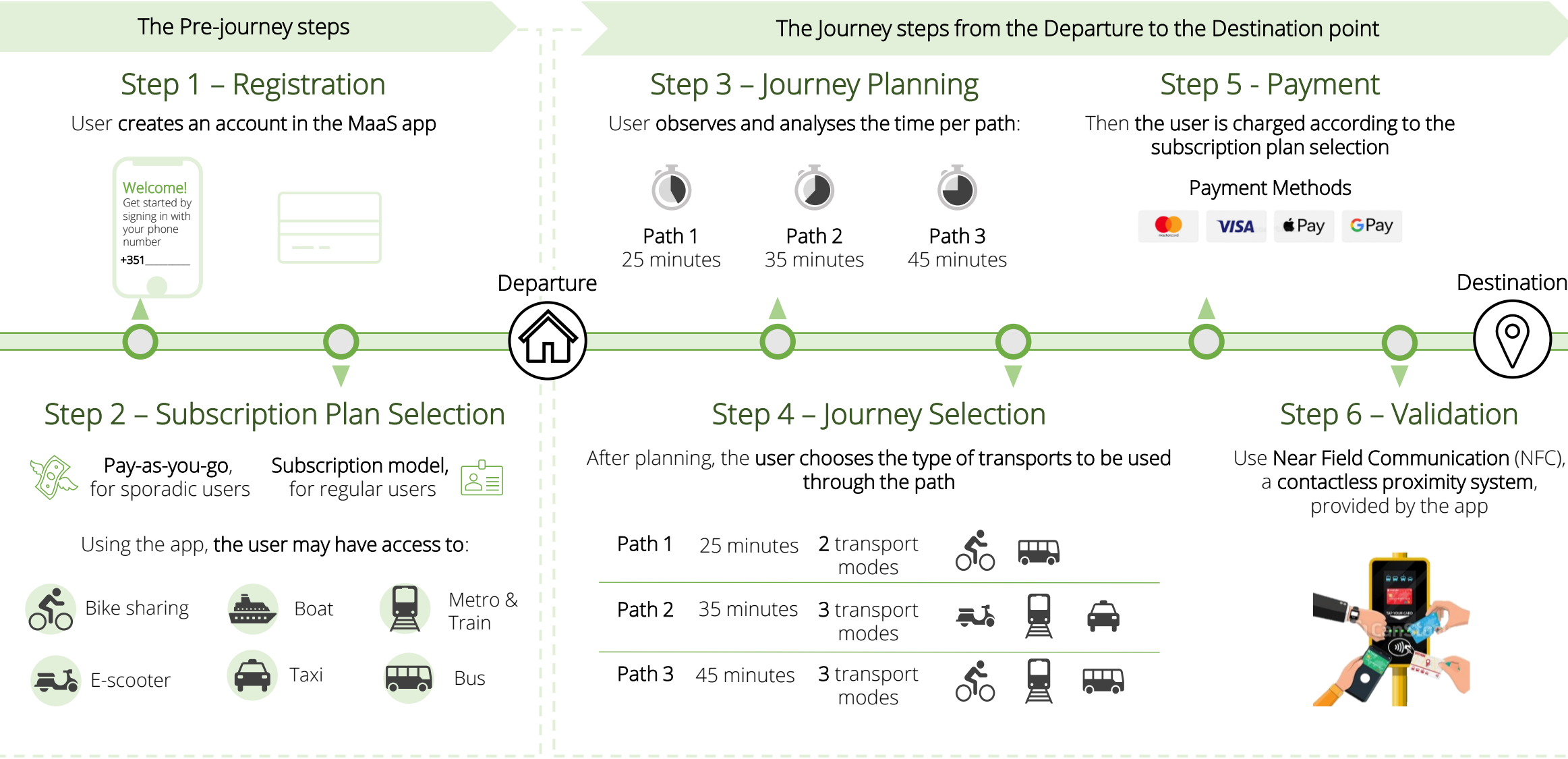
Payment services ⁽⁴⁾

All the transportation modes are integrated in the same ticket paid via credit card already associated with the app ⁽³⁾

Integration → Convenience ⁽²⁾

“We want to prove we can beat the service level of a car” – Sampo Hietanen, CEO of MaaS Global ⁽²⁾

A MaaS service in Lisbon would entail 2 pre-journey steps, before having the service, and 4 journey steps, occurring from the user's departure to the destination





The Metropolitan Transport Authority and a MaaS provider must collaborate to integrate Lisbon's mobility players and create the mobility app

The TML should be the trigger for the MaaS service in Lisbon due to its know-how in managing the transportation system and integrating the tickets

- The Metropolitan Transport Authority, TML, is a public company owned by Lisbon Metropolitan Area, AML
- It is responsible for the **management** of the **public transportation system** and the **integration of the tickets** in a single card ⁽¹⁾



Interview Quote: "TML should be the player triggering the MaaS service integration in Lisbon" ⁽²⁾ – Marcos Paulo, Deloitte

TML needs to hire a MaaS app provider...

Cooperate with the MaaS app provider for the development of the software: ⁽²⁾



... and integrate mobility players

Ensure the mobility players integrate their services into the app: ⁽³⁾



Car-sharing



Parking



Metro



Bicicletas de Lisboa Bike-sharing



Bus



Train

The MaaS provider must seek collaboration with data providers ...

Identify a range of transportation options and offer real-time traffic updates: ⁽³⁾



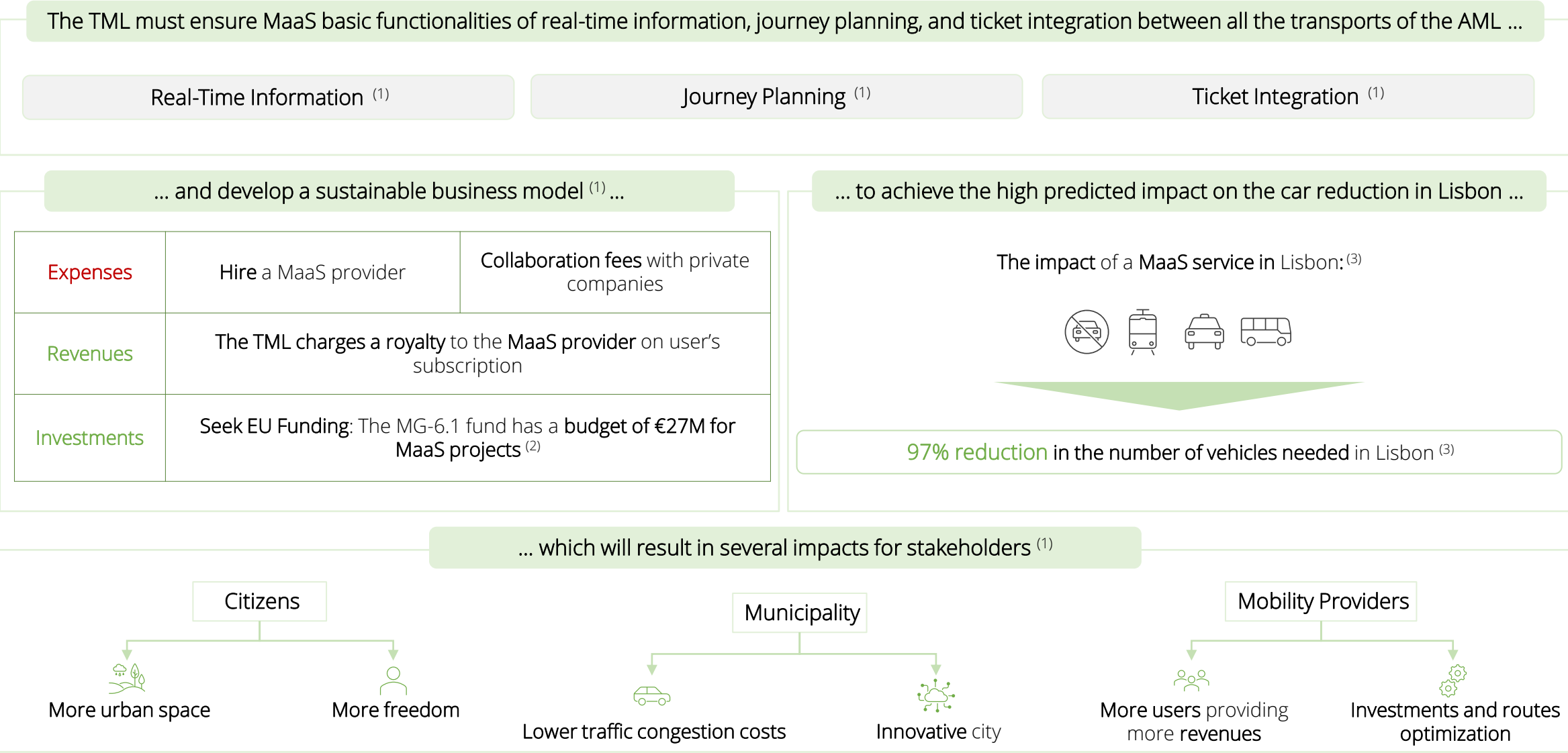
... and companies to aggregate the data

Link mobility services, arrange bookings, and facilitate payments in a single gateway: ⁽³⁾



Interview Quote: "The MaaS operator is the **core** of the whole **strategy**. All the **players** need to **collaborate** to promote the **final mobility as a service** " ⁽²⁾ – Marcos Paulo, Deloitte

For the successful implementation of the MaaS service in Lisbon, the TML must ensure basic functionalities and develop a sustainable business model, to generate a positive impact



Thank you

We are ready for your questions!

Appendix

Disclaimer



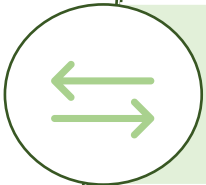
Expertise limitations on technology, programming or engineering

The group has no background in technology, programming, or engineering. Therefore, the recommendations were based on initiatives of best practice cities, with no technical implementation details.



Specific context of Lisbon

Lisbon's characteristics as a city might influence the potential impacts that can result from the specific recommendations made. There are structural and cultural aspects that can be a challenge for future changes and specific evaluation of the city.



Difficulty in contacting municipality due to changes in the executive

In September 2021, after the definition of the project scope and the start of the analysis, the elections were won by Carlos Moedas and his coalition "Novos Tempos". The transition to the new executive diffculted the process of interviewing new and past members of the executive staff.



Space and time constraints of the work project

The group used the IMD Smart City Ranking as a tool to identify Lisbon's main Governance and Mobility challenges. A market characterization of each challenge followed. Considering the time and space constraints of the Work Project and the fact that each of the challenges is part of a specific market, the analysis of each of the challenges is not as thorough as the group wished.

Appendix A: Stakeholders have different perspectives on the smart city definition

National Governments

Denmark	"Initially, the concept was only used in a narrow and governmental context especially in relation to environmental, energy and infrastructure issues in terms of how information and communication technologies can improve urban functionality. Subsequently, virtually all other areas of welfare started working with Smart City, for example in business development, innovation, citizen involvement, culture, healthcare and social services, where the use of data and digital platforms helps smart new solutions"
Latvia	"Smart city as a city which implements a strategic package of measures to address the most pressing challenges and boost the competitiveness of the area, providing solutions for citizens and entrepreneurs, inter alia such measures which i) do not require substantial maintenance in the long term (save resources); ii) provide more efficient public services (faster, more comfortable, cheaper, e-services, one stop shop principle); iii) improve overall well-being of society, security and public order; iv) allow timely anticipation and prevention of potential challenges (flood hazards, energy shortages, heat losses, sewer leaks, etc.); iv) do not affect, reduce or eliminate impact on environment; and v) are based on smart development planning, which responds flexibly to the most pressing challenges and development opportunities in the area, identifying existing and potential competitive sectors and promoting their development, as well as providing cooperation between different stakeholders (public administration, entrepreneurs, academics, NGOs, citizens).
United Kingdom	"The concept [of the smart city] is not static: there is no absolute definition of a smart city, no endpoint, but rather a process, or series of steps, by which cities become more "livable" and resilient and, hence, able to respond quickly to new challenges."

International Organizations

European Union	"A smart city is a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses" (European Commission, 2014).
United Nations	"A smart city makes use of opportunities from digitalization, clean energy and technologies, as well as innovative transport technologies, thus providing options for inhabitants to make more environmentally friendly choices and boost sustainable economic growth and enabling cities to improve their service delivery." (United Nations, 2016)
Inter-American Development Bank	"an innovative city that uses ICT and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects" (Bouskela et al., 2016).

Appendix A: Stakeholders have different perspectives on the smart city definition

Private Sector

Smart Cities Council	"This collective of several major large corporate firms active in smart city technology (including Cisco, IBM, Intel, and Qualcomm) proposes the following definition: "a smart city gathers data from devices and sensors embedded in its roadways, power grids, buildings and other assets. It shares that data via a smart communications system that is typically a combination of wired and wireless. It then uses smart software to create valuable information and digitally enhanced services" (Smart Cities Council, 2012)
IBM	"A smart city makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources"
Cisco	"Smart cities as those that adopt scalable solutions that take advantage of ICT to increase efficiencies, reduce costs, and enhance quality of life"

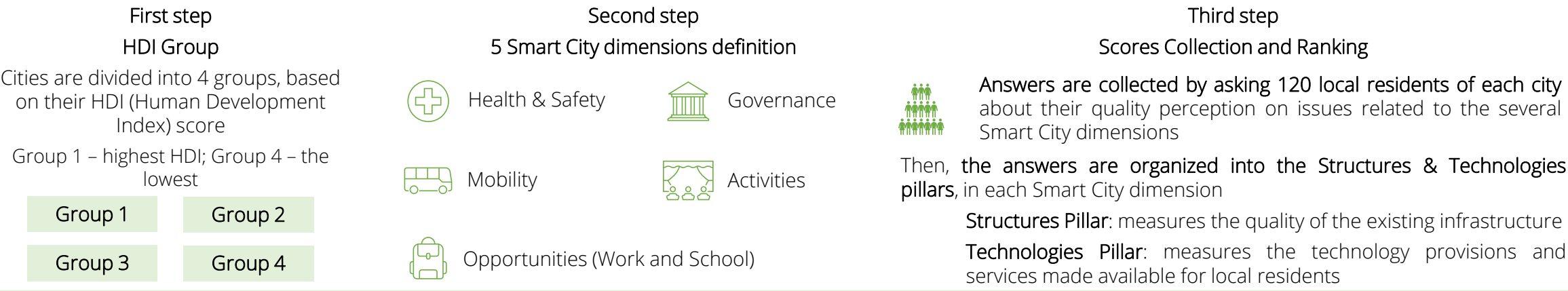
Appendix B – There is ample room to move towards smarter solutions

- Levels of Complexity and Benefits of different smart city solutions +			
Quality of life	"Fix my street": non-emergency problems are risen from the citizen to the municipality	Digital kiosk widely installed throughout the city	E-participation of citizens into decision making of municipality
	Connected CCTV monitoring the city	Predictive policing based on camara feeds and crowd analysis	Facial recognition of people from CCTV and automated tracking
	Clever repartition of patients in function of hospital capacity	Real time air quality measurement at granular local level	Body temperature and other health parameters monitored by on-street camera to detect epidemics
	Detection-based traffic light priority order when no traffic (binary system)	Traffic light order based on number of cars awaiting, detected by cameras	Autonomous car sharing infrastructure with automated route optimization based on traffic and incidents
Economic Value Creation	Corrected bins notifying full for garbage truck routing optimization	Connected LED lights controlled dynamically in function of outdoor luminosity and amount of people	Underground waste vacuum system with automated sorting and recycling at the waste station
	Smart lockers for last mile delivery	User-customized advertisement on street screens	Drone deliveries to decongest ground traffic
	Location-based advertisement	Crowd management by localizing individuals to optimize crow moves	Drone surveillance of large-scale events
	Smartmeter: consumption meter sends data to energy/water provider at regular intervals	Automated reporting to citizens about their energy usage and plan for optimizing energy use	Smart grid, enabling bi-directional energy flow with adaptive energy storage and power management
	Widely Available	Piloting Phase	Cutting Edge

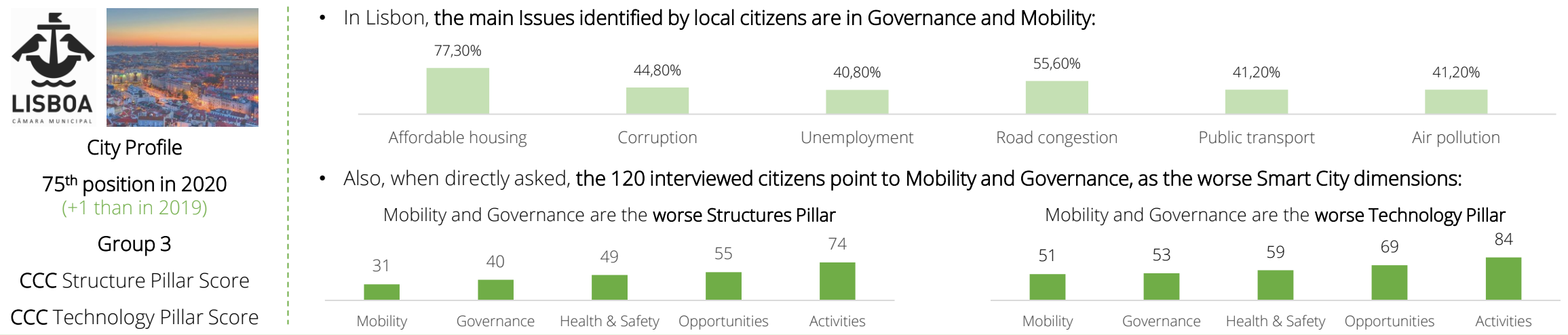
Appendix C – Ranking methodology and Lisbon scores

The Smart City ranking methodology is based on asking 120 citizens, their perceptions on different dimensions, of their city

- The Institute for Management Development organized the IMD Smart City Ranking 2020, which had 109 worldwide cities ranked, based on the perception of its citizens on several Smart City dimensions and issues



Lisbon ranked 75th in 2020, with its lowest scores on Governance and Mobility



Appendix D – Methodology and Data Collection

12 expert interviews were conducted

Qualitative research was conducted to collect **primary data**. The need to understand deeply the smart city concepts and to have access to Lisbon-specific information motivated the realization of **12 expert interviews** on the **topics** of **transparency**, **participatory governance**, **traffic congestion**, **parking solutions**, **mobility sharing apps**, and **mobility as a service**. The interviewee's **expertise** in the previously mentioned topics was **attested** by a **research** of their profiles. The interviewees were contacted via email interviewed either by Francisco Fialho, Matilde Florêncio, or Rodolfo Junqueira.

The **interviews** were **semi-structured** and lasted **30 minutes**. The **interviewers followed a guide** of predetermined open-ended questions on the topics to cover but were able to **ask other questions** considered relevant within the trajectory of the interview.

Introduction used during the interview

"Good afternoon. My name is ... and I am a MSc management student at Nova School of Business and Economics. I am in the thesis semester, doing **market research on smart cities** with two other colleagues. The **focus** of the research is **Lisbon** as a smart city. Based on the score Lisbon obtained in the IMD index (International Institute of Management Development), we decided to deepen the analysis in the **smart mobility** and **smart governance** areas. [Specific description of the topics to be covered during the interview depending on the expertise of the interviewee]. To be successful in our analysis, we need your collaboration and expertise to answer the questions during the interview. We understand that your schedule is busy and so we will try to do the best of your time. This interview should take approximately 30 minutes, and consists of a semi-structured interview, which means that I will ask you several questions, to which there are no right or wrong answers, and you are free to say whatever you think of the subject. To analyze our interviews later, I would like to record our conversation. Is that okay with you? All recordings will be destroyed when the thesis ends, in January 2022."

Filter question

"I have two initial questions to ensure we are on track on the different stakeholders of a smart city project heard during the process. What is your current job? What are your current functions? "

Final appreciation

" Thank you very much for your time and feedback - the contribution of our thesis to make Lisbon "smarter" will be better because we could count on your opinion and expertise! Have a great day!"

Appendix D – Interviewees Profile used in Smart Governance

Bernardo Sousa Coordinator at Portugal Digital 	Bernardo is coordinating the first pillar of the action plan for the Digital Transition in Portugal. The strategy aims to provide digital skills to citizens to avoid digital exclusion. The plan predicts the mobilization of public and private stakeholders, the design of measures and initiatives, and the monitoring of the implementation process. Bernardo has a complete vision of the digitalization scenario in Portugal, with a focus on the citizen as a stakeholder.
Filipa Roseta Councillor of Urbanism at Câmara Municipal de Lisboa 	Filipa is the newly elected Councilor of Urbanism and Public Housing at Camara Municipal de Lisboa, where she faces the difficult challenge of rising housing prices in the capital. Part of the new Mayor Carlos Moedas team, she joined CML in September 2021. Filipa has prior experience as Councilor of Urban Planning at Camara Municipal de Cascais. In the political spectrum, Filipa is part of Partido Social Democrata (PSD) and was part of the Assembly group of the party, leaving in September 2021, to be able to join Carlos Moedas' team.
Helena Martins Manager of Smart City Projects at Câmara Municipal de Lisboa 	Helena manages the laboratory of urban data of Lisbon's municipality, <i>Portal Lisboa Inteligente</i>, which integrates <i>Portal dos Dados Abertos</i> and <i>Lx Data Lab</i>. She has been involved in the implementation of sensors in Lisbon to collect data about mobility, pollution, etc., and in the project ZER, aiming to reduce traffic circulation in the main arteries of the city. Helena has, therefore, a deep understanding of the governance and mobility environments in Lisbon.
Jean Barroca Associate Partner at Deloitte 	Jean is the Global Public Sector Digital Modernisation Leader at Deloitte. At the beginning of his career, Jean gained experience with Smart Cities, mobility, and open data working as an Open Innovation Consultant at the World Bank. Now at Deloitte, Jean focuses on projects associated with the public sector's digital transformation. He is also in charge of CitySynergy, a venture that focuses on developing and implementing mobility solutions for global clients.

Appendix D – Interviewees Profile used in Smart Mobility and Implementation of a Mobility as a Service in Lisbon

Afonso Sousa
Head of Engineering at Yunex



Afonso used to work in Road Management at Siemens. However, the company decided to create Yunex, a single and specialized company on road Intelligent Transport Systems (ITS). Then, earlier this year, Afonso was promoted to Head of Engineering of the Intelligent Transports System department. Afonso and Yunex have several projects in Portugal, having a close relationship with CML. During the interview, Afonso mentioned several projects on road sensorization and implementation of an AI-based traffic lights system in Lisbon

Claudia Marante
Smart City Innovation Lab



Claudia is a **research fellow** at DTx - Digital Transformation CoLAB and at the **Smart City Innovation Lab**, a Teaching Assistant of International Strategy and Business Model Innovation at Católica Lisbon, and a previous Data Analyst at Cisco Systems Portugal. Claudia has deep **knowledge** of **urban technologies** and their **impact** on the **government**, the **citizens**, and the **businesses** and is familiar with the Lisbon ecosystem.

Diogo Santos
Partner at Deloitte



Diogo is the **Operations Transformation Leader** assisting leading organizations in the conceptualization and implementation of initiatives to transform their procurement functions, optimization of supply chains, and align operating models with best practices. Diogo has a deep understanding of the **15-Minute City** concept, being adopted by Smart Cities around the world as a solution for **mobility challenges**, having written about it in the report “Urban Future with a Purpose | Urban Trends: Shaping the future of cities” released by Deloitte.

João Castro
Professor at Nova SBE



João is an Associate Professor at Nova School of Business and Economics. After **concluding the Ph.D. in Engineering Systems at MIT**, he spent a short time at Stanford University as a post-doc with the Center for Design Research and later was the director of disruptive innovation for a leading FMCG beverage company in charge of digital transformation. João has served extensively in the industry, leading and managing innovative technology projects such as the **first website designed for broadband in Portugal** and the **world's first fully contactless ticketing system for multi-modal public transportation in Porto**.

Appendix D – Interviewees Profile used in Smart Mobility and Implementation of a Mobility as a Service in Lisbon

João Vieira Head of Innovation at Carris 	João is the Strategy and Innovation Director at CARRIS, being responsible for leading test and demonstration projects of new transport technologies and solutions in the company, as well as structuring collaborative projects with universities and large companies. He is also responsible for managing research projects, working with start-ups, and cooperating with academia in all matters related to the future of urban mobility. He has a degree in Environmental Engineering, a Master in Transport, and an MBA from The Lisbon MBA.
Marcos Schlikmann Senior Partner at Deloitte 	Marcos Paulo joined Deloitte Porto 4 months ago. Despite being new in the consulting firm, he already accumulated several years of experience in the MaaS field, both in Brazil and Portugal. Marcos's knowledge of the urban mobility environment in Porto and Lisbon is very important for our understanding of how to implement a MaaS service in Portugal.
Miguel Santos Head of Intelligent Transport Systems at EMEL 	Miguel has an Executive MBA from AESE/IESE Business School. Miguel has extensive experience in the electrical and electronic manufacturing industry, where he worked at Siemens and Canas for several years. Since 2019, Miguel is Head of the Intelligent Transport Systems Business Unit at EMEL where his main responsibility, now, is to develop a strategy to disrupt traffic management in Lisbon, based on AI, IoT, and sensors.
Pedro Pereira Head Innovation at Metro de Lisboa 	Pedro has basic training in Energy Engineering and Power Systems to which he later added an Executive MBA and a Masters in Business Management, completed in 2019 with a thesis on the Public transport concession contract. Definition, monitoring, and control of the fulfillment of public service obligations. Working at Metropolitano de Lisboa since 1989, having held various positions in the areas of maintenance, operation, and expansion projects both in the Metro itself and in North Africa.

Appendix E – Survey Description

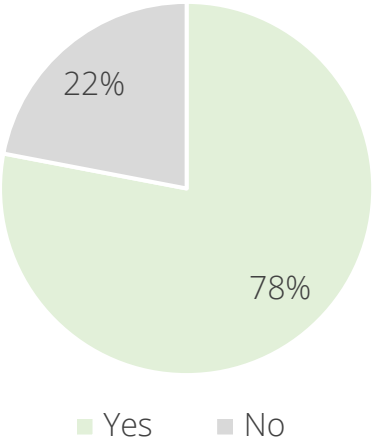
A survey was conducted to understand the opinions of Lisbon citizens about governance and mobility aspects, with 206 responses to 18 questions

The survey was conducted in Portuguese and was made through online platforms, with:

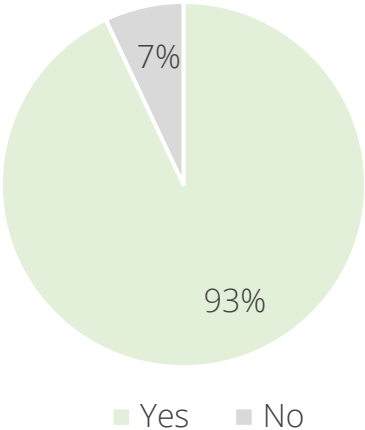


Mobility Questions

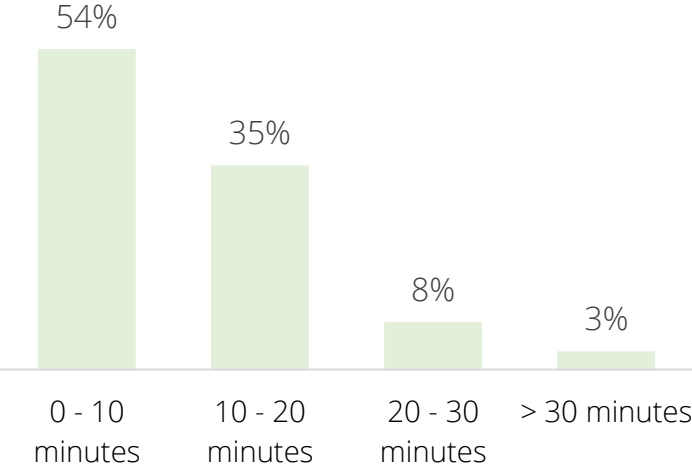
2 - Do you own a car?



3 - In Lisbon, when you use your car, do you have to worry about the easiness and availability of parking spaces at your destination?



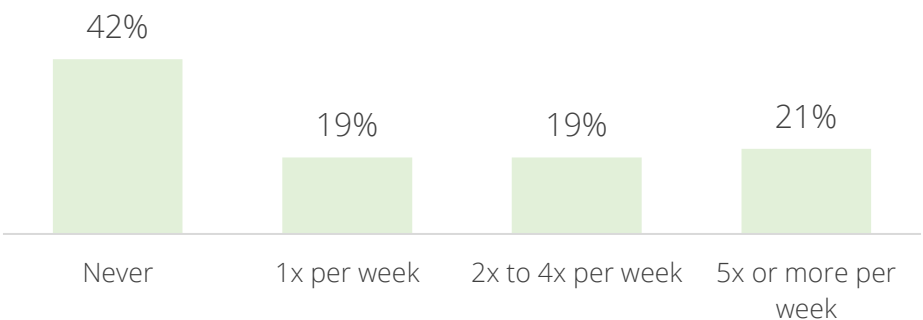
4 - On average, in Lisbon, how long do you take to find a parking space?



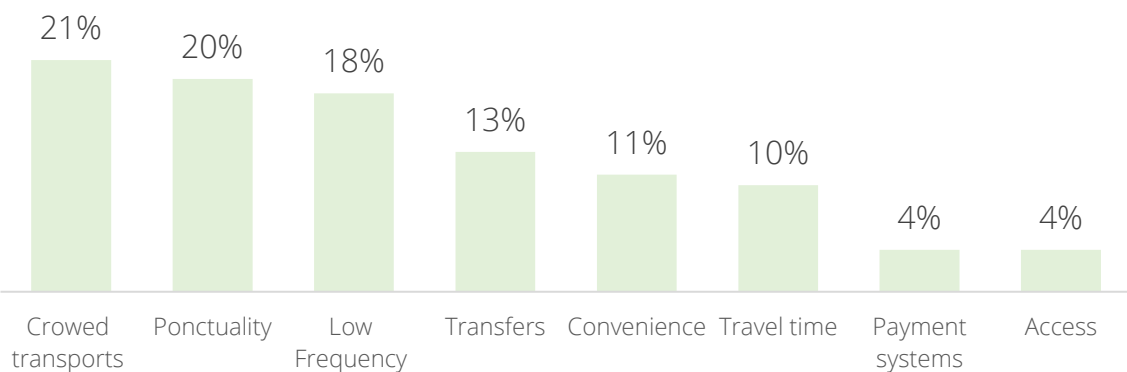
Appendix E – Survey Description

Mobility Questions

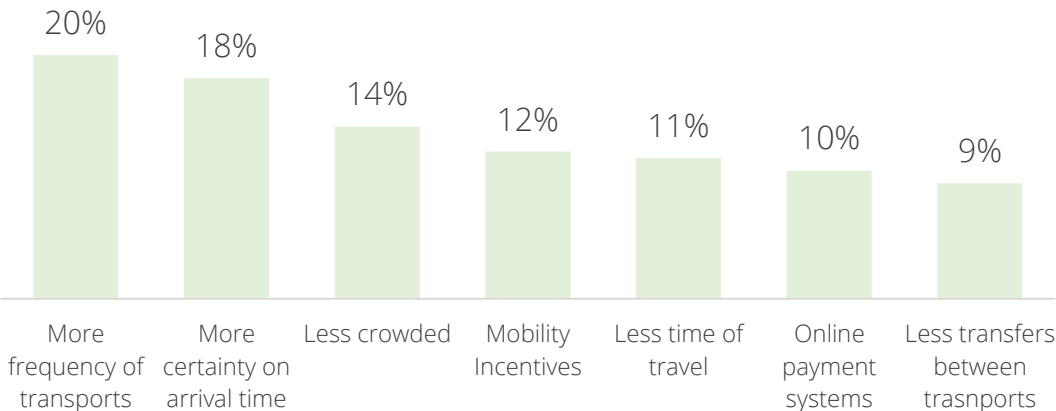
5 - How regularly do you use public transports in Lisbon (Carris and Metro)?



6 – What are the 3 main problems with public transports?



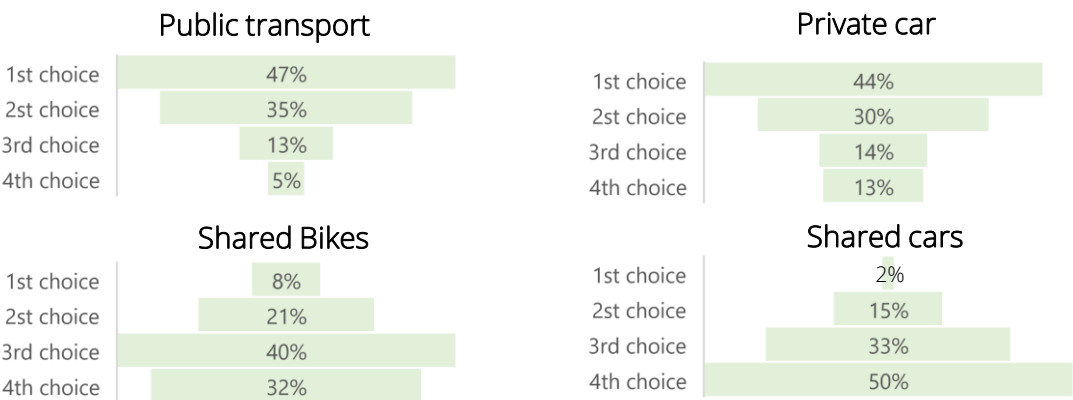
7 - Which options would you make use of with a higher frequency of public transports?



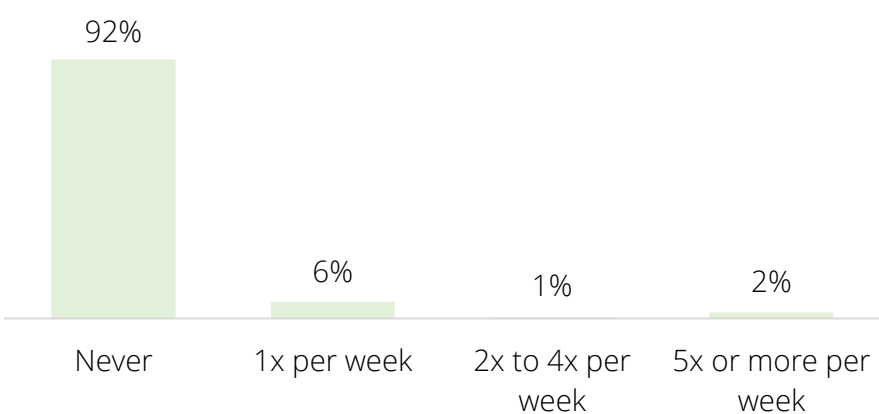
Appendix E – Survey Description

Mobility Questions

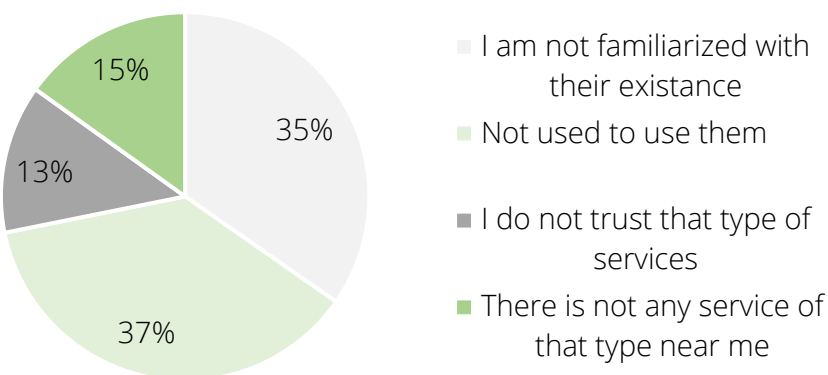
8 – Order by order of importance the following modes of transport in Lisbon?



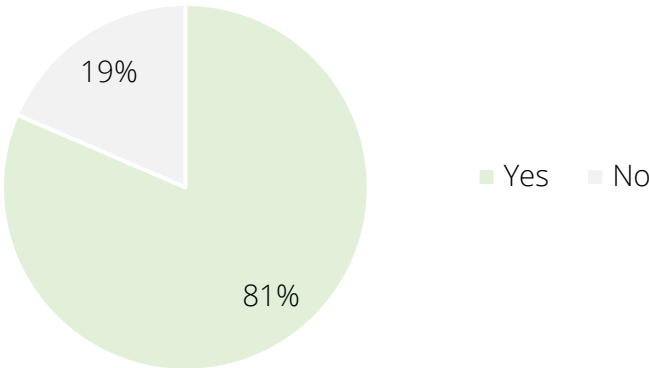
9 - With which frequency do you use or have used car-sharing services?



10 - What are the motives for not using car-sharing services??



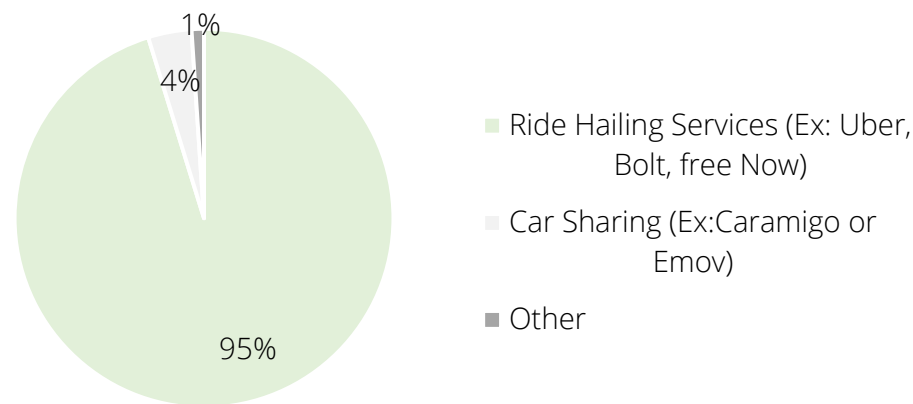
11 - Would you use a car-sharing service promoted by the company or institution where you work?



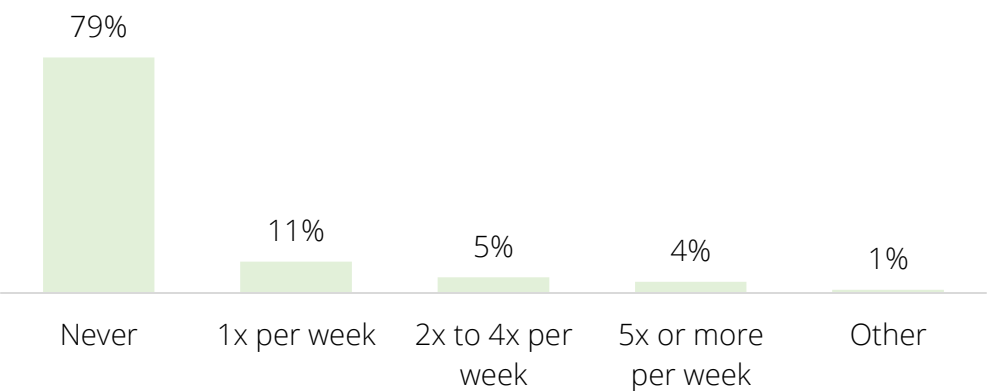
Appendix E – Survey Description

Mobility Questions

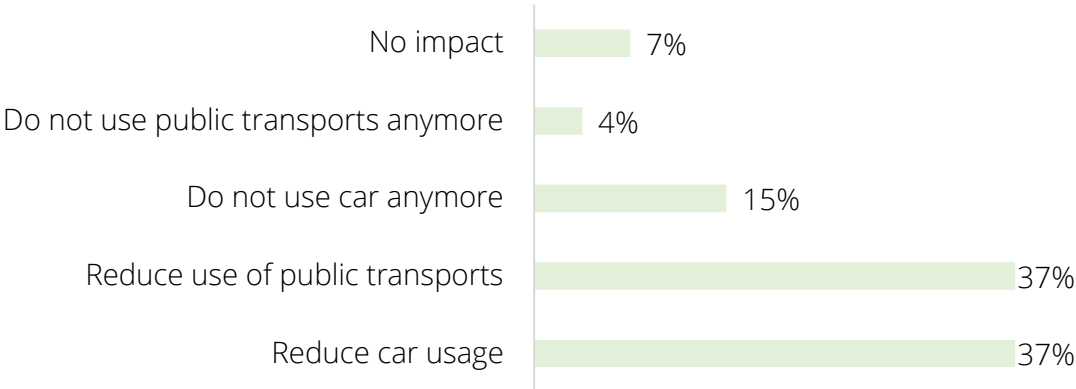
12 - Which are the options you use more daily?



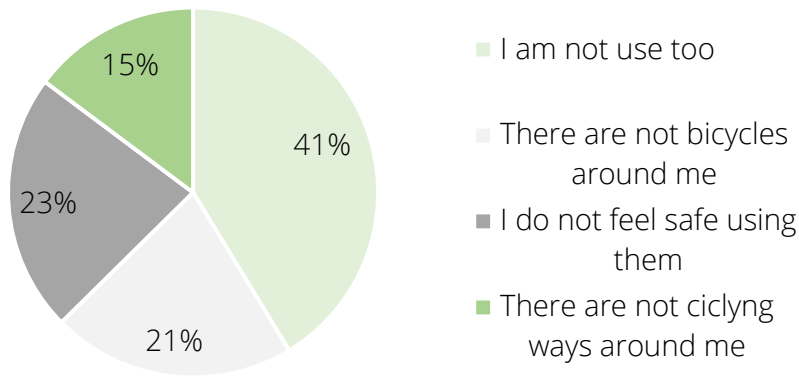
13 - What frequency do you use bike-sharing apps to travel? (Ex: Bolt or Gira)



14 - In what sense, the use of bike-sharing apps to travel change your habits?



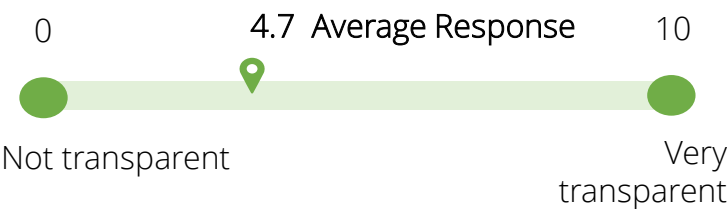
15 - Select the options for which you do not use bike sharing apps to travel?



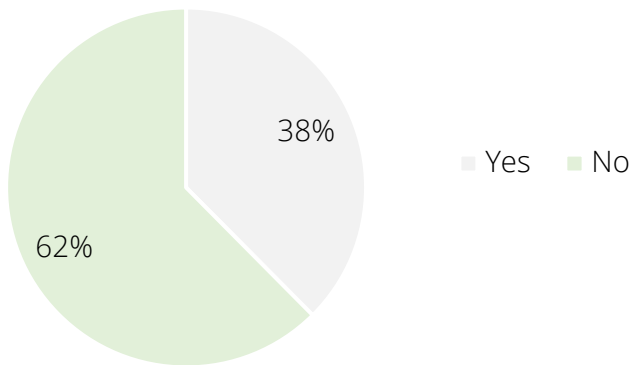
Appendix E – Survey Description

Governance Questions

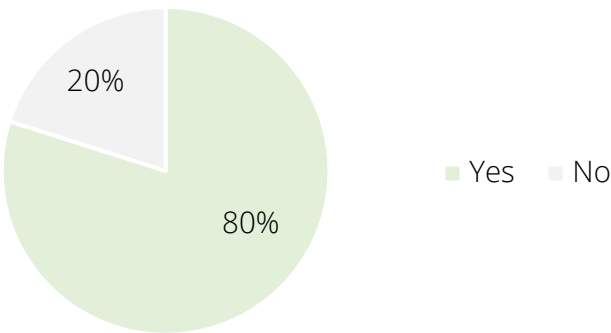
16 - What is your perception of Lisbon's Public Administration?



17 - Do you feel that the administration of the Lisbon municipality is inclusive and cares about citizens' opinions when developing a new project or initiative?



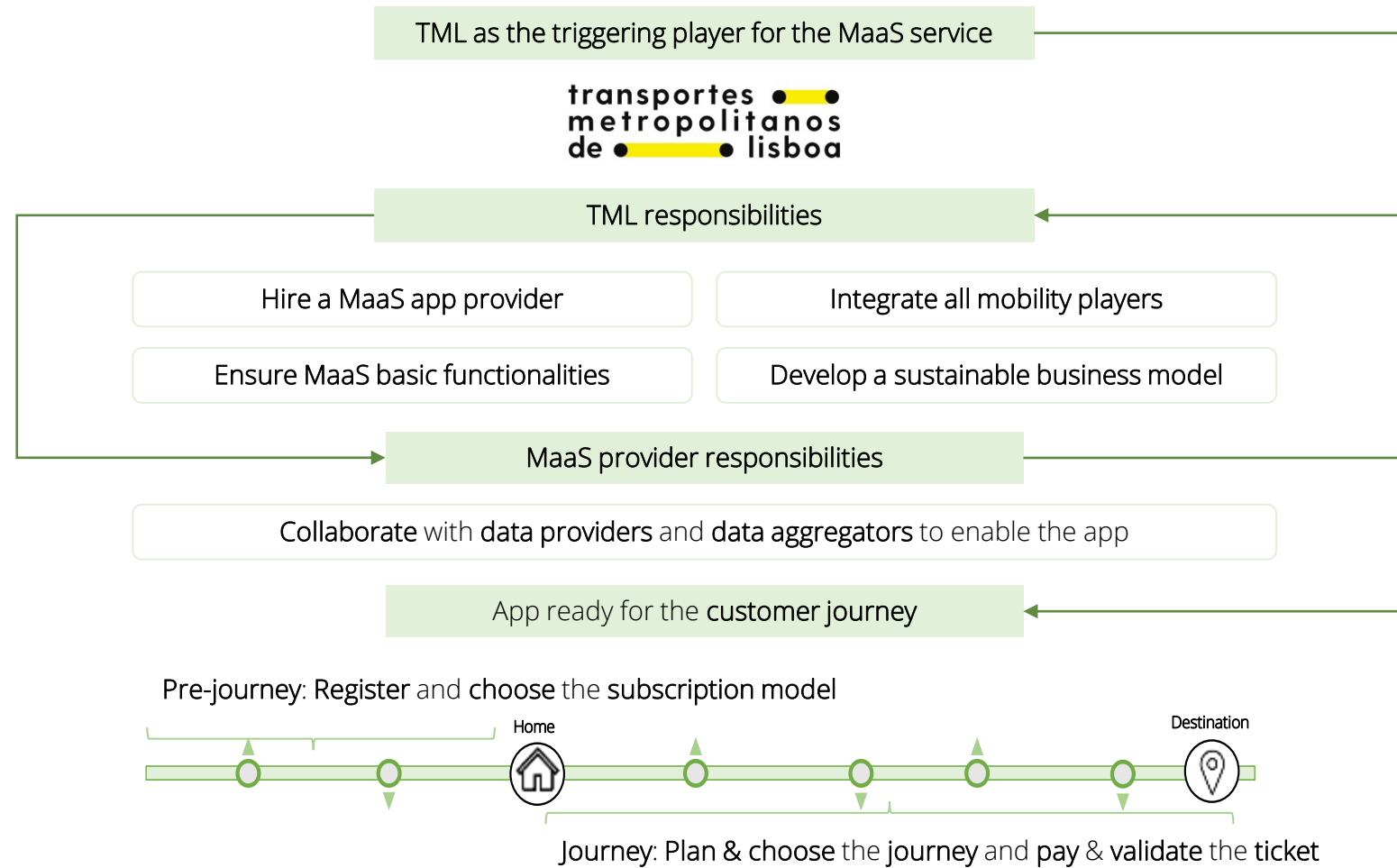
18 - Do you think that corruption in the CML is a problem?



Appendix F - Key takeaways of the MaaS recommendation to Lisbon



4.4 – Recommendation for Mobility as a Service in Lisbon



Appendix G: Chapter 3 – Recommendations for Car and Bike-sharing apps

The municipality can promote car-sharing within corporations to reduce traffic congestion



Citizens never use car-sharing apps due to: ⁽¹⁾

- Lack of awareness, habit, and trust

The municipality can promote car-sharing within corporations

Municipality

- Incentivize companies. E.g., deducting the costs for cars from taxable profits ⁽²⁾

Companies

- Hire a tech company to build a carpooling app. Co-workers check the map to verify who is available for a ride, establish the hour and the pickup location ^{(3) (4)}

81% of respondents have a willingness to use this service ⁽¹⁾. The promotion of the app by an employer overcomes the lack of awareness and trust barriers of users

- Some companies doing it worldwide ⁽⁴⁾:



VOLKSWAGEN

Interview Quote:

“Car-sharing can work if the municipality drives its use, through companies, facilitating the adoption between their employees” – Diogo Santos, Deloitte ⁽⁵⁾

- The potential impacts in Lisbon: Reduce... ⁽⁶⁾



Pollution



Number of cars circulating



Occupation of parking spaces

The municipality transforms car into bike-friendly infrastructures to reduce traffic congestion



Citizens never use bike-sharing apps due to: ⁽¹⁾

- Inappropriate infrastructures
- Cultural resistance

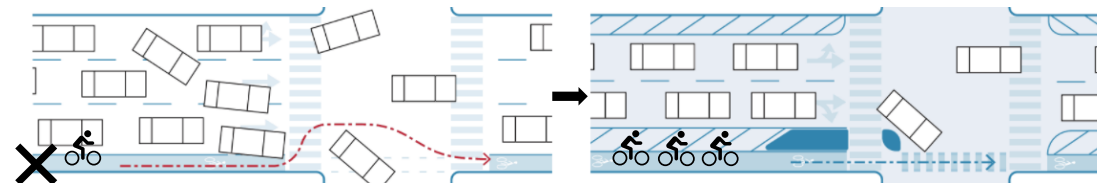
Municipality changes the infrastructures while promoting change in mindset

Invest in temporary cycle paths to make them permanent ⁽⁷⁾



Gradually create new cycle paths ⁽⁷⁾

- Create alternative routes, shortcuts, and space in main arteries for cyclists ⁽⁸⁾
- Create protected bike lanes and traffic-calmed streets for increased safety: ⁽⁹⁾



Promote behavior change ⁽⁷⁾

- Adapt the approach to each target group of citizens. E.g., partnering with NGOs to teach road safety and bike maintenance, can attract different groups ⁽¹⁰⁾

Interview Quote:

“Lisbon does not have the most adequate bike infrastructures to reach top Smart Cities like Amsterdam or Barcelona” – Claudia Marante, Smart City Innovation Lab ⁽⁵⁾

- The potential impacts in Lisbon, based on the best practice of Copenhagen: ⁽¹¹⁾



Reduce travel time



Reduce pollution costs

Saving €0.16 /km traveled by bicycle instead of the car

Appendix H: The Metropolitan Transport Authority and a MaaS provider must collaborate to integrate Lisbon's mobility players and create the mobility app

The TML should be the trigger for the MaaS service in Lisbon due to its know-how in managing the transportation system and integrating the tickets

- The Metropolitan Transport Authority, TML, is a public company owned by Lisbon Metropolitan Area, AML. It is responsible for the management (coordination and planning) of the public transportation system and the integration of the tickets in a single card to travel in the metropolitan area ⁽¹⁾



Interview Quote: "TML should be the player triggering the MaaS service integration in Lisbon" ⁽²⁾ – Marcos Paulo, Deloitte

TML needs to hire a MaaS app provider...

The TML contributes with its existing resources, but it must cooperate with the MaaS app provider for the development of the software: ⁽²⁾

	MaaS Portuguese startup, experienced with Lisbon's mobility environment ⁽²⁾
	The company responsible for the most advanced MaaS service in the world, with a presence in 6 countries

The MaaS provider must seek collaboration with data providers ⁽³⁾ ...

The MaaS platform needs to manage the data from multiple service providers, the APIs, and the analytics on usage - demand, planning, and reporting ⁽³⁾

	The data providers identify a range of transformation options and offer real-time traffic updates ⁽³⁾

Interview Quote: "The MaaS operator should be the core of the whole strategy. All the players need to collaborate to promote the final mobility as a service. In the end, every citizen needs to have the app on their phone" ⁽²⁾ – Marcos Paulo, Deloitte

... and integrate mobility players ⁽³⁾

The TML ensures the mobility players integrate their services into the app:



... and companies to aggregate the data ⁽³⁾

Data aggregators link the services of private and public operators, arrange bookings and facilitate payments through a single gateway ⁽³⁾

	Expertise in data management and analytics
	Pick, an app created by Ubi Rider to buy and pay for public transport tickets through the phone ⁽⁴⁾

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Slide 3

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