Paper ID #928

Cycle parking as an enabler of cycling in Lisbon: User-centred design in policymaking

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Abstract

Employing design-inspired methodologies in the creation of new services is not new. But applying these in the realm of public policy is not yet a common practise. In Lisbon (Portugal), EMEL - an operating arm of the city council for mobility management - is at the forefront of public policy making by embedding novel methods in the development of urban mobility solutions. One of our latest successful experiences was the creation of a new secure cycle parking service in the city that entailed a design thinking process underpinned by a citizen-centred approach. We engaged bicycle users from the very beginning to uncover the main barriers to a more frequent use of bicycle in daily journeys around the city. Afterwards, we mapped out the pain points for parking a bicycle and co-created a solution that not only addresses user needs, as it contributes to a more seamless integrated mobility system.

Keywords: CITIZEN ENGAGEMENT AND CO-CREATION, PUBLIC POLICY, SECURE CYCLE PARKING, ACTIVE MOBILITY, SEAMLESS INTEGRATED MOBILITY

Introduction

Cycling has been exploited in European cities and Lisbon is no exception. The city of Lisbon is working hard to find ways to tackle the global challenge of climate change with a wide ranging strategy that encompasses not only the reduction of private vehicles in the city centre but also the promotion of more sustainable transport modes such as cycling and walking.

One of the key agents responsible for the implementation of such policies is EMEL, the municipal company for mobility and parking of Lisbon (100% owned by the City Council). EMEL manage all controlled on-street parking and over 40 car parks in the city. But in more recent years its mission has been expanding to a broader mobility management role. In particular, EMEL have evolved into an active change agent in the mobility system of Lisbon with an extended set of responsibilities, and helping the City Council delivering its strategy for sustainable mobility and managing a large number of mobility infrastructure and services (e.g. the public cycle sharing scheme).

Determined to better inform decision-making, in 2019 EMEL set up a multidisciplinary innovation team (hereinafter 'we') that brings together a variety of skills and competencies, from user research to data science, with expertise in collaborative approaches and design-inspired methodologies.

The fact of the matter is that innovation approaches have been evolving over the years, and top-down approaches have been replaced, whenever possible, for bottom-up strategies where citizens are put in the centre of the action. This translates into a more horizontal way of governance that brings together different stakeholders. The introduction of design-inspired methodologies into public policy in Lisbon has been occurring, and especially under the European project VoxPop - People, Processes & Technology towards the digital transformation of the urban mobility system of Lisbon[1] umbrella.

The work carried out under the scope of VoxPop concerning the design of a secure cycle parking

[1] Vox Pop - *People, Processes & Technology towards the digital transformation of the urban mobility system of Lisbon*, it is a project co-financed by the Regional Development Fund through the Urban Innovative Actions.

in close relation with potential users is presented in this article. The research conducted in this work had two major goals, namely:

- to better understand the bicycle use habits in Lisbon, through user routines, daily concerns, family context and every dimension that impact their mobility and transport choices;
- to explore how users of private bicycles were parking, what where their needs and barriers that were preventing a more frequent use.

In recent years, the city of Lisbon has been directing its urban planning towards the inclusion of active mobility helping its users to feel the city as a more liveable space. However, barriers for fully embracing active mobility still exist especially when it comes to adopt cycling in daily life, not just for leisure purposes. For this specific design challenge, it was also important to consider the difficulty in changing the deepen-rooted habit of using private car as the main daily transport mode. As such, adopting a user-centred methodology was paramount to ensure that all pain points were correctly mapped, resulting in a solution that would overcome one of the main barriers identified: lack of secure cycle parking facilities.

Background

The most recent data available concerning the daily commuting habits reveal that only 0,5% of the daily trips in the Lisbon Metropolitan Area (LMA) used bicycle and 58,9% used private car (Instituto Nacional de Estatística, I. P, 2018). The city of Lisbon has an area of approximately 100 km^2 and nearly 550.000 inhabitants. Every day, a substantial daily commute inflow from surrounding municipalities contributes to doubling the number of city users, not to mention tourists which, prior to the COVID-19 pandemic, represented approximately 10 million visitors a year. There is a sense of urgency for the city to find ways to effectively accommodate the needs of its users, namely by ensuring the proper functioning of its mobility system, one of the key levers of the local economy. For the past few years, cycling has been on the top of the sustainable mobility agenda of Lisbon Municipality.

Multiple policies and measures (P&M) leading to significant investments have been put in place to promote bicycle usage, particularly as an alternative to private cars. Some of the P&M implemented since 2017 by the municipality focuses on the following approaches: expanding the cycling network, financial incentives to bicycle purchasing and awareness raising initiatives. The municipality has also been investing on secure cycle parking facilities at pilot scale, and free on-street parking solutions such as Sheffield cycle stands or car bike ports[2].

In response to the worldwide COVID-19 pandemic in March 2020 (WHO, 2020), and while cars remained parked and roads empty, Lisbon's residents started to use their bicycles for outdoor exercise and regain confidence in riding a bicycle, reclaiming their space in the urban environment. Following the relief of lockdown measures, it was possible to notice a willingness to adopt cycling as the main transport mode, this was noticeable by the unprecedent peak of bicycle demand – 500% when comparing to the previous years (Neves, 2020)- and the observations made on the field by our team[3] as well as in bicycle purchases, leaving stores with empty shelves (DN, 2020)

With various P&M in place and the window of opportunity opened by the pandemic, we realised it was crucial to go deeper into studying cycling habits: understand user behaviours, triggers and motivations to cycling, as well as comprehend what needs and barriers were preventing people from adopting cycling as their daily transport mode. Based on previous interactions with users, we were aware that the lack of secure cycle parking at the journey's start, typically someone's home, was one of the most prominent aspects hindering the adoption of cycling on a daily basis.

Methods and materials

[2] cycle parking solution that provides for 10 bicycles in a standard on-street car parking space. The outline of a car demonstrates the space efficiency of bikes.

[3] See section "Understanding user needs uncovering barriers & unmet needs"

The work conducted is based on the design thinking methodology (Figure 1) which can be illustrated by a double diamond. It is an iterative process, allowing to better inform the decisions and improve the solution until it reaches its final form. Additionally, it provides a collaborative/co-creative vision that allows to build a broad and robust solution for the final user.

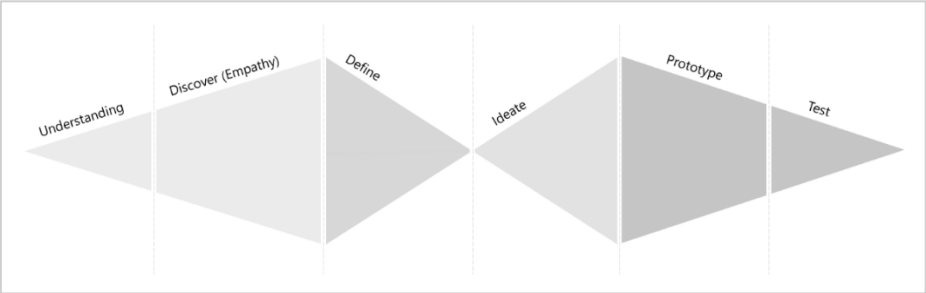


Figure 1 – The design thinking methodology adopted (the double diamond). Source: authors

Understanding the problem

All design challenges start with a problem that must be solved. In public policy, these problems are often wicked problems[4] (Interactive Design Organization) that by definition are ambiguous and lack clarity of their real causes. This means that while attempting to address part of the problem, one might be creating unintended problems in some other domain. Hence why the understanding phase in design thinking is fundamental to define the clear problem one is trying to address and to provide focus when navigating through the different aspects of it.

Aware of the magnitude of the problem at hands, we found necessary to focus on one of the aspects that were already known to be one of the causes hindering cycling adoption: lack of secure parking facilities for medium to long stay parking. To better understand the problem, we conducted an initial desk research to comprehend how other cities were tackling this challenge and benchmark solutions for cyclists. Additionally, the work included 80 flash interviews in the field, inquiring both private and shared bicycle users. The information gathered allowed a deeper understanding of how users felt about their cycling experience in Lisbon and to better comprehend the challenge at hands.

Understanding user needs, uncovering barriers & unmet needs

The discovery phase is an essential step *"to gain an empathic understanding of the problem you are trying to solve. This involves (…), engaging and empathizing with people to understand their experiences and motivations, as well as immersing in the physical environment to gain a deeper personal understanding of the issues involved"* (Interaction Design Foundation, 2020) and allows to put the research's own assumptions apart.

For this study, we adopted qualitative and quantitative methods (Table 1) to explore and understand bicycle usage habits in Lisbon with users and non-users:

Table 1 - Qualitative and Quantitative methods adopted

Method	Quantity	Description
Bicycle counting	2 weeks	gender, private and shared bicycles. Exploratory exercise using a simple random sampling technique

[4] A wicked problem is a social or cultural problem that is difficult or impossible to solve—normally because of its complex and interconnected nature**.** Wicked problems lack clarity in both their aims and solutions and are subject to real-world constraints which hinder risk-free attempts to find a solution. Source: Interactive Design.org

In-depth interviews	6	semi-structured interviews with users of private access bicycles. Besides the aim of exploring their habits, these interviews also focused specifically on identified mapping parking issues.
Informal conversations with bicycle store owners	4	semi-structured interviews to understand market trends and the impact of the covid-19 pandemic in bicycle demand.
Online survey	463 valid responses	Lisbon's bicycle usage habits quantitative mapping, which included users and non-users. Opportunistic sampling with no statistical representativeness intended

(re)Define the problem

With a better understanding of the problem, we were ready to deep-dive on the scope of the challenge ahead. It was clear that there was a need for secure cycle parking but it was necessary to precisely map the pain points blocking the use of existing parking solutions, mainly *ad-hoc* solutions at home or public. Based on the information collected in the previous phase, it was possible to map five main pain points regarding cycle parking (Figure 2).

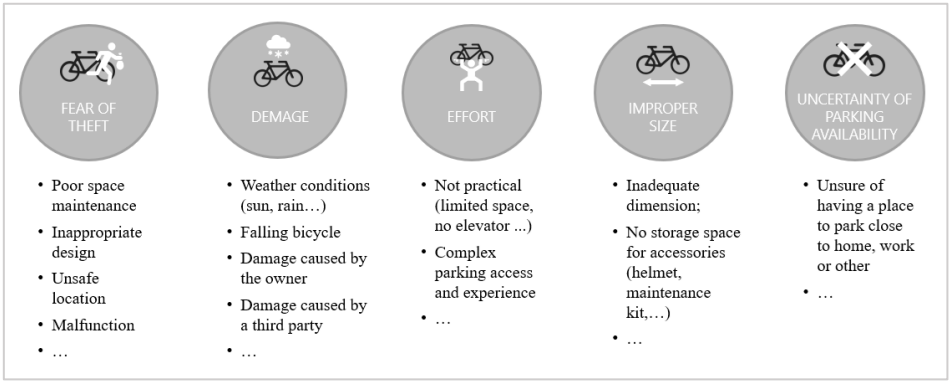


Figure 2 – Pain points regarding cycle parking in Lisbon

At this stage and with a well-defined scope and concrete pain points to be addressed, EMEL organised a remote workshop with several practitioners from EMEL and Lisbon's City Council from different areas and backgrounds to spark discussion beyond the obvious solutions, gather different perspectives and possible strengths. With active facilitation exercises it was possible to go deep on each identified pain point and generate solutions for each one. It was also possible to map an initial and desire user journey both for an on-street and off-street cycle parking solution.

Ideation - co-creating a concept to address unmet needs

The chosen method for this phase was to conduct a series of one-on-one co-creation sessions with twelve users[5] and an additional webinar with four extra users. The goals of these sessions were:

- Validate technical requirements such as material, preferred type of access, etc. - facilitators repeatedly put the users in different scenarios by asking "*what if...*" questions; this allowed to expand on users' motivations and fears, and we were also able to gather a richer knowledge of what was expected and necessary from a cycling parking solution.
- Assess price elasticity for the future service - we adapted the Van Westendorp price sensitivity meter method (Sadwick, 2020) by introducing an extra question *"What is the fair price for this service?"* as it removes the focus from the user's own socio-economic conditions and their own perception of added value created by the new service, and it

[5] Due to sanitary measures in place and in order to ensure both participant and facilitators safety these sessions were hosted remotely.

gives an opportunity for reflection about the balance between the added value created by the new service *versus* the added value from other mobility-related services in the city

- Prioritise user needs - we used an adaption of "buy a feature" co-creation game (Innovation Games, 2018). Users were given 100 coins to "purchase" a set of design aspects that we wanted to validate.

Prototype, test and finetune

With a clearer view on how real users would feel, act and think when interacting with the cycle parking service and its infrastructure, it was time to subject it to a real test. The first location chose to build the cycle parking facility to serve as an MVP[7] (Figure 3) in order to test internal processes, materials and to gather the first impressions from real users and all the involved stakeholders. The first structure and its improvements were replicated into thirteen additional structures that were deployed in different city's locations. EMEL will collect additional user feedback and sentiment towards the new service that will inform further improvements towards the service itself (pricing, bundle with other mobility products, etc) as well as to prioritise additional features.

Figure 3 - The MVP that was also repurposed for a fully functioning cycle parking facility

Data and results

Cycle parking service

The online survey gave a clearer view of cycling habits as frequency of use, duration of journeys, safety and satisfaction levels. [8]
As for the co-creation phase the main conclusions are presented in Table 2, Table 3 and Table 4.

Table 2 - Users' feedback towards access control requirements

Access control		
Address pain points	**Hypotheses**	**User feedback**
Theft Effort	Key/Card Access	90% of participants choose a simple key or a contactless card solution for access. Food for thought: Fear of losing their card. One extra item to carry. Not as practical as mobile phone.

[7] Minimal viable product
[8] The research study will be published during 2021.

	Mobile application	The app is an instinctive response, but after a reflection exercise, users identified more disadvantages than advantages compared to a contactless card-based solution: - Risk of running out of battery in the cell phone; - Limited data allowances; - Reduced mobile coverage.
	User identification	All users agreed that identification was inevitable: important to know who enters the facility.
	User authentication (add on to identification)	Users recognise it would provide greater security. However, is not valued as it considered an unnecessary and inconvenient additional step.

Proposed solution based on user feedback: contactless card access assigned to a specific user: Given that the identification of who would enter the facility would not be possible with a typical key, the proposed option consisted of a personalised contactless card that would allow to record who accesses the cycle parking facility.

Table 3 – Users' feedback towards infrastructure requirements

Structure		
Address pain points	**Hypotheses**	**User feedback**
Theft Effort Damage	Opaque enclosure	Although it discourages theft, users mentioned some disadvantages: - claustrophobic space - compromises the safety of those inside.
	See-through enclosure (semi-opaque or grid)	Most of the users mentioned they would feel safer and more comfortable with this option

In order to address the fears of beginner bicycle users and for being a versatile solution (usable in cycle park in a structure park as on the public road) the proposed solution based on user feedback was to use perforated metal mesh with an open area below 30%.

Table 4 - Users' feedback towards other security features

Other security features		
Address pain points	**Hypotheses**	**User feedback**
Theft Effort	Car park operator	Users consider that: the more forms of surveillance, the better is the solution. However, the possibility of being only controlled by the car park operator was generally considered, albeit imperfect, as enough.
	Video surveillance inside the bicycle facility	Video surveillance inside the cycle park was not particularly valued ("it feels too much").
	Video surveillance outside the cycle facility, facing its door	This hypothesis was very well received and considered to be the fittest. Some users would not trust the system as it is prone to be tempered with.

Proposed solution based on user feedback: the cycle park location in off-street parking facilities is key. Ensuring that the cycle park is located in sight line of the already existing security systems is crucial to ensure security as well as ensuring that the entrance door is installed in the operator's

cabin viewing angle.

Cycle parking access control system of the facility

The access system should be easy to use and simple to manage and the system's peripherals should not be a block for service scalability. As such, the access card should be widely available and the reader should be easily procured. The preferred solution was to use a combo of an already existing system (VIVA system, a Calypso-based solution[9]) and a reader that would account for service scalability and future adaptability towards virtual ticketing. The access system should also account for a seamless integrated mobility platform, that although not in use at this time, will be the norm in the upcoming years. We also accounted for other factors when sourcing for the right combo of technologic systems and peripherals:

- ✓ **Integration and seamlessness** – The Metropolitan Transport Company of Lisbon (TML) a company managed at a regional level by the Metropolitan Area of Lisbon (AML) manage the ticketing system at the metropolitan level and operates the VIVA system, currently shared by 27 operators. Whilst at this time our service has not achieved fare integration, a significant step towards seamlessness has been taken with the adoption of the same contactless card (as to become a cycle parking client, the person must own a VIVA card and load the monthly pass in it).
- ✓ **Standardisation and interoperability** – The VIVA System is Calypso ticketing system based on open standards for the actors of mobility ecosystem. It is a secure, interoperable, open and flexible ecosystem which allows transport and mobility operators to use the same compatibly and interoperable technology, using a common Data Model and embedded API. The adoption of an open standards, already in use by the mobility ecosystem of Lisbon enables the interoperability at national and European levels.
  As for the card reader, the equipment installed is in fact a contactless smart terminal module capable of managing all ticket media (physical and digital), prepared for a potential future smart ticketing development (e.g. pay-as-you-go or virtual wallet). The service is also easily scalable as the readers are prepared for outdoor conditions, allowing for future cycle facilities to be easily deployed in on-street parking spaces.
- ✓ **Technology agnostic** – The access system is also future-proof as all possible future evolutions are already accounted for: it is adaptable to new access types (debit cards, mobile applications, QR codes, etc) as the reader is able to manage all digital tickets: closed-loop cards (Mifare®, Desfire®...), NFC devices, contactless tickets, mobile apps (through Bluetooth) and the open payment terminals can handle all kinds of future ticketing media and new transport applications. A standard service can easily become into a hyper-personalisation one, where the specific user needs are accounted for.
- ✓ **Inclusive** – The user-research study pointed us to a card-based solution, as such, we chose the VIVA card, a card that most Lisbon's residents already possess being the go-to card for mobility in Lisbon serving several operators in the city. This way, only a minority of users will have to acquire an additional card. Low digital literacy segments and lower socio-economics segments will have the same degree of access as the access system will not require additional costs to the end user and users will not rely on a digital solution to adhere and use the service.

Cycle parking facility design

A tailor-made solution (instead of an off-the-shelf solution) was adopted, not only to meet users' pains and needs but also to accommodate the variability of implantation areas, restricted by pre-existing parking bays that needed to be converted into cycle parking facilities. This option allowed for customisations (Figure 4) such as the creation of bi-directional aisles with at least 1,75m wide and the installation of individual bicycle supports. These features and a closed facility

[9] Calypso is an open standard for electronic ticketing deployed by transit operators to ensure seamless integration and support global interoperability.

were design to ensure a secure and comfortable place to park a bicycle for medium to long stays.

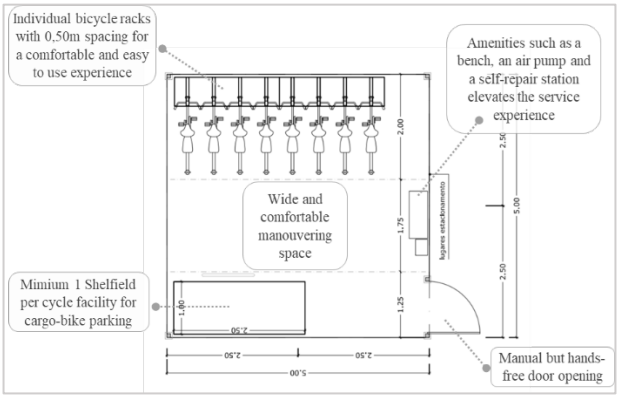
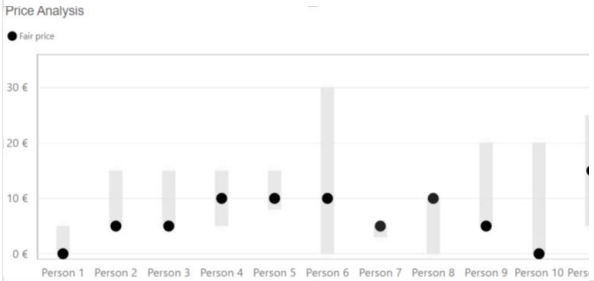


Figure 4 - Cycle parking facility blueprint. Source: EMEL

Price elasticity testing results

As for the price elasticity testing (Sadwick, 2020) the results gave an interval between 6,5€ and 10€ per month as a comfortable price range for the proposed service. Being 10€ the most frequent response for a "fair price". However, when setting a price in public services it is necessary to guarantee that no segment is excluded from a particular service. Also, public services tend to be not-for-profit but value-driven to address a specific public need. For these reasons, the final price for this service was set between the *"a bargain*" price point and the "*fair price"* price point. Companies aiming for profit in their services, usually set the price point between the questions "*At what price is this service too expensive that you won't even consider using?"* and the *"At what price this service begins to seem expensive?"* as to maximise earnings.



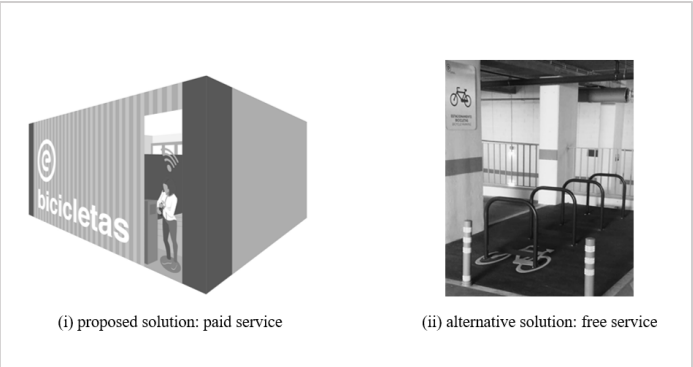
	"A bargain"	"Fair price"	"Too expensive"
Min	1,00€	3,00€	5,00€
Max	7,50€	15,00€	29,00€
Most Frequent	5,00€	10,00€	15,00€

Figure 5 – left: price assessment (grey vertical lines depict the declared price range from 'a bargain' and 'too expensive', black dots signal the declared 'fair price'); right: summary of results

Results of the prioritisation of features exercise

The results from this dynamic were very similar, which gave us confidence of which features should be prioritised: (i) the need for user identification when accessing the cycle parking facility was chosen in 6/16[10] participants (ii) following by the need for a hands-free door (6/16). Only two users (participants from the webinar – a non-exploratory session) preferred to have an individual locker instead of the proposed community shared space validating that a restricted but shared cycle parking facility was the best option. For further validation of the proposed enclosed solution and its main features, it was shown to the co-creation session's participants two parking solutions: (i) the proposed one that was a paying service and (ii) a free service that merely consisted of Sheffield cycle stands without any additional security or amenities features. Only 1 in 12 participants, chose the free option.

[10] 12 participants from the co-creation sessions plus 4 from the webinar



(i) proposed solution: paid service (ii) alternative solution: free service

Figure 6 – Illustration of 2 parking solutions tested with users: a paid service and a free service

Surprising discoveries from the research study

Personal safety *versus* bicycle security

The fear of theft was one of the strongest pain points referred by users in our initial research. However, in the one-on-one co-creation sessions, it was clear that there was also a concern about user's own safety. This aspect is more prominent when talking about parking a bicycle in an off-street parking facility, where vehicle and people movement is lower or non-existent. For this reason, we designed a cycle parking facility that would take in consideration both bicycle security as well as ensuring that the user felt safe when using the service by creating a spacious and well-illuminated facility privileging locations closed to pedestrian exits and ensuring an access control system that would register who enters the cycle parking facility.

Mobile application *versus* access card

During the one-on-one co-creation sessions, it was noticeable that a mobile application was the most immediate solution in users minds when accessing the cycle parking facility. However, when on further reflection a great part of users did not want to have this as their only option when accessing the cycle parking facility. Being dependent on a mobile device to access their means of transportation and the fear of technical issues occurring were some of the concerns raised by a large part of the users (regardless of the users age group). In the buy-a-feature game, only 1 in 16 users chose a mobile application against 6 in 16 users that chose an access card and a hands-free door as their top priority when interacting with the cycle parking service, proving that when comparing with other service aspects a mobile application is not a priority. This discovery was just one of the most prominent examples that demonstrates that technology is a mean and not an end as technology should serve the community and not the other way around.

Limitations of the study

Remote participatory research: the delivery of this phase took place during the first wave of COVID-19, in 2020. It was a great challenge to conduct a participatory methodology in this period when most people were working from home. To this end, we had to adapt most approaches (except flash interviews) to the digital space.

Fortunately, technological challenges were easily overcome both by us and the users and, due to the interactive / learning from experience of the process, it could effectively lose a certain depth collection of information (due to the impossibility of physically visiting usual user parking, for example). Nonetheless, we believe this kind of information was gathered over various stages of the project.

Conclusions

The design challenge started with understanding the habits of bicycle users in the city of Lisbon and identifying the barriers and unmet needs preventing a more frequent use of bicycles. Through

an exploratory journey we were able to validate that the lack of secure cycle parking for medium to long stay parking was a big barrier to wider bicycle adoption. The whole process was supported by several methods used in user-research and service design that bring the user to the centre of the design process. The conclusions drawn from the whole process enabled EMEL to create a network of thirteen cycle parks (first phase) installed throughout Lisbon. The first results of the service launch validate, once again, the need of these type of solutions. Due to its success, EMEL is already in the process of expanding the service to other locations in the city. This project also gave us a range of new insights on innovative and participative projects:

Innovation does not need to be disruptive - innovation can take up the form of incremental advancements in practices, such as in public policymaking. By meaningfully engaging users and allowing them to voice their views directly, we were able to have a deeper insight that otherwise would not have been accessible to inform decisions and ensuring that public policies are effectively aligned with user needs. This is especially true when trying to understand and change preconceived ideas that people have regarding how they interact with urban space and mobility habits. The design challenge was not about creating a cutting-edge solution nor digitising an existing one, the goal was to remove existing barriers for adopting cycling as frequent commuting mode, while taking a step forward towards a more seamless integrated mobility. True innovation occurs when change is beneficial and successful, and not necessarily technological. In this particular design, we selected technologies that serve both the current needs of users (using an access card instead of a mobile application) and that accounts for user needs and the vision for the city intended.

Participatory process to reach solutions adapted to real needs - design thinking is a widely spread methodology in the private sector and it has been used greatly across industries. We chose to use this methodology which was received with enthusiasm and great adoption from the several stakeholders. This allowed for the process to be quick and sharp avoiding the possible burden of bureaucracy, budget constraints and organisation complexity. Also, involving the user from day one brought dynamism to the design process, challenging preconceived ideas and made us feel accountable to the end-user.

Acknowledgements

Due to template limitations, not all people involved have been appropriately credited: Sofia Taborda, Director of Innovation and Mobility Solutions, scientific coordinator of the project, Francisco Caldas for the desk research and support in user-research activities, and Liliana Magalhães for her valuable inputs to the paper. The entire team extends their regards to the various colleagues from EMEL and Lisbon's City Council involved in the making of this project.

Disclaimer

This paper was written for the purpose of sharing the knowledge generated with the wider community. The views and opinions expressed in this paper are those of EMEL's innovation team and do not necessarily reflect the views of the European Commission nor of the Urban Innovation Actions Initiative.

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