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SmartHubs

Smart Mobility Hubs as Game Changers in Transport

WP4. SmartHubs Living Labs
T4.3. Brussels Living Lab implementation of Mobility Hubs

Deliverable4.3
Living lab implementation Brussels

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Responsible partner: Vrije Universiteit Brussel
Authors: Lluis Martinez (VUB), Jelten Baguet (Mpact vzw), Imre Keserü (VUB)
Contributors: Andreina Lombardo (Municipality of Anderlecht), Charlotte van Vessem (VUB), Arie Jan Vreeke (VUB), Kathleen Cauwelier (VUB), Simon Bothof (VUB), Jesse Pappers, Les amis de l'Etincelle asbl, Cosmos vzw, Maks vzw, and STIB-MIVB.

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Introduction

This deliverable comprises all the information related to the Anderlecht living lab (Brussels): context, goals, planning, development and a summary of the findings. Section 1 explains the set-up of the living lab, with a description of the context, the goals of the living lab, the expected contributions and the target users of the living lab. Section 2 describes the planning of the living lab, including the stakeholders' and citizens' needs, and the status quo of the case study. This section also explains the adjustments that have been done throughout the process, as well as the results of the co-design process and the Smarthubs questionnaire survey conducted in Brussels. Section 3 refers to the two types of evaluation conducted in the living lab: the co-evaluation of the mobility hubs conceived during the co-creation process, and the assessment of the process and the methodologies used with participants. Section 4 comprises the conclusions, recommendations for practitioners and decision-makers, and a reflection on the limitations of the living lab and further research.

1. Living lab set-up

1.1. City context

The Brussels Capital Region [1] consists of 19 municipalities and counts over 1.2 million inhabitants on a surface of 150km (Ibsa, 2022a). It is Belgium's political decision-making centre (national parliament, Flemish parliament, the parliament of the French-speaking community, Brussels regional parliament and of course the European Parliament and NATO), most national administrative bodies have their seats in Brussels, and the city hosts the head offices of numerous national and international enterprises and NGO's. Estimates show that some 60.000 diplomats, international and consular officials, staff members and their families live and work in the Belgian capital (Federal Public Service, 2022). Its function as an international political and economic centre as well as Belgian's migration history since the 1960s makes Brussels a city with a very international character: more than one-third of the population does not have Belgian nationality (Kennis Centrum WWZ, 2021). The largest groups of foreigners have the French, Romanian, Italian, Moroccan and Spanish nationality (in descending order) (Ibsa, 2022b).

In socio-economic terms, the Belgian capital is a city of contrasts, in which most wealth and the highest employment rates are concentrated in the south-eastern part of the Brussels Capital Region. By contrast, the municipalities along the canal are much poorer, have higher unemployment rates and are characterized by a higher percentage of non-European natives. Local sociologists and urban planners describe this part of the capital as the disadvantaged area of Brussels. Data on the inhabitant's income illustrate the considerable socioeconomic differences in the Belgian capital (see Figure 1). Note that more socio-economic data on the Brussels Capital Region are presented below in Table 1.

[1] Note that we will use the terminology 'Brussels Capital Region' and 'Brussels' interchangeably. Please also note that Brussels has two official languages, Dutch and French. In this Deliverable, we have opted for the French spelling. The translations of the French names into Dutch are as follows: Bruxelles = Brussel, Bruxelles Mobilité = Brussel Mobiliteit, Cureghem = Kuregem, Place du Conseil = Raadsplein.

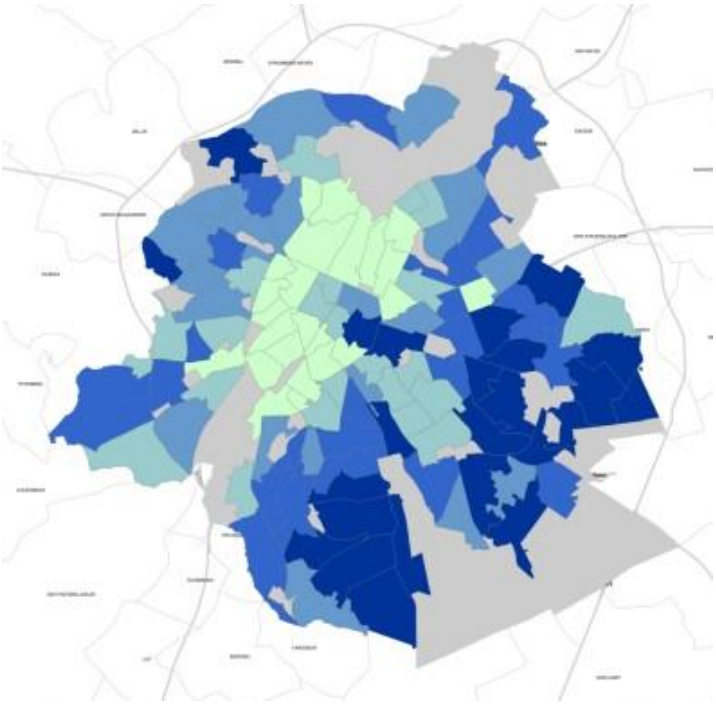

Figure 1. Median taxable income of households declared in each neighbourhood of Brussels. Stronger blue means higher income, clearer green/blue means lower income and grey means that no data are available (in business parks or forests, for instance). Source: Monitoring des quartiers, 2019.

Given its central location in a densely populated and economically well-developed country, Brussels functions as the country's major transport hub for passengers and goods. The capital's challenges regarding mobility are numerous:

- In 2019, Brussels ranked 16th among cities (with more than 800,000 inhabitants) that have the largest traffic congestion in Europe (Brussels Mobility, 2021). Data provided by TomTom show that travel time during rush hour in Brussels is almost double the optimal travel time (61 vs. 37 minutes over a 10km distance). This is similar to Milan and Paris, but much worse than for instance Amsterdam, where a 10-km ride takes 19 minutes in optimal circumstances and 28 minutes during rush hour (Tomtom, 2022).
- Although the inhabitants of Brussels have the lowest car ownership in Belgium, the parking pressure remains high and is still increasing. A part of the explanation lies in the fact that, on average, more than 130.000 commuters a day drive to the capital (figures for 2017). Data for 2021-2022 show that 36.6% of people working in Brussels travel to work by car. The fact that the population grows faster than the number of available parking spots also contributes to the increasing parking pressure.[2]
- The modal share of public transport within Brussels (and not towards Brussels as in the foregoing paragraph) is around 26%, which is more or less the average for comparable cities. Yet, despite the substantial offer by various providers, a too small share of the population uses public transport to travel within the capital. This is, among others, due to a very uneven coverage of regional trains (so-called S-trains).

[2] Brussel Mobiliteit, *Diagnosefiche 7: Waarom is parkeren in Brussel zo moeilijk, terwijl er toch veel parkeerplaatsen zijn?* (10.2017). See Service public fédéral Mobilité et Transports, *Enquête fédérale sur les déplacements domicile travail 2021-2022* (Brussels) 61p. for data regarding home-work traffic in Belgium and it's regions. Available here: https://mobilit.belgium.be/fr/mobilite-durable/enquetes-et-resultats/enquete-sur-les-deplacements-domicile-travail.

This network serves more than 30 railway stations in Brussels, but these do barely play a role in intra-urban travel: most train traffic serves the already saturated Bruxelles Midi – Bruxelles Nord junction. In addition, there is a lack of coordination between the three regional public transport operators (STIB/MIVB in Brussels, De Lijn from Flanders, and TEC from Wallonia) serving the capital. Finally, the commercial speed of surface public transport is low (15 km/h) due to traffic congestion.[3]

- Estimates show that transport is responsible for 27% of greenhouse gas emissions in Brussels. It is also hard to neglect the impact of air pollution. Research estimates that air pollution leads to 600 deaths a year in the capital. In financial terms, air pollution would cost Belgium more than €18 billion a year in external costs.[4]

In order to cope with these and other mobility-related challenges, the Brussels Regional government has developed a regional transport strategy for the years 2020-2030, called 'GoodMove'.[5] This plan is the result of a participatory process that involved numerous regional and national mobility actors from both the public sector, the private sector and the civil (non-profit) sector.[6] The main ambition is to improve the quality of life in the Brussels neighbourhoods and to create a city of neighbourhoods (or, as some would call it, the "15-minute city",) in which walking and cycling are encouraged. Concretely, Good Move aims, among others, to be:

- Green – Reduce greenhouse gas emissions by 35% by 2030 compared to 2005,
- Social – Reduce household spending on travel from 12% in 2015 to 8% by 2030,
- Pleasant – Develop 250 km of car-free zones by 2030,
- Safe – Reach zero deaths and serious injuries when travelling in the Capital Region.[7]

The Good Move plan contains a practical action plan of over 100 pages, consisting of different sheets in which various ambitions, concrete actions, budgetary requirements and involved partners and administrations are listed. Mobility Hubs are discussed as a part of the action sheet C.11, which discusses how shared mobility modes can be enforced: *"The ambition is to create a network of mobility points (Mobility Points) at a neighbourhood level, bundling different services (shared vehicles, bike pumps and bike chargers and charging stations, parcel delivery) and allow maximum grouping of the proposed offer."* By doing so, the Region wants to increase the complementary between shared cars, bikes, scooters, etc. and the existing public transport offer, hence providing an alternative to private car ownership.[8] When the GoodMove plan was first published, no concrete figures were given on the number of planned mobility hubs. However, at the moment of writing, the regional authorities are investigating

[3] Brussel Mobiliteit, *Diagnosefiche 4: Waarom nemen niet meer mensen het openbaar vervoer, hoewel het gebruik sterk gestegen is?* (07.2017).
[4] Brussel Mobiliteit, *Diagnosefiche 10: Heeft de transportsector een grote impact op het Brusselse leefmilieu?* (02.2019).
[5] See T4.2 for an elaborate discussion of the institutional and political context and the mobility policy in Brussels.
[6] Brussel Mobiliteit, *GoodMove: Gewestelijk Mobiliteitsplan 2020-2021. Strategisch en Operationeel plan* (Brussels, 2021) pp. 16-17.
[7] Brussel Mobiliteit, *Samenvatting van GoodMove, het mobiliteitsplan 2020-2030* (Brussel, 2021) pp. 4-5. Available here: https://mobilite-mobiliteit.brussels/sites/default/files/2022-02/Samenvattig%20van%20Good%20Move%20-%20Gewestelijk%20Mobiliteitsplan%202020-2030.pdf.
[8] Brussel Mobiliteit, *GoodMove: Gewestelijk Mobiliteitsplan 2020-2021. Strategisch en Operationeel plan* (Brussels, 2021) p. 203.

the implementation of 20 hubs in the city by 2025. More information on the policy framework for mobility hubs can be found in Deliverable D2.3.

1.2. Living lab goals

The main goal of the living lab is to deploy a temporary space for research in Place du Conseil, at the heart of Cureghem. In this physical and social space, several activities will be conducted to answer three research questions:

- How can the design of neighbourhood mobility hubs incorporate the needs and motivations of (vulnerable) citizens?
- How can digital kiosks facilitate the use of mobility hubs for vulnerable users and people with low digital skills?
- To what extent can a stakeholder assessment tool support the co-creation process of a mobility hub?

We will answer the first research question by adopting a bottom-up approach and involving local potential users and stakeholders to design an inclusive hub that is tailor-made to their needs. Our methodology to achieve this will be discussed in section 2.2. During our fieldwork, particular attention was devoted to vulnerable users. Hereby, we refer to people with a migration background, unemployed persons, those earning lower wages, having limited digital skills, the elderly, etc.

As pointed out earlier, socio-economic contrasts in Brussels are significant. Research has shown that socially disadvantaged groups – having lower wages, being unemployed, less schooled or less digitally skilled – are less inclined to make use of shared mobility modes.[9] If the Brussels Capital Region wants to achieve the goals it has set out in the Good Move plan (such as promoting active and shared modes as an alternative to the privately owned car, reducing greenhouse gas emissions, and reducing household spending on mobility) considerable attention will have to be devoted to transport poverty among vulnerable groups, who often do not know what shared modes are, how they work, how much they cost, and which benefits they have. Mobility hubs can be a part of the solution as (1) they bundle different shared modes at a dedicated on-street location, thus increasing visibility and (2) provide information via an analogue or digital pillar on how to use the services present at a mobility hub, thus lowering the barrier to use shared modes.

Another objective of Good Move is to increase the quality of life in the neighbourhoods. In the Brussels context, living space in socially disadvantaged neighbourhoods is extremely limited, with many families living on a very limited surface (see further). Moreover, many families in these neighbourhoods do not have a garden and access to parks in the poorer parts of the capital is limited (note that most of the parks and forests are located in the wealthier south and east parts of the region). A well-designed mobility hub takes this challenge into account and integrates for instance greenery, picnic tables, a

[9] See Brussel Mobiliteit, Enquête over het gebruik van de elektrische step in Brussel (2019) pp. 7-9 on e-scooters. Durand et al (2022), 'Access denied? Digital inequality in transport services', *Transport Reviews* 42:1 regarding mobility services as a whole. Available here: https://www.tandfonline.com/doi/full/10.1080/01441647.2021.1923584.

playground for children, workout stations, and a coffee bar so that the mobility hub is not just a point from where to commute from A to B, but also fulfils some of the outdoor functions that are currently often lacking.

The first research question is the one that requires more activities, which are conducted during the entire implementation of the living lab. The second and third research questions will be answered by studies occurring in specific periods during the implementation of the living lab. An experiment with a digital information kiosk will be performed to answer the second question, and the third question will be answered by performing the stakeholder assessment tool during the last stage of the living lab.

1.3 Case study context of the living lab

The Brussels Living Lab was set up on the Place du Conseil, in the heart of the Cureghem neighbourhood, just outside the centre of Brussels and a stone's throw away from the Brussels South Station, the largest railway station in Belgium. From a socio-economic point of view, this can be considered a disadvantaged neighbourhood. It is one of the most densely populated parts of Brussels, with more than 20 000 inhabitants per km², almost threefold the regional average (see Table 1) The median taxable income in Cureghem is around 15 500 €, more than 4 000 € below the regional average. The unemployment rate stands at a staggering 27% and almost 20% of Cureghem's minors grow up in a family in which none of the parents has an income from labour. It hosts a higher share of people without Belgian nationality (European Union, Turkey, Northern Africa, Sub-Sahara) than the regional average. On top of that, figures for the municipality of Anderlecht as a whole indicate that around 47% of the residents that has a Belgian ID card ha non-Belgian origins.[10] Given Cureghem's migration history and its role as an arrival point for migrants, many residents may have a Belgian ID-card and non-Belgian roots. The share of people above the age of 25 with a higher education degree is also much lower than the regional average: 16% in Anderlecht compared to 28% for Brussels as a whole.[11]

Although many families in Cureghem cannot afford a car, parking pressure is among the highest in the Capital Region (due to the high population density). Its proximity to some of the major road axes in Brussels has repercussions for the neighbourhood as well: data regarding the concentration of nitrogen dioxide – and emission gas that is traditionally linked to traffic – are among the highest in the region, being twice or thrice as high as the levels defined by the World Health Organization.[12]

[10] See the figures provided by STATBEL, 'Herkomst'. Available here: https://statbel.fgov.be/nl/themas/bevolking/herkomst#figures.

[11] Regional average calculated from the separate data for each of the 19 municipalities, retrieved from STATBEL, Datalab – Census Onderwijs. Available here https://statbel.fgov.be/nl/themas/datalab/datalab-census-onderwijs#figures.

[12] Environnement.Brussels, 'Qualité de l'air à Bruxelles : Les zones trop pollués sont une réalité. Available at : https://environnement.brussels/citoyen/news/qualite-de-lair-bruxelles-les-zones-trop-polluees-sont-une-realite. Last retrieved on 20.04.2023.

Table 1. Demographic and socio-economic data from the living lab. Source: Monitoring des quartiers

	Cureghem	Brussels Capital Region
Population density	20 679	7 501
Median taxable income	€ 15 518	€ 19 723
Unemployment rate	27 %	19 %
Share of minors living in a family without revenue from labour	21 %	16 %
+25 year-olds with a higher education degree (Anderlecht)	16.3 %	28.1 %
Occupation rate parking facilities (5-7u)	91 %	71 %

Concerning mobility, Cureghem is well deserved and a central area in the transport network (see Figure 2). It contains several lines of bus, and tram, a metro line and one of the most important train stations in the country, Gare du Midi. Moreover, there are several stations of shared mobility services and an increasingly developed cycling infrastructure. This is a neighbourhood with a lot of traffic and flux of passengers. In part, this is due to its centrality, but also to the location as one of the entry points to the centre of Brussels, while hosting the biggest market in the country and other manufactures and businesses that attract workers and clients form the region.

Figure 2. Map of Cureghem, highlighting the transport network

Cureghem has been one of the first neighbourhoods where the new circulation plans prescribed by the regional mobility plan (GoodMove) have been applied. The aim of the circulation plan is to reduce traffic as much as possible and direct it towards the major traffic axes around the neighbourhood. This has to increase the liveability of residents and increase traffic safety for active modes.[13] Cureghem was one of the first neighbourhoods in the capital where a circulation plan was implemented. It was designed by a technical committee consisting of municipal and regional mobility administrations and transport operators. Residents had been involved in the process as well: on-street meetings were organized at, among others, the Place du Conseil and the metro station Clemenceau; the testimonies of the local citizens allowed the administrative bodies to identify the major mobility-related issues; and different scenarios of mobility plans were presented to citizens through online and on-street meetings. The plans were approved by the municipal council in February 2022 and a one-year test phase started in the summer of 2022.[14]

Rolling out the plan has, however, given rise to many tensions in the neighbourhood: residents launched petitions against the new circulation, temporary roadblocks and signposting were continuously displaced or sabotaged, heated debates took place on the street and there were tensions between some of the residents and council members during the city council. As the municipality concluded that there was currently not sufficient popular support among the residents, they decided to (temporarily) put a halt to the test phase of the new circulation plan. The municipality removed the roadblocks and signposting, and circulation returned to the initial situation.

[13] Bruxelles Mobilité, '50 quartiers apaisés'. Available here: https://quartiersapaises.brussels/. Last retrieved on 20.04.2023.

[14] The way in which the new circulation plan in Cureghem has been developed and implemented is described in detail in an interview with S. Deblomme, mobility advisor at the municipality of Anderlecht, in 'Du projet à la réalisation : genèse de l'élaboration du quartier apaisé de Cureghem', *Moniteur de la mobilité et de la sécurité routière* 66 (2023) pp. 4-7. Available here: https://brulocalis.brussels/sites/default/files/2023-01/MOMO%2066_FR.pdf.

1.4 Mobility hub goal(s)

It was not possible to make major interventions in the square and transform it into a (temporary) mobility hub. However, we placed a digital information kiosk in front of the town hall during three testing days (see section 2.2). From this kiosk, the tram stop, *Cambio* shared cars, *Villo!* shared bike and car parking facilities were visible. No signposting was added to the bike-sharing station (around the corner) and the metro station as this would have required permits.

For the moment, the regional administration does not have concrete plans to transform the Place du Conseil into a mobility hub. Still, Brussels Mobility is currently developing a shortlist of locations in Brussels that can be developed as hubs. At the moment of writing, the Place du Conseil figures on that shortlist of 20 locations.

In the current situation, the Place du Conseil scores level 1 regarding the physical integration ladder developed by the SmartHubs-team, and level 0 on the digital integration and democratic integration ladders (see the SmartHubs Open Data Platform). This is because there is very limited physical integration of different modes, such as the absence of wayfinding between public transport and shared mobility. There is no digital integration of all services in a single platform, and there has not been any form of citizen involvement in the design and management of the mobility hubs. Yet, if the administration decides to develop the square into a hub, the input from our co-creation process (see further) and other tools will allow for the following integration levels:

Table 2. SmartHubs integration ladder. Source: Geurs & Münzel, 2022.

		Physical integration	Digital integration	Democratic integration
Smart Mobility Hub	4	Conflict free and place making	Integration of societal goals and policies, and consideration of universal design principles	Social learning
	3	Visibility and branding	Integration of service offers and consideration of universal design principles	Integration of different knowledge
	2	Wayfinding and consideration of universal design principles	Integration of booking and payment and consideration of universal design principles	Deliberative engagement of stakeholders, including (vulnerable) user groups
Mobility hub	1	Acceptable walking distance to shared and public transport, minimum inclusive design standards	Digital integration of information	Appropriate representation of stakeholder interests, no or limited attention for vulnerable user groups
Single mobility services	0	No physical integration	No digital integration	No stakeholder involvement and consideration of (vulnerable) user needs

- **Physical integration**: targeting level 3. The research on the needs of vulnerable users (Deliverable 3.2) and wayfinding (Deliverable 3.3) allows the development of good wayfinding infrastructure, especially towards the bike-sharing (Villo!) which is not visible from the car-sharing station (and vice versa), as well as between the metro station and the mobility services at the Place du Conseil, which are at walking distance but not directly visible. Our research will allow for equitable, simple and intuitive use of the hub. Given that bike-sharing and car-sharing are visible from the tram stop, level 3 could be achieved as well, under the condition that an attractive and recognizable

hub branding is designed and deployed across the entire Capital Region – and not just in the municipality of Anderlecht - for reasons of brand awareness. Level 4 cannot be reached given the fact that one has to cross the street to transfer between the metro station and the services at the Place du Conseil.

- **Digital integration**: target level 2 is feasible under the condition that universal design principles and insights from the test with the digital kiosk are incorporated. In its current version, the kiosk allows for an integration of information regarding public transport, car- and bike-sharing, and other (non-) mobility-related services at the hub (level 1). The input gathered during the testing of the digital kiosk has provided valuable insights on how to improve the user experience of digital tools, especially among vulnerable to exclusion citizens. Our findings will be communicated in a dedicated paper co-authored by VUB, UT and Mpact. Note that the Brussels' transport operator STIB-MIVB is currently developing a MaaS application that will allow for planning, booking and paying for trips. Public transport (tram, bus, metro) will be integrated with the services of some private players (car, scooter, and bike sharing). Provided that the insights from our research are integrated in the MaaS-application that is being developed by the region, level 2 is feasible.
- **Democratic integration**: level 3 is feasible under the condition that the regional authorities are willing to take the input, gathered during the SmartHubs co-design process, into account when designing and implementing the hub at Place du Conseil. As will be described in more detail on the following pages, various stakeholders, notably vulnerable users, have been actively involved in the design process. Their vision of what a hub could look like, needs and worries have been taken into account via several interactive participation methods.

1.4.1 Expected contributions of the living lab

The activities developed in the mobility hub according to the principles set out in the SmartHubs Deliverables 3.1, 3.2 and 3.3 are expected to improve information flow towards vulnerable-to-exclusion citizens regarding the use of shared modes and the co-creation of mobility hubs or other transport facilities. During our activities in Cureghem, we observed that this particular target audience is often ill informed about shared mobility. In addition, given the fact that mobility hubs allow for increased visibility of shared modes and better information flow, more people are likely to make use of them instead of privately owned vehicles. This will lead to a reduction of NOx emissions, which are particularly high in Cureghem (see section 10).

To understand how the implementation of a mobility hub at Place du Conseil, the KPIs developed in the SmartHubs project (Pappers et al., 2022) have been used. The KPIs are used to reflect on the contribution of such implementation (see Annex 1).

1.4.2 Users of the living lab

The potential end users of the mobility hubs are the inhabitants of the neighbourhood and other individuals that use the mobility hub to change between transport modes. The KPIs and

goals outlined above will have a positive influence on all inhabitants of Cureghem and other users of the mobility hub. However, given the characteristics of the neighbourhood described in section 1.3, additional attention is given to the inclusion of vulnerable-to-exclusion citizens, who are often overlooked when planning mobility services and implementing new solutions. More concretely, this concerns the following groups: children and teenagers, digitally excluded citizens, migrants, older people, people with impairments, peri-urban and rural inhabitants, and women. Their needs regarding mobility hubs are discussed in detail in Deliverable 3.2.

2. Living lab planning

This section describes the different stages of the living lab, as well as all the activities conducted in it. The data obtained through the co-design process and the Smarthubs quantitative survey are presented in sections 2.5 and 2.6.

2.1 Stakeholder needs and requirements

In order to understand the needs of stakeholders, reach out to our target groups and carry out our research, we relied on the following partners:

- Bruxelles Mobilité – the regional transport administration was a cooperation partner in the SmartHubs-project. They followed the living lab advancements, participated in the co-creation process, provided feedback to our work and are kept up-to-date regarding our progress and findings via bi-monthly meetings;
- STIB-MIVB – the public transport operator in Brussels, participated in the aforementioned bi-monthly meetings and supported the living lab by providing the 'Living Together Bus' during the events organised in Cureghem. They also participated in the co-creation process.
- Municipality of Anderlecht – the municipal administration was a SmartHubs project partner. They provided concrete knowledge of the terrain, ensured the liaison with neighbourhood organisations, and took care of the organisation of on-street events;
- Cambio – the largest car-sharing operator in Brussels was interviewed to understand their vision for mobility hubs. They also participated in the co-creation process.
- Felyx – the largest moped operator in Brussels was interviewed to understand their vision for mobility hubs. They also participated in the co-creation process.
- The citizens – an essential part of the co-creation process. On the following pages, their implication and contribution will be discussed in more detail.

Adopting a user-centric approach, the needs of citizens were identified in the first stage of the co-creation process. During the 'user needs assessment' stage, from January to July 2022, local experts and citizens were interviewed and participated in four focus groups. This stage enabled the identification of the needs of citizens. The results of this process, which was implemented across all living labs, can be found in Deliverable 3.2 'Needs of users and digitally excluded citizens'.

The needs of the other stakeholders were identified during the co-design stage, from September 2022 to January 2023, and were incorporated into the co-creation process. The needs identified can be divided into two main categories: (1) needs concerning the implementation of the living lab and (2) needs concerning the design of mobility hubs. The first category is explained in the following paragraphs, and the second one is in section 2.5 'Mobility hub design'.

The needs concerning the implementation of the living lab were related to the availability of the stakeholder to engage with the activities and the co-creation process, as well as the methods and the location of the activities. To ensure the participation of all stakeholders, flexibility and adaptability were relevant. For instance, several dates were proposed to make

sure that everyone could join, and a new member with Arabic literacy joined the research team, to act as an interpreter and facilitate the participation of individuals with Arabic as their mother tongue. A series of public events were planned in June 2022 on six different dates between September and November 2022 (see section 2.4). During these events, all stakeholders were invited to participate in the living lab activities. The locations in which the events took place were Place du Conseil and the metro station Clemenceau. Both locations were at a distance of 250m form each other. The choice of both locations was made for several reasons: the centrality in the neighbourhood, the social relevance, and the role within the transport network, as these locations include several transport stops and services, both public and shared.

2.2. Living lab implementation

The methods used were chosen to accommodate the diversity among stakeholders, taking into account their level of education and literacy of the local language. The different methods were applied at different moments, as part of the three stages of the living lab, which are aligned with the co-creation process (see Figure 3).

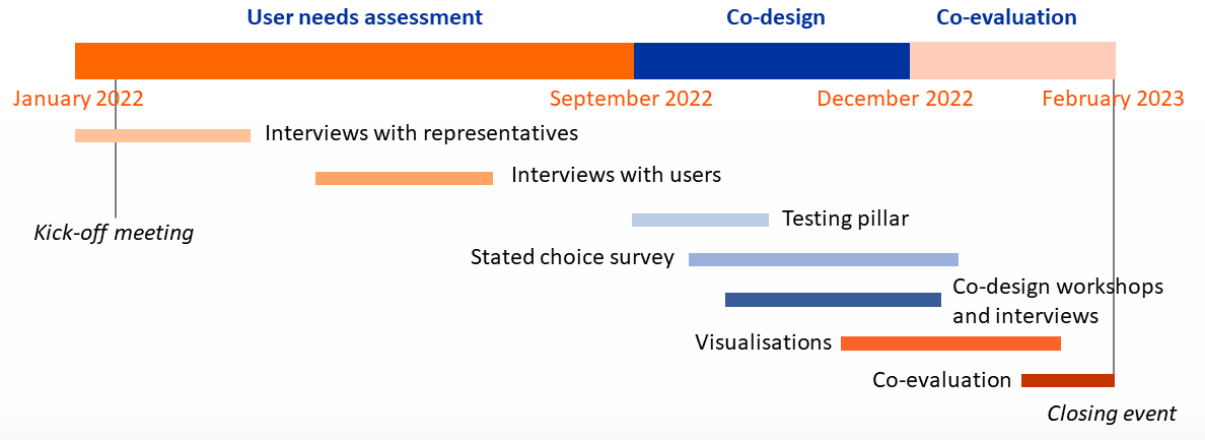

Figure 3. Planning of the activities conducted in the living lab.

During the three stages of the co-creation process, more than 150 people participated in the activities organized. Table 3 and Table 4 summarize the activities, methods and participants for each stage.

2.2.1 Stage 1: User needs assessment, from January to July 2022

The user needs assessment aimed to identify the requirements in the location of the living lab concerning the implementation of a mobility hub. This entailed identifying the transport behaviour of citizens and potential users, as well as the barriers they encountered to travel, especially by public transport or shared mobility services. The results of this study can be found in the SmartHubs Deliverable D3.2 (Martinez et al., 2022a)

Table 3. Summary of the activities conducted in the first stage of the living lab.

Activity (in chronological order)	**Data collection method**	**Date**	**Location**
Interview ***1 participant***	Semi-structured interview	21/01/2022	Remotely (video call)
Interview ***1 participant***	Semi-structured interview	24/01/2022	Remotely (video call)
Interview ***1 participant***	Semi-structured interview	11/02/2022	Remotely (video call)
Interview **1 participant**	Semi-structured interview	15/02/2022	Remotely (video call)
Interview ***1 participant***	Semi-structured interview	16/02/2022	Remotely (video call)
Focus group ***13 participants***	Observations and assisted questionnaire	17/02/2022	Local non-profit organisation
Interview ***1 participant***	Semi-structured interview	23/03/2022	Local social centre
Focus group ***15 participants***	Observations and assisted questionnaire	23/05/2022	Local primary school
Focus group ***8 participants***	Observations and assisted questionnaire	25/05/2022	Local non-profit organisation
Interview ***1 participant***	Semi-structured interview	07/06/2022	Local social centre A
Interview ***1 participant***	Semi-structured interview	16/06/2022	Local social centre A
Interview ***1 participant***	Semi-structured interview	16/06/2022	Local social centre A
Interview ***1 participant***	Semi-structured interview	16/06/2022	Local social centre A
Interview ***1 participant***	Semi-structured interview	20/06/2022	Local social centre A
Interview ***1 participant***	Semi-structured interview	20/06/2022	Local social centre A
Focus group ***6 participants***	Observations and assisted questionnaire	22/06/2022	Local non-profit organisation

2.2.2 Stage 2: Co-design, from September 2022 to January 2023

The co-design stage was a part of the co-creation process in which stakeholders gave input and imagine solutions for the future mobility hub. This mainly concerned the design of the mobility hub, but also other elements related to the digital integration of services, pricing and user involvement.

Table 4. Summary of the activities conducted in the second stage of the living lab.

Activity (in chronological order)	**Data collection method**	**Date**	**Location**
Experiment with digital pillar ***10 participants***	Observations and questionnaire survey	19/09/2022	Local social centre A
Experiment with digital pillar ***4 participants***	Observations and questionnaire survey	20/09/2022	Local social centre A
Experiment with digital pillar ***6 participants***	Observations and questionnaire survey	29/09/2022	Local social centre A
Experiment with digital pillar ***7 participants***	Observations and questionnaire survey	03/10/2022	Local social centre B
Experiment with digital pillar ***7 participants***	Observations and questionnaire survey	04/10/2022	Local social centre B
Experiment with digital pillar ***5 participants***	Observations and questionnaire survey	07/10/2022	Place du Conseil
Experiment with digital pillar ***11 participants***	Observations and questionnaire survey	24/10/2022	Place du Conseil
Co-design workshop ***6 participants***	Co-design game, observations and assisted questionnaire	24/10/2022	Place du Conseil
Co-design workshop ***8 participants***	Co-design game, observations and assisted questionnaire	10/11/2022	Non-profit organisation
Interviews ***10 participants***	Semi-structured interviews and assisted questionnaire	28/11/2022	Place du Conseil
SmartHubs survey ***29 participants***	Assisted questionnaire	28/11/2022	Place du Conseil
Co-design workshop ***5 participants***	Co-design game, observations and assisted questionnaire	05/12/2022	Municipality of Anderlecht

Interview ***1 participant***	Semi-structured interview and assisted questionnaire	14/12/2022	Remotely (video call)
Interview ***1 participant***	Semi-structured interview and assisted questionnaire	21/12/2022	Remotely (video call)
Interview ***1 participant***	Semi-structured interview and assisted questionnaire	11/01/2022	Remotely (video call)

The first part of the co-design stage consisted of an **experiment with a digital pillar** of which the software was designed by Mpact. This experiment aimed to identify how digital kiosks can be made more inclusive, and how they can facilitate the use of the mobility hub for people with limited digital skills.

The starting page of the digital screen can be divided into three sections (see Figure 4).

- Above, general information such as time and weather is shown.
- In the middle part, real-time information on the next departing public transport services is available.
- Below, a navigation bar allows users to access a map that shows nearby transport services, to obtain information regarding vehicle sharing services and nearby transport facilities (parking, EV-charging, etc.), or to get a more detailed overview of departing services, ordered according to the platform (public transport button). An information page regarding the SmartHubs-project was included as well.
- Via a language button right below, participants could switch between Dutch, French and English.
- Above right, users could navigate to a satisfaction survey, which can be used to improve the user experience.

Figure 4. Left: the digital kiosk in Anderlecht - Middle: starting screen of the digital kiosk - Right: detailed page on car sharing.

The experiment consisted of three parts:

- Firstly, participants tested the digital kiosk by conducting a set of seven predefined tasks (see Annexe 2)
- Secondly, participants were observed while conducting the tasks. The researchers took notes about the number of tasks achieved, errors, difficulties and reactions of participants.
- Thirdly, participants were assisted while responding to two surveys: one short satisfaction survey related to the kiosk and answered through the kiosk's screen (see Annexe 3), and a second paper survey regarding previous experience with similar devices, feedback on the pillar, the level of digital skills and socio-demographic data (see Annexe 4).

In total, 50 persons participated in the experiment in Anderlecht. A similar experiment was done in Rotterdam, with 55 participants (see Deliverable 4.4). An academic paper will be devoted to this experiment.

The second part of the co-design stage consisted of **workshops, during which a game was used** as an introduction to the co-design process. The co-design game aims to make sure that everyone understands the concepts and elements of mobility hubs, to identify what elements are important for each participant, as well as to start the reflection on what elements are relevant for other users and why. The co-design game is a card game for 2 to 6 participants. All the possible elements that can be found at mobility hubs are included in the set of cards (see Figure 5, left). Throughout the game, participants pick elements that are important to them, and place them on the board, to create their preferred mobility hub, according to personal preferences. Once each player has their mobility hub, everyone picks a persona card (see Figure 5, right), and must adapt the mobility hub they made during the first part of the game to what they think the persona would need. For instance, if the persona does not have a driving license, the transport modes available at the hub should be usable without it.

Figure 5. Left: co-design game cards, and elements. – Right: co-design game cards, and personas.

After playing the co-design game, participants were encouraged to express their preferences concerning future mobility hubs. A part of the workshop was devoted to **the Stakeholder Assessment tool (MAMCA)**, asking participants to indicate what criteria were important for them concerning mobility hubs and giving weights to each criterion to express their relevance.

For this, they were given a paper questionnaire survey, also referred to as co-design survey (Annex 5), in which they could indicate their preferred modes and elements, as well as the criteria of the MAMCA. At the end of the workshop, an additional survey was provided to participants so they could assess the activity (see Annex 6). Furthermore, to also collect the input of citizens or stakeholders that did not have the time to participate in the workshop, the co-design survey was also conducted with other participants with the assistance of a researcher.

The result of the co-design stage was four co-designed options for a mobility hub (see section 2.5) which combined the elements that were indicated as more relevant during the co-design workshops and interviews. Two locations in the square were chosen as more adequate by participants and thus, two options were placed at each location. The four options also contained non-mobility services and functions that were suggested and reflected the aesthetical preferences of participants. The input of participants was channelled in a way that the four options could also represent four types of mobility hubs depending on the number of elements and their complexity, from more basic to more complete. This was to enable the production of co-designed options that also were aligned with more strategic views on the local needs or on how a network of mobility hubs should be. The resulting options were transmitted as descriptions and diagrams to a visualization office that produced four models, and realistic pictures of the designs.

2.2.3 Stage 3: Co-evaluation, February 2023

The co-evaluation stage was a part of the co-creation process in which stakeholders assessed the co-designed options and the process. This was mainly done during a fourth on-street event, taking place on February 6th as the final on-street event of the living lab. The event was announced on the Facebook page of the municipality, through flyers distributed in each mailbox within the neighbourhood and by e-mail, to inform participants of previous events. Nonetheless, most participants (n=47) were attracted by the on-street activities, in which snacks and games were proposed, and invited by the researchers to participate. During the event, the four co-designed options were showcased in the interior of the 'Living Together' bus from the local transport operator STIB-MIVB (see Figure 6). This bus was used by the local transport operator to support public events that aim at enhancing social inclusion, awareness about mobility services and support digitalisation processes. The bus was used in the living lab as the interior space where the four co-designed options were presented to each participant, who then could share their opinion, make suggestions, choose their preferred design, and assess the activity on a paper survey (see Annexe 7).

Figure 6. 'Living together' bus at Place du Conseil.

The stakeholders that could not attend the co-evaluation event but participated in the co-design event were invited to evaluate the co-deigned options remotely, by e-mail or via a video call (n=6). In total, 53 people participated in the co-evaluation stage, 29 women and 24 men. The average age of participants was 41 years old, and 36 lived or work in the area, while 15 lived in another municipality of the region and 2 outside the region. This is because some representatives of other stakeholder groups, such as the regional government or the public transport operator, do not live in Anderlecht. The results of the co-evaluation are explained in section 3.

2.2.4 Elements considered throughout the living lab

The living lab considered the three elements. The physical integration and its related elements were thoroughly discussed during the co-design process. Likewise, digital integration was considered, as an experiment with a digital kiosk was conducted. The experiment aimed to know the opinion of residents and potential users of the mobility hub concerning the digital kiosk, as well as to know how a digital kiosk can make a mobility hub more inclusive. Lastly, democratic integration was considered throughout the co-creation process, putting the focus on the inclusion of vulnerable people and the production of social learning. Several methods were tested to come up with a more inclusive approach to the co-creation of mobility hubs, such as visual elicitation, co-design games, and social activities around the notions of the co-creation process and the process itself.

2.3 Case Study status-quo

In Cureghem, two hotspots for shared (public) transport can be defined. The first is the metro station Clemenceau. This stop is situated on metro line 5 that runs east-west across the capital (see Figure 7). At the northern exit of the metro station, there is a bus stop as well as shared bikes (docked) operated by Villo!, the largest shared bike provider in Brussels. The square is vibrant due to the many (locals) taking the metro to (and from) the city centre or connecting between tram and bus. The second location is the Place du Conseil, situated in front of the

town hall of Anderlecht. Numerous shared and sustainable modes are available here, such as the tramway line number 81, which goes eastbound towards the nearby Brussels South Station and westbound towards the commercial heart of Anderlecht; station-based cars operated by Cambio, the largest car-sharing operator in the capital; station-based bikes by Villo!; a bike box where residents can stall their bikes; and EV-charging facilities in nearby streets. The entrance to the aforementioned Clemenceau metro station is only 250 meters away from the Place du Conseil. Although both locations can be considered as one large mobility hub, there is currently no signposting available that nudges (potential) users to transfer between the modes present at Clemenceau and the Place du Conseil.

Figure 7. Map of the transport infrastructure in the Region of Brussels, with the metro Clemenceau at the bottom-left side. Source: OpenStreetMap, 2023

2.4 Adjustment of living lab goals

The six on-street living lab events were supposed to start on September 2022, but due to the events that followed the implementation of a new circulation plan in the neighbourhood, the municipality did not authorise the on-street activities (see section 1.3). This was due to some local groups that started protesting against the new circulation plan, sometimes violently, and the municipality was afraid that they would think the living lab was related to the circulation plan. The municipality, therefore temporarily stopped the on-street events, and new planning for the living lab had to be made. While the new plan was being considered, the living lab continued through indoor activities in public buildings, with smaller visibility and in controlled environments. Moreover, as one of the two locations – Clemenceau - was the on-street activities were planned was at the centre of the protests, it had to be removed from the planning. As a result, four on-street events and several indoor activities were organized from October 2022 to February 2023 in Place du Conseil (see Figure 8 and Figure 9).

Figure 8. Place du Conseil/Raadsplein. Source: Dominic Verhulst, 2021

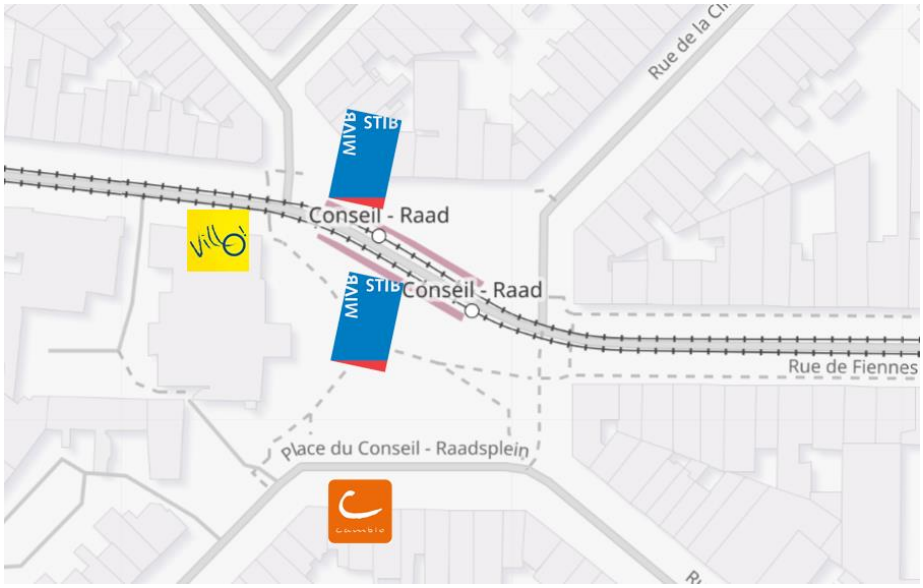

Figure 9. Place du Conseil, with public transport stops and shared mobility stations.

2.5. Mobility hub design

The discussions held during the co-creation process mostly concerned the physical and digital elements of the mobility hubs, and not the ones concerning digital integration. This is because the debate on mobility hubs in the Brussels region was at a very early stage, and many participants did not know what mobility hubs were or it was unclear to them. Thus, the discussions focused on elements that participants found more essential and tangible, concerning their daily mobility and their use of transport. In this regard, the digital integration of the mobility services found at the hub is considered essential by most stakeholders. According to the preferences of participants, level two of physical and digital integration should be aimed at the mobility hub of Place du Conseil.

During the co-design stage, 32 participants from the six initial stakeholder groups were asked to indicate what modes of transport they would like to include in the mobility hub at Place du Conseil (see Table 5). Most participants belonged to the group of (vulnerable) citizens, with five participants from the local government, and one participant for each remaining stakeholder group.

Table 5. Transport modes selected by each stakeholder group

	Citizens	Local government	Regional government	Public transport operator	Station-based shared mobility	Free-floating shared mobility	Total
Tram	X	X	X	X	X	X	6
Metro	X	X	X	X	X	X	6
Bus	X	X	X	X	X	X	6
Train	X	X	X		X	X	5
Shared bikes	X	X	X	X	X	X	6
Shared cargo bikes			X		X	X	3
Shared cars	X	X	X	X	X	X	6
Shared e-mopeds						X	1
Shared e-scooters				X		X	2

Participants were also asked to indicate what other services and features they would like to have in the mobility hub (see Table 6).

Table 6. Services and features selected by each stakeholder group

	Citizens	Local government	Regional government	Public transport operator	Station-based shared mobility	Free-floating shared mobility	Total
Shelter	X	X		X			3
Waiting room	X	X					2
Staffed kiosk	X			X		X	3
Public toilet	X	X	X	X			4
Changing room			X				1
Commerce		X		X			2
Bike parking			X		X		2
Secure bike parking		X		X			2

Bike repair station			X	X			2
Car parking						X	1
EV charging station		X			X		2
Parcel locker			X				1
Free Wifi	X	X			X	X	4
Simplified signage	X	X	X	X	X		5
Text-free signage						X	1
Information in foreign languages		X			X		2

During the co-design stage, observations were conducted by researchers, allowing them to identify several elements that were highlighted and more thoroughly discussed by the different stakeholders:

- Citizens:
    - The shelter is important, to protect from weather heather conditions and wait for vehicles. Additional facilities are important, especially public toilets for people with health issues, for children and women.
    - Support personnel can be very useful to help vulnerable groups, such as older people, or digitally illiterate.
    - Safety and security must be guaranteed. Good lighting and CCTV cameras can be helpful.
    - The information could be provided in foreign languages, to facilitate the use of migrants and tourists.
    - Barrier-free facilities are important, with devices that enable their use by people with visual and hearing impairments.
    - Free-floating shared mobility services, such as e-scooters, should have clearly designated parking spaces
    - The hub should be made with warm materials, such as wood, including green elements and avoid plastic. Glass should we used to enhance inter-user visibility and safety.
    - The square of the mobility hub should maintain space for social events.
- Municipality of Anderlecht (local government):
    - Barrier-free facilities and vehicles are necessary to ensure physical accessibility.
    - The design and the lighting must enhance security, and personnel but also prevent vandalism and theft of private and shared vehicles.
    - Support personnel can be very useful to help vulnerable groups, such as older people, or digitally illiterate.
    - Using wood and glass makes the facilities less resistant to vandalism. The use of steel is recommended.
    - Some vegetation and green elements are relevant, but they should be easy to maintain.

- STIB-MIVB (public transport operator):
    - Simple signage and information are required because it is at the centre of the user experience. Simple signage can substitute multilingual signage.
    - Stair-free vehicles and facilities are necessary to enhance accessibility and inclusivity
    - Secure and well-lighted space is important, and security also comes with a pleasant and well-curated design, social control and lively environments. A small shop or a kiosk could enhance this.
      social control and street-life, which are the best security and safety measures, are even better than security staff.
- Cambio (station-based shared mobility):
    - Adding services and physical facilities reduces the flexibility of hubs. Hubs and parking places of shared vehicles often need to be moved do to public events or street works. This can not be done if the hub has permanent constructions. Moreover, hubs with buildings and other facilities are more costly and difficult to maintain.
    - Enhancing the inclusivity of the services by being able to use it without a credit card, and providing support with staff that belongs to different social and ethnic groups.
    - Facilitating the feeling of ownership that increases social control and prevents vandalism or undue use of shared vehicles. This is possible with station-base vehicles that are permanently in the same location.
- Felyx (free-floating shared mobility):
    - Hubs must be visible, with painting on the floor indicating the parking spaces and wayfinding. Only a sign, such as a pillar, is not enough.
    - There must be always space available to park shared vehicles, or the experience of users is very detrimental and will not use the service.
    - Hubs must be easily reachable from car and bike lanes. Especially car lanes, because charging the e-scooters is done by vans, that need to reach the hub.

The elements identified were combined to produce four diagrams of a mobility hub at the Place du Conseil. Two designs were located on one side of the square, at Clinique street, and two designs on another side, at Rossini street (see Figure 10**Error! Reference source not found.**). The four diagrams together with a description of each were transmitted to Frame, an architectural visualization studio that made a 3D-model of the four designs, and realistic pictures of each design were obtained.

Figure 10. Locations of the co-designed mobility hubs in Place du Conseil

2.5.1 Co-designed option 1: Clinique street – Steel version

- Location A
- Transportation modes: Bus, tramway, shared bikes, shared cars.
- Amenities: Shelter, designated parking space for shared e-scooters, bike parking, secure bike parking, and an EV-charging station for cars.
- Other elements: Improved bicycle access, the information provided in English and Arabic, adapted to people with visual and hearing impairments, CCTV cameras, and increased vegetation.

2.5.2 Co-designed option 2: Clinique street – Wood version

- Location A
- Transportation modes: Bus, tramway, shared bikes, shared cars, shared cargo bikes.
- Facilities: Shelter and waiting area, designated parking space for shared e-scooters, bike parking, an EV-charging station for cars, restrooms, monitored info point, and maintenance room.
- Other elements: Improved bicycle access, signage, accessibility for people with reduced mobility, adapted to people with visual and hearing impairments, additional lighting, new tables and benches, increased vegetation, and use of sustainable materials.

2.5.3 Co-designed option 3: Rossini street –Steel version

- Location B
- Transportation modes: Bus, tramway, shared bikes, shared cars, shared cargo bikes.
- Facilities: Shelter and waiting area, designated parking space for shared e-scooters, bike parking, secure bike parking, bike repair shop, parcel lockers, restrooms, coffee kiosk, and maintenance room.
- Other elements: car parking, text-free signage, accessibility for people with reduced mobility, additional lighting, new tables and benches, and increased vegetation.

2.5.4 Co-designed option 4: Rossini street – Wood version

- Location B
- Transportation modes: Bus, tramway, shared bikes, shared cars.
- Facilities: Shelter and waiting area, secure bike parking, bike repair station, restrooms, maintenance room.
- Other elements: parking, signage, accessibility for people with reduced mobility, additional lighting, CCTV cameras, new benches, increased vegetation, and use of sustainable materials.

2.6 SmartHubs questionnnaire survey

The goal of the joint SmartHubs survey is to get more (quantitative) understanding of the current and potential use of mobility hubs, and the importance of different integration levels of the hub itself. The survey consists of multiple parts, starting with questions on individual characteristics of the respondents, e.g., residence area, socio-demographics and digital skills, followed by a section on mobility characteristics and mobility hubs. Here, a distinction is made between hub familiarity and (future) needs and preferences. The next part of the survey consists of two choice experiments, one on mode choice behaviour and the other on hubs' attributes preferences. The survey ends with a section on participation and democratic integration, ensuring that the three dimensions of the SmartHubs integration ladder (physical, digital and democratic) are all included in the survey.

The sampling process targeted at least 500 participants from the Brussels region, from which at least 200 had to be women, 200 had to be participants with low income and 100 with low education. Moreover, 35 participants had to be over 65 years old, and 25 participants had to be digitally excluded. The targets aimed at the beginning were achieved during the period that the survey was accessible, from December 2022 to March 2023. As a result, 730 individuals from the Brussels region participated in the survey.

The data cleaning process consisted in removing respondents that (i) did not provider their consent to save the data, (ii) only previewed the survey, (iii) were missing a respondent ID, (iv) were living outside the Brussels region (based on ZIP code), (v) did not fully complete the survey and (vi) had a response duration below four minutes, which was set as the minimum response time. This resulted in 432 (59% of total responses) valid responses for the Brussels living lab.

Participants were mostly between 25 and 45 years old, with 30% of them between 45 and 65 and less than 15% had more than 65, or below 25 (see Figure 11).

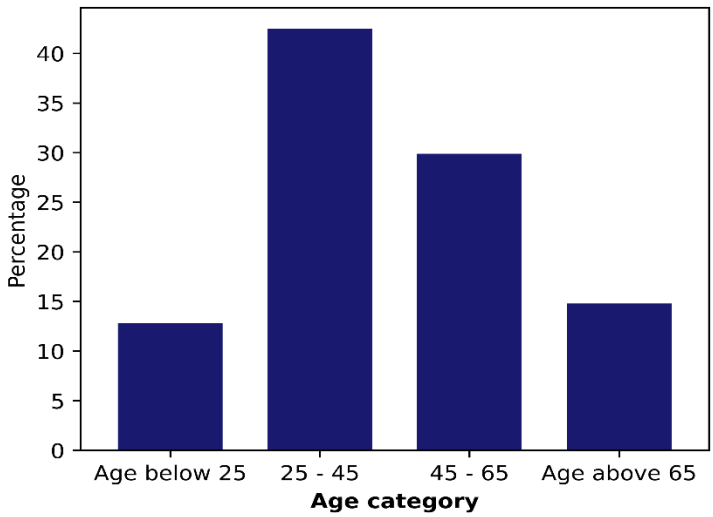

Figure 11. Age of participants in the questionnaire survey

Half of the participants had a medium level of income (between 1600 and 4800€ per month), more than 20% belonged to the low-income group (less than 1600€ per month), and more than 10% to the high-income one (more than 4800€ per month). The remaining participants did not indicate their level of income (see Figure 12).

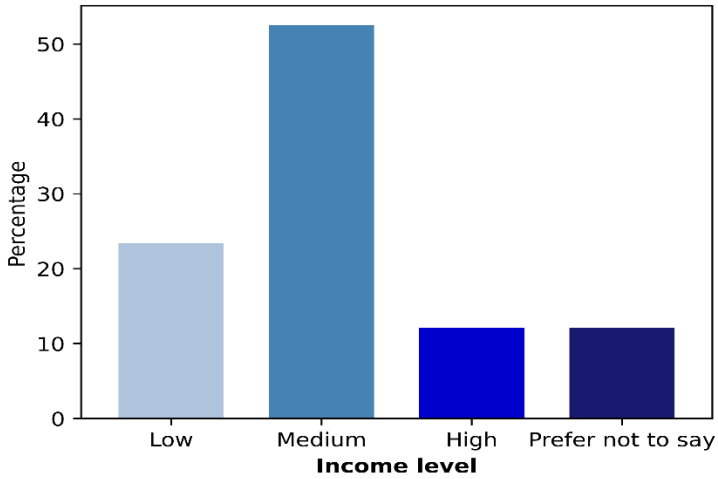

Figure 12. Level of income of participants.

The majority of participants did not complete their education after high school, and more than 40% have completed a university degree (see Figure 13). Very few participants have not completed senior high school, and the ones belonging to this group are mostly migrants. This is because senior high school is compulsory in Belgium.

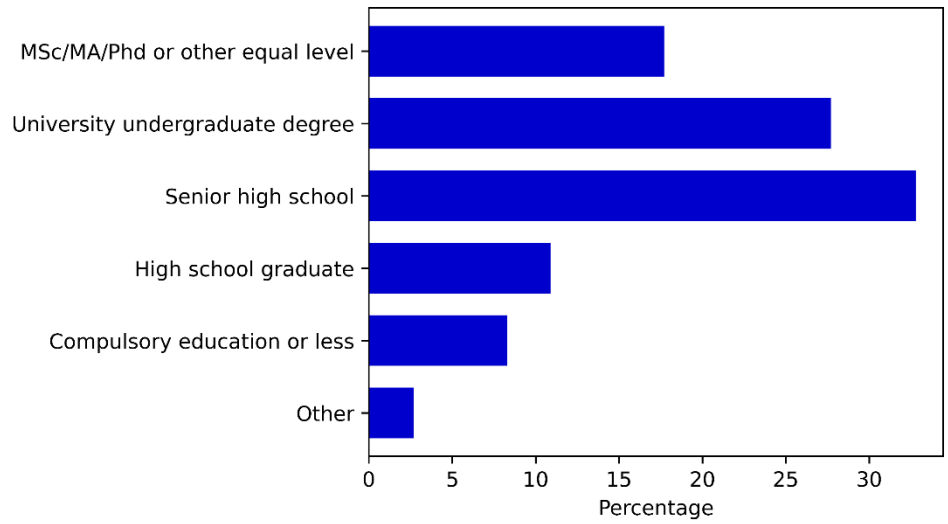

Figure 13. Level of education of participants

The results of the questionnaire survey show the current use of transport and the likelihood to use other modes. For instance, Figure 14 shows that walking and public transport are the most frequently used modes.

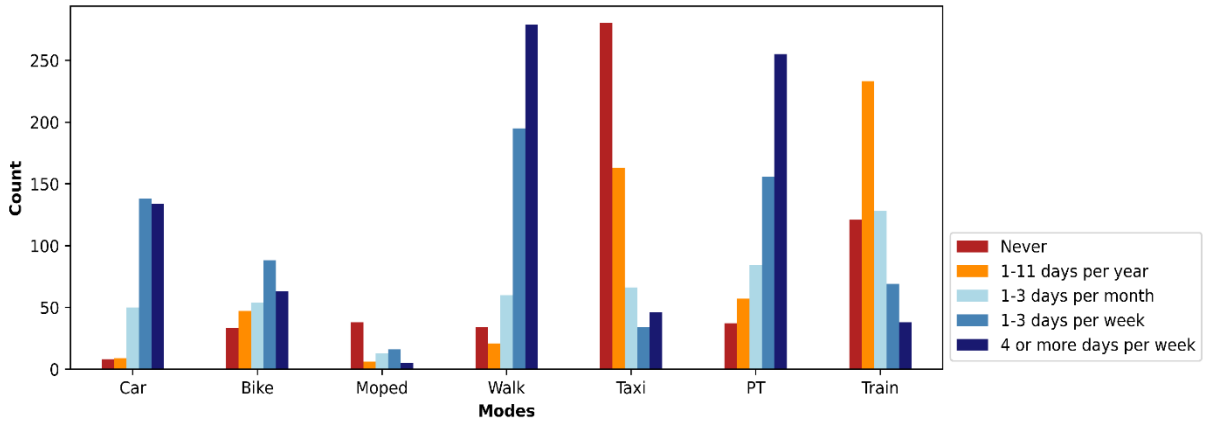

Figure 14. Frequency of transport mode use. In the chart, PT refers to public transport.

Concerning shared mobility, most participants state that they have never made use of it (see Figure 15).

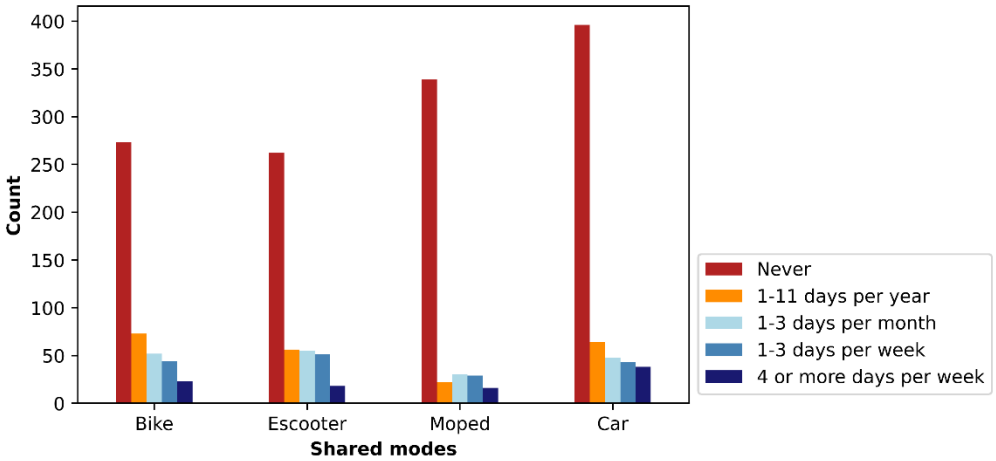

Figure 15. Frequency of use of shared mobility modes

Although most participants stated they would not use shared mobility modes at mobility hubs (see Figure 16), those who would do so would use shared cars and bikes to a similar extent, and e-scooters more often.

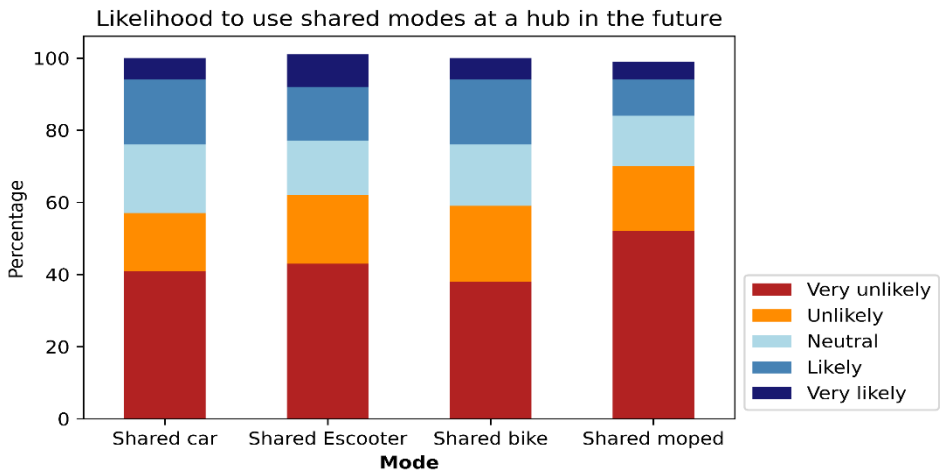

Figure 16. Likelihood to use shared modes at a mobility hub

Most participants are familiar with mobility hubs. Around a third of participants have seen and used a mobility hub before, and another third have seen it, yet not used it (see Figure 17).

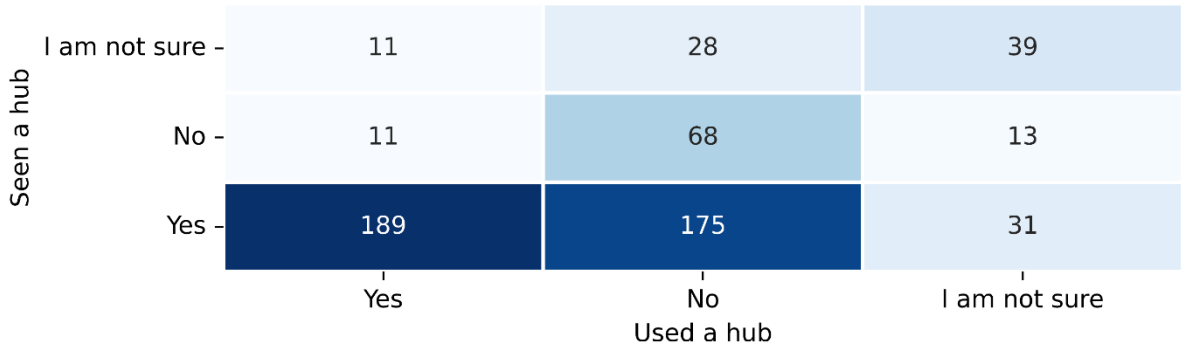

Figure 17. Familiarity with mobility hubs, by number of participants.

The Smarthubs survey also asked participants about the barriers they encounter to using different shared mobility options. The barriers to not using a shared bicycle indicated most often by participants are that they prefer to use their vehicle, that this service does not fulfil their travel needs, and that it is too dangerous (see Figure 18).

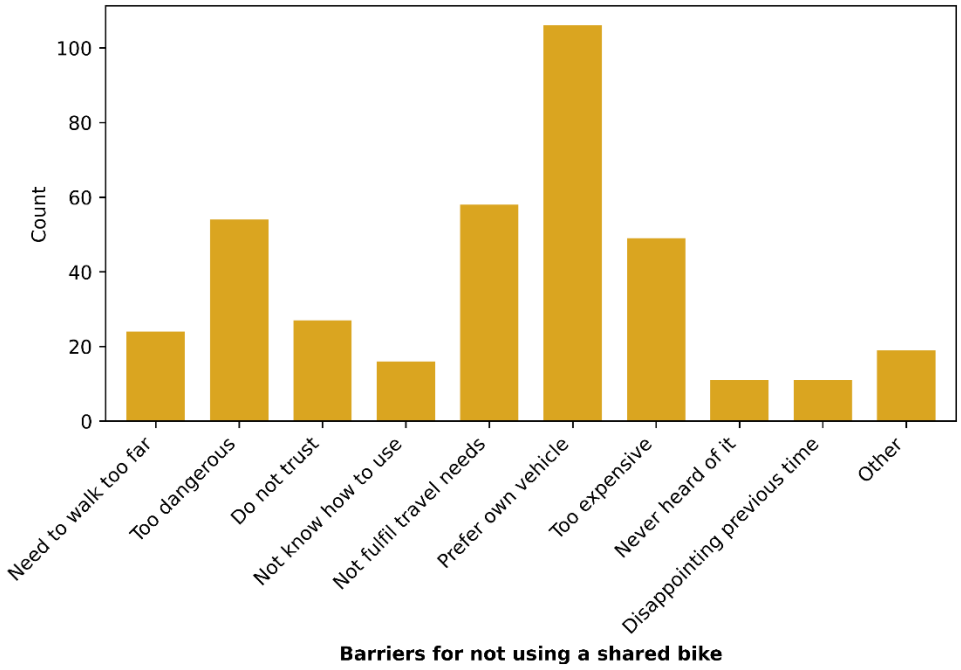

Figure 18. Barriers to not using a shared bike, by counts.

The barriers to not using a shared car indicated most often by participants are that they prefer to use their vehicle, that this service does not fulfil their travel needs, and that it is too expensive (see Figure 19).

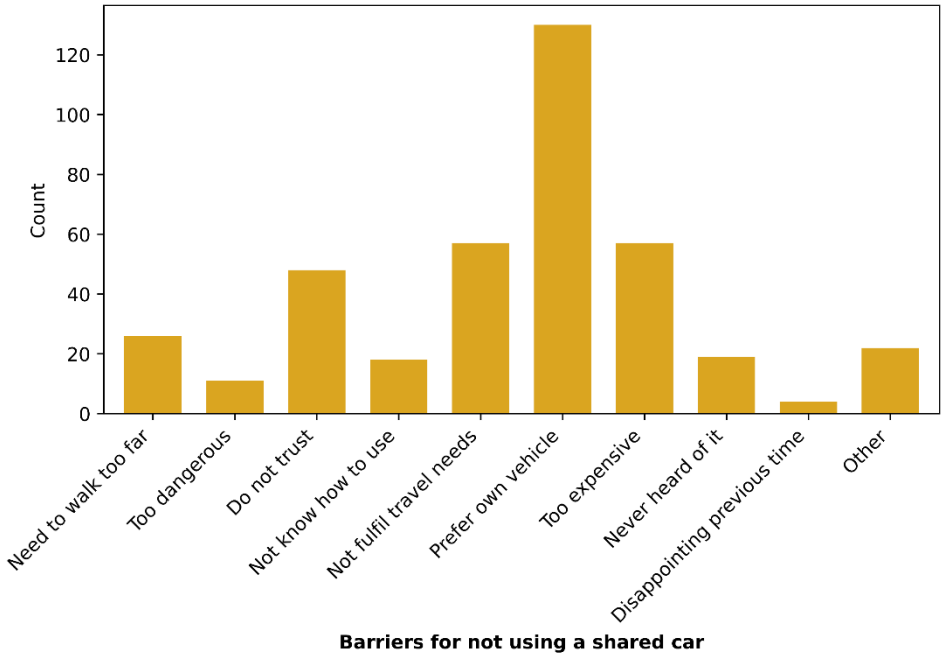

Figure 19. Barriers to not using a shared car, by counts.

The barriers to not using a shared e-scooter indicated most often by participants are that it is too dangerous, that this service does not fulfil their travel needs, and that they prefer to use their vehicle (see Figure 20).

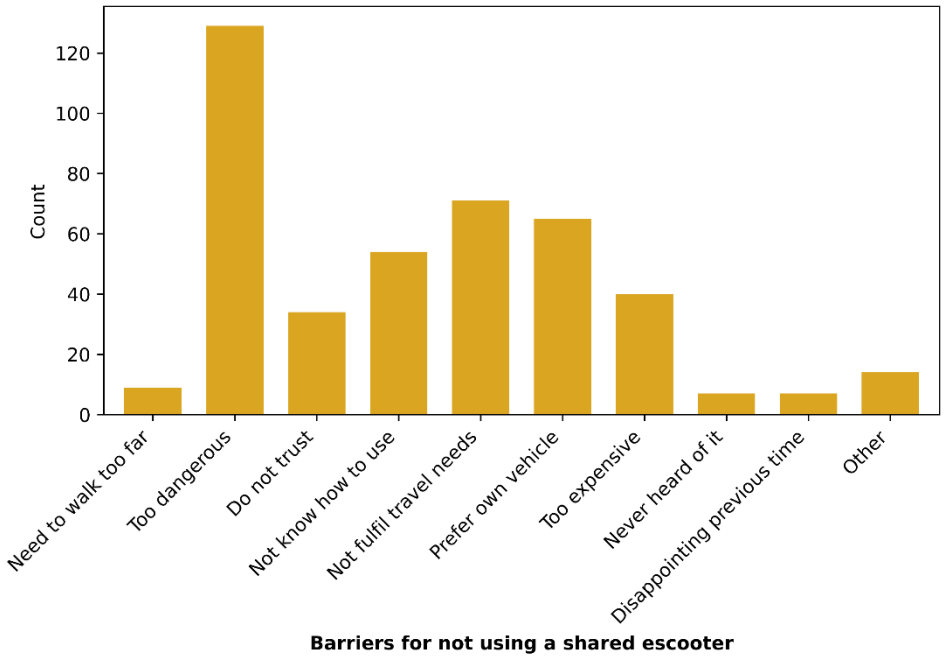

Figure 20. Barriers to not using a shared e-scooter, by counts.

3. Living lab evaluation(s)

The living lab includes two types of evaluations, which rely on the answers that participants gave in two different questionnaire surveys. Firstly, the co-evaluation of the co-designed options is presented. This type of evaluation is part of the co-creation process and is used to decide what option of a mobility hub will be implemented. The co-evaluation is supported by the Smarthubs appraisal tool, consisting of a stakeholder assessment (MAMCA) and a sustainability appraisal (MCA). The results of both assessments are presented in this section. Secondly, the participants evaluated the co-creation process and the methods used.

3.1 Satisfaction of stakeholders

The four co-designed options were assessed by the 47 citizens through a questionnaire survey. The preferred design was option 3, selected by nineteen participants. Nonetheless, option 4 was chosen by fifteen citizens. The elements that citizens highlighted as most positive among all options were:

- The staffed kiosk or coffee that would enhance security, support for users as well as the maintenance of the mobility hub;
- The shelter or roof to protect from the rain and the wind;
- Having more services: kiosk, bike and e-scooter parking spaces, toilets, bike repair station and ticket vending machines;
- The vegetation added to the square;
- The use of wood as a construction material;
- The spaces to sit and socialize.

The four co-designed options were evaluated by the other four stakeholders. The free-fating shared transport operator (Felyx) did not participate in this stage. The preferred option of each stakeholder group was:

- Local government (Municipality of Anderlecht): Option 1
- Regional government (Brussels mobility): Option 1
- Station-based shared transport operators (Cambio): Option 1
- Public transport operator (STIB-MIVB): Option 3

The concerns of the four stakeholders were related to the feasibility, costs and performance of each co-design option as transport infrastructure and public space. Thus, option 1 was preferred by three of the four stakeholders. The reasons given were that it was more flexible, less costly, and the location was more adequate while having a lesser impact on the square. This option would also easily allow the displacement of elements and adapt the mobility hub to necessary transformations. However, adding cargo bikes was recommended to offer more shared mobility options.

3.2 Stakeholder assessments

The four co-designed options were analysed with the SmartHubs stakeholder assessment tool (MAMCA) by researchers of the VUB and Mpact. The description of the tool and the details about how this analysis is performed can be found in Deliverable D3.5 (Martinez et al., 2022b). The impacts of each co-designed option on the criteria indicated by all stakeholders are shown in Figure 21. Option 2 was considered the co-design that best matched the interests of all stakeholders.

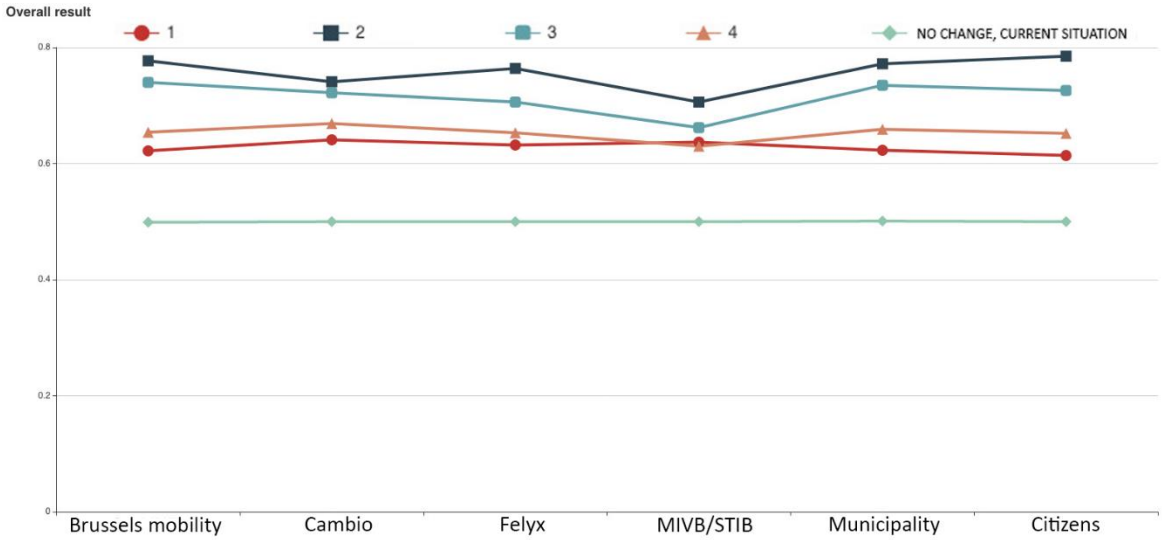

Figure 21. Results of the stakeholder assessment (MAMCA) of the four co-designed mobility hubs.

The results of the stakeholder assessment tool do not match the choice of the participants. This can be explained because participants gave criteria at an early stage of the co-design process when the reflection was at a more abstract level. However, the choice of the co-design options was made through concrete visualisations of the designs, leading participants to reflect on other elements that might have not been considered in the given criteria, such as the attractiveness of the design. Furthermore, option 2 has elements of option 1 and option 3 that were highlighted as positive by participants, and could be considered an intermediate design.

3.3 Sustainability appraisal

The four co-designed options presented in section 2.5 were analysed with the SmartHubs sustainability appraisal tool (MCA). The description of the tool and the details about how this analysis is performed, can be found in Deliverable D3.5 (Martinez et al., 2022b). The impacts on the economic, environmental and social sustainability of each option are shown in Figure 22. Overall, options 2 and 3 obtained the best results in the MCA analysis performed by Mobilise (VUB) and Mpact. Option 2 performs better in terms of environmental sustainability, and options 2 and 3 perform similarly regarding social sustainability. The economic sustainability of all options is the element that performs the worst, as their operation would considerably rely on public funding.

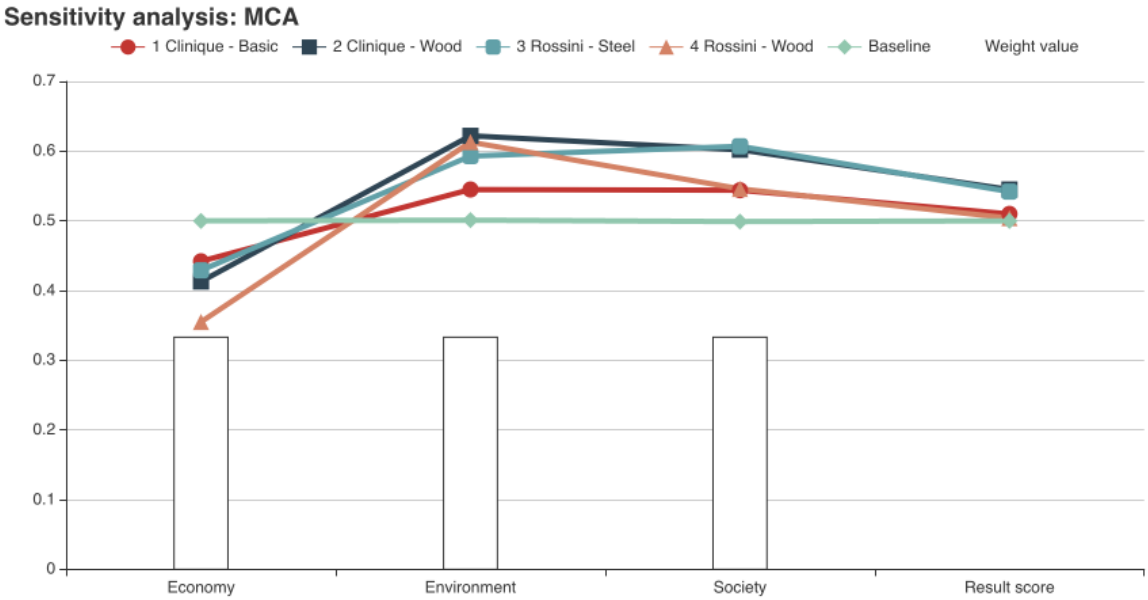

Figure 22. Results of the sustainability appraisal of the four co-designed mobility hubs.

3.4 Evaluation of the co-creation process

This section present the results of the assessment of the co-design workshops and co-evaluation activities. In both cases, a short questionnaire was handed at the end so participants could assess the activity and the methods used in the co-creation process. For the workshops, there was a researcher making observations and taking notes. The following three paragraphs explain the summary of the findings of the two questionnaires and the observations.

The participants that were involved in the co-design workshops (N=19) also assessed their experience and the participatory methods used in the activities. Participants were mostly satisfied with their experience in the co-design workshop, and they considered the perspectives of other participants to be interesting. In terms of learning, they learned very few things about urban mobility and some more things about co-creation. Participants stated that the workshop was very interactive, there were very few conflicts, and there was some negotiation among them. They believed that their ideas would be partially taken into account. The co-design game is considered to be entertaining, simple and clear. The participants felt very engaged with the game, stating that the support of the facilitator is very useful, as well as the material provided.

Researchers observed the behaviour of participants during the co-design workshops, identifying that participants were overall enthusiastic about the activity and talkative. The interaction among participants and their engagement increased during the workshops. The co-design game enhanced the engagement as well as the negotiation among participants. During the co-design workshop, conflicts sometimes arise, but participants negotiate and also show empathy for the interests of others. Participants seemed to acquire new knowledge about mobility and co-creation and applied it during the activity.

The participants in the co-evaluation stage (N=53) also assessed their experience. Participants were mostly satisfied with the visualisations of the co-design options and they were mostly satisfied with the result of the stakeholder assessment tool (MAMCA). However,

participants indicated not being sure if the tool was easy to understand, with some participants indicating it was difficult.

4. Conclusions

This section summarizes the findings obtained in the Anderlecht living lab, issuing several recommendations, and reflecting on the limitations of the study and subjects of further research. The living lab was situated in Cureghem and included a single case study, enabling the development of a comprehensive co-creation process.

4.1. Main Findings and Recommendations

The findings of the living lab are relevant to practitioners, citizens and decision-makers interested in developing mobility hubs. The results were obtained by answering three research questions:

- How the design of neighbourhood mobility hubs can incorporate the needs and motivations of (vulnerable) citizens?
- How can digital kiosks facilitate the use of mobility hubs for vulnerable users and people with low digital skills?
- To what extent the co-creation process of a mobility hub can be supported by a stakeholder assessment tool?

Firstly, the co-creation was useful to identify how a design of a neighbourhood mobility hub that incorporated the needs and motivations of (vulnerable) citizens can be obtained. The exploratory approach of the living lab enabled the test of different methods and the results obtained offer empirical evidence to answer the first question. To incorporate the needs and motivations of (vulnerable) citizens, the co-creation process must be context-sensitive and adapted to the needs of the stakeholders and inhabitants of the neighbourhood where the living lab will be implemented. This increases the inclusivity of the process, ensuring the participation of vulnerable and hard-to-reach groups whose needs are often neglected.

To increase the inclusivity of the co-creation process, the activities must adopt a format that better suits the needs of all stakeholders. Shorter activities, that do not require a lot of effort from participants and are simple and easy to understand, are recommended. Making sure that all participants understand the process, the concepts and what is expected from them is mandatory. For this, visual elicitation can be helpful, as well as using the language that participants understand the best. Likewise, the location, dates and times of the activities must also take into account the availability and lifestyle of participants. Social activities in the public space have proven to be especially inclusive and can be useful to let people know about the future mobility hub and the co-creation process.

Secondly, a digital information kiosk was tested to gain knowledge on how such kiosks can facilitate the use of mobility hubs to users, especially people with low digital skills or without a smartphone. The study was part of the co-design stage of the living lab, and the conclusion is that digital information kiosks can facilitate the use of mobility hubs for many individuals, and also people with low digital skills. However, they must be designed according to the needs of users with low digital skills, limited literacy of the local language and low education. Thus, the interface of the kiosk must be simple, and the use of pictograms, colours

and sizes of elements and fonts must be thoroughly considered. Likewise, the content of the digital kiosk must be useful to users of public transport, shared mobility and other services of the mobility hub, but it should not be too complex or contain unnecessary information.

Thirdly, the stakeholder assessment tool is useful to allow participants to know the preferences of all stakeholders. This is useful to reflect on how the preferences of stakeholders can be ensured in the implemented mobility hub. Nonetheless, assessment tool was difficult to understand for some participants (e.g., measurements, calculation process), especially citizens with lower education or other vulnerable groups. In order to understand how the assessment works, a lot of explanation is necessary, and many participants did not have the time or motivation for it. Furthermore, the choices of participants did not coincide with the results of the tool although it performed the best concerning the criteria of most stakeholders. This is because the choice of participants is often based on subjective preferences, emotions or how each option is represented. In the case of participants that did not understand the tool, and the results, it did create a feeling of mistrust and it was difficult for them to align their final choice with the results. Most participants stated that they rather keep their personal choices, even if the stakeholder assessment tool indicated that their stakeholder group would benefit more from another option. In this regard, visual elicitation has to be critically applied, as it may facilitate an emotion-driven choice.

4.2. Limitations and further research

The Anderlecht living lab included an early stage of the design and implementation of mobility hubs in which the lead on promoting mobility hubs and shared mobility was taken by the local and regional government. Moreover, the initiative to start a co-creation process of a mobility hub was taken by the project partners, and not by the residents of the neighbourhood. At this stage, the debate about the needs of (non-)users had to be limited to more concrete or tangible elements, focusing mainly on the physical dimension. Although the co-creation process targeted a high degree of citizen involvement and inclusivity, no further discussions about the type of governance that the mobility hub(s) were held. Likewise, the debate on the digital integration of the service was not thoroughly included in the co-creation process, as it was only indicated by the transport operator and shared mobility provider.

Concerning the implementation of the living lab, certain limitations were found throughout the process. The Brussels living lab had to be adapted to the events that followed the new circulation plan in Cureghem. Although such events may seem problematic at first, they add additional layers to the study and the research, making it more complex and bringing it up to date. In the context of this study, such events are considered part of a dynamic and uncertain reality, which is the result of ongoing transformations and social interactions. In the context of a living lab, such limitations should not be a surprise, but always be considered as a possibility, to find alternatives and overcome potential obstacles and difficulties as they arise.

Further research could study how the selected design becomes a reality and to what extent it answers the needs and preferences of stakeholders. As the co-creation of the mobility hub adopted in some cases a relevant degree of abstraction, the results in practice may differ. It might be relevant to study how this process occurs and to what extent the

physical and digital elements of a mobility hub are perceived by (non-)users. Furthermore, the stakeholder assessment tool could be reconsidered: firstly, to identify to what extent it reflects accurately the preferences of stakeholders, and secondly, to make it more accessible and easy to understand to all participants, including people with low education.

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Annex 1: Application of KPI's

No.	Category	KPI	Measurement unit	Why/How?
2	Mobility	Number of passengers transferring through the hub	No. of passengers exiting one vehicle and entering another	Increased visibility and information will make shared modes more attractive and will reduce barriers.
3	Mobility	Modal split	No. of passengers arriving and departing per transport mode	A functional alternative is offered for privately owned vehicles.
4	Mobility	Number of transportation modes at the hub	No. of modes (incl. private, public, and shared modes)	Increase if design options (below) are implemented.
7	Mobility	Number of parking places adapted for a bicycle/moped/scooter	Number	Increase if design options (below) are implemented.
9	Mobility	Possibility to buy a ticket that combines several modes	Yes or no	Depends on the development of the MaaS app by STIB-MIVB.
13	Mobility	Integration of hubs with local/regional/national transport policy	Yes or no	Hub can be an accompanying measure for the GoodMove plan.
14	Mobility	Number of hubs in the network	No. of hubs of the same brand/organisation	Plans of the region to develop 20 hubs.
16	Services	Quality of the waiting infrastructures	Presence of covered waiting areas/shelters Score	Yes if the design options (below) are implemented.
18	Services	Presence of a display with an overview of location and explanation of mobility options available at the hub	Yes or no	Yes, if the design options (below) are implemented.
19	Services	Presence of a display with an overview of points of interest near the hub	Yes or no	Yes, if the design options (below) are implemented.
21	Services	Quality of the ticketing service	Score	Presence of ticket vending machines or staffed kiosks if design options (below) are implemented.
23	Services	Spaces adapted to pick up packages	Yes or no	Yes, in the case of one of the design options (option 3) being implemented.
25	Services	Presence of commercial activities (e.g., shops and businesses)	Yes or no	More people transferring to a hub will positively influence local businesses. One of the

				design options includes a coffee bar.
26	Services	Availability of toilets	Yes or no	Yes, if design options 2, 3, or 4 (below) are implemented.
27	Digital dimension	Availability of digital ticketing (incl. mobile applications, smartcards, and digital ticket machines) per service provider and/or hub operator	Yes or no	N/A. Will depend on the transport operators and the service providers.
28	Digital dimension	Presence of digital manuals explaining the use of modal options at the hub	Yes or no	Yes, if design options (below) with digital information kiosks are implemented.
29	Digital dimension	Presence of a digital map to find locations of modal options at the hub	Yes or no	Yes, if design options (below) with digital information kiosks are implemented.
30	Digital dimension	Availability of real-time departure and arrival information for public transport at the hub	Yes or no	Yes, if design options (below) with digital information kiosks are implemented.
31	Digital dimension	Availability of real-time information about the availability of shared mobility options	Yes or no	Yes, if design options (below) with digital information kiosks are implemented (currently: the kiosk provides this information for bike-sharing).
32	Digital dimension	Possibility to plan a trip in a digital travel planner in which all modes available at the hub are taken into consideration	Yes or no	Yes, under the condition that the MaaS-app of STIB-MIVB is implemented.
37	Accessibility	Quality of wayfinding within the hub	Score	Improvement if principles from D3.3 are implemented.
41	Accessibility	Accessibility of hub facilities for people with disabilities	Score	Improvement if principles from D3.3 are implemented.
43	Safety and Security	Number of accidents at the hub	Number	Decrease if the hub becomes conflict-free and if STOP-principle is applied (see D3.3 as well).
48	Democratic integration	The number of citizens participating in the design of the hub	Number	Yes, if the co-creation methods described here are applied.

49	Democratic integration	The involvement of (representatives of) vulnerable-to-exclusion citizens in designing the hub	Number Score	Yes, if the co-creation methods described here are applied.
51	Democratic integration	Number and type of participation opportunities offered during the planning of a mobility hub (e.g., dialogic or one-directional, in-person or digital, …)	Number	Sufficient, if the co-creation methods described here are applied: dialogic and in-person.
52	Democratic integration	Provision of comprehensive information on the participation process to (possible) participants	Score	Sufficient, if the co-creation methods described here are applied. The material used was adapted to different levels of education and proficiency in the local languages.
53	Democratic integration	Scientific quality of provided information on the participation process to (possible) participants	Score	Sufficient, given the implication of academic partner (VUB)
54	Democratic integration	Ease of understanding to (possible) participants of provided information on the participation process	Score	This is evaluated in section 3. Most information was easily understandable, but not in all cases.
55	Democratic integration	The number of people reached per participation format (e.g., website, reading signs about the participation process on the street, participants attending workshops/information stands, …)	Number	On-street events 1: 7 On-street event 2: 17 On-street event 3: 35 On-street event 4: 47 Workshop 1: 6 Workshop 2: 5 Workshop 3: 8
56	Democratic integration	Number and type of announcements on the participation process (e.g., newspaper, flyers, billboards)	Number	The on-street events were all announced with posters hung in the neighbourhood, with flyers distributed in the mailboxes, and with announcements on the Facebook page of the municipality. All the workshops were agreed upon beforehand with

				participants and/or a representative.
57	Democratic integration	Number of responses to the announcements on the participation process	Number	Very little. Most recruitment was made through representatives and on-street.
58	Democratic integration	Presence of external moderation or other forms of mediation to address power imbalances between participants in the participation process	Yes or no Score	There was always the presence of an external moderator, from academia or with a research background.
59	Democratic integration	The transparency of the participation process (e.g., structure, task descriptions, reporting)	Descriptive	The process was thoroughly explained in the workshops, briefly explained in the interviews and quickly explained in shorter interactions (e.g., co-evaluation questionnaire).
60	Democratic integration	Number, duration, and intensity of interactions with participants	Number Score	Depends: between 5 min and 2 hours.
61	Democratic integration	Number of contributions (both oral and in writing) per participation activity	Number	All participants contributed at least once orally, and when possible, also written.
62	Democratic integration	Number of participants participating in more than one activity	Number	10
63	Democratic integration	Knowledge transfer between participation givers and participation takers during the participation process	Score	This is evaluated in section 3. There is a certain degree of knowledge transfer.
64	Democratic integration	Implementation of participation outcomes	Score	Uncertain if this will be implemented. It will depend on the municipality and the region.
65	Democratic integration	Strengthening of a network of participation givers and participation takers by establishing or strengthening social contacts	Score	A network among representatives was built, but not do much with/among participants, beyond existing ones.

Annex 2: Assignments experiment with the digital kiosk

1. Look up when the next tram/bus to X will depart
2. Look when the next metro to X will depart
3. Look up where the nearest bike-sharing/car sharing service is situated
4. Look up how to rent a shared bike/shared car
5. Look up what services or facilities are available at this hub
6. Look up the walking time to X
7. Look up information about SmartHubs

Annex 3: Satisfaction survey on the digital kiosk

For this part, the testers could express their feelings about the digital kiosk via a set of smileys, to answer the following questions:

- How useful do you find this kiosk?
- How easy did you find it to look up information?
- How likely is it that you would use this kiosk when you saw it in the streets?
- Which functionalities of the kiosk do you find most useful?
    - Real-time timetable
    - Facilities/Services
    - Map

Annex 4: Questionnaire survey about the digital kiosk

Via an assisted questionnaire, information was obtained about how the digital kiosk can be improved, travel behaviour, smartphone use and demographics. Participants had to be over 18 years old and were in no way obligated to answer questions they did not feel uncomfortable with.

- Digital kiosk
    - Have you ever used a digital kiosk similar to the one you just tested? (Y / N)
        - If yes, where/how often?
    - Do you intend to use these types of kiosks in the future? (Y / N)
        - If yes, how? (when/how many times/for which types of purposes?)
        - If not, what makes you refrain from using them?
    - Do you think this kiosk can help you to use mobility services (e.g. public transit, shared bikes, shared scooters)? (Y / N)
        - If yes, which services become easier to use?
        - If not, why?
    - What did you struggle with? (e.g. too many options, selecting options, understanding information, language, etc.)
    - How would you improve this kiosk?
    - Which functions do you miss?
    - Would you buy a ticket for public or shared transport via the kiosk if that were possible? (Y / N)
        - If yes, for which services would you buy a ticket?

        - If not, why?
- Transport behaviour
    - Which of the following mobility modes do you use at least once a month:
        - Public transport (bus, tram, metro, train)
        - Private bicycle
        - Private car
        - Taxi or Uber
        - Shared car
        - Shared bicycle
        - Shared moped
        - Shared scooter
- Digital skills
    - Do you have a smartphone? (Y / N)
        - If yes, where do you use it for?
            - Using an app on your smartphone to plan a trip by your own means of transport, like the car or bicycle (for instance Google Maps)
            - Using an app on your smartphone to plan a trip by public transport
            - Using an app on your smartphone to book a means of transport as you do with, for example, a shared car or a shared bike?
            - Online payments
            - Scanning QR-codes

- Demographic data
    - How old are you?
    - What is your native language?
    - Do you consider yourself as:
        - Male
        - Female
        - Other
        - Prefer not to say
    - What is your highest degree?
        - None
        - Primary school
        - Secondary school
        - Post-secondary
        - Prefer not to say
    - Have you been living in Brussels/Rotterdam for more than two years (Y/N)

Annex 5: Co-design survey

Gender: ☐ M ☐ F ☐ Other Age:

What services do you need?

- ☐ Shelter
- ☐ Waiting room
- ☐ Monitored counter
- ☐ Public toilet
- ☐ Changing rooms
- ☐ Commercial shops
- ☐ Bicycle parking
- ☐ Secure bicycle parking
- ☐ Bicycle repair station
- ☐ Parking for cars
- ☐ Charging station for electric vehicles
- ☐ Parcel crate
- ☐ Free wifi point
- ☐ Simple signage
- ☐ Signage without text
- ☐ Information provided in other languages

  _____
- ☐ Other

  _____

What transport modes do you need?

Public transport

- ☐ Bus
- ☐ Tramway
- ☐ Train

Shared mobility services

- ☐ Shared bicycles
- ☐ Shared cargo bikes
- ☐ Shared cars
- ☐ Shared e-scooters
- ☐ Shared mopeds

Please note here your preferences for the design of the mobility hub

1. Location of the mobility hub
   ☐ A ☐ B ☐ A and B ☐ No
2. Construction: structure
   ☐ A ☐ B ☐ A and B ☐ No
3. Construction: walls (several choices are possible)
   ☐ A ☐ B ☐ C ☐ No
4. Urban design (several choices are possible)
   ☐ A ☐ B ☐ C ☐ No

What is most important to you?

Availability and reliability of vehicles	1	2	3	4	5	6	7	8	9	10
Adapted, reduced and/or flexible tariffs	1	2	3	4	5	6	7	8	9	10
Barrier-free and adapted to people with special needs	1	2	3	4	5	6	7	8	9	10
Use of services without the need for smartphones	1	2	3	4	5	6	7	8	9	10
Simpler, clearer and easier to understand text, advertisements and signs	1	2	3	4	5	6	7	8	9	10
Promotion, explanation and training in the use of the services offered	1	2	3	4	5	6	7	8	9	10
Assistance and support from on-site staff	1	2	3	4	5	6	7	8	9	10
Safety and security	1	2	3	4	5	6	7	8	9	10
...	1	2	3	4	5	6	7	8	9	10
...	1	2	3	4	5	6	7	8	9	10

Annex 6: Workshop assessment survey

Gender: ☐ M ☐ F ☐ Other
Age:
Level of education:
Professional activity:

1. How did you experience the perspectives and intentions of the other players?

☐ very interesting ☐ quite interesting ☐ no opinion ☐ rather not interesting ☐ not interesting at all

2. To what extent did you learn something new?

☐ many things ☐ some things ☐ no opinion ☐ few things ☐ nothing new

3. To what extent did you learn something new about alternatives for your mobility?

☐ many things ☐ some things ☐ no opinion ☐ few things ☐ nothing new

4. To what extent did you learn something new about participation and co-creation?

☐ many things ☐ some things ☐ no opinion ☐ few things ☐ nothing new

5. How entertaining do you find the game?

☐ very entertaining ☐ fairly entertaining ☐ no opinion ☐ fairly boring ☐ very boring

6. Do you find this game simple or complex?

☐ very simple ☐ fairly simple ☐ no opinion ☐ fairly complex ☐ very complex

7. How clear were the tasks you had to perform?

☐ very clear ☐ fairly clear ☐ no opinion ☐ very unclear ☐ not clear

8. How did you experience the facilitator's support?

☐ very useful ☐ quite useful ☐ no opinion ☐ not very useful ☐ not at all useful

9. How useful was the material provided?

☐ very useful ☐ quite useful ☐ no opinion ☐ rather not useful ☐ not useful at all

10. How committed do you feel to the activity?

☐ very committed ☐ fairly committed ☐ no opinion ☐ not very committed ☐ not at all committed

11. How do you assess the level of interaction between participants?

☐ very interactive ☐ quite interactive ☐ no opinion ☐ rather not interactive ☐ not interactive at all

12. How do you evaluate the conflicting situations that occurred during the activity?

☐ There was a lot of conflict ☐ There was some conflict ☐ No opinion ☐ There was not too much conflict ☐ No conflict

13. How do you evaluate the negotiation between the participants?

☐ A lot of negotiation ☐ Some negotiation ☐ No opinion ☐ Not much negotiation ☐ No negotiation

14. To what extent do you think your ideas can actually be realised?

☐ most of my ideas ☐ some of my ideas ☐ no opinion ☐ few of my ideas ☐ none of my ideas

Annex 7: Co-evaluation survey

Gender: ☐ M ☐ F ☐ Other
Age: City and neighbourhood of residence:
In which part of the co-creation process did you participate?

Please rank the proposals by order of preference, and indicate what you like, and what you don't like of each option. In case you don't like any proposal, or you like only one or two, you don't have to rank the others. Likewise, if two or more options are equally relevant to you, you can also indicate it.
1st:

2nd:

3rd:

4th:

After you have seen the assessments, what is your order of preference?
1__ 2__ 3__ 4__
Could you explain why the assessment did or did not make you change your mind?

Please indicate your level of agreement with the following statements, only if you participated in the activity being referred to:

- I participated in the interview or focus group (February-May 2022) and I am satisfied with my experience

☐ Strongly agree ☐ Agree ☐ Undecided ☐ Disagree ☐ Strongly disagree

- I participated in a co-design workshop or interview (October-December 2022) and I am satisfied with my experience

☐ Strongly agree ☐ Agree ☐ Undecided ☐ Disagree ☐ Strongly disagree

- I am satisfied with the visualisations of the results

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☐ Strongly agree ☐ Agree ☐ Undecided ☐ Disagree ☐ Strongly disagree

- The assessment method used to evaluate the designs is understandable

☐ Strongly agree ☐ Agree ☐ Undecided ☐ Disagree ☐ Strongly disagree

- I am satisfied with the assessment of the results

☐ Strongly agree ☐ Agree ☐ Undecided ☐ Disagree ☐ Strongly disagree

Do you have any other comments or suggestions (e.g., about the co-creation process, the result, or the event…)?

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