



## Smart Mobility Hubs as Game Changers in Transport

WP5. Impact assessment of SmartHubs Living Labs

T5.6. Application of co-design game

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### Deliverable D5.6

## Co-design game applications and results

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MOBILITY LAB The logo for "mpact" features the word "mpact" in a bold, blue, sans-serif font, with a small blue triangle pointing downwards to the right of the letter "t". To the left of the word, there is a small graphic of a grid of colored squares.

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# 1. INTRODUCTION

In this deliverable, we summarize the key findings from our use of design games as co-design tools across our four SmartHubs Living Labs. We provide an overview of how the design games were developed and utilized within the SmartHubs Living Labs. Design Games are introduced and discussed in [Deliverable 3.4 “Report on recommended co-design technologies.”](#) In this context, our attention is directed toward their practical application and the outcomes observed through an analysis of their usage across SmartHubs’ four specific sites.

ACUR supplied the same set of gaming materials, such as tokens, cards, dice, and a design game guide, to facilitate the design process within the SmartHubs Living Labs. Each Living Lab partner was tasked with creating their own design games using these materials and the provided guide. ACUR supported this process through online meetings and workshops with the Living Lab partners.

Upon the completion of the design process, we conducted structured evaluation meetings with each Lab to gain insights into the development of their respective games. This analysis focuses on the processes involved in creating these design games within the Living Labs and the resulting games themselves.

In addition to a series of online meetings that provided support, we organized special evaluation meetings with the Living Labs to gain insights into their entire game design process and progress. These evaluation meetings had a two-part structure: in the first part, the Labs presented their games or their progress, and in the second part, the meetings transitioned into a focus group format. In this structured discussion phase, we delved into the design process and the utilization of the materials provided, following a [guideline](#).

Here is a breakdown of how these evaluation meetings were conducted with the SmartHubs Living Labs:

- Munich: Held on 09/06/2022, with a duration of 01:11:22
- Rotterdam / The Hague: Held on 10/06/2022, with a duration of 01:11:13
- Brussels / Anderlecht: Held on 10/06/2022, with a duration of 01:23:44
- Austria East: Held on 10/06/2023, with a duration of 01:18:04

To ensure accuracy and thorough analysis, we recorded and transcribed these meetings. The transcripts, along with materials provided by the Living Labs pertaining to their games, such as photos and individually designed game components, constitute the foundational data for this analysis.

The data analysis process involved several iterative steps, following the thematic analysis method proposed by Braun and Clarke in 2006:

1. Initial Game Analysis: In the first iteration, we examined and described the games themselves. This analysis utilized materials provided by the Labs, such as game descriptions, photos, gaming files, and gameplay documentation. The initial categorization was structured according to the guidelines outlined in the design game guide.
2. Transcription Review: The second iteration involved reviewing the transcriptions of the evaluation meetings. AI-generated transcriptions were manually cross-referenced with the original recordings to ensure accuracy and facilitate a deep understanding of the content.
3. Coding with MAXQDA: In the third iteration, the transcribed recordings were coded using MAXQDA. Initial codes were assigned to statements from the evaluation meetings and roughly grouped using color coding.
4. Code Refinement: In the fourth iteration, the resulting codes underwent a second review and were regrouped to identify the emerging themes within the material.
5. Theme Documentation: The fifth iteration was dedicated to documenting and describing the identified themes. Specific codes were further refined and reallocated to provide a clear and comprehensive representation of the results.

First of all, we want to summarize the profiles of our Labs in the project (Section 2). To give an overview we will show briefly the design games that resulted in the design process at the SmartHubs Living Labs (Section

3), before a detailed description of the resulting themes and the overall outcomes of this analytical process is presented in Section 4, including direct statements (quotes) from the developers of the design games.

## 2. PROFILES OF SMARTHUBS LIVING LABS

To establish a design setting for the SmartHubs Living Labs, we provided Design Game Guide (for details a [Deliverable 3.4 “Report on recommended co-design technologies”](#), p.22ff).



This guide supports the Labs in designing their individual Design Games tailored to the context of their project, Lab, or case study. Within more than 80 pages it describes the process of the creation of a design game, by introducing several key aspects, (Figure 1) defining the characteristics of the game, showing what the key aspects are, why they are important in the process, and how they should be seen as a step to carry out within the whole designing process. Additional questions provided at each step help to progress while designing the

game. Summaries and quick check suggestions help designers to be aware of already carried out steps and the highlights as outcomes. The guide also provides space for taking notes during the design process for documenting the ideas.



Figure 1: Key aspects defining the characteristics of a design game created by using the “Blank analog Design Game (Iteration 1) – Version 1.0: TU Wien Mobility Games ADG” package.

In the following, we show the detailed information we captured from the Labs at the beginning of the project, for which an overview is given in Deliverable 3.4 (p.14ff) before we started with the design and development of the design games in SmartHubs. After receiving filled-out templates from each Lab, the following Lab profiles were used as a starting point for creating the Blank analog Design Games at the sites. The template to gather the Lab profiles consisted of the following structure:

- **Context of the Lab** – What are the framing conditions of the Lab? Where is it located? What is the social context of the Lab? What are the solid restrictions and circumstances that need to be considered?
- **Stakeholders and partners** – Which organizations are involved in the Lab? Which stakeholders are relevant to the Lab? What is their relationship to the Lab, and how are they involved? Are there challenges in the interaction with the stakeholders and partners in communication and cooperation?

- **Relevant topics, key contributions, results, and goals of the Lab** – Which issues are mainly addressed by the Lab? What is the focus and the overall goal of the Lab in SmartHubs? Which outcomes have already been produced and are planned to be made by the Lab during SmartHubs?
- **Challenges** – What are the challenges the Lab is dealing with on a daily basis general? What are the reasons for these challenges? Are there approaches and ideas on how to overcome these challenges?
- **Major activities within the Lab** – In which activities and events does the Lab engage – in general, with the stakeholders, with the citizens? Please give some examples. How often does the Lab engage with stakeholders? If there has been no interaction so far, please state this here.
- **Methodology** – Which (research) methods are used, and how are they applied to support the Lab activities? What is your experience with the already applied methods so far? What methodology works well, what is problematic in the Lab, and why?
- **Application of SmartHubs Design Game** – Which topics and goals could be addressed in the Lab using the SmartHubs Design Game? Which locations can be used to gather and to play the SmartHubs Design Game (Mobility Hubs, Living Lab Facilities)? Please use your research questions here as a starting point, but consider that the SmartHubs Design Game can only cover particular questions you formulate.
- **Contact Person** – Who is the contact person (including contact data) of the Lab regarding the application of the SmartHubs Design Game? (We did not include this category in this deliverable.)

## 2.1. Context of the Labs

In this category, the Labs had to answer the following questions: *What are the framing conditions of the Lab? Where is it located? What is the social context of the Lab? What are the strong restrictions and circumstances that need to be considered?* For further information about our Living Labs see the reports our Living Labs provided at <https://www.smartmobilityhubs.eu/publications>: Deliverable [D4.2](#), [D4.3](#), [D4.4](#), and [D4.5](#).

### 2.1.1. Eastern Austrian Living Lab (EALL)

Case studies, their locations, social context, and strong restrictions and circumstances:

- Bruno Marek Allee:
  - Nordbahnhofviertel (Vienna)
  - Mobility Hub located in a central urban brownfield development site which is still growing (last building phase).
  - More liberal and mixed context in Bruno-Marek Allee (self-organized housing groups in close surrounding).
  - More complex governance structure around the hub, including financing streams combined from public (Wiener Linien) and semi-private (property developer) institutions. Future inhabitants living on one side of the hub (west) not known yet.
- Seestadt Nord:
  - Aspern Seestadt (Vienna)
  - Mobility Hub located at the northern edge of a decentral urban development site, building developments around will start earliest in 2023. Important interchange hub for public transport and P&R commuters from Lower Austria.
  - Still undeveloped housing area in Seestadt Nord station, future social context unclear. Within the SmartHubs Living Lab, inhabitants of the already finished areas will be involved where an average mix of population groups (for Vienna) regarding income (more tending to young families) can be found.
  - Combined hub with wide spatial extension (up to 250m distance between single services), complex customer structure ranging from future inhabitants to commuters from Lower Austria.
- Pillichsdorf:
  - Pillichsdorf (Lower Austria)

- Scattered Mobility Hub in the center (close to the town hall) of the village Pillichsdorf, close to a regional center (Wolkersdorf). Average age structure compared to the rest of Austria.
- Rural and relatively conservative (following voting behavior) surrounding in Pillichsdorf.
- Small possible customer group, highly funded hub (uncertain self-sustainability), high level of car ownership.

### 2.1.2. Brussels / Anderlecht Living Lab

- Goal: (Physical and later digital) Social integration, identification of inhabitants' needs
- 28.000 inhabitants, 45% are non-Belgian and 23% non-European.
- Relatively young population.
- More men than women.
- Historically, it has been an arrival area for immigrants.
- Socio-cultural points of reference
- Low rental prices
- Low-skilled job opportunities and a lot of unemployment

The population of this neighborhood is composed of a high amount of disadvantaged and vulnerable individuals. This is due to the low-income levels, which are around 25% lower than the regional average, and the condition of this neighborhood as an entry point for migrants and ethnic minorities. Furthermore, many newcomers leave the neighborhood as soon as they have sufficient income, and newcomers might not speak any official language (French or Dutch). The disadvantaged or vulnerable to exclusion groups that will be involved in this Living Lab are ethnic minorities, foreign people/migrants, women, and caregivers.

### 2.1.3. Rotterdam / The Hague Living Lab

- North end
- 40k people/day present - multicultural (90% migrants)
- There are shared mobility stakeholders
- Reconstruction of the area and crossings, redesign
- How to support the involvement of users in the redesign?
- Square with PT stop and multiple road intersections.
  - PT stop is one of the most used in the city.
  - The square is a link between two shopping streets and a large market and, therefore, has economic importance for neighborhoods around it.
  - Large market located south of square with.
  - Most space in the square is taken up with car transport.
  - A large part of car traffic on the square does not have an origin or destination in surrounding neighborhoods, but traffic safety for pedestrians and cyclists is an issue, and bus traffic flow is hindered.
  - Multiple intersections on the square - complex traffic situation and congestion.

The municipality plans a redesign/reconstruction of the area. The tram stop needs to be reconstructed (to accommodate new tram types) and the municipality wants to take the chance to improve the traffic situation, liveability and traffic safety, and redesign and redistribute public space. The municipality plans simplification of road design, roads will be distributed to local traffic instead of through traffic, maximum speed will be reduced to 30km/h.

The goal is also to include a greener square to make it more climate-adaptive (at the moment it's a 'heat island').

Wishes of the municipality:

- Making the square an attractive entrée for the market. Accommodation quality needs to be high and pedestrians and cyclists need to be a priority.



- Simplification of road design.
- Public transport stops need to become an attractive transfer point for neighborhoods.
- Climate adaptivity of square.
- Improvement of quality of stay on and around the square.

Participation plans of the municipality:

- Early participation of inhabitants when formulating solution avenues, scenarios, and versions and participation in consideration and decision-making of the design and the changes of the road design and traffic flow changes.

### 2.1.4. Munich Living Lab

- Integrate: Urban freight + public transport + shared mobility → access points: cargo bicycles, bike sharing, public transport - bicycles repair shops.
- Students and residents in the university area, at the TUM main campus in three different areas.
- Language issues of international students.

Goal: This Living Lab should create a mobility hub to integrate urban parcel delivery, bike sharing, and cargo bike rentals within the same area. The idea is that people will be able to pick up parcels at the parcel station, and then rent cargo bikes to transport large or bulky parcels to their final destination.



The current plan is to locate the mobility hub at the main campus of the Technical University of Munich. There are three main options for locating the mobility hub, each with its own benefits and downsides. The map shows the three locations of the Living Lab. Location 1 is the most ideal location and location 3 is the least ideal location. Location 1 is in a large, open area and is immediately adjacent to an existing bike-sharing station. Location 2 is also a large, open area, but it is not visible to street traffic. However, the area is very visible and accessible to students, who are the target audience. This space is currently occupied by an exam tent, which may be there longer than expected since the COVID-19 pandemic has continued. Location 3 is also immediately adjacent to a bike-sharing station; however, the open area is somewhat secluded and there is not a lot of

traffic on Arcisstraße. It may also be possible to rotate the mobility hub between the locations.

## 2.2. Stakeholders and partners

In this category, the Labs had to answer the following questions: *Which organizations are involved in the Lab? Which stakeholders are relevant to the Lab? What is their relationship to the Lab and how are they involved? Are there challenges in the interaction with the stakeholders and partners in communication and cooperation?*

### 2.2.1. Eastern Austrian Living Lab (EALL)

Case Studies:	Involved organizations (formal = x; informal = *)	Relevant for EALL	Relationship to EALL	Challenges in EALL com. and coop.
<u>Bruno Marek Allee</u>	MO.Point (x)	x	Full SmartHubs Partner	
	Property developers (x)			
	Wiener Linien (x)	x	Informed about location choice	Having concrete enough offers and

			and possible process	demands (methods, data, etc.) for single locations, switching to network level and questions
<u>Seestadt Nord</u>	Wiener Linien (x)	x	Informed about location choice and possible process	Having concrete enough offers and demands (methods, data, etc.) for single locations, switching to network level and questions
	ÖBB (x)			
	Wien 3420AG (x)	x	Associated SmartHubs Partner	Having concrete enough offers and demands (methods, data, etc.) for single locations
	Stadt Wien (x)	x		
<u>Pilichsdorf</u>	Federal State of Lower Austria (x)	x	Associated SmartHubs Partner	Choice of Hub
	Fahrvergnügen (x)			
	VOR (x)		Associated SmartHubs Partner	
	NÖ Regional (*)	x		

### 2.2.2. Brussels / Anderlecht Living Lab

- VUB Mobilise (Prof. Dr. Imre Keserü): leads the Anderlecht Living Lab. As Mpact and the municipality are more knowledgeable about the social context of the neighborhoods, they will play an important role in contacting local organizations and inhabitants. Brussels Mobility's role is limited.
- Mpact (Jelten Baguet, Gerben Van den Abbeele)
- Anderlecht 1070 (Susanne Müller-Hübsch)
- Brussels Mobility (Bram Vercauteren)
- Local networks and NGOs that represent vulnerable groups will also be involved. The target groups are: Ethnic minorities, non-Belgians/migrants, women, caregivers.

### 2.2.3. Rotterdam / The Hague Living Lab

- Municipalities of The Hague and Rotterdam: Responsible for redesign. Good communication situation with citizens and other stakeholders. Interest in collaboration.
- The Hague Transport Operator (HTM): Public Transport operator and operator of shared free-floating bikes) is involved as an operator of trams, buses, and shared bicycles. Good communication situation. Interest in collaboration.
- Regional PT authority (MRDH): Good communication situation.
- Other providers of shared mobility operating in the area of the hub

- Greenwheels (station-based carsharing)
- Sixt Share (free-floating carsharing)
- Felyx (free-floating scooter sharing)

#### 2.2.4. Munich Living Lab

- Technical University of Munich
- UPS
- MVV - Munich public transport
- City of Munich
- International students

TUM and UPS are the main partners responsible for this Living Lab. However, MVV and the City of Munich may contribute small parts to the Living Lab. They may be more involved if alternative locations need to be found.

While international students are not exclusively targeted, they may find the package station the most beneficial. It is harder for foreigners to find accommodation in Munich, especially when they first arrive. Many students might need a fixed address where they can quickly receive parcels. A parcel station where the students already spend a lot of time could be tremendously helpful.

### 2.3. Relevant topics, key contributions, results, and goals of the Lab

In this category, the Labs had to answer the following questions: *Which issues are mainly addressed by the Lab? What is the focus and the overall goal of the Lab in SmartHubs? Which outcomes have already been produced and are planned to be made by the Lab during SmartHubs?*

#### 2.3.1. Eastern Austrian Living Lab (EALL)

Topics:

- Support in building up a network typology and transferable learning for future hubs in another context (relevant for Wiener Linien and the Federal State of Lower Austria)
- Wayfinding in complex intersections (especially Seestadt Nord and Bruno Marek Allee)
- Coordination of hubs in complex stakeholder settings (learning from the Bruno Marek Allee Case Study)
- Digital integration of hubs: How well does this work via the WienMobil App at the moment?

Strategic focus and goal:

- Enhance cross-institutional learning processes in the region on mobility hubs
- Support of local stakeholders in long-term planning and network building/impacts
- Reflecting SmartHubs Tools with planning practitioners
- Enhance data availabilities in Case Study areas through Smart Hubs surveys

Operative focus and goal on case study level: First outcomes:

- Workshop with planners from the region on the topic of mobility hubs in the context of MaaS (<http://www.fsv.at/veranstaltungen/seminardetail.aspx?IDTermin=ecec67d9-2704-47c9-b1ae-e8cb062525b9>)
- First networking activities together with national MoHubs project towards Vienna stakeholders

Planned outcomes:

- Long-term networking group on Mobility Hub development in Eastern Austria
- Network impacts and mobility hub network concepts, including typologies for Vienna and Lower Austria

- User-centered design ideas and frameworks for Seestadt Nord stations to be taken into account in future planning steps

### 2.3.2. Rotterdam / The Hague Living Lab

The main focus of this Living Lab is on the mobility and accessibility impact of different levels of digital-physical integration transport modes with public transport. Does the integration of public transport and shared mobility increase the use of public transport and satisfaction with travel, and which aspects of such integration are particularly important for travelers to develop future policies in this direction?

The goal is to create societal support for reconstructing the public transit stop and the urban design of the square and surrounding area. The focus is on learning how the court can be designed as a (smart) mobility hub and how this can be achieved in a co-design manner. A further open issue is to learn if users' and citizens' involvement increases societal impact and public support.

### 2.3.3. Brussels / Anderlecht Living Lab

The Brussels Living Lab in the municipality of Anderlecht will co-create the first neighborhood-level prototype mobility hub with critical stakeholders (citizens, businesses, transport operators, cities, etc.). The aim is to demonstrate the SmartHubs co-creation process for mobility hubs and appraise the feasibility and potential impact of such mobility hubs.

Experiments will be set up to test possible digital information tools (e.g., physical-digital information boards) with users and especially vulnerable-to-exclusion citizens (digitally excluded) and give recommendations on the user-centric design of such systems.

The key objective is to co-design a mobility hub from scratch and involve the potential users as much as possible.

The study of transport disadvantages in the hub is a main concern of this Living Lab. Thus, a user-centric approach is applied to identify, analyze, and overcome the barriers experienced by users and vulnerable populations. In this regard, different co-design tools will be used to incorporate the needs of these groups.

A further focus is also to investigate to what extent digital exclusion poses a barrier to using the hubs and how digital elements of the seat (e.g., the information pillar) should be designed inclusively using universal design principles.

### 2.3.4. Munich Living Lab

The main elements to support the integration of urban parcel delivery, bike sharing, and cargo bike rentals within the same area should be included in mobility hubs.

## 2.4. Challenges

In this category, the Labs had to answer the following questions: *What are the significant challenges the Lab is facing – in general, on a daily basis? What are the reasons for these challenges? Are there approaches and ideas on how to overcome these challenges?*

### 2.4.1. Eastern Austrian Living Lab (EALL)

In general, the main challenges of this Living Lab are clear communication structure/materials / ... towards stakeholders, the balance between regular updates (to keep everyone informed and involved) and specific meet-ups with particular needs, identification of overlapping needs between stakeholders across case studies, and particularly for rural Lab Pillichsdorf it is unclear if interest in mobility hub services exists at all (due to the low presence of push factors, e.g., high car ownership rates, no parking pressure).

On a daily basis there are vital time restrictions for operative level within stakeholder institutions. An additional issue is that there are overlapping stakeholder communications regarding other projects and project proposals which increase the complexity of the setting.

#### 2.4.2. Brussels / Anderlecht Living Lab

One major challenge will be the recruitment of participants. VUB does not have any connections in the neighborhood. However, M pact and the municipality will use their networks to reach those vulnerable-to-exclusion citizens.

Another challenge will be the sustained participation of citizens. The Lab intends to involve citizens at different stages of the project. However, sustained participation is often a problem in co-creation projects, especially when there is no clear goal for the project outcome.

Reaching vulnerable to excluded populations might be even more challenging during a pandemic. In the last two years, Belgium has had many rules and restrictions regarding gatherings of people. A game is usually played near other players, and proximity to others has been discouraged or even forbidden in the last two years.

#### 2.4.3. Rotterdam / The Hague Living Lab

The square is unattractive, has high traffic volumes, and can be and feel unsafe for pedestrians and cyclists. The challenge is to redesign the square in a way that is attractive and offers an attractive multi-modal transport hub for citizens to have an improved access to shared mobility. Because migrant levels are very high (>90%) in the neighborhoods, it is an additional challenge to design the hub so that it is accessible to the inhabitants and fits their needs. Involving these population groups in a co-design process offers further difficulties as, e.g., language and knowledge of the transit system or digital skills can be a barrier. For details see [Deliverable 4.4](#).

#### 2.4.4. Munich Living Lab

Currently, the most pressing challenge is gaining permission from the university to locate the Living Lab on campus. Placing the Living Lab on campus has already started, but the administration at TUM can be prolonged. This issue can be overcome by using other partners (the City of Munich, MVV) to find alternative locations that do not involve the TUM main campus.

### 2.5. Major activities within the Lab

In this category, the Labs had to answer the following questions: *In which activities and events do the Lab engage – in general, with the stakeholders, with the citizens? Please give some examples. How often does the Lab engage with stakeholders? If there has been no interaction so far, please state this here.*

#### 2.5.1. Eastern Austrian Living Lab (EALL)

Interaction with parts of the stakeholders in Aspern Seestadt is already institutionalized in the aspern.Mobil LAB. On the Living Lab level, only bilateral exchange with selected stakeholders, especially in the case study choice process. Two meet-ups are planned internally for SmartHubs' full partners.

#### 2.5.2. Brussels / Anderlecht Living Lab

The Lab will be co-created with inhabitants. Different activities, such as co-design sessions, are foreseen in the coming months to collect the needs and interests of residents. Currently, the focus is on contacting the representatives of vulnerable to-exclusion groups for interviews.

### 2.5.3. Rotterdam / The Hague Living Lab

No interaction so far with the citizens, nor with providers of shared mobility (besides HTM bike) or MaaS app providers. Regular contact with the municipality and the public transport provider exists. There are discussions and sharing plans.

### 2.5.4. Munich Living Lab

The Living Lab in Munich should primarily engage everyday citizens, especially students. Most engagement will happen at the physical location when people show up to pick up or send parcels. The space around the mobility hub may also be used to provide information on the surrounding transportation options (bike share, transit).

## 2.6. Methodology

In this category, the Labs had to answer the following questions: *Which (research) methods are used, and how are they applied to support the Lab activities? What is your experience with the already applied methods so far? What methodology works well, what is problematic to use in the Lab, and why?*

### 2.6.1. Eastern Austrian Living Lab (EALL)

Case Studies:	<u>Bruno Marek</u> <u>Allee</u>	<u>Seestadt</u> <u>Nord</u>	<u>Pillichsdorf</u>
Planned implementation of SmartHubs methods			
SmartHubs co-design technologies		x	
Digital integration and signage of mobility hubs		x	
Reaching out to users and digitally excluded citizens	x		x
Virtual and physical mobility needs and patterns		x	
Accessibility assessment		x	x
Integration of mobility hubs and public transport	x	x	x
Integration of freight and mobility hubs	x	x	
Policy governance impacts	x	x	x
Evaluation of Mobility Hubs within Living Labs	x	x	x
Appraisal tools for sustainability and stakeholder assessment		x	
Mobility hubs in the urban space	x		

### 2.6.2. Brussels / Anderlecht Living Lab

- Five interviews with representatives of vulnerable-to-exclusion populations
  - Who are vulnerable groups?
  - What are the barriers?
  - How can these barriers be overcome?
- 10 Interviews with potential end users
- Organize a co-creation process using participatory methods
- Trial of new participatory co-design tools (from Task 3.4)
- Appraise the co-designed options (using Task 3.5)

Experiments with the digital information pillar. People with different digital/physical capabilities will interact with the prototype pillar to collect feedback and redesign selected features.

### 2.6.3. Rotterdam / The Hague Living Lab

- Data analysis (smartcard; shared mobility), (before and after) surveys and interviews among PT users, visitors, and residents (user needs; impacts)
- WP3 co-design method, workshops

In this specific case of the Haagse Markt hub, the plan is to use the co-design method, surveys, and focus groups/workshops. There are some ideas on how to engage with the targeted vulnerable-to-exclusion groups but interaction is needed. Through these links, the plan is to recruit people to participate in research activities (all methods).

### 2.6.4. Munich Living Lab

The evaluation of this mobility hub will likely rely on user feedback and surveys. Additional observation methods may be used to examine how users interact with the space around them.

## 2.7. Application of SmartHubs Design Game

In this category, the Labs had to answer the following questions: *What topics and goals could be addressed using the SmartHubs Design Game in the Lab? Which locations can be used to gather and play the SmartHubs Design Game (Mobility Hubs, Living Lab Facilities)? Please use your research questions here as a starting point, but consider that SmartHubs Design Game can only cover particular questions you formulate.*

### 2.7.1. Eastern Austrian Living Lab (EALL)

- For EALL: Understand possible cooperation fields in the Eastern Austrian Living Lab, and collect innovation barriers for mobility hub development connected to national/federal policy frameworks.
- For Seestadt Nord: Visibility, acceptance, walkability, marketing strategies combined with mobility management, User-Centered design ideas, and framework.

### 2.7.2. Brussels / Anderlecht Living Lab

Research questions:

- How can the availability of more mobility options create a positive experience for residents?
- How can mobility hubs lead to changes in the mobility and accessibility of users?
- How can the SmartHubs design game enhance the inclusion of vulnerable populations?
- To what extent can mobility hubs have an impact on transport disadvantages?

Game questions:

- Where should the mobility hub be located in the Cureghem/Kuregem district?
- Which services should be offered by the mobility hub?
- What non-mobility functions do inhabitants expect from a mobility hub?
- How do users feel about mobility hubs regarding their design (for instance, perceived safety, accessibility, and wayfinding)?

### 2.7.3. Rotterdam / The Hague Living Lab

The focus in this matter is to achieve the goal of engaging with vulnerable-to-exclusion groups and designing the mobility hub to fit their needs. For that, the partners' locations (HTM/municipality) will be used where the citizen groups to reach out are also using the same contact.

## 2.7.4. Munich Living Lab

Using the SmartHubs Design Game for this Living Lab may be challenging. Using a design game to collect user feedback on the setup of the Living Lab might not be helpful since almost all of the participants will not come into the play with a basic understanding of the Living Lab. Nothing similar combines cargo bike rental and urban parcel delivery. People cannot bring in their perspectives and experiences because they do not have any.

## 3. RESULTING DESIGN GAMES

The information about our Living Labs presented in Section 2 was gathered as a first step of the design and development process regarding design games in this project. The “Bland analog Design Game” we provided to the Living Labs was used to create the tailored games on sites that we supported during the development. Details on the design process can be seen in [Deliverable 3.4](#).

The result of the design process at four SmartHubs Living Labs (their design games) is briefly summarized in this section (for details see Deliverable 3.4), to create a reference to the analysis presented in the following sections.

### 3.1. Eastern Austrian Living Lab (EALL)

The main objectives are to make mobility hubs more attractive through non-mobility services (e.g., events, communication, services, ...). This game can be played by 2-3 person teams, by 2-4 teams, and additionally one moderator or referee (not playing). There are three phases in the EALL Design Game: the setup phase, the game phase, and the final evaluation phase. The game is played in two rounds, one design round and one evaluation round, which could take min. 1-1,5 hours to play.

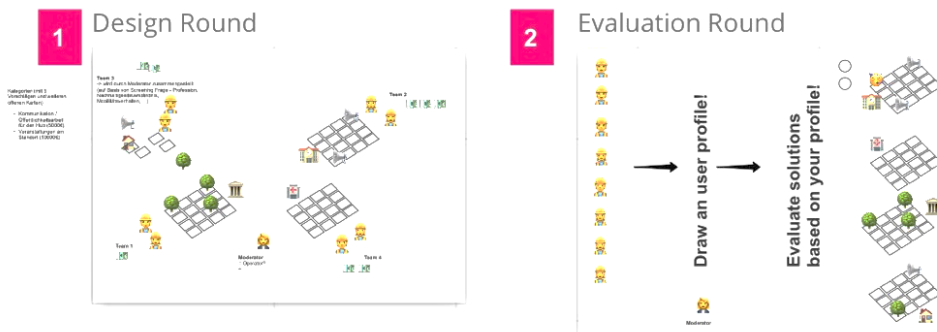


Figure 2: The first version of the EALL Design Game in Miro.

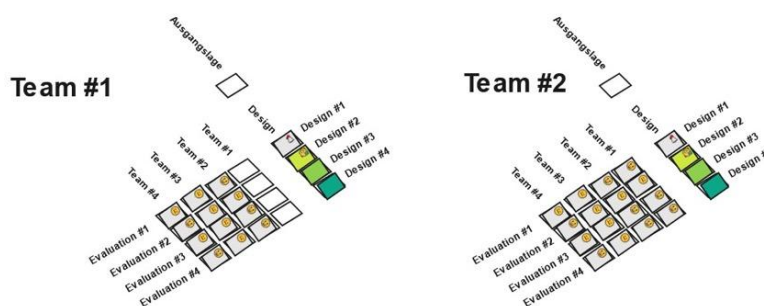


Figure 3: The second version of the EALL Design Game in Miro.



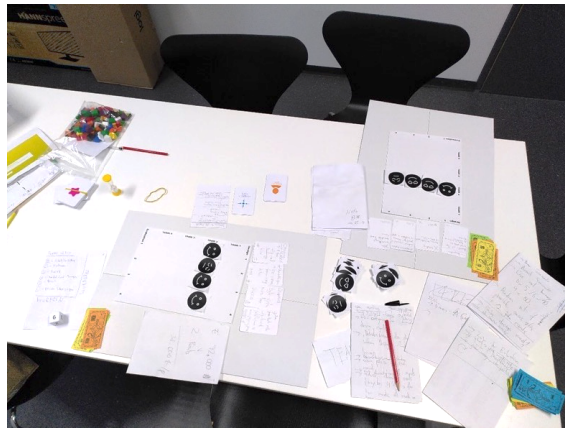


Figure 4: The third version of the EALL Design Game, played by two teams.

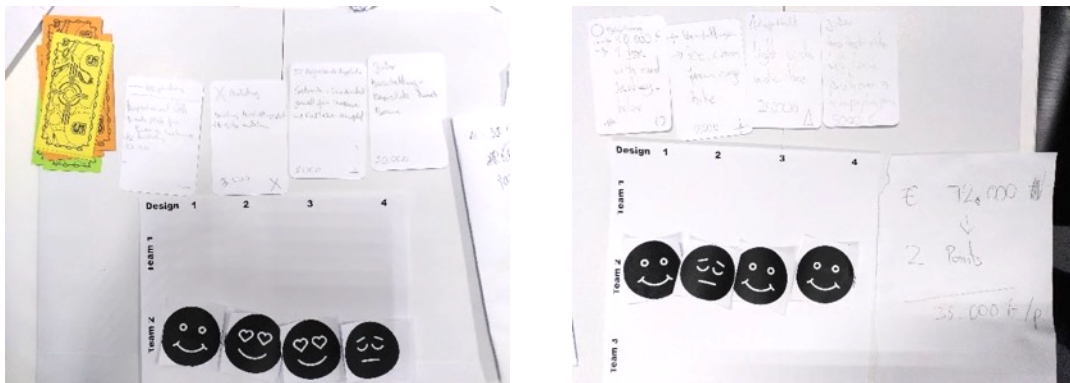


Figure 5: Results of Team 1 (left), and results of Team 2 (right).

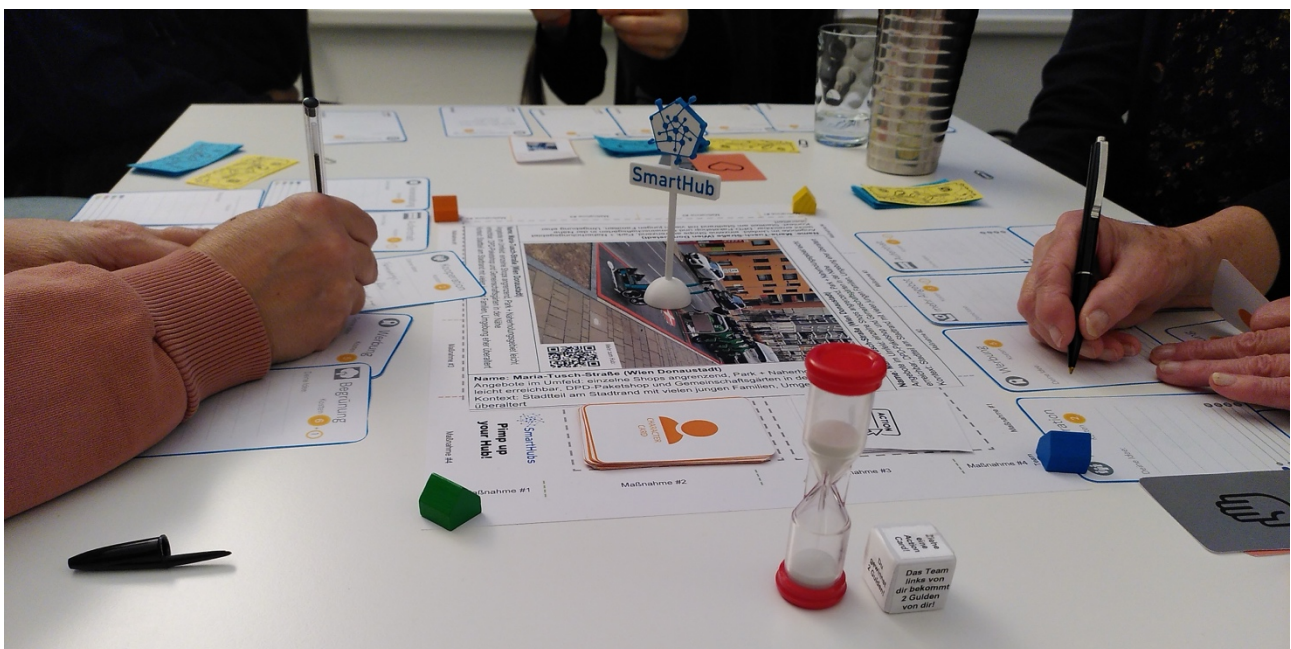


Figure 6: The final version of the game in EALL.

### 3.2. Brussels / Anderlecht Living Lab

The narrative in the design game is about inclusivity. This narrative is dealt with in two stages: 1) by making the preferred mobility hub from an independent point of view, where each player can decide what to include and explain why he or she makes such choices; 2) by randomly picking a “persona board” per player and making the most inclusive mobility hub for these personas. In the second stage, the previous design must be adapted in such a way that the result will produce a general group score. The new design will also give an individual score to each player depending on the remaining elements they choose.



Figure 7: The game after the first iteration, played and filled in with data during the game.

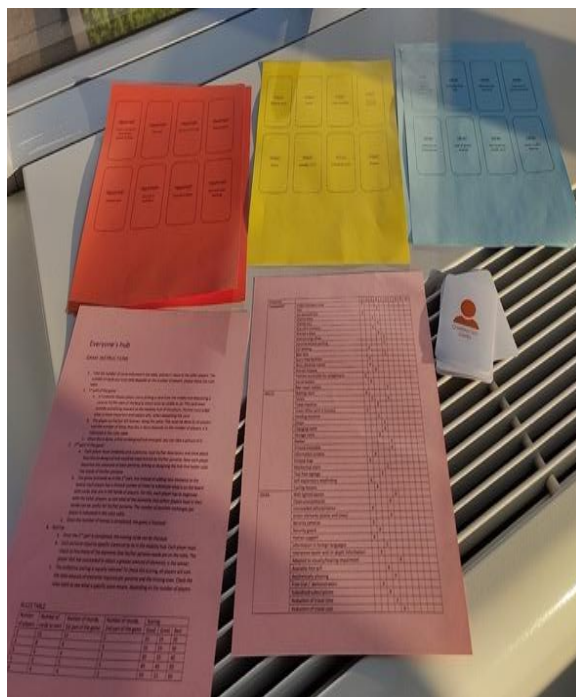


Figure 8: The game after the second iteration, played and filled in with data during the game.

### 3.3. Rotterdam / The Hague Living Lab

The SmartHubs Rotterdam-the Hague Living Lab project team designed a game to elicit the preferences of users, citizens, and other stakeholders for different mobility and mobility-related elements (e.g., shared bikes, cars, scooters; digital information kiosk) and other functions (e.g., design elements, trees, places to sit) in the re-development of the square Hobbemapplein.



Figure 9: The result of a game played on 20.04.2022. The board shows a lot of information about the player's background, interests, and ideas, combined with the audio recording which is then analysed by the Lab.



Figure 10: The augmented reality extension of the game designed in The Hague Living Lab.

### 3.4. Munich Living Lab

The serious board game is a co-creation game designed to identify the elements that players wish to have in a hub. Furthermore, the game encourages the participants to design inclusive mobility hubs by introducing characters vulnerable-to-exclusion as potential users. The game's goal is to identify the elements that players consider/wish to have in a new mobility hub. The maximum number of elements the players can choose is six, representing the limited spaces and resources that can be part of the hub's design process. Additionally, they are encouraged to negotiate and prioritize, selecting only a few elements from all the provided options.



*Figure 11: The played game at Munich Living Lab.*

### 3.5. Overview of the characteristics of the design games

As part of the analysis of the four resulting games, we have described them in regard to the categories of the provided design game guide. An overview of the different approaches, types, and characteristics of the games in relation to the categories is provided in the following MIRO-Board (Figure 12).

The *context and topics* addressed in the Living Labs were deferred by having some commonalities among them: while Eastern Austrian Living Lab was interested in generating ideas to make hubs more attractive through non-mobility services, understanding mobility hubs much more as “places to meet”, Munich Living Lab was focusing on identifying relevant hub elements, both mobility, and non-mobility related. On the other hand, Brussels / Anderlecht Living Lab and Rotterdam / The Hague Living Lab both emphasize the inclusivity of the mobility hub design: it is to design an inclusive and useful mobility hub based on empathy and to raising awareness among citizens by using such elements that enhance accessibility.

The *research questions* asked in the Living Labs were multi-folded by envisioning the future of mobility: To design an inclusive mobility hub, it is essential to consider the diverse needs and preferences of different user groups, particularly focusing on elements of importance for mobility and non-mobility aspects. This process entails not only understanding the specific requirements of vulnerable groups but also integrating their perspectives into the design, as their involvement can lead to varied and context-sensitive solutions. Furthermore, enhancing the hub’s appeal through “fun” elements and carefully choosing its location and form are crucial strategies for increasing long-term usage and ensuring that the hub meets the needs of all users in a comprehensive and engaging manner.

Throughout all Living Labs, *actors* who are supposed to participate in co-design activities by means of the design game were citizens, travelers, facilitators, civil society organizations, public institutions like municipalities, transport operators, private organizations or businesses.

The *framework conditions* of all games were more and less similar: on average 2-4 players and teams are formed to play the games. Max. 30 minutes were planned to finish a game.

Two *narratives* provided by the Living Labs are interesting to mention: coming up with creative ideas to make hubs more attractive through non-mobility services (e.g., events, communication, services, ...) and designing a mobility hub that is of value for different groups.

Different *materials* were used in design games: gameboards, persona cards, personal goal cards, element cards, action cards, money, and scoreboards.

Our Living Labs planned the *mechanics* of their design games by planning dynamics while playing facilitated by setting up the game, rounds including design and evaluation activities by also hosting negotiation and discussion about the actions taken.

		Living Labs			
		Eastern Austria	Brussels / Anderlecht	Munich	Rotterdam / The Hague
<p><b>Design Game Guide Categories</b></p> <p>(1) DG Design Phase: Description of the DG: Results based on materials provided</p> <p>(2) DG Design Phase: Analysis of the evaluation process: Documents, Videos of the common sessions</p> <p>(3) DG Application Phase: DG Survey (Master + Player), Photos, opt. Meeting for clarification, etc.</p>	<b>Context &amp; Topic</b>	generating ideas to make hubs more attractive through non-mobility services understanding mobility hubs much more as "places to meet"	Design of a mobility hub Needs an motivations of citizens Empathy = raising awareness An inclusive and useful mobility hub Form and elements of a mobility hub to enhance accessibility and obtain an inclusive design that considers the needs and preferences of local populations, and especially those of vulnerable citizens.	Identify relevant hub elements (mobility and non-mobility related).	support the Municipality of The Hague with our research into the layout of Hobbemaplân Designing hub that is of value for different user groups (also under-studied groups like migrants?) <b>Inclusive hub design</b>
	<b>Research Question</b>	How to make mobility hubs "fun" to increase usage in the long run	How a context sensitive and inclusive mobility hub should be designed? Which elements? Which location? Which form?		Which elements are of importance for different user groups? What are the preferences for mobility and non-mobility elements? What are needs and preferences of different user groups? For different vulnerable user groups design a hub addressing the most value different elements? Of different vulnerable groups are included in the design process, are different design elements?
	<b>Actors</b>	citizens? 1 facilitator	citizens (main actor) public institutions (municipality, etc.) civil society organizations transport operators private organisations / businesses all players represent citizens / users game master as additional role	hub users facilitators	residents visitors game master (helps and supports negotiations) travelers migrants shopkeepers
	<b>Framework Conditions</b>	Four clear setups: alps, Tulln / countryside, inner city of Vienna, Airport Nord 2-3 persons in teams 2-4 teams	2-6 Players 20-30 minutes of gameplay Table game (card game) location: ideally where the hub will be implemented	Play in teams 2, 3 or 6 players	4-6 players approx. 15 minutes of gameplay
	<b>Narrative</b>	come up with creative ideas to make hubs more attractive through non-mobility services (e.g. events, communication, services, ...)			Designing a SmartHub on Hobbemaplân that is of value for different groups
	<b>Mechanics &amp; Rules</b>	players draw missions to accomplish predefined mobility services predefined location factors no written instructions for research phase Players change roles from designers to users	Each player draws cards of different types: Values, Transport, Skills, ... for the second part each player picks a persona design group can make changes to adapt the hub to the previous needs Additional overall scores	choose mobility options as team randomly choose a persona reconsider mobility options as team	players choose a character and a personal goal choose an element to place and explain why draw an action card and perform action try to reach the personal goal at the end of the game. try as a group to score as many points as possible
	<b>Materials</b>	Action cards to change "circumstances" Gameboard with specific amount of fields Money	cardsets: design, transport, idea 12 persona cards Rule board Score board extra cards for randomness (+1, etc.)	gameboard with aerial view of hub location Persona Cards cards with different mobility options	gameboard with a specific square on it personal goal cards character cards action cards
	<b>Playing</b>	setup phase, game phase, final evaluation phase design rounds and evaluation rounds	design round and redesign round individual phase = design round, cooperative phase = redesign round negotiations among players in redesign-round for getting needed cards from other players	Design round, redesign round (changed conditions)	Elements are put around board Taking notes by facilitator/observer
	<b>Design Procedure</b>	open brainstorming not following the guide several "hackatons" conducted guide was used later in the process	3 Design iterations documented in a Word file.		
<b>Notes and Comments</b>	Has the game been played yet? (5/10/22)	In the last game there is feedback in the redesign round "Quick check" and extra pages in the guide were not used input to the guide's categories is to some extent redundant Used a redesign of the provided persona cards	very simplified game not very much information provided via research sheet	documentation partly in Dutch	

Figure 12: Overview of the design games created by the SmartHubs Living Labs, analyzed by using the categories of the provided design game guide.

## 4. ANALYSIS RESULTS

In this section, you will find the themes that emerged from our analysis of the game design process within the SmartHubs Living Labs. Each theme is extensively explored, accompanied by quotations from the game designers to provide context. It is important to note that these themes are not isolated entities but are intricately interconnected throughout the data. As a result, you will find references to other themes within the descriptions wherever strong connections exist, reflecting the complex interplay of ideas and insights.

### 4.1. Game design process

This theme illustrated the approach in the design process of the design game the SmartHubs Living Labs took. The general approaches of the Labs are presented here as well as specific aspects such as documentation, the need for external support, and varying phases of individual and teamwork.

Three of the four Labs followed a **quite similar design approach** after the package with the material was delivered and an introduction to the person in charge of executing the game in the Lab was given in an online workshop. As within the SmartHubs Living Lab partners, most people have no design background, and no or little experience with the creative process of designing in general, all were **initially overwhelmed by the task** they were confronted with as the following statements illustrate (also related to 4.3):

*“So, I mean, we really appreciated the package, but we also felt that there were a lot of things and we didn’t know how to start. But because I really liked games, I kind of started myself like pushing, okay, let’s do something with it ...” (LL3, IP2)*

*“I think L<sup>1</sup> you have like a design background, like architecture or urban studies, or like least you have some background in designing things. I don’t, my colleagues also don’t. So very happy that L took on this task because at least he had somewhat of an idea of what could be a possible game. ... When I received the box, I was like, they looked very nice, but it was all blank. ... And ... what am I supposed to do with this? Like, there are too many infinite possibilities that can be done with this. And then you just panic, close the box, and put it away ...” (LL3, IP3)*

All Labs took an **iterative design approach**, where the goals of the game and questions were addressed in initial sessions and then the game was refined in further iterations until the designers felt, that it was ready to be play-tested. Three Living Labs defined **one person** who is mainly **responsible for the design of the game**. This person organized regular meetings with other colleagues from the Labs to get internal feedback and refine the game, but the actual work of crafting game material, such as cards or the gameboard was mainly done by one single person individually. The challenge of finding a fruitful mixture of teamwork and individual work is illustrated by the following statements:

*“... we already had an idea from your presentations about what was in there and then A, K, and I, when we were in the office together, looked at the things and looked through them a bit and developed the first ideas. ... what could that be? What kind of game could we play? ... without looking at your material any further ... we actually discussed it directly with you and looked at what possibilities could be and then had the first rough ideas, ... I also started to design these character cards, the elements, so to speak the list of to make the elements. ... And then I wrote down the first ideas and scenarios. So and so, these are the steps you go through. And then again in a meeting we refined it again or changed it a little bit and ... the box that you sent, then at some point it went to me here at my house, and then I got it too really printed and designed and crafted the material.” (LL2, IP1)*

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<sup>1</sup> The names of the persons are anonymized in this deliverable.

The **challenge of being individually responsible** for designing an entire game, crafting the material, and assessing the possible goals and impact of the game was mentioned explicitly as the following statement shows:

*“Of course, I had fun thinking about it or thinking up the role cards or something like that. But I have to say, I was with us there too. So, we always have it, we discussed it with you. I discussed it with K and A from time to time, but I actually designed it on my own. And I think designing a game isn’t something you should actually do alone. ... So, I think it would have been even more fun in a group.” (LL2, IP1)*

One SmartHubs Living Lab took a different approach and worked **mainly as a team** of two and only split up for individual work in a late stage of the process when they were able to clearly define single tasks and both had an overall understanding of game design status and progress. For teamwork, they conducted so-called “hackathons” where they met and worked on the game commonly.

*“... basically, we always designed together, so I think there was only one moment where I went to the MIRO for documentation and made maybe the first version in MIRO, which was based on discussions and one flip chart from the first hackathon. This was one step done alone, but the rest was always collaborative with Lu and other people. ... I think we had a rhythm of it, and we had one hackathon, so they were quite distant from each other.” (LL4, IP1)*

*“We came up with four of five challenges, not challenges, but designed tasks for this morning, then we split up, Lu made his stuff, I made my stuff, and so half an hour. We came back together, put all the material on the table, and then we went on.” (LL4, IP1)*

*“It was in the later stage so today that was the first time that we really could split up because we had, we both had a clear enough idea where to go.” (LL4, IP1)*

Throughout their design process, all SmartHubs Living Labs **consulted external support but used different sources** for that. Two of the Labs, Rotterdam / The Hauge and Eastern Austria, were seeking advice and support from ACUR, which have experience with developing design games. Therefore, online meetings were conducted where the progress and status of the game were presented by the Labs, open issues were discussed and support was given by ACUR. The Munich Living Lab outsourced the very first phase of the design process to students and gave them the task of providing ideas for a design game. These ideas were then used as inspirations for developing the actual game for the Living Lab. The game designers from the Brussels Living Lab consulted video tutorials from professional game designers to get a better understanding of the use of different gaming materials and the design of gaming rules and mechanics.

One relevant factor that influenced the design process of all Living Labs a lot was **time pressure**. All designers from the Labs stated that they felt they did not have enough time to design the game because this came up as an additional task for them in the SmartHubs project and they had a predefined schedule for playing the game with stakeholders. Most of the designers experienced this factor **as a limitation**, **but** some also mentioned the necessity of time pressure **in a positive way** in order to get things done. The following statements illustrate the different experiences of time pressure:

*“So, we developed our game kind of in a rush way, and I think that’s kind of nice because we don’t invest that much time overthinking and losing time on unnecessary things because we had a street festival on the 28<sup>th</sup> of May, and in that street festival our department had a tent and we propose to present the SmartHubs project there with two foci first to play the game and second to be a complement of the game.” (LL1, IP1)*

*“But yes, unfortunately, or did we then realize that we can actually use very little of your stuff? Um, or at least it’s not that easy to implement because we had to do it relatively quickly. I had this one appointment in April and I had to create something relatively quickly.” (LL2, IP1)*

*“Because ... we all have different tasks to do and we’re busy. So, for instance, I didn’t forget that there were elements pre-designed in the research drive in this, ... we get like driven by all the things that we have to do and we have limited time.” (LL3, IP1)*



*“... the evaluation meetings were important because they put pressure on me so honestly I think we would not have done this hackathon today if there had been no pressure in the process in such a context like a project, we have, we’re designing the design game is not my main task it is very important to have a clear structure and a bit ‘Peitsche’ on the way to bring it forward in our case.” (LL4, IP1)*

For **documenting** the design process, the Labs took **different** approaches. Many used the design game guide (see 4.2) as a basis and structured digital documents along the categories in the guide. Others took notes directly in the guide and one Lab used the online tool MIRO to document the design process.

In the evaluation meetings, the designers from the SmartHubs Living Labs were asked what kind of enhancement to the process they would need, if they had to design another design game. Many valuable contributions and suggestions for enhancing the process were mentioned by all four Labs. Regarding the provided material and the design game guide (see 4.2), designers **requested more examples of resulting design games** to get a better vision of the possible outcome of the design process. A better **link** between the design game guide and the provided material would support the use of both. Additional materials that are more mobility-related, such as **ropes**, were requested. As the variety of the provided **materials** was overwhelming, designers stated that having this broad variety of materials supports getting inspiration, but in a later stage of the process, they would have liked to get provided more tailored materials.

*“I think ... examples for maybe even for the categories? ... Showcasing per category how this category was solved in one particular game. I don’t know if that’s clear, ... showing a game and then saying, okay, look they solved this topic of actors in this, and this way they have these parties concerned.” (LL4, IP1)*

*“... how do we set up rules or maybe some different games? So, now you’re asking me, how do we design the game? Maybe it would be nice if you tell us a story of how others have designed games.” (LL1, IP1)*

Since the task of designing a design game on one’s own without being a designer and having experience in such processes was highly challenging, some interview partners wished for **a ready-made game**, they only needed to apply but not design, or that **one common game** was designed for all SmartHubs Living Labs.

*“And ... we thought we’re going to design one in the Smart Hub consortium. So maybe with workshops and stuff, and that’s what this is for. And then ... okay, we have to do it ourselves, it was like ... let’s do it.” (LL1, IP1)*

*“Maybe we should have said that we as the entire SmartHubs project are thinking about a game together if we have the same goals with the game. Maybe then we would be more creative because we all have the same goal, but different games have already come out. Maybe if we had worked together a little more, we could have, well, designed the best game.” (LL2, IP1)*

*“I would have appreciated it most if you had just sent us a game. Just be like, this is the game. This is how you going to play it? I’m going to play the same game and four different locations and then compare the results.” (LL3, IP2)*

## 4.2. Design game box and materials

Within this theme, the use of the provided materials, the game elements in the design game box, the design game guide as well as the development of additional, tailored materials are illustrated. The theme is strongly related to 4.1 and 4.5 as the design of tailored material is part of the design process and the materials are used for the resulting games.

The provided box with gaming material was experienced as **overwhelming** in the first place. It provided such a broad variety of opportunities for designing a game that the designers from the Labs initially felt lost and did not know how to start using the materials.

*“And in terms of also finding all these elements and wanting to do a game with it, it can even be overwhelming ... But, for me, the key was having a guide like this question in this order of how to.” (LL3, IP1)*

*“When I received the box, I was like, they looked very nice, but it was all blank. Like everything was blank. And then I was like, but what am I supposed to do with this? Like, this is there’s too many, there’s infinite possibilities that can be done with this. And then you just panic, close the box, and put it away ...” (LL3, IP2)*

*“On the one hand, it felt to bit overwhelming in the sense of so many possibilities, so a bit stress in the material perspective.” (LL4, IP1)*

After initial irritation about the broad selection of materials, some Labs started to use the **content of the box as a source of inspiration**. This was especially important in the early stages of the design process, to develop an idea of which material could be used and which possibilities they got to design an individual game.

*“But on the other hand, in the first meeting it was a bit of a kind of inspiration.” (LL4, IP1)*

*“Yes, at the beginning, when we looked at it together, we looked through it with interest and it was already the source of inspiration and I had it, I have it now, it’s still here behind me.” (LL2, IP1)*

*“I think it was good for inspiration to see. But at the end, to see what alternatives of games are. Because at the end, ... some people are used to one game, the others for other games.” (LL1, IP1)*

Others focused on the **goal of the game and the question** that could be answered by playing a design game and **used the box after generating initial ideas**.

*“Now we also realize that we are playing a game which is card based in which we’re actually not using most of the elements in the box as you see. So that could maybe be explaining this through this process. We didn’t start taking the element and say, what do we do with it? We started putting the box on the desk that was there next and having the meeting in another room saying, okay, what ideas do we want.” (LL3, IP1)*

Although the material acted as a source of inspiration, nothing from the provided material was used by the Labs and integrated into the design game. Throughout the process, it was easier and faster for the SmartHubs Living Labs to **produce their own tailored material**. Provided cards, for example, were too predefined, persona cards were done in English but would have been needed in Dutch. Too much effort was needed to print individual Labels fitting to the predefined blank cards. Designing tailored cards for the specific game was easier. This was the case for almost all types of provided material, except ordinary dice. The designers from the Labs admitted to not using the provided material.

*“And, in the end, we saw that it can turn more complicated with these things and we want simplicity and to do it fast. So that’s why we kind of decided not to take any of that. Actually, just the board that maybe would have been nice to have like a fixed board to print. We could have used that. Yeah, but we wanted to print it like an A1 paper.” (LL1, IP1)*

*“I think it’s a pity because there’s so much cool stuff in there and we don’t actually use any of it. ... we just used it as inspiration.” (LL2, IP1)*

*“We have a box with a lot of things super well designed and beautiful and printed and material and so, but at the end, we’re using just some pieces of paper or maybe we’re doing it on the side. And maybe just also because ... a physical set to build a game. Maybe it’s already too predefined.” (LL3, IP1)*

*“And then we went to check what was there. And yeah, there are different cards that could be useful, but then they should be printed and stuck on that or written by hand. So, we went more to the option of ... let’s just print them on paper. And at the end of the same function in just one printing action. And we don’t have to stick it in something which already exists.” (LL3, IP1)*

For practical reasons, the Labs started to design tailored materials for their games. Most of these materials were different forms of cards but also gameboards. As illustrated in Section 2, **all games include cards in their game mechanics**, for example for briefly describing personas as roles in the game, for dealing with changing conditions as elements of surprise in the game, but also for representing objects placed on certain fields on a gameboard or cards representing different mobility modes.

*“Well, in the sense that at the beginning you had these cards, these character cards, in there anyway. So, we actually adopted the idea of one-to-one. Of course, we didn’t use your character cards because we needed them in Dutch and wanted to have a few other things on there.” (LL2, IP1)*

*“And for example, the cards, this person, the role cards, or this action card, they were in English and they were just general things that you came up with, but we just made more specific things out of them.” (LL2, IP1)*

*“But this one, the character card that you mean, I think. This is the one that we use for personas and this is useful. But also, we realize that maybe we want to have this four-line standard of physical abilities, digital skills, and language skills. And ... this is not here. So, we should also print and ... Glued something here or just print them with a kind of thicker board like a paper board, as we did with this. And then we already have the cards.” (LL3, IP1)*

The Munich Living Lab even used an **online tool to elaborate the persona cards**:

*“We went online and there is a Web page that is called Cards for Humanity. So, it’s not cards against humanity. It’s cards for humanity. ... I’m going to share that because they have already personas. ... This is also new for me. This is just kind of a discovery. ... The idea is that ... this is a deck of cards, you randomly, for example, build a new pair and you have two options. So, here’s kind of a person with one kind of internal characteristic. And here I would say vulnerability we could call it. So, you choose randomly something. And what I like is that you have this option to view the need. So, for example, we have Pedro Rodriguez and he’s meticulous. So, the needs of a meticulous person, we can have it here. In terms of vulnerability, we also, for example, here is partially deaf. What are the problems of deaf people? What should we consider for that person? For example, people with hearing loss may not be able to hear verbal announcements and listen to the code. So, the idea was to print them and we translated them into German. And they chose it. And then they were supposed to choose again to change the options that they already chose. But based on those and those personas.” (LL1, IP1)*

Three of the resulting games used specific **gameboards** in addition to the cards. The Rotterdam / The Hague Living Lab and the Munich Living Lab used the gameboard to directly refer to a certain area or place that was illustrated on the gameboard. The Eastern Austria gameboard was designed to provide structure to the game and to illustrate a certain scenario.

The **design game guide** which was provided as part of the design game box and was supposed to guide the Labs through the design process by taking notes and answering questions directly in the guide, was **used by all of the Labs but not as planned**. The Labs stated that the guide was useful and gave structure to the design process. The designers from the Labs consulted the guide at the beginning of the design process and then rather selective. When issues and challenges came up, the guide was taken to get support and information on how to deal with them. None of the Labs worked through the entire guide and took notes extensively and directly in the guide. Most Labs used the guide to structure digital documents and did their documentation there, but not in the guide itself. This is related to practical reasons, as digital documents can be handled more flexibly, but also to personal preferences, such as preferring large whiteboards for taking notes and designing the game. The following statements from the evaluation meetings give an impression of the use of the guide:

*“So, we opened it to see. So just briefly, to see what was there. And it was we were searching basically for the rules because at the end of the presentation, it was pretty intuitive what it was kind of there and it helped us to see what to develop.” (LL1, IP1)*

*“We browsed through it at the beginning and didn’t know exactly what to do with it. And then I basically copied the headings and the questions that you wrote in the headings into my Word document. ... in that sense, we always looked at it because there were suggestions ... we still have to think about it or we have to somehow ... install a mechanism like that. So, it was always more food for thought where we still have to think about how we should describe the material or what we need ... But the book (remark: the guide) itself, the one you sent, I actually haven’t looked at again.” (LL2, IP1)*

*“Yeah, I think that the most helpful was the guide, actually, because it started with very specific what data you want to collect with whom. This actually helps to organize the ideas a lot ... That’s why we’ve used that.” (LL3, IP1)*

*“... A punctual guidance so we only use the questions actually ... in the first two workshops we just ... made some short looks into single pages and see okay, this is this question. ... If there were a two-pager with the list of questions over the whole process, we could ... say, try to reflect a bit on what we were discussing on this question, not all questions, but some. But ... we were too lazy to follow all the steps in the book (remark: the guide).” (LL4, IP1)*

As illustrated in Section 4.1 some game designers from the SmartHubs Living Labs **missed a direct connection between the guide and the provided material:**

*“So, that definitely helped. But, if I mean, correct me if I’m wrong, but the guide explains the things which are in the box but doesn’t explain what you can do with them, right?” (LL3, IP2)*

*“So, it’s a good start to know what the game is about, but then it doesn’t relate the aim and the structure of the game with objects and how to use these objects. This is not found in the guide.” (LL3, IP1)*

### 4.3. Roles

Throughout the evaluation meeting, the game designers referred to various roles in their games. These roles are briefly described in this theme.

**Players represent the most relevant role.** The SmartHubs Living Labs mainly referred to citizens, students, and children. Players were either explicitly invited to specific events to play the game or they were recruited in the public area as passers-by.

*“We put this wish list on and people were passing by. They should tell us what they would like to have in a mobility hub.” (LL1, IP1)*

*“Yes, to see that they play a few more rounds with the residents. And now we are in Rotterdam. It’s starting to happen more and more. This case study is where we get specific work with the municipality and public transport providers to see that we can also play the game.” (LL2, IP1)*

*“Why with children? Well, for some reason, because we are doing workshops with children now, we have the opportunity to test it. Second, because if it is children proof, let’s say it can be played by many others, like in a simple way of explaining ... but we didn’t actually try it with children because we felt it was not mature enough.” (LL3, IP1)*

Besides players, **other stakeholders** were mentioned as roles such as municipalities or urban planners who **have an interest in the outcome of the game.**

*“I would think it also would be interesting for the urban planner. So maybe they don’t play and they watch how people play and then they learn by that. You get inspired by things.” (LL1, IP1)*

The role and capabilities of the **game master** were discussed throughout the meetings. The workload for the game master was emphasized and the needed effort of leading the game and documenting it at the same time. Another issue is the activeness of the game master and the power in decision-making. The question came up if the game master should make a decision within the game or if this should be handled through other mechanics (e.g., throwing a dice).

## 4.4. Resulting design games

Within the evaluation meetings, the designers from the SmartHubs Living Labs referred to the resulting design games they developed. This includes aspects like the goal of the game, game mechanics and rules, the gameplay itself, generated results, future use of the game, and needed adaptations.

One term that came up regularly was “simplicity”. The Living Labs aimed to develop **simple games** that can be played easily. Players play these games usually only one time and for a limited duration. Therefore, the purpose of the game and its mechanics needed to be simple and easy to communicate.

*“So, we decided to do a very fast game that gives us fast results, not that it’s not entertaining, so it’s fun, but not kind of ... this competition with action cards, which is nice and I really liked it. But in the end, I think they are time-consuming and not providing us with information, but it’s more to entertain people, which is maybe another goal, but we didn’t want that. So the game basically it’s super easy.” (LL1, IP1)*

*“... Yes, it just has to be simple and people have to understand quickly, but that’s just standard game mechanics.” (LL2, IP1)*

*“Well, I think it was well reduced. I think if you take the costs out, it’s actually pretty simple ...” (LL4, IP1)*

In the **initial** parts of the design phase, Labs **defined** certain **goals for their games**. Games should motivate players to exchange their perspectives, they should lead players to express their expectations and wishes for a certain place or location, describe their preferences for a smart mobility hub, and help to identify new ideas.

*“And at the end, we came to the idea that what we really need is, that people tell us what they want if in a new location. So we propose a location and people should tell us what they want and also not thinking just as themselves, but maybe thinking as other people.” (LL1, IP1)*

*“It doesn’t have to be the best, greatest game. It has to get people talking and discussing things.” (LL2, IP1)*

*“I mean if you’ve seen the video, the part where the users first have cards with different elements that can be implemented in the mobility hub depending on their own personal preferences, and players explained why they have such preferences. It’s quite insightful for us to get data about individual aims and needs.” (LL3, IP2)*

*“Lu has set up a drinks machine. So, it was like that for us in one round alone. There are two or two new things that we said, okay, we hadn’t actually thought of that yet and that’s what we’re hoping for in terms of impact.” (LL4, IP1)*

Regarding game mechanics, many different aspects were discussed in the meetings included in the single games. One popular game element is the use of **personas** that allow players to represent different people or roles within the game. This raises the number of different perspectives and supports negotiation if two conflicting personas meet at a certain stage of the game.

*“But I like this idea of they being themselves at the beginning that they don’t know that personas exist and then they take a persona because they say like, okay, then it’s maybe something different.” (LL1, IP1)*

*“And then there’s the second part ... and then each player becomes kind of the advocate of this person and has a limited amount of moves to adapt what is already on the table to this new persona and negotiate with others.” (LL3, IP1)*

The designers tried to generate mechanics that support **negotiations between players** and thought about possible ways of **turn-taking** and adding **dynamics** to the game.

*“And the idea was that we just want to tell them that you should put six here. So first you start H, then G, H, G, H, G, and then at the end, we say ... maybe what about H? You can change something that G did.” (LL1, IP1)*

*“The idea that there would be one card of each and players should be to negotiate and actually whether convince the other player why they needed more and why the other player doesn’t need it or exchange it for something that the other player needs.” (LL3, IP1)*

*“So, we have this element of surprise, we would try to strengthen it. So, it was always a nice moment when you were in the evaluation round, and then suddenly the sun came. It’s very cold and, for example, you’ve planned an event where you’re giving out ice cream and then you think, oh, kind of stupid. The conditions are a bit controversial or destroy my actions a bit. It was kind of a nice dynamic.” (LL4, IP1)*

Another relevant part of the game mechanics is the **termination of the game and defining a winner**. This was referred to as challenging by the Labs, finding mechanics that make the game fun and dynamic, achieving the goal of the game, and creating a winner among the players.

*“And so, you have to be clear about the goals, a game has to have a clear goal. So, when do I not win? Exactly. And that’s your problem. You’re right, that’s not good because I don’t know, should I look after my interests now or should I look after the common goal? ... But this effect for you was: aha, I have the most points, oh I prevailed. That gave it this surprise and pleasant game effect. I think that worked better than shared goals.” (LL2, IP1)*

*“The thing is that at this time in terms that every single thing should have a price and that involves a lot of time for deciding. And you’re right, what I was missing in the game is or maybe also the perception of participants is that they don’t have a conclusion. So, they play, they have the design and they say like, and now what? So for them, it’s not ready or done, the game.” (LL1, IP1)*

By the time the evaluation meetings were conducted most Living Labs were at the point where they finished a version of the game and play-tested it internally or even with citizens. Therefore, various ideas for adapting the game and enhancing it came up during the evaluation meetings. LL2 planned to **do a more general version of the game** for using it at different locations since the current gameboard represented a specific place at The Hague.

*“Yes, to make it more general, we actually don’t necessarily design it as a Hobbemaplein, specifically for this Hobbemaplein Square, but because we also want to play it in Rotterdam, for example. That would perhaps be the idea of actually making a simple ... thing with fields in the playing area, without the local context of how the streets run exactly because at the moment the game isn’t really about, ... where to place them ... the players exactly, in which corner do they place the things, but rather what things do they place?” (LL2, IP1)*

Labs also identified the need or the purpose for **adapting the game mechanics to realize livelier and more dynamic gameplay**.

*“But it could be good that there’s maybe two extra cards for players to give open kind of ideas and somehow ask them to see and count for the score. Maybe it’s more difficult, but at least they have the opportunity to express something specific so ... that could be interesting and maybe then showing an image of a mobility hub to give them an idea of what they can ask for is not good. Then. This thing of having a bonus card and knowing what the options are. I think it’s interesting to add dynamism to the game, with no uncertainty or unexpected elements. So maybe that card would actually, instead of showing like the 30 or 40 ... 50 elements that you can add, maybe just knowing about ten or I don’t know. What do you think about it? That’s more like a question. And then if you get this bonus card and you know about ten elements that others don’t know. Or everyone should at least see all the elements. I don’t really know which one would be better.” (LL3, IP1)*

*“But what we noticed is the problem. So, the character cards have now changed every round. On both teams. And that was a bit of a problem because then you didn’t get to know the character cards. So, we would change that again so that there are maybe only four-character cards. This means that if four teams play, then after the first round you already know who is my user, so to speak.” (LL4, IP1)*

Many ideas for enhancing the game addressed the used materials. Labs identified various ways of **adapting the material** to achieve a more professional and easier-to-handle game.

*“So, in the perfect world, I would like to have not (remark: 2D elements on) a board but 3D. So, like the real buildings and the stuff. And also, because I cannot show people with everything with that, they would see what’s really space there. And if we had instead of like really tokens representing the things, then they would be real, and we make it on the scale, we can really make to see people what they make can fit there because now it’s a card, it’s paper, some things are small, some things are big. But with the real kind of size of things, people really can kind of play with, with their built environment in the perfect world.” (LL1, IP1)*

*“So, for instance, the cards should have a symbol to make it easier to identify because now we have two, three words. That explains something ... for ... the average player, it’s too complex, like, say, electric shared bikes. I mean, yeah, it can work, but maybe if there’s a drawing of a bike at an electric sign, it’s easier. But other things, such as subsidized tickets or subsidized subscriptions. Well. Of course, there was going to be someone facilitating the game. That can explain what it means, but we should try to make it as self-explanatory as possible.” (LL3, IP1)*

*“I think especially for these cards ... only a friendly look and they have to be bigger. Maybe so that is with the size maybe we have to make some adjustments they are too small I think to write a good story about your design.” (LL4, IP1)*

## 4.5. Feelings and emotions while designing

The partners from the SmartHubs Living Labs developed design games for the first time without having much experience or knowledge in that field. Therefore, some feelings and emotional attributions regarding the design process and the material were mentioned. These attributions are illustrated by this theme which is strongly related to the development process, the provided materials, and the resulting game.

The tasks were experienced as challenging due to the fact that there were no professional designers in the Labs and people developing the game had no prior knowledge. The first contact with the provided materials and the guide was described as **overwhelming, confusing, or even frustrating**.

*“... maybe we didn’t have this clear that there were no rules. So maybe that at the beginning we would have prepared more. Because we were expecting that they will come somehow. So, it was not very clear, maybe in the presentation.” (LL1, IP1)*

*“So, I mean, we really appreciated the package, but we also felt that there were a lot of things and we didn’t know how to start.” (LL3, IP1)*

*“But it’s basically it’s like receiving a package from IKEA without knowing what you’ve bought. Like, there is all, all the parts are there.” (LL3, IP2)*

*“Only frustrating things like ... having infinite possibilities. ... Then you have to really think about what you want to do, what you can’t do. And then. Might get frustrated over the number of options.” (LL3, IP2)*

*“On the one hand, it felt a bit overwhelming in the sense so many possibilities, so a bit stress in the material perspective.” (LL4, IP1)*

Some moments of **frustration** also arose throughout the design process, **caused by the lack of experience and support but also by impatience and the urge to develop a satisfying game**.

*“But yet to come to this, which is relatively simple, you go through all the complexity of imagining different ways of doing it better than just putting time on it and trying. So, this can be maybe a bit frustrating. I wonder. Now there’s an idea. I wonder if there’s maybe some. The kind of methodology to create scoring for games that is also more like. Step by step. So, I don’t know, maybe it doesn’t exist. ... because all that was done without googling anything.” (LL3, IP1)*

*“... I think the frustration comes from my impatience. I see that getting this experience with designing the design game takes time. I have the feeling that I learn in each meeting we do around the design game, but it is a slow growth about this topic and the game itself.” (LL4, IP1)*

Besides situations of frustration, various statements about the design process referred to occurring **uncertainties, concerns, or open issues** that needed to be clarified. These concerns addressed mainly game mechanics, the actual output, and the usefulness of the game.

*“I would need a goal for the game because even with the game that we have now, I can see how it’s fun. I don’t yet really see how the data that we collect with it can be used for a publication, for example, because it’s just too much data that can be compared with anything else. So it’s like, well, if we play this game, then what?” (LL3, IP2)*

In addition to these rather negative associations, people reported also **satisfaction with the outcome and having fun playing the game**.

*“But now that you say that I’m happy that we developed something, this is nice, even though it was time-consuming, but I’m happy with the outcome.” (LL1, IP1)*

*“Yes, I find it funny ... So far, we’ve had good feedback that people found it interesting, or found it funny, or wanted to play it again, or whatever. In that sense, I’m happy with the game.” (LL2, IP1)*

*“And I think playing it was nice.” (LL3, IP1)*

*“I’m pretty satisfied it feels like it is an easy game, or ... it’s not too complex it feels like easy to transfer and to copy.” (LL4, IP1)*

## 4.6. Design game method

This theme encompasses contemplation of the design game as a methodology. Participants noted that this method has the capacity to spark **fresh ideas and encourage individuals to articulate their desires**. However, there were **concerns** raised regarding the tangible outcomes and effects of a design game. This involved questions about how insights gained through gameplay translate into real-world actions and, on the other hand, how to derive meaningful scientific findings given that the four distinct games produced are not directly comparable to each other.

*“I think it’s a nice complement, especially to take out things because when you ask a question, so for example, now in the interview, I have to reflect on that and come up with some decisions that I do it consciously. But when playing you might come up with things that you wish to have that you never thought before somehow. So, you are kind of also popping up these into people to address their needs that they didn’t even know they want to have. And so, it’s a very nice approach. But the delicate issue ... how to say disadvantage would be how well designed is the game. So, if it’s really proper games like very well-designed games they (remark: game players) would say yes, definitely. But what if I took ... the dice ...? Then it’s I’m losing my time there, and maybe it’s entertained, but I’m losing my time in terms of design.” (LL1, IP1)*

*“I understand it for you from the design perspective; that’s very relevant. But then, the data gathered via the game about mobility, I wonder how we will incorporate it into anything I can see, for example, that we can use. We can use it, for example, for the design of the mobility hub because we will have a professional artist draw different designs of a mobility hub, and input that we get from the game could be used for it. But then, on the other hand, the game is a bit steering as well, because you have personas ... their wishes need to be fulfilled. So, of course, it’s*



*going to be step-free. Of course, there will be shared electric bicycles. But I'm thinking about this from a very public perspective. Like the data that we collect, can we use it?" (LL3, IP2)*

## 5. AUGMENTED REALITY IN DESIGN GAMES

AR is a promising technology to be implemented in design games. It preserves the experience of the real world while objects of the real world are enhanced by virtual, computer-generated content. Using this virtual layer, information can be added to the perception of the real world. By doing so, users are enabled to interact with real and virtual objects likewise. This is usually realized by special AR glasses such as the Microsoft HoloLens or by AR applications for mobile phones which use the camera of the mobile phone to provide a live image of the real world and add specific virtual information as an overlay to this image.

First of all, we have to mention that a significant number of the testers of the design games have a smartphone but only use it for the basics, such as texting or calling. They have low digital skills. This means that having a smartphone does not imply that one can exploit the full potential of these devices. On the other hand, the functionalities, effectiveness, and precision in image processing by smartphones are relevant aspects of this approach for realizing design games within the SmartHubs project: smartphone applications can be tested very easily with users due to the widespread availability of such devices. In contrast, virtual reality, which does not provide a perception of the real world and therefore is completely virtual, needs specific VR glasses and environments where such a system is set up to provide a satisfying experience. Therefore, virtual reality is rather suitable for Laboratory use than for field work involving users as in the SmartHubs project. Figure 13 illustrates the vision of an AR-supported board game in the context of smart mobility hubs as a mock-up.

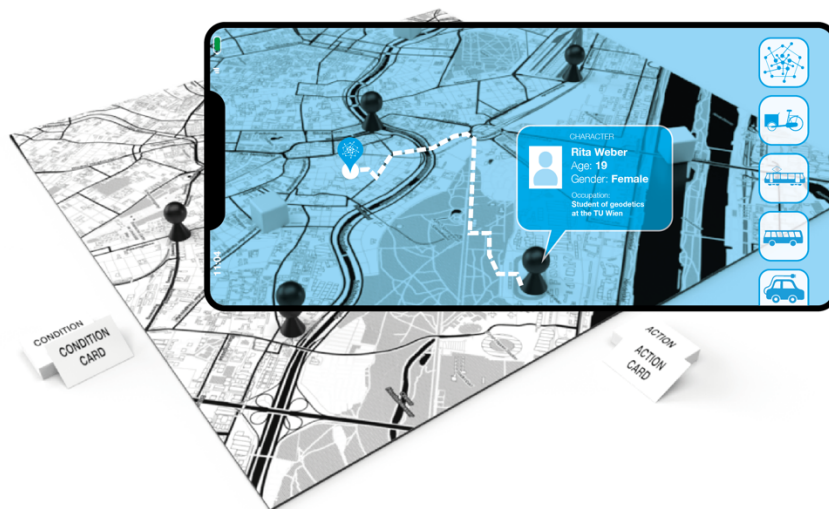


Figure 13: Mock-up of an augmented reality supported board game.

Within the SmartHubs project, an augmented reality (AR) version of a Design Game was developed and realized as a proof of concept. The AR Design Game is based on the analogue Design Game of the Rotterdam / The Hague Living Lab. The goal of this proof of concept was to enhance the game with an augmented reality layer displayed on the player's smartphone in order to support the gaming experience for players (having more fun with a digital component), for game masters (automated digital point counting and game documentation), and other stakeholders (availability of digital data for further use or documentation).

## 5.1. Planning of the AR smartphone app

The AR smartphone app combines the analog Design Game that was used first with mixed reality elements. The ruleset, gameplay, and mechanics stay largely the same but specific parts of the game are realized in a virtual environment. Smartphones can possibly be used to implement this and to realize a game, which is still played as a board game but enhanced by virtual parts such as further information, game statistics, or specific actions. For example, the actions and results that are invoked by playing a specific card can be displayed virtually on the smartphone. Points and game results can be collected and saved on the smartphone. Tokens can be individually configured and visualized as bicycles, pedestrians, cars, etc. This supports the scientific evaluation process of the game as well as the gameplay itself: results can be directly shared with others and compared to others. Additionally, the Design Game can be adapted by players or stakeholders to relate to the real context in which it is played, e.g., in our case, based on different scenarios and hub conditions.

The planning of the AR features for the SmartHubs project started with a very broad and general internal brainstorming session where initial ideas for features, services, and applications of AR were collected and described. The resulting ideas are summarized as follows:

- **Planning the public space in AR**  
AR could be used for community engagement and feedback in spatial planning. An app could be developed that allows citizens to “rearrange” public spaces according to their minds and expectations. Through such an approach the visions and wishes of the citizens would become explicitly visible and could be realized – at least in an AR environment. For example, the community could begin to plant virtual trees in large concreted areas and re-organize these areas virtually. Spatial planning could use this information to get insights into the viewpoint of citizens and their expectations towards their surroundings and public spaces. If different things are placed at the same location, there could also be a voting or negotiation mechanism or a functionality which allows discussion within the community.
- **Finding SmartHubs using AR**  
A mobile app could use AR to display the SmartHubs (and/or other mobility hubs) and mobility services in a city. With the use of the camera, the display on the mobile phone would show the real world, an overlay would display the place and direction of the next SmartHubs, the next available shared car, bicycle, bus, etc. This would allow users to find mobility services more easily without the need to orient on a map. For public transport services, these features could be extended by showing schedules and directions for buses and trams. Here, the availability of open data is a relevant factor for a successful implementation.
- **Showing when to get off a bus, tram, or train**  
While riding buses, trams, or trains (in urban public transport) AR could support routing functionalities and show users when to get off the vehicle and in which direction the routing continues after leaving a bus, tram, or train. Combined with GPS tracking AR could be used to indicate how far the next stop is away and when people need to get ready to leave the vehicle.
- **Exploring the city with AR**  
AR solutions could provide information about the surroundings and, therefore, could be implemented to motivate users to explore cities or districts, for example, on foot or by bicycle. In addition to transport-specific information like the nearest bus stop, information about historical events, or specific landmarks could be provided via AR. The information on this could be extracted from open data sources.
- **Support spatial and transport planning**  
AR and VR can be used to support the planning of future cities, districts, and areas. Through AR and VR, the planning can be tested in virtual environments which allows and supports citizens to imagine planned changes in cities. This is also applicable to the planning of transport. New or changed stations and lines can be introduced to and discussed with citizens via AR and VR before these things are actually realized, and users can give feedback which contributes to better solutions.
- **Visualizing urban sensor data**

AR can be used to show data and information that are measured by specific sensors and are typically not visible to human beings. Several types of pollution data like CO<sub>2</sub> or particular matter can be measured by (mobile) sensors and visualization via AR to make the amount of the pollution perceivable. This supports the awareness-building process of citizens towards a more sustainable mobility.

In the second step, based on these initial ideas, a more focused brainstorming session was conducted. Here the analogue game of the Rotterdam / The Hague Living Lab was taken as a basis for an AR-supported Design Game. Within this session, it was clarified which elements of the game can be realized in AR in a useful manner and which elements need to have a haptic representation. A test session of the analog game showed that gaming material and elements which are available for everyone and can be seen by every player need to stay tangible because they are interpreted as a public good, which every player needs to have access to. More private elements were identified as candidates for being represented in the AR environment on the smartphone screen. These are elements that are only used by a single player and are not relevant for others or even secrets, such as personal goals or a specific role of the player. Through this, the first list of possible features for the AR smartphone app was generated. Features were categorized into certain areas or modules of the application, and in addition, each feature was categorized as “must have”, “nice to have”, or “not needed”. Table 1 includes the initial features and their categorization.

	Must have	Nice to have	Not needed
<b>Player management</b>	Checkbox for distinguishing Player and Master	Management of different game masters (accounts)	Login/Account for players
	Master registers with name and E-Mail	User roles (game master)	Avatars for players
	Players register per (nick) name & E-Mail		Extra role for game round master
	Color coding for players/ elements in different colors		
	Count points for each player		
<b>Documentation/server app/mobile app</b>	Saving E-Mail addresses of players in a database	Creating automated mailing lists	
	Saving the final state of the game as a picture (by game master) including points	Keeping track of single steps of the players and saving it in the database	
	Server app (a database with data on players and game information, object cards, character cards, and personal goal cards)	Web interface for game master	
	Native mobile application (iOS and Android) for playing	Editing of game elements by the master	
	The player finishes the move by tapping on a button		
	If a player is finished the next one gets a message that it is his/her turn		
	Display the game duration on the board		
	Server keeps a flag to know which player is active		
	Passive players can place objects for strategy (not the turn of this player)		
<b>Cards</b>	QR code on object cards	Game master can edit cards	User specific objects
	Confirm placement of object card by scanning the QR code	Master can add objects to the library	

	Must have	Nice to have	Not needed
	Object appears in the color of the player		
	Predefined set of action cards		
	Predefined set of personal goal cards		
	Predefined set of character cards		
	Action Card deck is presented on the board (only) in AR		
	Moving closer to the deck and tapping on it opens (draws) an action card		
<b>Counting points</b>	Send scores to players and masters per E-Mail	Overview/Statistics across different games	
	Removed object cards need to be scanned to keep track of points (and removed manually from the board)		
<b>Character</b>	Player gets his/her character on the phone at the beginning of a game	Players choose from a set of characters	
	Predefined characters (hard coded, not editable)	Characteristics can be edited by the game master	
	Character info needs to be accessible throughout the entire game		
<b>Game board</b>	Board is recognized by physical marker at the corner of the board	Display different traffic scenarios on the board	
	Experiment with markers printed on the board for positioning AR Elements (Card Decks, Points, etc.)	Adapt appearance of the board according to day/night-time. (rush-hour, etc.) Getting darker after 30min (reminder of finishing the game)	
	QR code for each player is printed on the board	Blocking streets and changing conditions	
	Players register in the beginning by scanning the code	Avatar is placed near the personal QR	
	Players start and finish every turn by scanning their code		

Table 1: Initial feature list for the AR Design Game app.

Throughout the design process, these features were adapted and partially reassigned to meet the specific requirements of the programming environment and to align better with the available resources within the SmartHubs project. However, the most relevant features were realized in the resulting “SmartHubs AR” smartphone app, which is described in the following section.

## 5.2. Resulting “SmartHubs AR” smartphone app

The “SmartHubs AR” smartphone app was finally developed as a prototype including the minimum feasible features needed for applying and testing the application as a proof of concept by the SmartHubs Living Labs. The design game application is available for both iOS and Android, and can be downloaded in the respective application stores. The application includes a multiplayer game of the AR-supported board game as well as a first introduction to a real-world version of the design game, where objects can be placed directly in the public space. For the AR-supported board game, a special game master mode is included. In addition to the smartphone application, a server app was realized for facilitating gameplay and making game results

accessible for downloading. This section provides an overview of the realized parts and app features. A detailed manual for the AR design game is included as an Annex to this deliverable.

### **Game master**

The game master opens the application and clicks on the “Game Master” button, which opens the user interface to create a game. The ID number of the game is displayed and needs to be communicated to the players and the maximum number of players is set to eight. The game master provides short information on the location of the current game as a description. Upon clicking the “Create Game” button, the game with its ID is created on the server. After that, the game master can view the objects in the game and the game board itself with the haptic elements. The game master can take a screenshot of the game and upload it to the server from the phone’s camera roll by clicking on the “Upload Screenshot” button. The game master should prepare the playing field for the players, the cards with the objects, and the Action Card deck. The haptic element will serve as the “Action Card” deck element. The game master should also put down the “Point Counter” haptic element card that will display the player’s points.

### **Player**

Players have to select the “Play Game” option in the first menu when opening the app. After that, they are prompted to input the game number; they have to ask the game master for the number of the current game. After editing the game number, a button “Next” appears on the screen, and they have the menu to select their player number. They can click on a player number and the application checks with the server if this player number is available. If it is, they are registered with this player number in the game. If it is not, a message saying “choose another player number” is displayed, and the players can then choose another player number until they pick a working one. After this, the top of the screen shows the player’s number and it is in the color of the player associated with that number. A “Character Card” appears on the screen presenting information about the player’s character. Multiple players can have the same “Character Card”. After clicking “Next”, the players are presented with their “Personal Goal” cards. The “Personal Goal” cards are unique between players. Both the “Character” and the “Personal Goal” cards are available for the players to view by clicking on their respective buttons located at the bottom left part of the screen.

At this point, the players can see the surroundings through their cameras. The players should point the phone to the playing field in order to see a green “Marker” that represents the point in the field where the players can place elements on the game board. The game works in rounds. At the beginning of each player’s turn, the player should scan the QR code of the element he/she wishes to put down first and then proceed to place the object onto the game board. If the player scans the element before putting it down the object appears in the color of the player for all players viewing the playing field. After putting down the object and scanning it, the player also sees his/her points on the point counter element. After this, the player scans the “Action Card Deck” haptic card, and the card deck object appears on the screen, when the player clicks on it, a new action card is drawn on the top of the deck and presented to the player. The player follows the instructions on the card and finishes the turn. When the player is finished with a turn the game master hands over to the next player for a new turn. During the playing of the game, the player can put down objects on the screen that can be selected at the bottom of the user interface. The highlighted object can be put down by clicking on the screen and is placed down in the place where the green marker is. Other players cannot see these objects. When an object that is placed down is clicked and selected again the player can rotate it and a delete button appears, so the player can delete the object. If the green marker is not present the player cannot put down objects anymore. This is likely due to the lighting conditions or the player locking the phone screen, closing the app, blocking the camera view, etc.

This version of the AR Design Game supports the players in placing objects on the game board and allows players to design their private vision of a place by placing objects in private mode. Point counting is also supported through the app as well as documentation possibilities for the game master. Figure 14 includes representative images of the app in combination with the tangible board game. Figure 15 provides a visual overview and description of the most relevant screens and features of the application.



Figure 14: AR Design Game supporting the analogue board game.

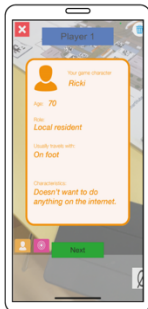
## App Elements and Screens

### Quit/Exit Game

Quitting or exiting the current game. For rejoining the game another player number needs to be selected.

### Character Card

Displays the character card.



### Private Elements

Selection of private elements that can be placed virtually by tapping the screen (to token needed). These elements can only be seen by the player (not by others). Can be used for pre-planning.

### Player Identification

Player number and colour.

### Clear Screen

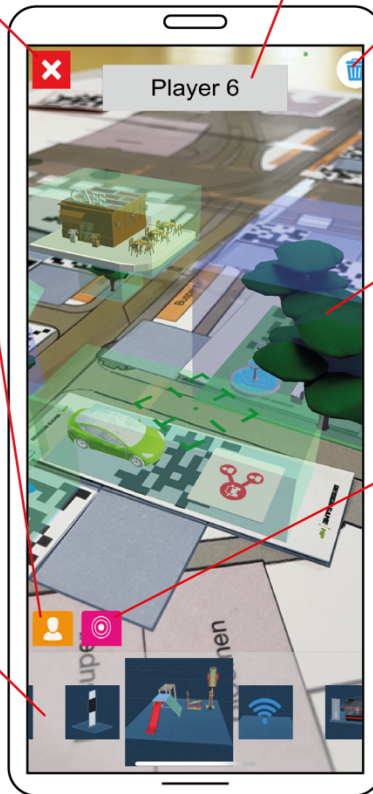
All virtual elements are removed from the screen (without impact on points). Elements can be added again by scanning the codes on the tokens.

### Virtual Element

Virtual elements (e.g. a tree) is displayed after scanning the code on the token placed on the gameboard.

### Personal Goal Card

Displays the personal goal card.



## Gaming Tokens



### Action Cards

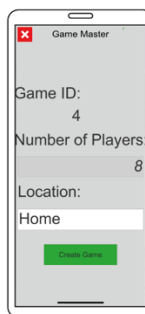
A deck of action cards is displayed by scanning the code on the token. Cards are changed by tapping on the deck.



### Score

The score of each player is displayed as well as the total score after scanning the code on the token.

## Game Master Screens



### Setup

For setting up the game the game master enters a location, hits create game and tells all players the Game ID.



### Master View

The game master can take screenshots of the scene by hitting the button. Through tapping „Finish Game“ the master confirms the end of the game.



### Deleting Elements

By tapping on an element the game is able to delete elements. Points are reduced for the respective player.

Figure 15: Illustration and description of the app's user interface and features.

### 5.3. Experiences and learnings

The SmartHubs AR smartphone app was tested by the The Hague / Rotterdam Living Lab, as well as by ACUR in several internal sessions and a public demo session during the SmartHubs Symposium in Bologna. Impressions, experiences, and learnings for future development are summarized in this section.

The smartphone app was developed as a prototype, not each feature from the list introduced in Table 1 could actually be implemented due to limitations of time and budget of the project. This led to an app that needs to be seen as a proof of concept and can be used as a demo application that mainly communicates the vision of supporting gameplay through AR.

Testers and users reported bugs that would need to be fixed to be actually able to use the app as a real supporting companion while playing. Fixing these bugs in the software was not possible within the available resources, but specific strategies were introduced and communicated via the game manual to handle them and still enable the use of the app while playing to facilitate the user experience with AR.

Nevertheless, the application was used to illustrate the basics of AR support in a Design Game for users and give them an idea of how this could work in a more elaborated version. Therefore, the application is a valuable contribution to the Design Game as the AR elements raised curiosity among players and other stakeholders. The feedback from players and game masters revealed specific contributions and characteristics of the application of the SmartHubs AR smartphone app as well as new future visions for beneficial applications:

- The AR game enables to **design of personal views** of the scene that cannot be seen by everybody. This feature supports building an individual strategy to reach personal goals through pre-planning of useful elements for the character a player represents. Specific pre-planned elements can be used in a later turn in the game and be placed on the game board, where they are then publicly visible.
- Integrating the **character card** as a personal item in the AR layer is useful for recalling the characteristics of this persona. In a future version, the metaphor of including a character the player is representing could be enhanced. Avatars or individual game tokens could be displayed in the AR layer and debate/discussion can be triggered among the players through specific actions, e.g., when the virtual characters are close to each other on the game board. This supports exchange between the players and provides deeper insights into the needs and visions of the specific characters, even a consensus.
- Including **scoring of points** in the app reduces the workload for the game master and provides up-to-date feedback about the current standings for each player, which increases the gaming experience of players. This feature can also be used for documentation and evaluation in future versions. For example, it could be analyzed if there is a relation between characters and scored points or if certain characters use similar elements across different games. Therefore, point counting needs to be connected more deeply with information on used elements, characters, and personal goals as well as timing by the server application.
- Using **visual codes** such as QR codes on haptic elements (element cards, scorecards, gameboards, etc.) is a powerful technique to combine haptic elements with visual representations. Such codes are easily detectable by smartphone cameras and can be assigned to any virtual object or action. For example, a haptic dice could include codes on its face and trigger a specific action. As the game board represents a specific place in the real world, codes can include real position data and the elements placed on the gameboard could be scaled and also represented in the AR view at the real place. Each game would deliver a location-based data set.
- **Digital documentation** of the game flow and archiving of gaming data on the server can support planners and decision-makers. Detailed data on the gaming procedures can be analyzed and used for planning processes. If the single steps of a game are saved on the server, the decisions of players can be understood more easily in the analysis process. Combined with qualitative data from in-game debates and discussions between players a valuable database for analysis would be provided. The availability of digital data enables automated analysis of the data and opens up possibilities for



combining data from games with the actual planning of spaces by, for example, using virtual elements from the game.

- The results from the AR Design Games could be used in **combination with other VR/AR applications** in future settings. As many leading digital companies such as Meta and Apple are developing devices and solutions for virtual reality environments, the result from the design games can be picked up, displayed in virtual reality, and therefore, be used for communicating certain aspects of the co-creation processes to a broader audience. Using these techniques citizens and stakeholders can directly experience the change of places as they are still in the design process.
- There are relevant **differences between simple analog cards and virtual objects** representing elements. The representation of an element on the analog card was realized as simple icons. These simple illustrations communicate the type of the element clearly but without details, leaving room for individual interpretation of how the element would look in the real world. Players built a common understanding about the placed element but are still open to their personal imagination of it. Virtual elements on the smartphone screen are illustrated in much more detail, showing almost real representations of elements. This may cause conflicts since single players imagine certain elements differently. For example, the represented sports device for public places needs to include weight-lifting for one player but cycling for another. Hence this requires a large library of different elements to allow all players to represent their individual vision in the virtual layer.
- **Context matters.** In order to be able to plan and design a certain location by placing needed or useful elements on a game board, the scene needs to communicate a certain degree of context information. Tests with different game boards showed that players handle their tasks more easily if there is additional information about the surroundings (e.g., shop names or types of shops) on the game board. If people know that there is a certain service or infrastructure in the vicinity, they respect this in their planning. Without such context information on the game board, orientation, and developing ideas for placing elements appeared to be harder for players.
- **Elements need to look like local, familiar objects.** If elements (especially AR elements, because they have more detail) are designed in an uncommon way for the location or area they are used in, players get distracted. Players then start to talk about the unusual model rather than on their actual tasks. For example, taxis should look similar to real taxis in this area. This is challenging to find good 3D objects for the AR application because there are many models representing well-known elements, such as New York City taxis, but it is hard to find models representing such things from a particular area or city.
- **Presence support debate.** The AR Design Game could be realized as an entirely digital version that does not need any haptic material, and therefore, such a version could be played remotely. Experiences from a solely digital application of cultural probes (during the pandemic) showed that participants likely dropped out during the application. Therefore, the AR Design Game was elaborated as a combination of haptic elements and AR support. This combination allows individual gameplay in the AR environment but also supports debate because players meet in person. Communication, the exchange of different perspectives, and turn-taking still appear to be easier when people meet in person to play a game.

These learnings show that there is still a long way to go, and much effort needs to be put into realizing AR Design Games in a way that supports player and game master while playing as well as decision-makers and planners in analyzing the collected data. Digitalizing game elements and representing these elements as AR layers in a smartphone app is a promising approach to enriching gameplay and data analysis. Data from the gameplay can be collected automatically and analyzed more easily. Nevertheless, the game materials and elements need to be tailored to a certain context, and location with respect to cultural characteristics. If this is given AR Design Games are a powerful method to commonly design places, communicate perspectives, and illustrate solutions.

## 6. CONCLUSION

Evaluating the process of developing design games by project partners who are not experienced designers gave insights into possible adaptations of the process. When people were introduced to the idea that each Lab designed a game on its own, and when the packages arrived, they were overwhelmed by the material and found themselves confronted with a task they had no time for and no immediate idea of a solution. Each Lab started a process on its own, somehow led by confusion and overwhelming initially, but quickly led to the structured activities and first results. People reported to have been frustrated, but they also said to be satisfied with the results. Ultimately, each Lab realized a design game that could be played with citizens and (mobility) experts, and produce results for reaching the initially defined goals.

However, the process also showed that the supporting material and approach must be adapted. The material in the box was inspiring at the beginning of the process. Still, the resulting games did not use the materials because the Labs needed tailored material. For giving inspiration, a smaller set of materials or different types of media, such as pictures or videos, would have been sufficient. Later in the process, the Labs must be supported in crafting tailored materials. The provided guide gave structure to the process and helped the Labs to get an overview of what is needed to design a game, but it needs to be linked better to the material. Examples, practical how-to's, and tutorials need to be included in the guide to better support inexperienced game designers.

The application of Design Games in the SmartHubs project clearly showed its potential to act as a game changer in co-creation processes. A new creative method to understand the needs and wishes of citizens and other stakeholders was introduced to planners. It is still not clear to some of the researchers of this project how to use the Design Games for further analysis and developments within the scope of mobility. In the future development of the Design Games as a methodology, this aspect should be considered explicitly and communicated with the researchers from the beginning of the design and development process. The method supported creative thinking and opened up new perspectives on how to co-create a public infrastructure. Design Games provide a joyfully structured framework for exchanging perspectives, acting in different roles, and expressing arguments. They support an intensive confrontation with a topic and certain tasks deliver clear suggestions directly from players. This leads to serious expectations from citizens. It needs to be communicated transparently and clearly that players' perspectives and ideas are highly valuable but not all collected ideas can actually be realized.

Design Games can easily be generalized and scaled, which might be an additional time-consuming process. Urban authorities and all involved stakeholders should consider the time and effort needed to design, run, and analyze co-creation events by using Design Games. The basic rules and the goals of the game can be applied in many different locations (with similar research questions). The needed effort to adapt the gaming materials to specific locations is low. Elements, persona cards, gameboards, and other materials can easily be tailored to specific locations, contexts, and cultures. This allows the application of Design Game throughout a long period of time in different planning processes, cities, and structures.

The AR Design Game was realized as a simple proof of concept, where many features need to be added to support players, game masters, and other stakeholders on a full scale. Nevertheless, its potential for enhancing gameplay and gathering more detailed digital data for analysis was clearly identified throughout the project.

The evaluation showed that design games are a powerful method for including citizens in decision-making and getting insights into the perspectives of various stakeholders. If non-designers design these games, they need to get the proper support at each stage of the design process. This includes providing the right amount of information at the right point of the process and supporting the designers with high-quality information and materials at the right time. This leads to less confusion and frustration and generates even better and more useful design games.

In the following sections, the lessons learned from the SmartHubs Living Labs are summarized.

## 6.1. Lessons learned from Eastern Austrian Living Lab

The design game was played in a refined form in three different workshops, featuring diverse target groups such as teenagers, residents, and experts. In total, 31 individuals participated in the game. An overview of these games can be found in [Deliverable 4.4](#).

### 6.1.1. Game materials and visual design

Overall, there was an admiration for the game materials, but some aspects were criticized. The game board, action cards, and character cards were deemed too small and difficult to read. A designated area for resource management was suggested. The central image of the hub they had to design had a more significant impact on players than their chosen character. The dice added momentum as a surprising element.

### 6.1.2. Player experience and game mechanics

Players expressed enthusiasm for testing the game in the beginning. Understanding queries were resolved within the first round, and immediate improvement suggestions were made. In the first two workshops enthusiasm for the game diminished over time because it was too repetitive. Game rounds were perceived as too lengthy, leading to a decrease in player attention. However, in the last workshop the game was so well-developed that despite the advancing time, participants would have gladly continued playing. The idea generation in teams of two was full of lively discussions, and all teams pitched their ideas with enthusiasm.

The players had to evaluate each other. The point distribution was very fair among the teams. Players were able to empathize well with the character cards in the final design round. One insight is that it takes many tests to elevate the fun of the game to a good level. Theoretical considerations within the project team are not sufficient.

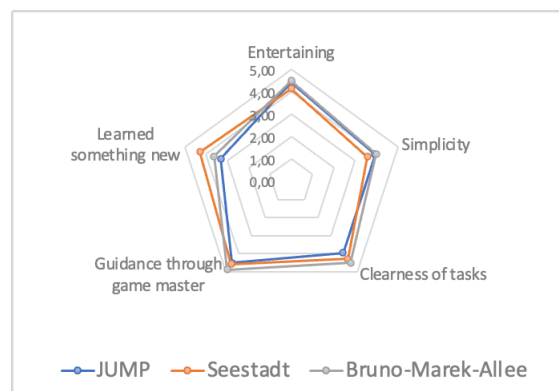


Figure 16: Evaluation by participants.

Overall, the player experience was good (see Figure 16), only varying slightly between the different groups. While within the Seestadt workshop (with inhabitants, students, and local stakeholders), they have stated they learned something new, and the simplicity and clarity of tasks can be improved for all the groups. The perception of the three groups was positive. Especially the entertaining aspect and the guidance through the game master had a high score overall.

To ensure that the collected ideas from the 3 workshops were not lost, they were compiled and clustered again in a spreadsheet. It can be observed that many ideas are repetitive, often addressing similar themes and not entirely out of the box. Probably, additional game mechanics are needed to draw innovative, crazy ideas from the players.

### 6.1.3. Game development within the EALL team

From one application of the game to the next, the game became more sophisticated and, hence, more enjoyable for the participants. However, developing an engaging game for all involved is very labor-intensive, especially for those without prior experience. This not only concerns the substantive development of the game (mechanics, goals, etc.) but also the development and creation of materials, which often cannot be reused in the same way after changes and require graphic adjustments. In the end, the team is very satisfied with the end result because it works well, is enjoyable, and actually provides written ideas that can be further analyzed. Moreover, it is a break from the daily work routine as it requires thinking in different logics. Finally, the game also offers a basic structure that could be adapted to other thematic contexts (with relation to public space) easily.

For vulnerable groups, the game might be challenging. However, for interested residents and experts, it serves as a valuable tool to discuss, present different perspectives, and empathize with others.

Below (Figure 17), you can find an overview of the ideas that were designed by the participants to increase the usage of services at mobility hubs through non-service-oriented measures. What stands out is that creativity is needed to come up with “cross-sector”-synergies, for example, with sport, tourism, or other local-specific contexts, which can serve as an enabler for the mobility hub.

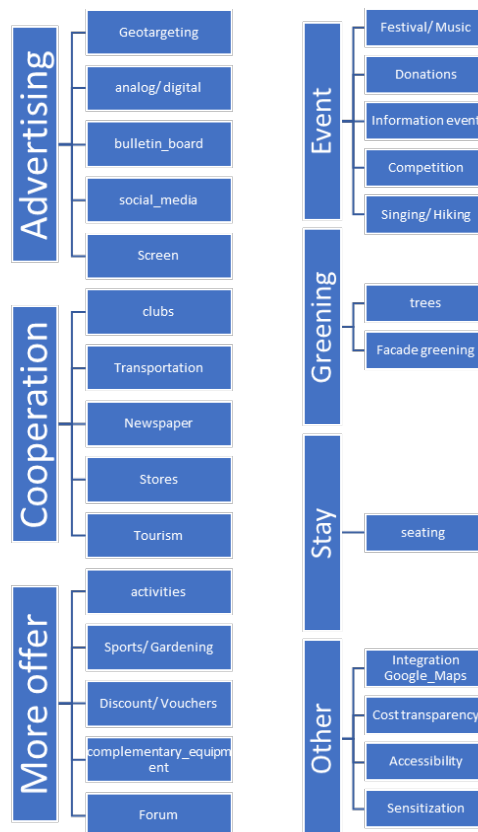


Figure 17: Categories and titles of measures to better communicate mobility hubs.

## 6.2. Lessons learned from Brussels / Anderlecht Living Lab

The co-design game used in Brussels / Anderlecht Living Lab was assessed on the base of participant observations done by researchers who were not facilitating the game, as well as direct evaluation of the participants (n=19).

In Brussels / Anderlecht Living Lab, the co-design game was used in three co-creation workshops to imagine a future mobility hub at a specific location (Place du Conseil/Raadsplein). It consisted of cards that portrayed various elements from the physical and digital dimensions of a hub, such as transport modes, infrastructure,

and services. This allowed participants to imagine how the mobility hub could look like and how they could use it, as well as to start reflecting on what elements were important for them. These elements were concrete, and although mostly known by participants, during the first stage of the game, they were explained with the support of pictures.

### 6.2.1. The game facilitates learning and engaging by playing

Through the game, participants acquired new knowledge. It was observed that the game enhanced the engagement of participants, as well as the interaction and discussion among them. The game also gave space to negotiation and conflict, enabling the emergence of opposing views and competing interests. Although the game increased the perceived empathy among participants, certain disagreements remained unresolved. Throughout the game, participants seemed to be increasingly enthusiastic, interactive, and engaged with the activity.

### 6.2.2. The game is entertaining, simple, and easy to understand

The participants (n=19) assessed the co-design game, indicating that it was entertaining and simple and that the game mechanics were easy to understand. They indicated that the activity was very interactive and they felt very engaged with the game. The support of the facilitator and the materials provided were considered very useful. When looking specifically at residents and public officials, the results of the assessment remain unchanged.

### 6.2.3. The game helps equalize participation by mitigating power imbalances caused by participants' prior knowledge, education, and language literacy

It can be concluded that the co-design game used in Brussels / Anderlecht Living Lab helped to reflect and co-create mobility hubs with different stakeholder groups and with several participants belonging to vulnerable groups. The game enabled getting everyone on board to a similar extent, partially overcoming power imbalances related to the previous knowledge of participants, level of education, and literacy of the local language. It can be stated that such a game would contribute to the co-creation of inclusive mobility hubs and, to some extent, make mobility hubs a game changer. However, it is important to acknowledge the central role of the facilitator as the output will highly vary depending on this.

## 6.3. Lessons learned from Rotterdam / The Hague Living Lab

The co-design game in the Rotterdam / The Hague Living Lab has been played on seven separate occasions. An overview of these games can be found in [Deliverable 4.4](#). A total of 43 participants tested and played the game: a combination of actual residents of the Living Lab location Hobbemapelein and policymakers or researchers working on the project, who played using personas. During the seven times playing the game, the most popular hub design elements were trees, café, wayfinding, parking for two-wheelers, and park elements.

The upcoming points will focus on choosing valuable lessons learned from the game applications within the Rotterdam / The Hague Living Lab for potential future use.

### 6.3.1. Getting vulnerable-to-exclusion citizens to participate is not straightforward

Encouraging residents to participate in a game session (15-30 minutes) during a walk-in, participatory event posed some challenges. Residents, in particular in neighborhoods with a high share of vulnerable-to-exclusion population groups, are not always willing to participate, as they do not immediately see the direct benefit for them. Interestingly, however, in the co-design game played in the Hague, there was not a large difference between the elements chosen by the actual residents and the policymakers using personas.

### 6.3.2. Most debated elements were related to shared vehicles and cars

The SmartHubs co-design game can be a helpful tool to facilitate a discussion on debated elements, highlighting the perspectives of different residents on, in this case, shared two-wheelers, shared cars, taxi stands, and car parking. The co-design game can help to document the pros and cons of the residents, which can be used as input for the municipality.

### 6.3.3. The size of elements does not correspond to the real-world situation

With the current size of the co-design game board and elements, participants placed a wide selection of the elements onto the board. In a real-world situation, there would be more discussion and more scarcity of space, and thus more difficult decision-making than during the co-design game. Increasing the size of elements could improve the discussion on space trade-offs.

## 6.4. Lessons learned from Munich Living Lab

The co-design game “Smart Hubs Card Game” is a tool for identifying the needs and wishes of potential users and also has the advantage of revealing the needs of vulnerable users in Munich. Players could discuss or negotiate some elements for the hub, which helped to prioritize the most important elements. In addition, playing the different vulnerable-to-exclusion personas helped to create awareness for this population and also to prioritize inclusive elements.

The following lessons learned are based on playing the game 5 times (1 resident, 3 students, and 1 person passing by): The most frequently selected elements were infrastructure for cycling, e-scooters, and electric vehicles, and additional elements beyond mobility, such as kiosks and urban gardening.

### 6.4.1. The game increases the acceptance and knowledge of mobility hubs

The game has the potential to create engagement and acceptance for mobility hubs. People understand why these hubs are needed, and if the main elements are chosen in a way that citizens prefer, implementation could be easier. As the game was rated as “cool and fun”, it can also help to communicate and spread the word about what mobility hubs are and why we need them in our cities.

### 6.4.2. The game creates awareness

After simulating the game in the role of a vulnerable-to-exclusion person, the player has developed empathy for the elements that vulnerable-to-exclusion users may experience and accepted that the player’s main desires may not be a priority. For example, younger people usually tend to choose WiFi as an element of nodes. However, after playing as a vulnerable-to-exclusion person, this element is usually no longer discussed.

### 6.4.3. The cost of the game is low

The game can be played virtually or with printed cards. The cost generally can be virtually zero.

### 6.4.4. The results of the game create misleading expectations among players

The idea of the game is that the decision-makers know people’s needs. However, people may think that the chosen design is the one that should be built, which may or may not be true.

### 6.4.5. The duration of the game can be challenging

The game takes about an hour. The game is more suited to playing indoors with a large crowd. If the game is played outside, the game master has to be especially careful with weather conditions.

#### 6.4.6. The game is not a substitute for assessment by vulnerable-to-exclusion persons

It should be emphasized that this game is not a substitute for vulnerable-to-exclusion involvement in the hub planning process.

## 7. ACKNOWLEDGMENTS

The support of SmartHubs project partners, especially of our four SmartHubs Living Labs, is gratefully acknowledged.

## 8. REFERENCES

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>

## 9. ANNEX: AR DESIGN GAME MANUAL



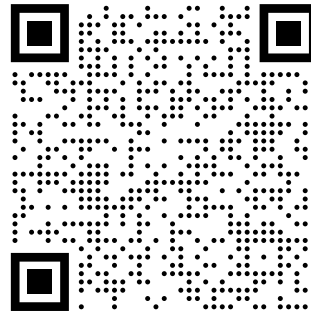
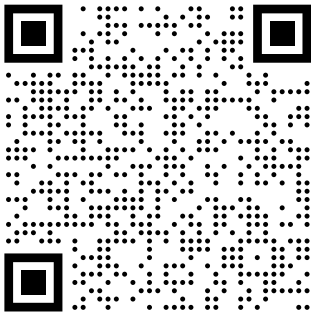
### **Multiplayer Augmented Reality (AR) Design Game**

**4-8 players + 1 game master**

**Duration:** 15-30 minutes

**Materials:** gameboard, element cards, AR token cards, SmartHubs Design Game MP App

**Multiplayer AR app available on Apple App Store and Google Play Store:**





## Introduction

The Research Objective of the game is described, and preconditions are explained.

We are researchers from Uni Twente researching Mobility Hubs in the European SmartHubs Project. We support the Municipality of The Hague with our research into the layout of Hobbemaplein. We will share our research results with the municipality.

The research aim of the game is to discover what different groups of people would like to have on the square. We want to learn which elements of a hub match the wishes of residents, entrepreneurs, and visitors to the square.

The game lasts about 15 minutes. One of the facilitators will document what is happening on the game board and take pictures in between. Please tell the facilitators if players do not want to be in the photo.

## Setup (done by the game master)



(1) Place the gameboard on the table and arrange the AR tokens (score, action cards) around the board so the player can quickly scan them with their smartphones. (2) Place the element cards at the game master's place. Make sure that codes are hidden (the downside of the card) to prevent accidental scans. (3) Open the *SmartHubs Design Game MP* App and set up a new game by tapping on the "Game Master" button. Remember the Game ID, enter a location, and tap the "Create Game" button. (4) Make sure all players have successfully downloaded the *SmartHubs Design Game MP* App. Players



can now open the app and join the game via the "Play Game" button. Each player needs to enter the number of the current game, which the game master tells them. The following players enter the game by tapping, and their character card and personal goal card are presented on the screen.

## Rules and Goal

It is a cooperative game – players must try to score as many points as possible as a group. The group with the highest score at the end of the day takes the victory. Next to it, everyone has a personal goal and must try to reach the personal goal at the end of the game. The personal goal is displayed in the app and can be accessed via the card button on the bottom left of the screen.

Players take turns. They perform two steps: (1) They may choose an element and place the token on the board. They explain why they choose the element. The game master hands out element cards. The player who places the element must flip the card, scan the code with the app to assign the points, and then place the card on the board. Other players can now scan the code and see the AR element in their app displayed in the active player's color. (2) The Player draws an action card and performs the action. (This concerns different types of actions, e.g., an extra element may be placed or an element may be removed that another player has placed.) Action cards can be drawn via the virtual card deck in the app. Players scan the token for action cards. By tapping on the virtual card deck, an action card is presented. Some actions require negotiation.

The game ends when the board is full. Then the personal goals are checked.

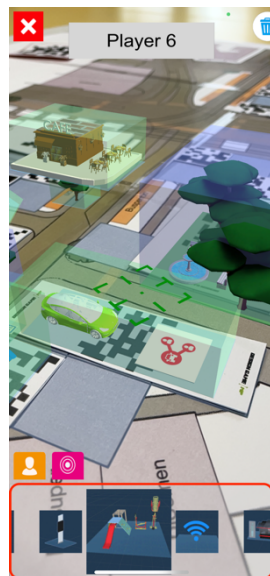
## Playing

The Player who picked Player 1 in the app starts, followed by Player 2, Player 3, etc. The Player number is displayed on the top of the screen. (Option: The player next to the game master starts, and other players follow clockwise.)

The active player performs two actions: (1) Decide which element needs to be placed on the board, ask the game master for the element token, flip the element token, and scan the code with the app by pointing the camera towards the code. (Element tokens need to be scanned by the active player first.

Otherwise, the points for the element will be assigned to the wrong player.) Then the element token is placed on the gameboard. Now all other players can scan the element token and see the virtual element in the current player's color. Element tokens can be moved and rotated; the virtual element will react to this. (2) The active player draws a virtual action card by scanning the action card token and tapping on the virtual card deck. The token can be moved and rotated for better readability. The player performs the action suggested on the card. The game master helps, if necessary, with facilitating a negotiation or a vote.

After the action is performed, the next player gets active by placing an element token and drawing an *action card*. Players can use the "private element placing mode" by selecting elements from the bottom line of the app screen and placing them by tapping on the screen. Other players cannot see these elements. Therefore, this functionality can be used for planning activities without showing it to other players. A privately placed element can be aligned and rotated on the screen. It can be deleted by tapping on it and pressing the delete button.



The game ends when the board is full. The players and the game master check if personal goals are reached. The player or team with the highest score takes the victory.

### Point counting

The points are counted automatically and saved on a server application. Each time the active player scans an element token, the points for this token are added to the player's score. The current stats can be displayed by scanning the code on the points token.

### Removing elements (game master)

Some actions or moves require that element tokens are removed. This has to be done by the game master. The game master takes the element token, scans the code, and presses the "delete" button. Points are subtracted for the player who placed the card.

### Feedback round

After the game is finished, players are asked how they liked the game. Are they happy with the design? What would they change?

The players are asked to leave their contact details if they want to win the gift voucher and/or they are interested in participating in another research activity (e.g., a survey).

### Documentation (game master)

A server app keeps the game's date, location, and score. Additionally, the game master can take a screenshot by pressing the "screenshot" button in the app. These pictures are uploaded to the server automatically. Screenshots should be taken after specific, relevant actions and moves, as well as at the end of the game, to document the final state.

### Downloading game data

The game data (date, location, points, and screenshots) can be downloaded from the server application. The server can be accessed via the following URL:

```

https://smarthubs.media.tuwien.ac.at/index
Username: game_master
Password: accessgames1040

```

SmartHubs Design Game Log Out

Available Games: 1 Download Images (.zip)

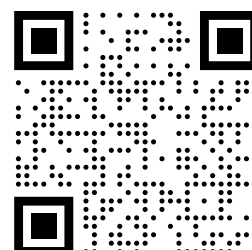
game number	number of players	location	closed	player number	claimed	points	goal card	object ID	object points
1	8		False	1	True	3	None	1	3
1	8		False	2	False	0	None		
1	8		False	3	False	0	None		
1	8		False	4	False	0	None		
1	8		False	5	False	0	None		
1	8		False	6	False	0	None		
1	8		False	7	False	0	None		

Image Table

game number | game images

Reset Database

Once logged in the game data can be downloaded as ZIP file for each game.



## Troubleshooting

If a player drops out of the current game (closes the app) the player can rejoin by using a different player number. Points need to be added manually by the game master in this case.

If a virtual element is out of place, rescanning the element can help. If not, the player can use the “clear scene” button on the top right to remove all virtual elements. Then the players need to scan the tokens again.

## Mobile App recommendations & troubleshooting:

General recommendations:

- It is recommended to use the iOS (Apple) version of the app. Due to the great variety of Android devices, it might not work properly.
- Character cards and personal goal cards should be also available as analogue versions (printed) and handed out to players. Players can use these cards in case they drop out of the app.
- Disable the screen lock on the phone. (iPhone settings - Display and Brightness - Auto-Lock = Never)
- Scan codes from the top. Be patient, it might take a moment.
- Count points manually. Automatic point counting of the app is not correct if a player drops out and rejoins.
- Players can rejoin the game without choosing a player number. Click “next” twice and then “start game”. Scanning elements and exploring the scene with AR is still possible, but points are not assigned to the player.

Workaround (This procedure can be just for exploring the AR scene):

- Register to game nr. 14.
- Do not choose a player number. Just hit the “next” button.
- Hit “next” again. The character card is blank (white image) and needs to be handed out manually as a printed card.

- Hit “Start game”. The personal goal card is blank (white image) and needs to be handed out manually as a printed card.
- No player number is assigned and counting points does not work automatically. Points need to be counted manually by the game master or an assistant.
- Placing private objects does not work.
- Player data is not available on the Server, since game nr. 14 is never finished (always active).

Alternative Workaround:

- Use the gamemaster mode for the demo and hand one smartphone around to let players explore the AR scene.

## Contact



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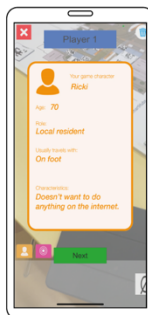
## App Elements and Screens

### Quit/Exit Game

Quitting or exiting the current game. For rejoining the game another player number needs to be selected.

### Character Card

Displays the character card.



### Private Elements

Selection of private elements that can be placed virtually by tapping the screen (to token needed). These elements can only be seen by the player (not by others). Can be used for pre-planning.

### Player Identification

Player number and colour.

### Clear Screen

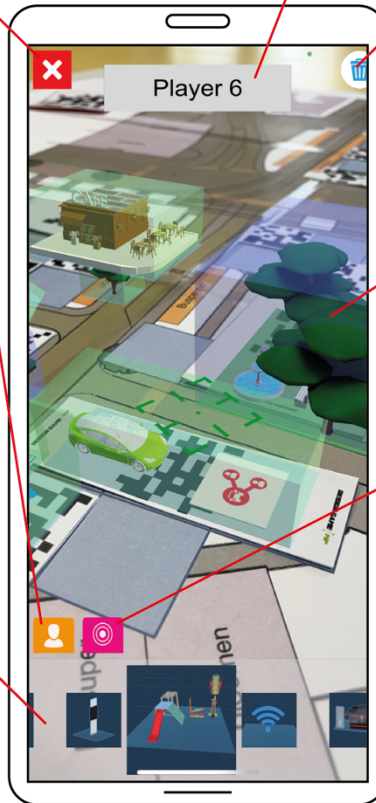
All virtual elements are removed from the screen (without impact on points). Elements can be added again by scanning the codes on the tokens.

### Virtual Element

Virtual elements (e.g. a tree) is displayed after scanning the code on the token placed on the gameboard.

### Personal Goal Card

Displays the personal goal card.



## Gaming Tokens



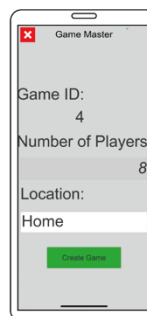
### Action Cards

A deck of action cards is displayed by scanning the code on the token. Cards are changed by tapping on the deck.



### Score

The score of each player is displayed as well as the total score after scanning the code on the token.



### Setup

For setting up the game the game master enters a location, hits create game and tells all players the Game ID.

## Game Master Screens



### Master View

The game master can take screenshots of the scene by hitting the button. Through tapping „Finish Game“ the master confirms the end of the game.



### Deleting Elements

By tapping on an element the game is able to delete elements. Points are reduced for the respective player.