

SYNCHRONICITY



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Executive Summary

SynchroniCity project targets the development of IoT enabled applications and services to help both cities and businesses developing shared digital services to improve the quality of life for citizens.

According to the Description of Action, Work Package 4 (WP4) copes with the validation in terms of architecture, services, user acceptance, market and replication. The key goal of this work package is to carry out the holistic validation of the different approaches, methodologies, designs and specifications mainly made in WP1, WP2 and WP3. Hence, the proposed validation goes much beyond a purely technical approach, addressing qualitative issues such as the assessment in terms of the stakeholder engagement methodology or the ability for common data model adoptions. The validation methodology is established based on the experience gathered from the different reference zones and Open Call pilots when analysing the user and stakeholder roles as well, the co-creation component in the corresponding ecosystems and the market context for each solution. WP4 Task 4.3 consists in providing and evaluating the results from the implementation of a set of tools and methods that support pilots developed in the scope of SynchroniCity to validate users, stakeholders and market. Ultimately, this work contributes to:

- Verify that the approaches followed in terms of stakeholder engagement and ecosystem consolidation fulfil the requirements for the agile replication in other European zones;*
- Validate the usability and user experience of the developed tools, components and services from the perspective of the citizen, platform manager and other stakeholders.*

The results derived from applying the WP4 Task 4.3 methodology, a citizen-centered design process, and co-creative tools shape the core of this document. The deployment of this methodology was intended to support SynchroniCity and Open Call pilot teams build a holistic understanding of users' behaviour and market context. As expected, there are different levels in terms of pilot solutions user, stakeholder and market adoption and engagement. The integration of a user-driven innovation strategy was identified as demanding, between teams that are mainly composed by technological profiles.

The insights and conclusions taken identified an existing gap between designing a great connected product or service and developing a technological IoT solution. Designing a product or service requires a holistic approach to user experience and cross-discipline collaboration between user research, design, technology, and business.

Abbreviations

D	Deliverable
EC	European Commission
Fig.	Figure
FTE	Full-Time Equivalent
KPI	Key Performance Indicator
POI	Point of interest
RZ	Reference Zone
SME	Small Medium Enterprise
SWOT	Strength, Weakness, Opportunities, Threats
T	Task
UA	User Accessibility
UI	User Interface
UX	User Experience
VC	Validation Categories
WP	Work Package
WT	Work Task

Contents

1	Introduction	9
2	User, stakeholder and market validation methodology	10
2.1	Framing of the methodology in the project	10
2.2	User and stakeholder engagement	12
2.3	Closer to the stakeholders and to the market	13
2.4	User, stakeholder and market validation methodology tasks	14
	A. Identification of a need and selection of the potential solution	15
	B. Training Sessions	16
	C. User, Stakeholder and Market Validation Toolkit	19
3	Deployment of the validation methodology per RZ	23
3.1	Porto's Reference Zone methodology implementation and validation	26
3.2	Santander's Reference Zone methodology implementation and validation	33
3.3	Eindhoven's Reference Zone methodology implementation and validation	37
3.4	Helsinki's Reference Zone methodology implementation and validation	41
3.5	Milan's Reference Zone methodology implementation and validation	43
4	Replicability	46
4.1	User, Stakeholder and Market Validation Methodology adoption	47
4.2	Citizen as the main beneficiary	49
4.3	Usability as a feature	53
4.4	Data as added value or the main barrier	54
4.5	Business Model Sustainability	56
4.6	Future connection to cities and SynchroniCity	58
5	User, stakeholder and market validation methodology: Final proposal	60
6	Conclusions and lessons learned	62
	ANNEX I	64
	ANNEX II	74
	REFERENCES	75

List of Figures

Figure 1 SynchroniCity holistic co-creation and validation approach.	10
Figure 2 Iteration process of the internal (RZ) Pilots	11
Figure 3 The Customer Development Model ¹	13
Figure 4 Adapted from IDEO Design Thinking venn diagram	14
Figure 5 User, stakeholder and market validation tasks as part of the co-creation process.	15
Figure 6 User and stakeholder validation workshop, FIWARE Global Summit 2018 Porto.	17
Figure 7 User, Stakeholder and Market Validation Toolkits presentation and clarification sessions SynchroniCity London Bootcamp.	17
Figure 8 User, stakeholder and market validation process - Toolkit.	19
Figure 9 User, stakeholder and market validation Toolkit Part I & II.	20
Figure 10 User, stakeholder and market validation process for internal pilots of SynchroniCity (high resolution image here).	21
Figure 11 User, stakeholder and market validation process for Open Call pilots of SynchroniCity (high resolution image here).	22
Figure 12 Percentage of Toolkit tasks' accomplishment for internal pilots.	25
Figure 13 Results from Porto's citizen centered validation process.	27
Figure 14 Workshops with citizens, municipality teams and SMEs in Porto.	28
Figure 15 Porto Multimodal Assistant application (mobile version).	28
Figure 16 Porto Multimodal Assistant application (desktop version).	28
Figure 17 User account history and recent searches screen of the Porto Multimodal Assistant application (mobile version and desktop version).	29
Figure 18 Proposed Business Model Canvas for Porto. Multimodal Assistant.	31
Figure 19 Alternative business model for Porto. Multimodal Assistant.	31
Figure 20 Iterations of the "Porto. Multimodal Assistant".	32
Figure 21 Context map canvas, persona profile and stakeholder map of Santander's pilots.	34
Figure 22 GUI Multimodal Transportation in Santander.	36
Figure 23 Proposed Business Model Canvas for Santander's "Park & Move".	36
Figure 24 Data side of Eindhoven's pilot: bicycle counts of three camera locations to be used for analysis.	38
Figure 25 Conclusions and insights from user interaction with Eindhoven's "Ring".	38
Figure 26 Four workshops were conducted in Eindhoven: one exploratory workshop (February 2018) and three co-creation workshops (May and June 2019).	39
Figure 27 Eindhoven's finished product: Road-Side display, showing the time to green use case for passing cyclists; AUDP – Home and Map Dashboard	40
Figure 28 Screenshots of Helsinki's Clean Air Journey Planner application.	42
Figure 29 Milan's Municipality geoportal viewer.	44

Figure 30 Stakeholders and personas for Milan's "Decision support system for bike planning".	45
Figure 31 Percentage of Toolkit tasks' accomplishment for Open Call pilots	49
Figure 32 A: Internal pilots end-users analysis; B: External pilots end-users analysis.	50
Figure 33 A: Internal pilots stakeholders' analysis; B: External pilots stakeholders' analysis.	50
Figure 34 Key factors impacting the problem, both for internal and external pilots.	51
Figure 35 Key factors impacting the problem, both for internal and external pilots.	51
Figure 36 Key factors impacting the problem, both for internal and external pilots.	52
Figure 37 Key factors impacting the problems addressed by the pilots.	53
Figure 38 Main conclusions from user testing task of User, stakeholder and market validation Toolkit Part II.	54
Figure 39 Common challenges collected in the Marker Validation Questionnaire Part II.	55
Figure 40 Main challenges accessing real time data from other stakeholders (Annex 1).	56
Figure 41 User, Stakeholder and Market Validation Toolkit (final proposal).	61
Figure 42 Validation methodology process of User, Stakeholder and Market Validation Toolkit.	62

List of Tables

Table 1 WP5 Open Calls contribution to the identification of a need and selection of the potential solution.	15
Table 2 Tasks from T4.3 User, stakeholder and market validation Toolkit, Part I & II	23
Table 3 Activities performed by each RZ for user, stakeholder and market validation	24
Table 4 Conclusions and insights from user interaction with Porto. Multimodal Assistant.	29
Table 5 Conclusions and insights from user interaction with Santander's "Park & Move".	34
Table 6 Conclusions and insights from user interaction with Santander's "Park & Move".	38
Table 7 Conclusions and insights from user interaction with Helsinki's "Clean Air Journey Planner".	41
Table 8 Conclusions and insights from user interaction with Milan's "Decision support system for bike planning".	45
Table 9 Tasks performed in the validation process of the Open Call Pilots (grey - documented; x - tasks referred to as performed but not documented)	47
Table 10 A summary of the Open Call pilots potential Business Models	57
Table 11 Evaluation of the SWOT analysis for Open Call pilots.	58
Table 12 Evaluation of the Open Call pilots SWOT analysis.	59

1 Introduction

SynchroniCity aims to deliver a single digital city market for Europe by piloting its foundations at scale in reference zones (RZ's) across 8 European cities in a first phase, and then reaching companies and new cities through an Open Call. The RZ's served as light-house initiatives to inspire others to become part of the established ecosystem and contribute to the emerging IoT-enabled city marketplace. One of the goals was to incentivise and build trust for companies and citizens to actively participate in **finding common co-created IoT solutions for cities that meet citizen needs** and to **create an environment of evidence-based solutions** that can easily be replicated in other regions. Pilots implemented in the context of the project aimed to demonstrate the benefits of a single digital city market to the participating cities, businesses and European citizens involved, linked directly to the global market.

To ensure user acceptance and optimize impact with each one of these pilots, a **continuous co-creation process was adopted that pro-actively engaged stakeholders (e.g. citizens, end-user organizations)** throughout the design and development of novel services, deployment in the reference zones and their performance and impact assessment.

Applying different tools and methods, Work Package (WP) 4 - Pilot Validation, addressed the validation of the SynchroniCity project in different dimensions, using the pilots implemented as a basis for this validation. Evolving the guidelines and the holistic validation methodology provided by *WP4 D4.1 Validation Methodology Description [1]*, *Task 4.3 User, stakeholder and market validation* focuses on the assessment of different end-users and stakeholders' interests and expectations. Also, it was designed to provide a better understanding of the potential market, to ensure the end result of the projects is a reflection of real needs and priorities, to develop accountability and trust towards the product/service solution and to motivate for a long-term commitment that can, ultimately, lead to sustainability.

D4.1 Validation Methodology proposed was adapted in the Task 4.3 context to fit the project timeline and evolving needs. The focus was set on the user, stakeholder and market validation of the internal pilot solutions (**WP3**) and the solutions deployed within the scope of the Open Call (**WP5**).

This document collects and analyses the results of this validation process, providing a general overview for each pilot that can reflect the interest and potential of SynchroniCity as an ecosystem.

2 User, stakeholder and market validation methodology

The *T4.3 User, stakeholder and market validation* methodology was designed to ensure that the product or service developed within SynchroniCity by each reference zone (RZ), meets the needs of users and stakeholders, and comprehends the market context. Also, the methodology was suggested to Open Call Pilots with the same purpose.

To secure that the validation was conducted in a consistent manner across the pilots developed under the scope of SynchroniCity, a common methodology was developed and proposed, adjusting the holistic validation methodology provided by *WP4 D4.1 Validation Methodology Description [1]*.

An iterative approach was applied throughout the SynchroniCity project and more particularly in the User, stakeholder and market validation methodology. Iteration is considered to be a systematic repetition of sequences that aims to achieve a given result. A process where different ideas and data are tested until the desired result is obtained.

By following this process, teams behind the pilots studied the context and collected feedback from users and stakeholders based on their interaction with the pilot solution. Also, these products and services were assessed considering the value-networks and governance of required commercial partners. The goal was helping solutions to be developed meeting real citizen needs and reducing risks while developing a sustainability model.

2.1 Framing of the methodology in the project

The *T4.3 User, Stakeholder and Market Validation* methodology aimed to generate insights on the pilot solutions in an active and participatory way. This methodology was framed in a wider co-creation process, developed along with the project, using conclusions and results from WP1, WP3 and WP5.

The following timeline shows in which work packages and corresponding tasks the citizen-centered model and validation methodology were considered or applied throughout the project with the main objective of co-creating, iterating and validating the pilot solutions for each internal and external pilots.

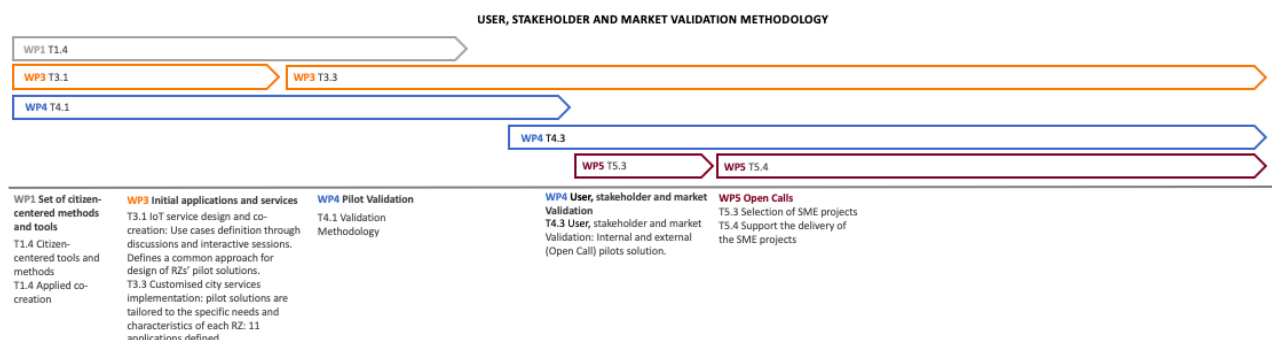


Figure 1 SynchroniCity holistic co-creation and validation approach.

- *WP1 Tools, guidelines and support | T1.4 Multi-stakeholder, citizen-centered methodology*

Taking place in the beginning of the SynchroniCity project, this phase aimed to provide a clear picture of the needs of the RZs in terms of co-creation and guidance on the methodologies and tools to apply in order to successfully perform pilots with citizens and stakeholders, by involving

them in the whole lifecycle of service and/or product development. The objective was not to define a new methodology but to build on existing citizen-centered models and tools, successfully applied in different contexts and establish first a solid framework on co-creation approaches within the smart cities environment.

- *WP3 Base Applications and Services | T3.1 IoT service design and co-creation*

Each RZ contributed with the first uses cases where main objectives and interests for the applications (pilot solutions) were presented. Potential functionalities were designed, the type of information that should be analysed and processed was identified, as well as users and stakeholders to be targeted. A set of co-creation tools was provided in this WP as guidance to the RZs so that the teams could easily design a common use case for each theme.

At this point, we can conclude that the use case suffered **an iteration**: first use case was designed by each RZ and then iterated to a common use case by all the RZs (WP3 D3.1 – Documentation of service designs [4]).

- *WP3 Base Applications and Services | T3.3 Customised city services implementation*

Further in the project, it was identified that a common IoT platform could be developed and deployed, instead of a common use case development. In T3.3, all the RZs custom made their use cases to fit their context, user and stakeholders needs and expectations. The use cases went through a **second iteration** process (WP3 D3.5 – Customized IoT service prototypes for lead ref. zones – basic [3]).



Figure 2 Iteration process of the internal (RZ) Pilots

- *WP5 Open Calls | T5.3 Selection of SME projects*

The identification of challenges to be addressed as part of the Open Call was done in a co-creation process that involved all RZs. The selection of pilots also allows for the deployment of solutions that better fit needs in each one of the cities, as further presented.

- *WP4 Pilot Validation | T4.3 User, stakeholder and market validation*

Finally, co-creation methods with users and stakeholders were applied with WP4 Pilot Validation T4.3 User, stakeholder and market validation, in order to validate and evolve the solutions, as it will be further explained.

2.2 User and stakeholder engagement

The user and stakeholder validation require an understanding of the **surrounding ecosystem** and not just considering the product specifications and technologies. The focus shifts from the things people use, to **what/why/how they do** — their behaviours, activities, needs and

motivations. For this purpose, the user and stakeholder methodology was designed based on a user-centered approach model by cultivating an innovation mindset among all the internal stakeholders in order to obtain an innovative, effective and efficient final service/product. Because the user-centered approach, innovation practice is a collaborative process and involving people - including end-users, internal and external stakeholders - with different backgrounds to make the process inclusive and valuable. Planning innovation relies on the understanding of effective and compatible design methods, allowing the stakeholders to practice design innovation collaboratively, reliably and repeatedly.

“Co-creation is at the core of the SynchroniCity proposal and ventilated in all WPs: from engaging with citizens for problem/challenges definition to the pilot validation and including the open call. “

“For European citizens, the resulting environment will create a richer choice of affordable citizen-centric services that meet their needs and expectations through increased market competition and co-creation opportunities.”

SynchroniCity project

The validation process proposes to collect relevant information about the product, service and system vision in a **prospective way**, prior to process implementation, and in a **retrospective way** when the product, service, and system have been operating for some time. A list of potential validation points was co-created by the SynchroniCity consortium partners to be considered during the validation process. The following points are the design criteria considered during the user and stakeholder validation process:

- **User and stakeholder needs and requirements:**
 - Adaptability
 - Usability
 - User experience
 - Value co-creation
- **User and stakeholder engagement:**
 - Empathy
 - Interaction quality: trust and cooperation
 - Co-creation
 - Adoptability

2.3 Closer to the stakeholders and to the market

Proper market validation is highly dependable on the user and stakeholder validation. Only with a deep understanding of the potential users, customers and partners, it is possible to evolve towards the development of a competitive solution that addresses a real need, causing impact and guaranteeing willingness to invest.

Users, stakeholders and market validation methodology to be applied by pilots was developed considering the constitution of teams in the pilots, the need to adjust pilot planning along the project and feasibility until the end of the project.

This approach is centered in Steve Blank's "Customer Development"¹, inspired by Lean Startup², and making a special use of the Business Model Canvas³.

Innovative projects have an untested hypothesis in what concerns their users and customers. Steve Blank suggests the implementation of a set of tests, based on the scientific method. The process must be iterative, allowing to validate assumptions and to develop products or services that solve real problems and have a sustainability model that's scalable.

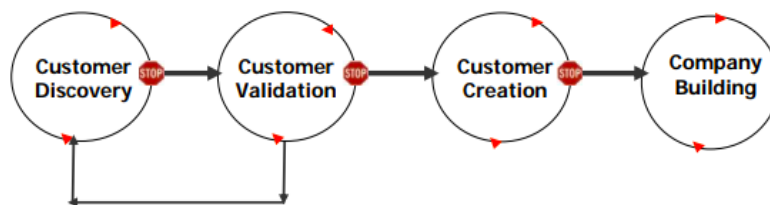


Figure 3 The Customer Development Model¹

First, it's important to understand if the challenge or problem being addressed is actually worth the investment of developing a solution. During the **customer discovery phase**, it is expected to find a **problem-solution fit**, meaning that the solution must actually solve the problem in the best way. After the customer validation phase, **problem-market fit** must be addressed, guaranteeing that there is a market and a sustainability model behind the solution.

As the process of customer development is implemented, hypotheses are turned into facts. Insights are collected and product, service and business model must be adjusted with iterations. This process must be continuous to increase the odds of success.

By adopting and implementing the Methodology described in this document, the teams developing solutions based on SynchroniCity are expected to achieve problem-solution fit, being closer to product-market fit.

¹ Blank, S. G. (2007). *The four steps to the epiphany: Successful strategies for products that win*. California: S.G. Blank

² Ries, E. (2011). *The Lean Startup*. USA. Crown Publishing Group

³ Osterwalder, A.; Pigneur, Y. (2013). *Business Model Generation*. Hoboken, NJ: Wiley

2.4 User, stakeholder and market validation methodology tasks

The User, Stakeholder and Market validation take place along the project, following the design and implementation of the SynchroniCity-based solutions.

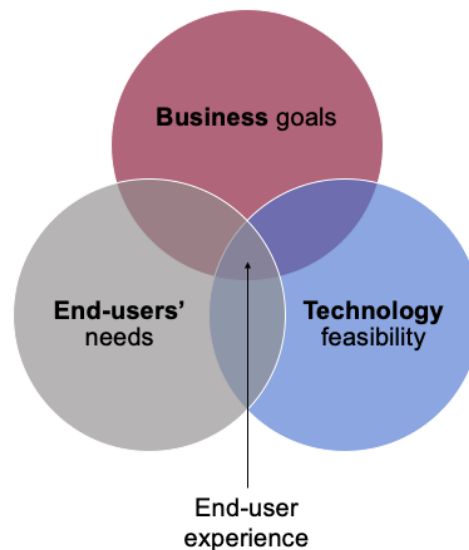


Figure 4 Adapted from IDEO Design Thinking Venn diagram⁴

To ensure user acceptance to the pilot solution, continuous co-creation processes and user-centric methodologies should be adopted that pro-actively engages stakeholders.

- **Citizens involvement and engagement:**
 - How will the pilot solutions impact citizens behaviour and their quality of life?
 - Assessment of the citizen value and acceptability;
- **Stakeholders engagement** (e.g. organizations);
- **Market fit and research.**

The methodology approach enables the RZs and SMEs to apply a solution-based approach to solve the problems or challenges detected in the beginning of the SynchroniCity project. This methodology was designed to be a useful tool to tackle complex problems that are ill-defined or unknown. This is accomplished by understanding the human needs involved, re-framing the problem in human-centred ways, creating multiple ideas in brainstorming sessions, and adopting a hands-on approach in prototyping and testing.

The *User, Stakeholder and Market Validation Toolkit* was created to help teams accomplish the proposed activities in the WP4 Task 4.3 (User, stakeholder and market validation). By following this process, pilots were expected to deliver **human-centered design solutions with a product/market fit**. These tools and methods are based on a design process that uses different methodologies, such as **design thinking, service design, and customer development**.

⁴ Venn diagram from [IDEO.org's Human-Centered Design Toolkit](https://www.ideo.org/human-centered-design-toolkit).

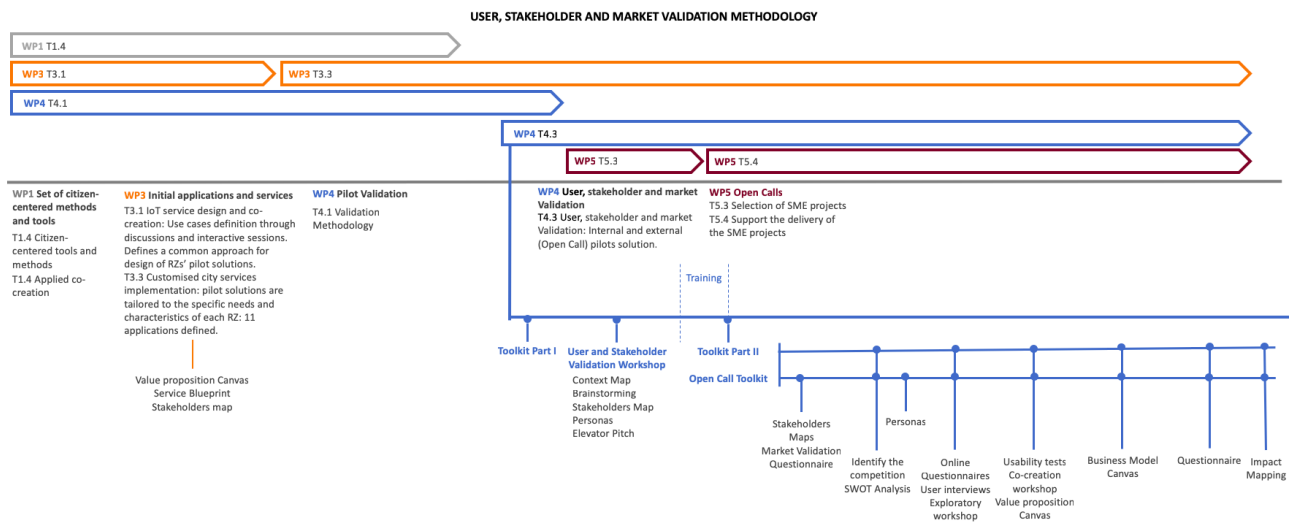


Figure 5 User, stakeholder and market validation tasks as part of the co-creation process.

The validation process can be summarized and divided into three main phases:

- A. Identification of a need and selection of the potential solution (WP3 and WP5)
- B. Training sessions (T4.3)
- C. User, Stakeholder and Market Validation Toolkit (T4.3)

The following section describes in more detail each of the main phases of the validation process.

A. Identification of a need and selection of the potential solution

The needs addressed in all the solutions developed in this context are identified and selected with the contribution of cities in a co-creation process.

With cities contributing with their specific needs, and through the application of service design procedures and methodologies, applications to be developed as internal pilots were defined, consisting of 4 different elements (WP3 D3.1 – Documentation of service designs (Specification and design of initial IoT applications [4]):

1. Description of target use case;
2. Value network and customer interactions;
3. Technological composition of system;
4. Service specification of target use case.

With this process, needs and specifications for solutions were defined.

For pilots that applied to the WP5 Open Call, the demanding selection guarantees a level of validation, as explained in the table that follows.

	Description
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Themes and Challenges definition	Themes and challenges to be tackled by applicant in the Open Call were defined together with the cities, in co-creation, in the scope of WP5. Solutions to be selected to pilot would be closer to answer to a real need.
Clinics	Clarification sessions performed by cities before application to clarify technical feasibility in the city, as well as fit to the city needs and priorities. In this process, companies were able to interview cities and understand the fit of the solution to their context.
Eligibility checks, including ethical and privacy requirements	The Open Call Evaluation Committee (OCEC) carried out an eligibility check. Compliance with basic requirements was guaranteed.
Individual Reviews	After all eligible proposals were anonymised, they were evaluated by three reviewers with complementary backgrounds (technical knowledge, local authority knowledge and commercial knowledge).
Technical feasibility	Performed by technical teams within SynchroniCity. Selection shows that cities were technically ready to receive the solutions.
Panel Review	The Open Call Evaluation Committee and the core pilot cities collected scores and feedback from each of the individual reviewers. Each city was responsible for an evaluation process of all applicants. It included not only evaluation of technical feasibility, but also an understanding of the willingness of city teams to support the Pilot implementation, as part of their priorities and city needs.
Rescoping	Rearrangement of the solution to be able to be implemented in the city on a technical and operational level, which could imply an iteration.

Table 1 WP5 Open Calls contribution to the identification of a need and selection of the potential solution.

B. Training Sessions

As part of the process of engagement with the methodology itself, as well as training to use and take the best advantage out of the tools, a group of sessions was performed.

User and stakeholder validation workshop

- Date: 9 May, 2018
- Took place within the “[FIWARE Global Summit 2018 Porto](#)” event (Porto, Portugal);
- Participants: 15 participants from the cities of Antwerp, Carouge, Helsinki, Manchester, Milan, Porto and Santander;
- Structure:
 - Validation Toolkit and activities introduction;
 - Elevator pitch of the city’s personas and stakeholders map;

- Use of Context Map canvas and brainstorming framework, in order to explore and understand different user and stakeholders contexts and identify new opportunities.



Figure 6 User and stakeholder validation workshop, FIWARE Global Summit 2018 Porto.

SynchroniCity London Bootcamp

- Date: 7 February, 2019
- Both RZs and new Pilots were introduced to the Toolkits. There were individual explanation sessions to clarify the process and motivate for its implementation.
- Participants: SMEs selected to implement Pilots as part of the Open Call (WP5) and partners representing RZs.

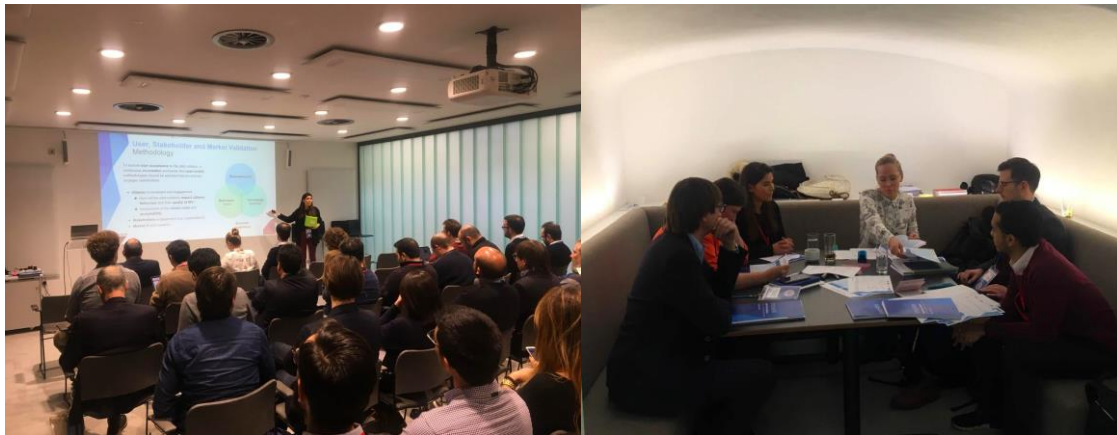


Figure 7 User, Stakeholder and Market Validation Toolkits presentation and clarification sessions SynchroniCity London Bootcamp.

Workshop: How to involve stakeholders in your pilots?

- Date: 7 February, 2019
- Took place as part of the [SynchroniCity London Bootcamp](#) (London, UK). Participants of the Bootcamp presented above had the opportunity to learn more in detail about the use of the tools and techniques proposed in the Toolkits. This session was also designed to support the definition of the execution timeline, as well as to define goals for the process;
- Participants: SMEs selected to implement Pilots as part of the Open Call (WP5);
- Event [wrap-up](#).

Other workshops and events

In order to learn and practice co-creation methodologies and end-user engagement methods to be applied throughout the user, stakeholder and market validation activities, the WP4 T4.3 team participated in the following workshops and initiatives:

- Workshops **IoT Week 2017 Geneva** (Geneva, 6-9 June 2017)
 - “End-user Engagement: Multi-stakeholder Co-creation for IoT Contexts ([Part I](#))”.
 - “End-user Engagement: Multi-stakeholder Co-creation for IoT Contexts ([Part II](#))”.
 - Workshop [wrap-up](#).
- [Co-Creation Workshop for Smart Cities](#) (Carouge, 22-25 May 2018).
 - Workshop [wrap-up](#).
- Workshops **IoT Week 2018 Bilbao** (Bilbao, 5-6 June 2018)
 - “[End-user Engagement Tools and Methods for IoT Projects](#)”.
 - “[IoT Adoption Barriers - which, why and how?](#)”.
 - Workshop [wrap-up](#).
- Workshop **Open Living Lab Days 2018** (Geneva, 22-24 August 2018)
 - “[Optimising the learning curve – implementing end-user engagement tools in IoT large-scale pilots](#)”.
 - Workshop [wrap-up](#).
- **European Week of Regions and Cities** (Brussels, 8-1 October 2018)

Moreover, the T4.3 team had the opportunity to collaborate with the [U4IoT User Engagement for Large Scale Pilots in the Internet of Things EU Project](#) by completing the user and

stakeholder validation methodology with cutting-edge end-user engagement methodologies, namely the "[Co-Creative Workshop Methodology](#)", "[End-User Engagement Toolkit](#)", "[Living Lab support](#)" and other online tools and resources.

Furthermore, the T4.3 team was supported by the City handbook to performance measurement result of the [CITYkeys project](#). The use of the performance measurement framework helped evaluate the impact of developed solution by comparing the 'before' and 'after' situations or comparing the expected impact with a reference situation.

C. User, Stakeholder and Market Validation Toolkit

The *User, Stakeholder and Market Validation Toolkit* was developed to provide guidance to engage with an open and citizen-centered approach in the development of the pilot solutions. The methodologies presented in the toolkit aimed to support the teams and create a better understanding of different co-creation and research methodologies available and why/how to adopt them. The validation methodology is divided into **4 main areas** that help understanding the challenge's situation and stakeholders involved, define and map the users and problem statement, co-create and brainstorming of ideas into tangible solutions, collect input for product or service improvements and understand their market context.

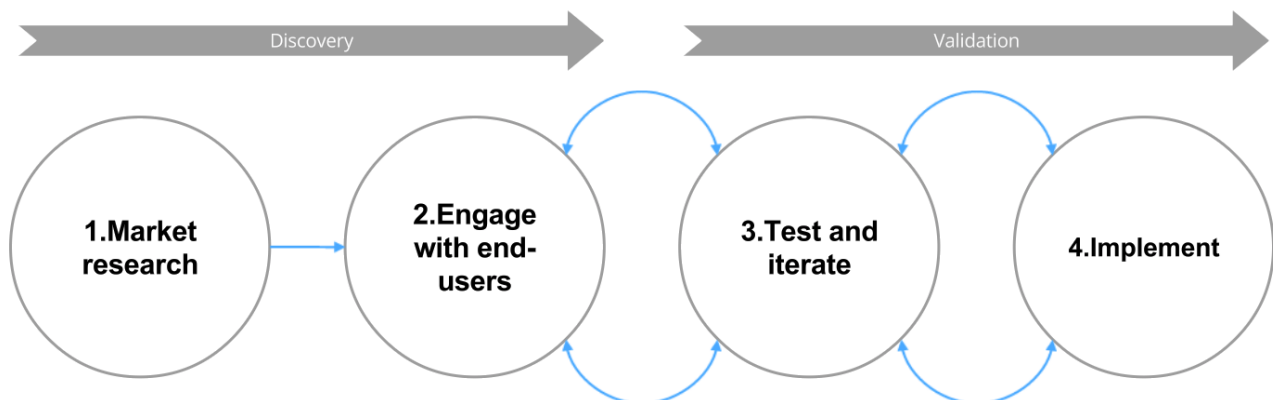


Figure 8 User, stakeholder and market validation process - Toolkit.

- **Market research:**
 - Understand the **market context** within the pilot city;
- **Engagement with end-users:**
 - **Consider the end-user:** interview them, understand them and build empathy with them;
 - Understand end-user **experiences**, and identify their **frustrations** or **unmet needs** by listening and co-creating with them;
- **Test and iteration:**
 - **Test the pilot solution** with potential end-users. Learn and **iterate** the pilot solution;
- **Implementation:**
 - Develop a **feasible and viable final pilot solution**, paired with a sustainable business model.

The Toolkit was developed as part of the validation methodology to approach the development of the SynchroniCity-based projects to the citizen and market needs.

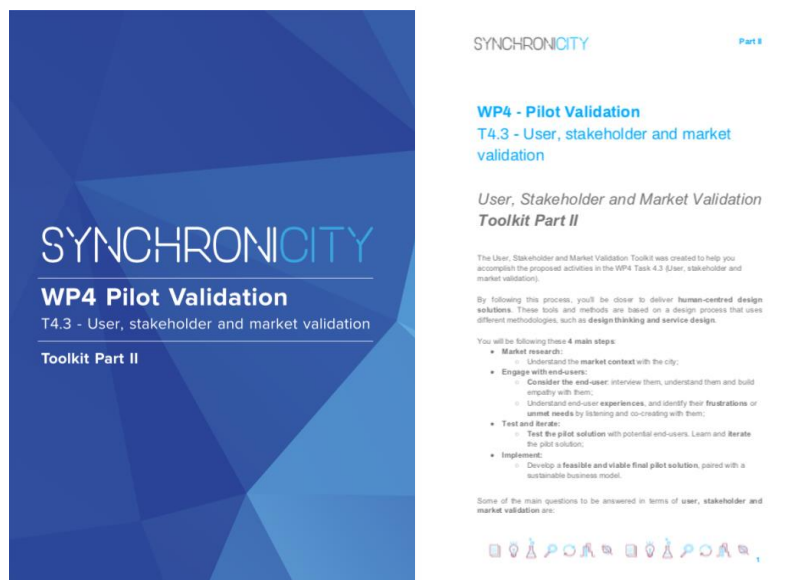


Figure 9 User, stakeholder and market validation Toolkit Part I & II.

Internal and Open Call⁵ pilots were suggested to implement a set of tasks, tools and methods with the support of a Toolkit⁶. The process suggested was based on co-creation methodologies, to support the development of products and services better related to user, stakeholder and market needs, and included:

- Build **stakeholder maps** to understand who the stakeholders are, and who are the most important people and organizations involved in the ecosystem of each city;
- Build **persona** profiles to represent groups of potential users, customers and partners that share common goals, attitudes and behaviours towards a particular service in each city;
- Understand the context, the **dimension** of the market, the **competition**, the potential interest for the new solution and the **competitive factors**, as well as the **sustainability model** behind it for the future;
- Run a series of online **questionnaires** and in-person **interviews** to potential users and customers of each service, in order to provide a quick overview of relevant pre-existing knowledge and to ensure that the service builds on existing knowledge;
- Make participant **observation** sessions in order to collect data about people, processes, and culture, and to understand what people are doing in reality;
- Organize **exploration and co-creation workshops** to evaluate and validate the end-to-end experience of the pilot solution to potential end-users as they interact with the solution;
- Build **prototypes** of the services in order to evaluate and/or communicate design ideas;
- Make **usability testing sessions** in order to understand users thoughts, not only as they occur, but also as they attempt to work through issues they encounter in the service interface;

⁵ SynchroniCity project - WP4 T4.3 User, stakeholder and market validation [Open Call Toolkit](#).

⁶ SynchroniCity project - WP4 T4.3 User, stakeholder and market validation [Toolkit Part I & II](#).

- Build a **perceptual mapping** to display the perceptions of customers or potential customers towards the pilot solution, compared to competing solutions;
- Build a **Value Proposition Canvas** to ensure that there is a fit between the service/product offer and the market demand, as well as provide answers to what are the customer values and needs;
- Build a **Business Model Canvas** to conclude on how the business will occur and describe the rationale of how an organization creates, delivers, and captures value.

The image below reflects the impact of the proposed tasks on the validation process of the **internal pilots**.

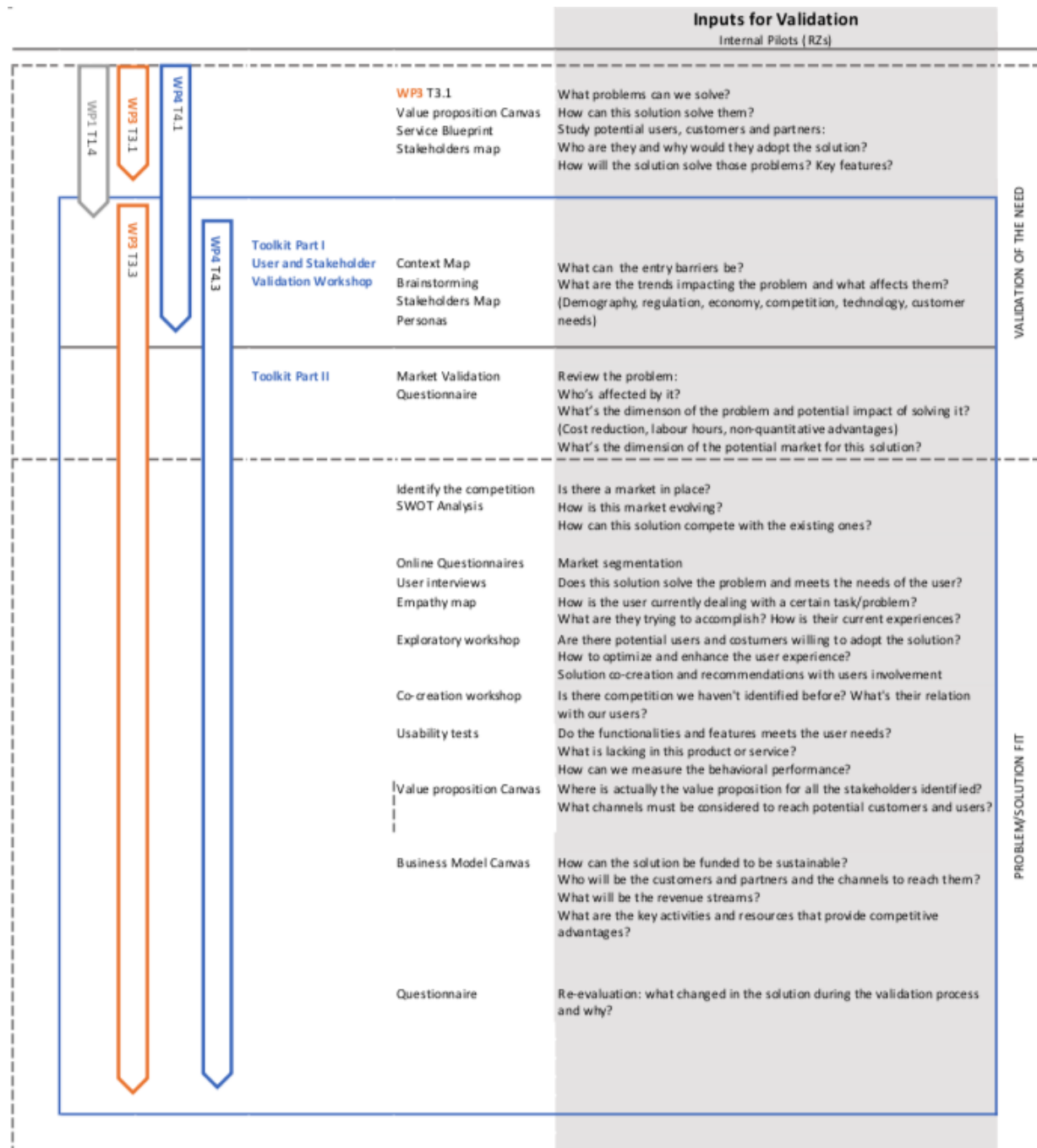


Figure 10 User, stakeholder and market validation process for internal pilots of SynchroniCity (high resolution image [here](#)).

The following image reflects the impact of the proposed tasks on the validation process for **external pilots** (Open Call).

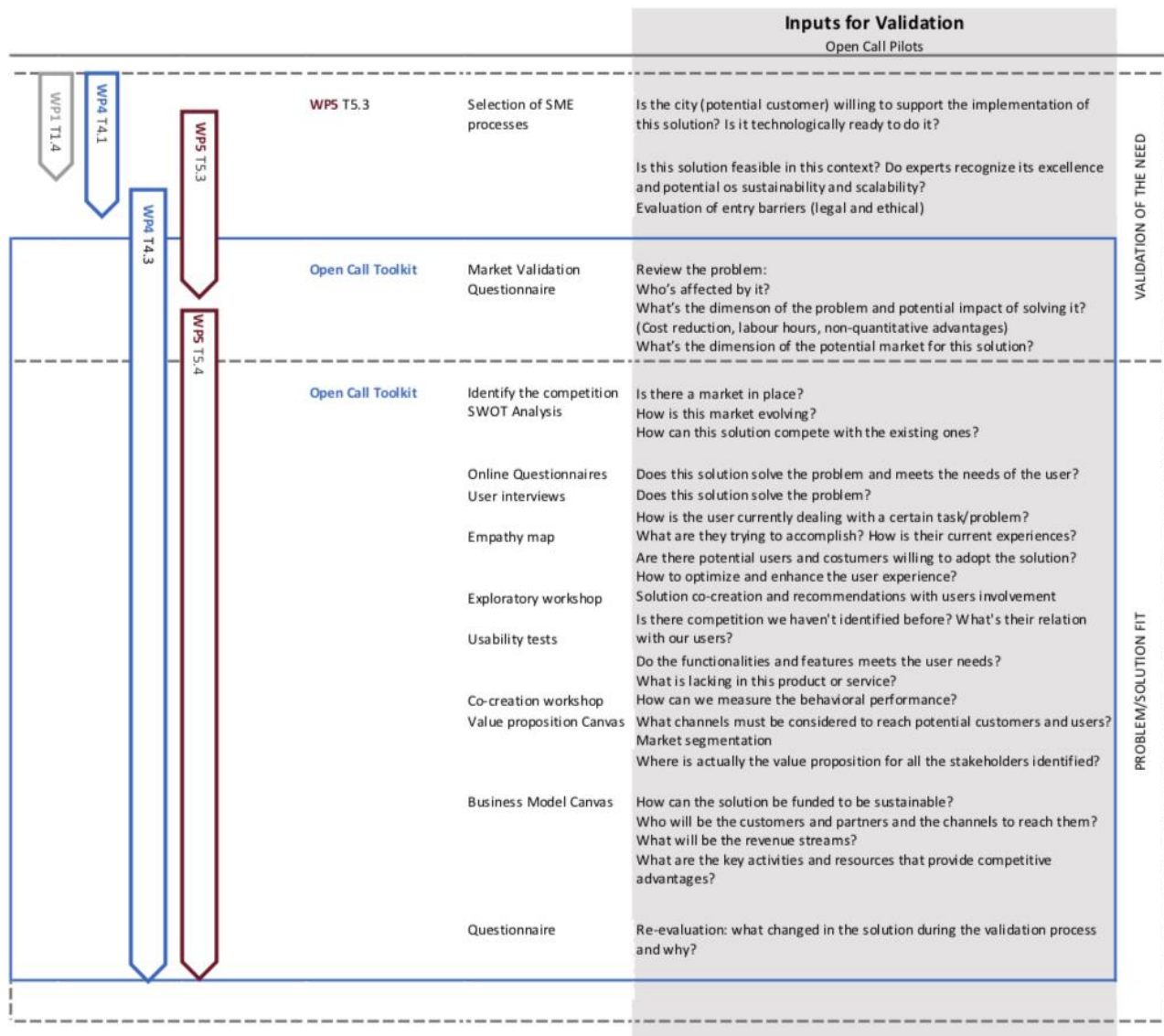


Figure 11 User, stakeholder and market validation process for Open Call pilots of SynchroniCity (high resolution image [here](#)).

The main activities related to users, stakeholder and market validation have been developed by WP3, WP4 and WP5 (in the case of the Open Call) partners. These aim at validating the solutions from an ideation phase to the deployment phase while involving end-users in co-design and co-creation processes as well as testing activities and potential sustainability depending on the goals, themes and maturity of each solution.

Both Pilots developed by the RZs (internal Pilots) and Pilots that were selected as part of the WP5 Open Call (external Open Call Pilots) were involved in this validation process.

3 Deployment of the validation methodology per RZ

The T4.3 User, stakeholder and market validation methodology was designed to be sufficiently flexible to work within different city-contexts and with applications across the themes of the project.

The Toolkit was presented to all the partners involved in WP3, and more in detail in T3.3 *Customised city services implementation*. Tools would be applied along with the development and deployment of the pilot solutions in the cities.

As a consequence of different constraints, including the SynchroniCity project delay, some of the pilot solution weren't able to completely apply the T4.3 Toolkit. Motives include lack of time and human resources, uncertainty about the methodology and design thinking tools and lack of information about end-users (*"no specific resources on this task where planned in the project proposal"*).

In order to gather enough data and information and generate deep insights on user, stakeholder and market validation, some of the tasks were mandatory to be done by all the RZs. For each task it was identified a percentage (%) that reflects the importance for the pilot solution validation process. This process aims to ensure that a co-creation and iterative process is applied and that the final product/service delivers a meaningful and valuable experience to the users and stakeholders.

The validation methodology was not possible to apply in such a wide range of project scopes and different pilots without customization and excessive workload. Using the feedback received from all the participants from applying toolkit, and considering the best market practices, mandatory success criteria were defined for all the pilots:

- The toolkit overall score had to be higher than 65%, complying with all the requisites;
- There were four mandatory tasks required on each of the different verticals that ensured a full market coverage.

According to the feedback shared by the RZs, it was decided between all the WP4 participants that the validation methodology would be applied in full in just **three of the eight RZs**, at least in one pilot solution. The RZs and the corresponding pilot solution, that applied more than 65% or in full the T4.3 activities, were the following:

- Eindhoven | Human-centric traffic management - Data-driven bicycle mobility
- Porto | Multimodal transportation - Porto Multimodal Assistant
- Santander | Multimodal transportation - Park & Move

For the remaining RZs, they were asked to deliver at least 65% of the proposed tasks in one pilot solution. This percentage is considered to be delivering enough data and insights to validate the pilot solution. The RZs and the corresponding pilot solutions that should apply 65% of the T4.3 activities were the following:

- Antwerp | Human-centric traffic management - Bicycle patterns in the city of Antwerp;
- Carouge:
 - Multimodal Transportation - Smart Parking;
 - Community Policy suite - Noise monitoring near bars;
- Helsinki | Multimodal transportation - Clean Air Journey Planner;
- Manchester | Community policy suite - Agile Governance;

- Milan:
 - Human-centric traffic management - Decision support system for cycle path planning;
 - Multimodal transportation - Multimodal-navigator for disabled people;

The table below shows all the tasks proposed in the T4.3 User, stakeholder and market validation Toolkit Part I & II and the corresponding influence to the validation process. The tasks highlighted were selected as mandatory to be completed in at least one pilot solutions for each RZ.

Phases	Process stages	Toolkit Part I & II		%
		Tasks	Subtasks	
Market research;	1. Understand the market context.	1. Market Validation Questionnaire	Market Validation Questionnaire Part I	5%
			Market Validation Questionnaire Part II	5%
		2. Competition	Identify the competition	5%
		3. SWOT analysis	SWOT analysis framework	5%
Engage with end-users;	2. Consider the end-user: interview them, understand them and build empathy with them.	4. Stakeholder Maps	Stakeholders Maps	5%
		5. User & stakeholder interviews	Online questionnaires	15%
			User Interviews	
	6. Personas	Personas	5%	
	3. Understand their experiences, and identify their frustrations or unmet needs by listening and co-creating with them.	7. Workshops	Exploratory workshop	5%
			Co-creation workshop	
Test and iterate;	4. Test the pilot solution with potential end-users.	8. Usability test	Usability test methods	20%
Implement	5. Develop a feasible and viable final solution, paired with a sustainable business model.	9. Perceptual mapping	Perceptual mapping	5%
		10. Value Proposition Canvas	Value Proposition Canvas framework	5%
		11. Business Model Canvas	Business Model Canvas framework	20%
		Total		100%

Table 2 Tasks from T4.3 User, stakeholder and market validation Toolkit, Part I & II

The tasks were classified through a perceptual mapping based on a framework⁷ for organizing design research and market tools and methods between a focus on design-led or research-led, and with an expert or participatory mindset. Four tasks of the four different phases were **mandatory while** the remaining ones were defined as not mandatory but **nice to have**.

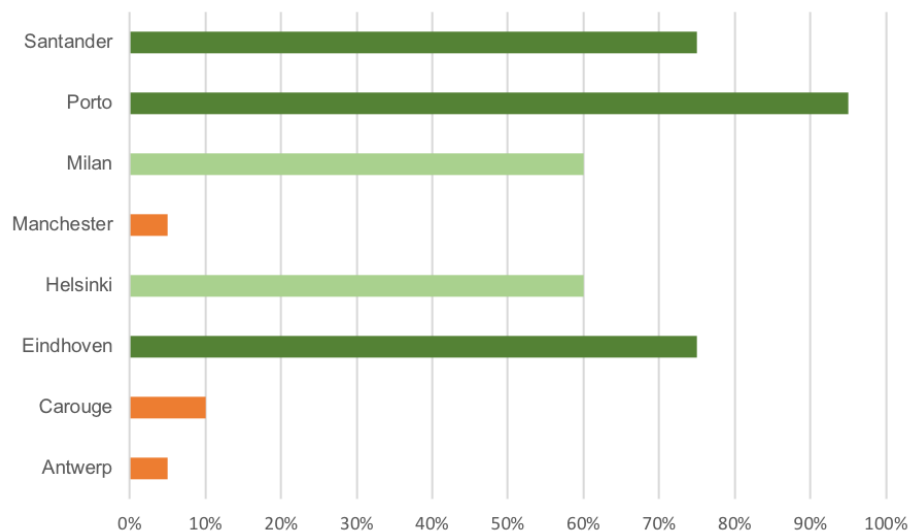
During the deployment of the tasks, the T4.3 team was responsible to monitor and review periodically the tasks results so that the methodology was adopted during the validation process (if needed). Each RZ collaborated in the user, stakeholder and market validation process by providing the required results from the proposed activities, shown in the following table.

⁷ Sanders, L. (2008). On Modeling: An evolving map of design practice and design research. *interactions*, 15(6), 13-17.

		WP1	WP3	Training	WP4 User, stakeholder and market Validation																	
					Toolkit Part I	Toolkit Part II																
						Market research					Engage with end-users				Test and iterate		Implement					
T1.4 Citizen-centered	T1.4 Applied co-creation	T3.1 IoT service design and co-creation	T3.3 Customised city services implementation	User and stakeholder validation workshop, FIWARE Summit	Other events on the subject	Synchronicity London Bootcamp	Personas	Stakeholders Map	Part I	Part II	Identify the competition	SWOT analysis framework	Online questionnaires	User Interviews	Exploratory workshop	Co-creation workshop	Usability test methods	Perceptual mapping	Value Proposition Canvas	Business Model Canvas		
Antwerp	Human-centric traffic management - Bicycle patterns in the city of Antwerp																					
Carouge	Multimodal Transportation - Smart Parking																					
	Community Policy suite - Noise mntoring near bars																					
Eindhoven	Human-centric traffic management - Data-driven bicycle mobility																					
Helsinki	Multimodal transportation-Clean Air Journey Planner																					
Manchester	Community policy suite - Agile Governance																					
Milan	Human-centric traffic management - Decision support system for cycle path planning																					
	Multimodal transportation - Multimodal-navigator for disabled people																					
Porto	Multimodal transportation - Porto Multimodal Assistant																					
	Community policy suite - Porto Open Interactive Map																					
Santander	Multimodal transportation - Park & Move																					

Table 3 Activities performed by each RZ for user, stakeholder and market validation

Reference zones tasks accomplishment results:



	The RZ exceed the percentage of minimum accomplishment tasks to be done in the validation.
	The RZ presented a reachable percentage of accomplishment tasks of the validation process.
	The RZ presented a low percentage of accomplishment tasks of the validation process.

Figure 12 Percentage of Toolkit tasks' accomplishment for internal pilots.

Considering the results collected from each RZ, the following section outlines some conclusions and findings based on the T4.3 “User, stakeholder and market validation methodology” results for the following internal Pilots that reached the tasks’ percentage of accomplishment:

- Eindhoven | Human-centric traffic management - Data-driven bicycle mobility
- Milan | Human-centric traffic management - Decision support system for cycle path planning
- Porto | Multimodal transportation - Porto Multimodal Assistant
- Santander | Multimodal transportation - Park & Move
- Helsinki | Multimodal transportation - Clean Air Journey Planner

3.1 Porto’s Reference Zone methodology implementation and validation

The city of Porto is involved in two pilot areas: Community Policy Suite (CPS) and Multimodal Transportation (MMT). The CPS pilot application is named “Porto. Open Interactive Map” and the MMT pilot application is named “Porto. Multimodal Assistant”. Within the context of the Multimodal Transportation pilot (WP3), the city of Porto employed **95% of the tasks from the T4.3** in the Multimodal Transportation - Porto Multimodal Assistant pilot solution. The process used almost all the tools and tasks proposed in the T4.3 Toolkit Part I & II. Some were performed in a different order and with a different approach.

As part of SynchroniCity, Porto identified Mobility as a priority area to be addressed. In order to develop a solution able to solve a problem felt by management teams in the city, but also by citizens, a set of validation tasks was performed. The development of the solution was iterated according to the results of the activities.

Regarding the context of the Multimodal Transportation pilot, the city of Porto considered that the application *“will be more than an ordinary route journey planner. It will be a mobility solution which will better inform citizen’s mobility choices and ease the citizen’s mobility experience from within and to the city of Porto”* (WP3 D3.7 Consolidated Pilot Deployment and Operational plan for all RZs [2]).

The pilot team completed almost all of the proposed T4.3 activities, such as:

- In-depth and guerrilla interviews with key stakeholders and citizens, to capture detailed insights and get a deep understanding of users’ experiences and expectations;
- Online questionnaires (quantitative and qualitative research);
- Development of a customer journey and service blueprint to help visualize the ‘citizen experience’ As-is and To-be;
- Stakeholder mapping to understand who the key stakeholders are, what are their value exchange and how is their relationship towards the service;
- Cultural probes to gather inspirational data about citizen's lives, values and thoughts;
- Observations to understand the usability of the current service and to have an overall view of the user experience;
- Analysis of the competition and competitive factors;
- User tests to test the user interface of the application;
- Rapid prototyping; iteration process;
- Analysis of market and mobility trends, paradigms and tendencies;
- Business model proposal.

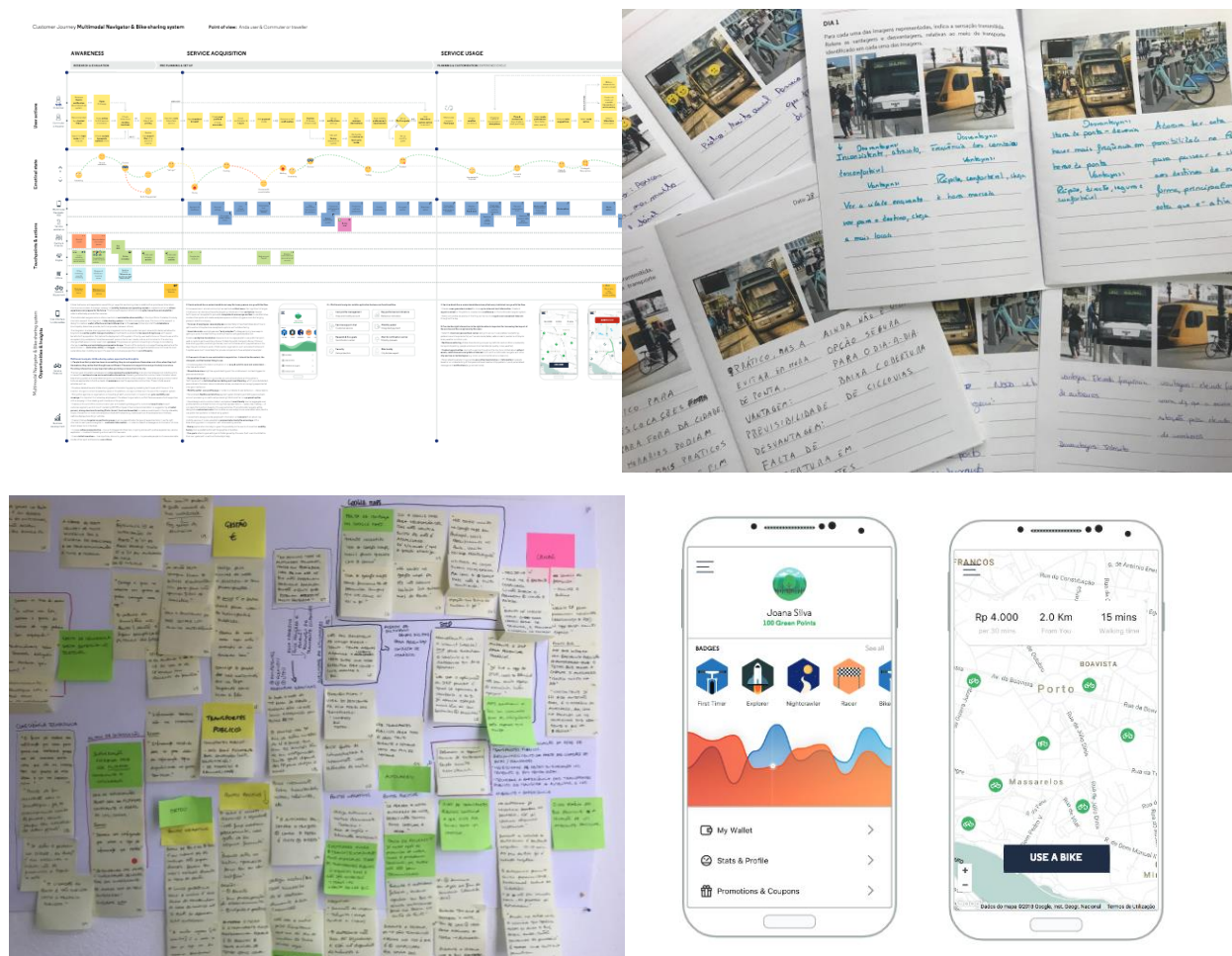


Figure 13 Results from Porto's citizen centered validation process.

The pilot team also organized workshops with several public transportation users, municipality teams and SMEs. The main objectives were to explore topics around general mobility, collect case studies and new mobility concepts in the city of Porto, pre-validate the concepts and functionalities of the Multimodal Assistant with potential end-users and convert the research and workshop results into insights, requirements and KPIs.





Figure 14 Workshops with citizens, municipality teams and SMEs in Porto.

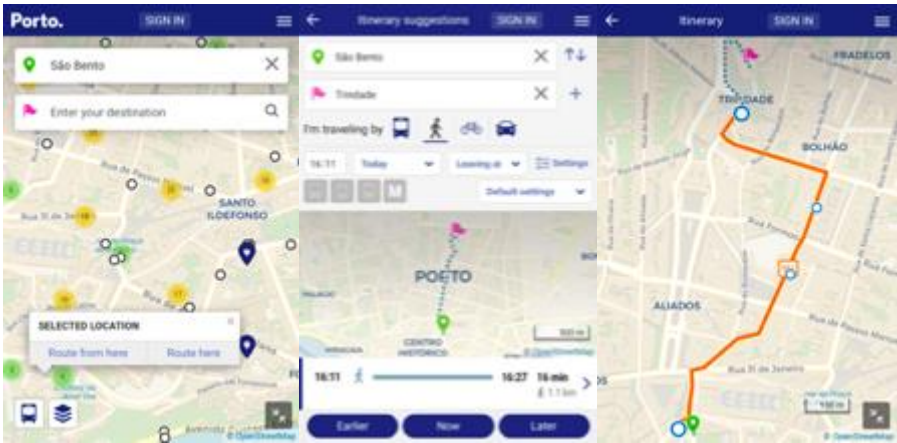


Figure 15 Porto Multimodal Assistant application (mobile version).

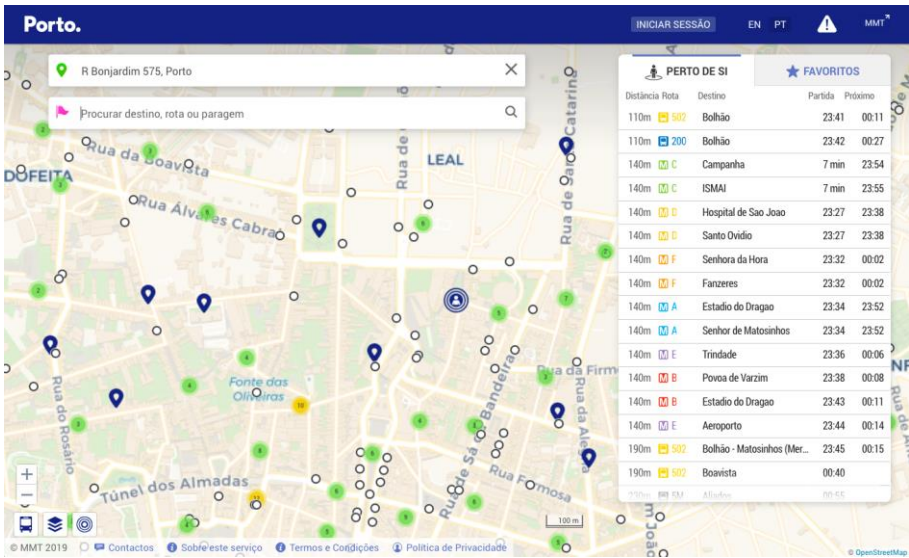


Figure 16 Porto Multimodal Assistant application (desktop version).

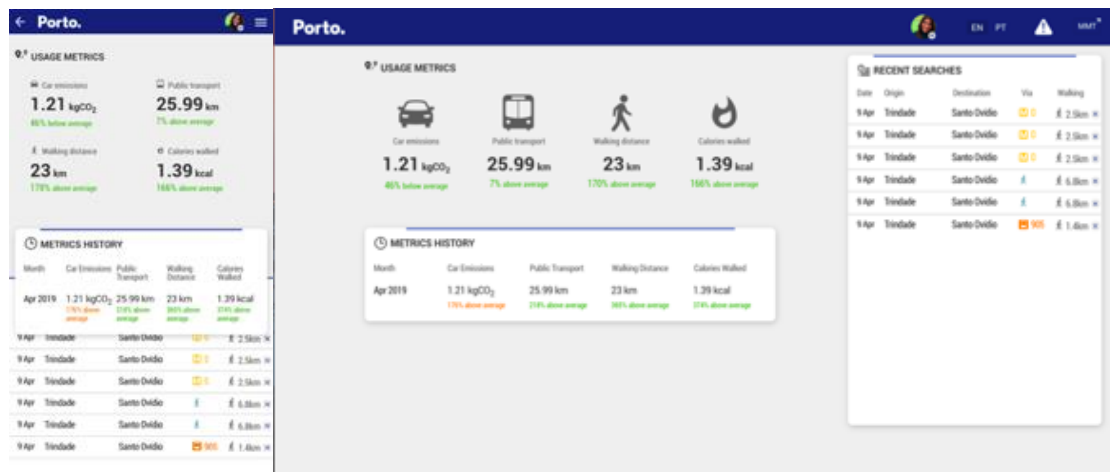


Figure 17 User account history and recent search screen of the Porto Multimodal Assistant application (mobile version and desktop version).

A minimum viable product (MVP) and an improved developed final working solution were deployed and tested with end-users.

Usability tests focused on the user experience and the results were obtained before all functionalities were implemented. For instance, **24% of the test group mentioned that they would not use the app because real-time data was not available**, which was due to the fact that it was not being provided at the time the UX tests were performed. Given the feedback received upon tests and opinions gathered from the usability test group, most of the participants (92%) **considered the application useful**. The Municipality of Porto (CMP) itself strongly believes that the “Porto. Multimodal Assistant” can be an interesting tool to **ease and encourage the use of public transportation** and other new transportation means (such as bike and scooter-sharing) in the city of Porto.

The table below details the main conclusions and insights in the activities of the T4.3, about the “Porto. Multimodal Assistant” application:

User and stakeholder	The users and stakeholders were iterated several times according to the results from co-creation activities done throughout the project. The initial application design (D3.1), identified inhabitants, commuters, travellers, city visitors and tourists as end-users. Furthermore, in the project, with the T4.3, the user's profiles have been characterized as ‘commuter expert’ and ‘sporadic’. Regarding the secondary stakeholders, the municipality still is an important stakeholder and will provide valuable mobility data to the city authorities and public transportation operators, which will enable better informed decision and policy-making in the areas of mobility, environment, urbanism and tourism.
Preferred features (functionalities to keep or add)	• Service should be so understandable, that every individual can easily use it; • The right information, in the right location, at the right time, is important to increase the effectiveness of the service; • 92% of the participants considered the platform useful but incomplete;

	• User-interface is clean: ◦ The typography (lettering, headings, titles) is clear and has legibility; ◦ It is easy to find a way around the product; ◦ Information is written in a style that suits the user; ◦ The product content is interesting to the user and it is well-suited to frequent visitors. • The Platform is useful and simple to use; • 77% trust the data because it has Porto branding; • Different alternatives of public transports from the same origin; • The suggestion of having calories displayed to incentivize walking/cycling; • 77% agree that the web app is easy to use and to get the right information.
Least attractive features (functionalities to change)	• Develop personalised mobility solutions and add flexibility to fit citizens' budget and lifestyle; • 62% consider the platform is incomplete; • 53% did not like the fact that this was not a native app (but a web app, instead); • 24% would not use it because real-time data is not available; • 54% disagreed that the information is clearly arranged and structured.
Major issues of the pilot solution (functionalities that are missing)	• Problems in finding some addresses; • Search is difficult to clean; • Too much information presented in mobile – clusters and POIs should be disabled; • Map area is very small in mobile when the filters are open; • Not a real-time information.
Suggestions for improvement	• Re-imagining urban spaces while the user waits for transport. • Technology will become further ingrained in citizens' lives and in their interactions with service providers - traffic flow management, parking lot locations, retail context, culture, mobility-as-a-service, location-based retail services and mobility wallet; • Remove the clusters because most users did not understand them; • The POIs' layer should only be visible after selecting it and not from the beginning because it represents visual noise; • Provide bicycle paths visibly when transportation by bike is selected; • Provide an option to match the best route that contains certain POIs; • Provide a greater range than only limited to the city of Porto; • 53% would like to have the warnings and impediments available; • 24% would prefer to use other apps (google maps, wase, moovit, etc.).

Table 4 Conclusions and insights from user interaction with Porto. Multimodal Assistant.

The tests performed with users also showed a lot of potential for evolution. For future improvements, a lot can be done to increase the likeliness of adoption of the app by the users, which can be split into two groups:

- Proposed features by the users involved in the tests;
- Features determined by the municipality, to improve the sustainable mobility within the city (such as including information about weather, pollution, traffic, estimations, etc.).

When evaluating competing solutions in the city, the possibility to provide reliable real-time data and including official information from the city, seemed like a potential strength and the strongest value proposition for this solution. This assumption was validated with all the interactions with the potential users, previously described.

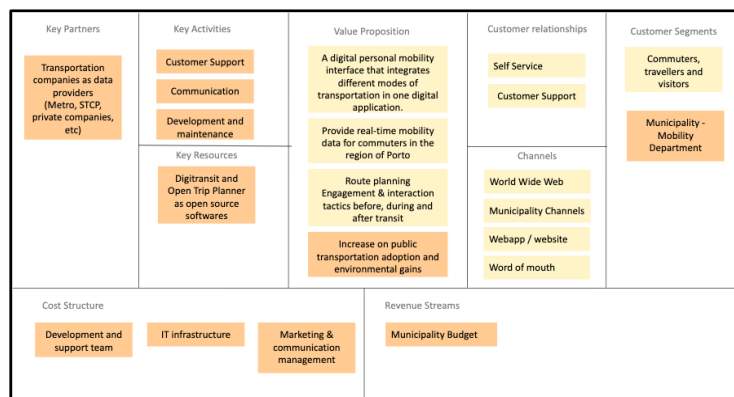


Figure 18 Proposed Business Model Canvas for Porto. Multimodal Assistant.

The process of learning about the users, the channels to reach them, their behaviour, how they deal with current solutions and how partners must be involved, led to the design of a Business Model for this solution. As in Figure 18, Porto provides a stand-alone application having the city as the client of the solution, fully funding it and having citizens using it for free, as competing solutions are for free as well. A set of interviews and conversations with stakeholders in the Municipality reinforced the interest to provide such a solution for citizens.

The feedback from Porto's technological team behind the development of the solution led to understand other potential alternative or parallel sustainability models after the end of the Pilot period (Figure 19). Conversations developed with teams such as the Tourism Department team, have demonstrated the value of including the solution in existing ones. In this case, Porto Digital would deliver a set of base components (themselves being backed by the SynchroniCity platform) to third party applications. This new perspective requires the development of a new validation process.

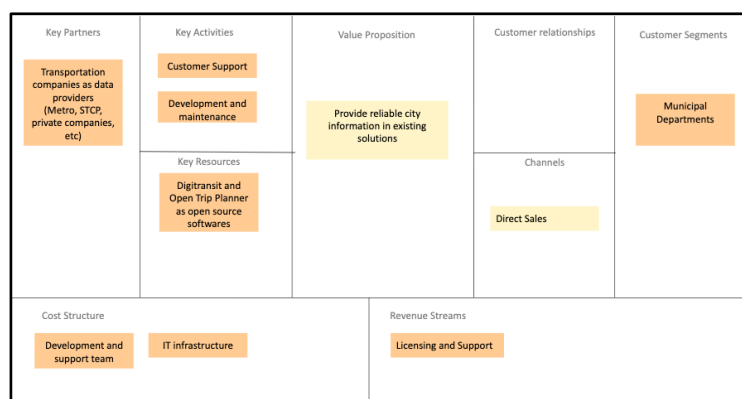


Figure 19 Alternative business model for Porto. Multimodal Assistant.

The following timeline shows the iteration process of the Multimodal Transportation pilot solution, and how it evolved during the SynchroniCity project.

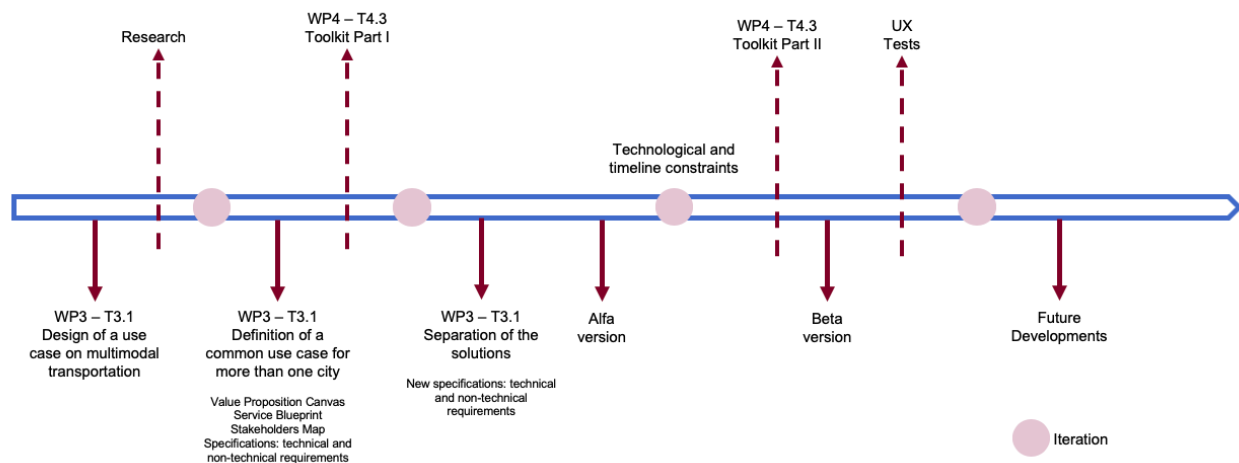


Figure 20 Iterations of the "Porto. Multimodal Assistant".

This process (Figure 20) shows that the pilot solution was iterated several times, adding and changing features and functionalities to meet the end-users and stakeholders needs, technological restrictions and business model potentialities.

The validation process resulted in the addition, changing and elimination of fourteen functionalities since the beginning of the project, but not all of these changes were implemented due to *lack of time and human resources*.

The validation methodology helped **understand the user needs and behaviour towards mobility** in the city and more particularly about the **user interface and experience of acquisition and use of the application**. These research activities have provided valuable insights and improved significantly the features and functionalities of the application to be applied in future developments, which will contribute to a solution that is closer to the user needs, thus reducing the impact of a challenge in the city. The main challenges when implementing such a methodology are related to the *lack of time and human resources*.

The city has been applying co-creation methodologies and customer development techniques in several service/product development processes, decision making process and policy making, and will continue to do so after the end of the SynchroniCity project.

3.2 Santander's Reference Zone methodology implementation and validation

Santander employed **75% of the tasks** from the T4.3 Toolkit.

The city of Santander is involved in the pilot area of Multimodal Transportation (MMT) with "Park & Move", an application which deals with multimodal transportation and looks for ways to complement it with a parking estimation. The city is implementing this solution because, according

to the team, traffic is one of the main issues identified by citizens when they access to the city center. Reducing time and traffic to access the downtown, guiding drivers to free parking lots or promoting sustainable mobility, will increase the quality of life of the citizens and revitalize the city center, besides improving environmental conditions.

It's hard to quantify the cost of the problem, but the team presents a few numbers that help dimension the opportunity for the city to invest in such a solution. Based on the number of annual journeys of the municipality bus service, the car journey statistic, and applying a ratio for movements that could be benefited, the team estimates the problem costs at least 5,000 FTE staff days per year. Applying an average cost of 250 € / FTE, the cost can be estimated at 1.250.000,00 € per year. The number of potential customers/users is approximately 80,000 per year taken as individual journeys.

Park & Move application is composed of 2 separate apps. Each application is focused on solving a different issue regarding urban mobility. The beneficiaries are citizens, commuters and casual visitors (including tourists). The information gathered and processed also benefits municipality teams responsible for urban services planning and maintenance (bus, urban infrastructures, etc.) and will ease City Council in governance.

The first App, "Smart Parking", will benefit users arriving to Santander city by car and will allow finding a parking place in an optimum way. Apart from the benefit from the user perspective in terms of economy, time and comfort, the rest of car users, citizens and also the City Council will be benefited in terms of reduction of traffic, traffic accidents, contaminants and an increasing of general life quality.

The second App, "Multimodal Navigator", will benefit people moving in the city without a private car. It will provide help in internal urban movements combining the information of all facilities (location, timetables, etc.). When compared to competing solutions, Park & Move is able to provide city information, such as parking spots and mobility premises, as well as multimodal routing options, and that is not available in other platforms. City's data is an important factor to compete in terms of value proposition.

Apart from the direct benefit to users (both inhabitants and visitors), it is expected to provide benefits to local businesses. Also, valuable information to the City Council in terms of insight knowledge of urban movements will be collected. Frequently and updated mobility information will be of great help for urban facilities maintenance optimization and planning and development of current facilities and infrastructures.

The pilot team completed almost all of the proposed activities, such as:

- in-depth and online questionnaires with key stakeholders and citizens, to capture detailed insights and get a deep understanding of users experiences and expectations;
- persona and stakeholder mapping to understand who are the key stakeholders, what are their value exchange and how is their relationship towards the service;
- user tests to test the user interface of the application;
- competition analysis and competitive factors, user, stakeholder and market paradigms and tendencies.

The following points indicate the main conclusions of initial T4.3 activities:

- About 33% of the respondents live outside the city and travel to Santander daily. They are missing more park and ride facilities and information about multimodal routing (car+bus or train+bus);
- Even citizens are highly satisfied with mobility premises, only 30% used to take advantage of them. They miss more information about their location;
- 64% of the respondents uses the car regularly. They feel traffic flow and finding a parking slot as big pain points;
- The most widely used app for mobility in the city is Google maps followed by TUS Santander. Users are missing accurate and reliable information in these Apps;
- Almost 50% of the respondents take into account the weather forecast to choose the means of transport.

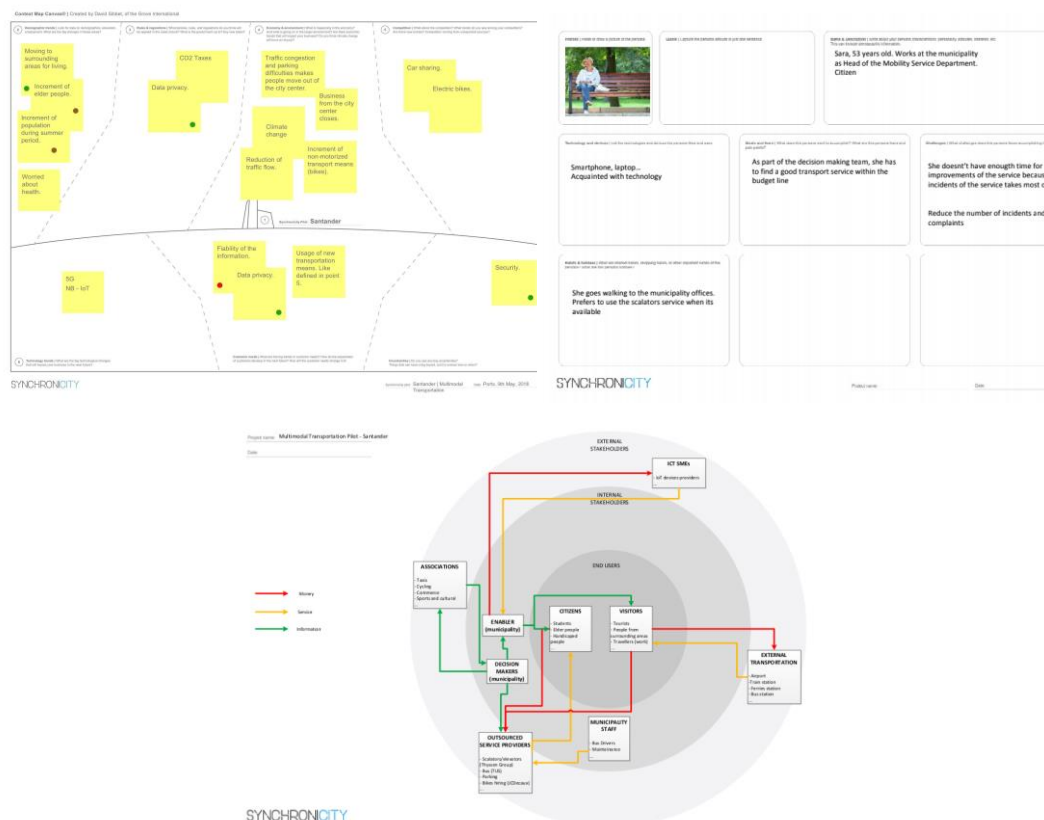


Figure 21 Context map canvas, persona profile and stakeholder map of Santander's pilots.

The pilot team has participated in various events presenting the work done with the goal to engage and involve the citizens in the project, as they are the end-users of the applications and services developed in the frame of the project. These events were also useful to retrieve valuable feedback used to improve the envisioned applications.

The table below summarizes the main findings of the concept, product and service of the Park & Move application:

Users and stakeholders	The users and stakeholders were iterated several times according to the results from co-creation activities done throughout the project. In the case of the city of Santander, in the initial application
-------------------------------	---

	design (D3.1), the end-user was identified as inhabitants, commuters, travellers, city visitors and tourists. Furthermore, in the project, on the T4.3, the user's profiles have been refined for car driver, pedestrian expert, pedestrian amateur and tourist. Regarding the secondary stakeholders, the municipality, authorities and public transportation operators continue to be an important stakeholder for the pilot and will be benefited in terms of reduction of traffic, traffic accidents, contaminants and an increasing in general life quality. Other stakeholders like local businesses will provide benefits from this application.
Preferred features (functionalities to keep or add)	• Different alternatives to public transports from the same origin. • Easy to use and get the right information
Least attractive features (functionalities to change)	• Unfinished platform • Initial trials ran in a web app: users would prefer a native application
Major issues of the pilot solution (functionalities that are missing)	• Problems in finding some addresses and sketching the corresponding routes • Absence of real time information in some cases
Suggestions for improvement	• Seamless integration of other means of transportation when possible • Increase the range that currently is only limited to the city of Santander

Table 5 Conclusions and insights from user interaction with Santander's "Park & Move".

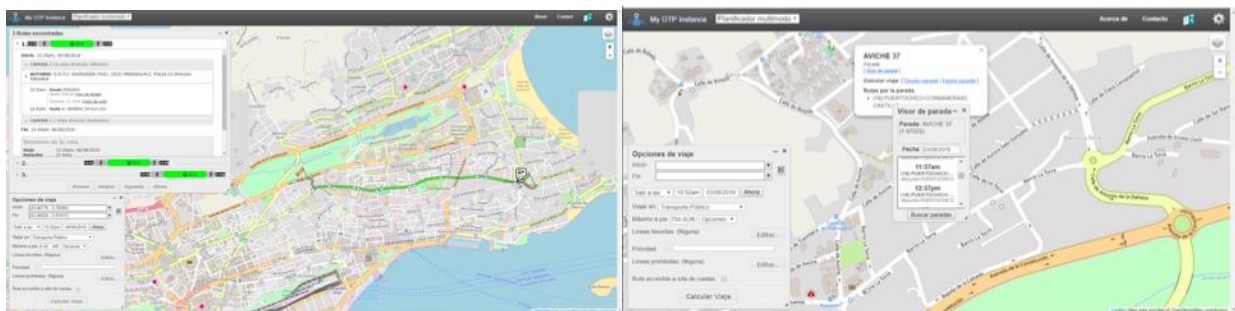


Figure 22 GUI Multimodal Transportation in Santander.

Comparing the final business model with the one first considered for this application, the team identifies adaptations in customer segments and adjustments on key activities and resources. Santander proposes a business model where the city is responsible for funding the solution for the citizens, providing it with no cost to the user.

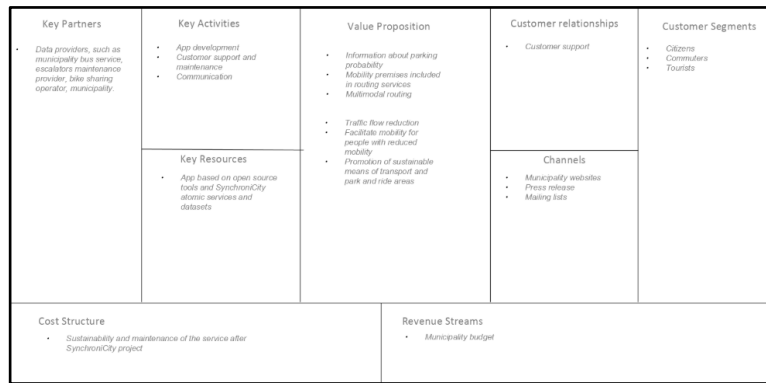


Figure 23 Proposed Business Model Canvas for Santander's "Park & Move".

The activities performed with end-users showed that the application can bring an **innovative approach to the mobility issue** in the city. For future improvements, the pilot team highlights the necessity to pay greater attention to citizen group's opinions, since they are the ones who would use the proposed solutions. These interactions will help technology partners focus on the added value of the practical solutions for citizens.

When asked via questionnaire, the team reveals the validation process resulted in the addition, changing and elimination of three functionalities, but to implement them they struggled with the lack of *development team available to implement the changes/improvements*. On the other hand, they also consider that "there is no room for improvements or changes", since "*the pilot solution was already developed. There was no turning back.*" They considered the validation methodology very relevant because they could get to "*know better end-users expectations and structuring correctly the work to perform.*" The main challenges that they encountered during the validation methodology application were related to the "*lack of time and human resources*" and "*uncertainty about the methodology and design thinking tools*".

3.3 Eindhoven's Reference Zone methodology implementation and validation

The city of Eindhoven is involved in a pilot area of Human-centric traffic management - Data-driven bicycle mobility, with **Ring**. The data-driven bicycle mobility application aims to improve bicycle mobility in cities, in a balanced way. Meaning that the needs of other traffic users will be taken into account too. By leveraging and combining data from different IoT systems 'data-driven bicycle mobility' aims to improve overall bicycle experience, safety, infrastructure planning and policy-making towards the future. Bicycles are an important transport modality in the city of Eindhoven, which is already known for the many bicycles in the city. The main goal for the pilot application was to improve the traffic flow for cyclists in balance with motorized traffic.

75% of the tasks from the T4.3 were applied for this Pilot, with activities such as:

- co-creation workshop and online questionnaires with key stakeholders and citizens, to capture detailed insights and get a deep understanding of users experiences and expectations;
- persona and stakeholder mapping to understand who are the key stakeholders, what are their value exchange and how is their relationship towards the service;
- user tests to test the user interface of the application;

- iteration process and analysis of user, stakeholder and market, paradigms and tendencies.

A context and market analysis show a strong commitment from the city in developing efforts to foster this kind of mobility. A vast network of speed lanes in the city is a good example of that commitment. Many stakeholders are involved in these efforts - Policy advisors on bicycle mobility, managers of traffic flow solutions including traffic lights, data suppliers and citizens using the Eindhoven ring road. Besides providing advantages for citizens, Ring is expected to reduce the time policy advisors and traffic management professionals spend on optimizing the urban bicycle system, which is estimated to have a cost of above 20 FTE per year. Based on previous cycling pattern analysis, more than one hundred thousand bike trips are made on a daily basis in Eindhoven. A large majority crosses one or more traffic lights with potential for optimisation. Other advantages not quantified are related to environmental, mobility and even public health benefits.

Existing solutions were analysed. When compared, the main value proposition of Ring for the city is the possibility to support city management.

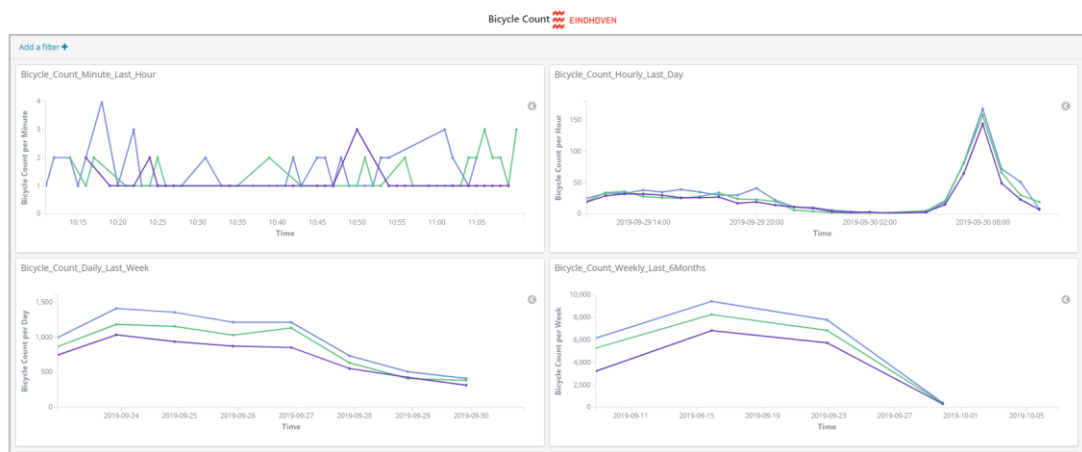


Figure 24 Data side of Eindhoven's pilot: bicycle counts of three camera locations to be used for analysis.



Figure 25 Conclusions and insights from user interaction with Eindhoven's "Ring".

The following points indicate the main conclusions of initial T4.3 activities:

- Focus on real added value for cycling: priority and speed advice, series of priority for multiple traffic lights along a specific route;
- Create smooth opportunities to cross, improve flow for non-motorized users;

- The informational value of displays is perceived as an extra, should not be the main focus;
- Make the Ring Road a safe bike boulevard and ensure smooth passage and safe crossing;
- Context-specific information for cyclists, such as a suggested route based on weather conditions and air quality can provide a bonus.

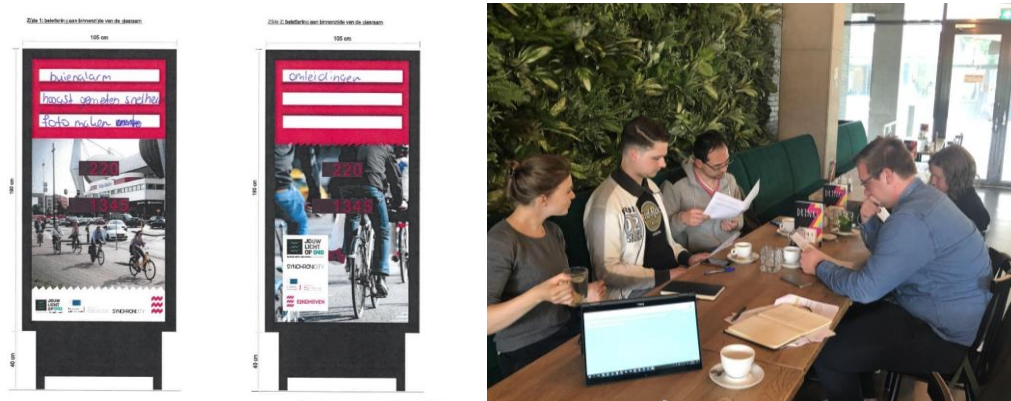


Figure 26 Four workshops were conducted in Eindhoven: one exploratory workshop (February 2018) and three co-creation workshops (May and June 2019).

Although cycling is one of the main modes of transportation in Eindhoven, some barriers exist that are detrimental to the cycling experience. Based on the workshops, cycling (along the Eindhoven Ringroad, but also in other areas) can be improved, mainly on the aspects of safety (intersections, mixed road use), security (e.g. dark tunnels/road sections), noise/air pollution, and traffic flow. The table below summarizes the main findings of the concept, product and service of the Ring application:

User and stakeholder	The users and stakeholders were iterated several times according to the results from co-creation activities done throughout the project. In the case of the city of Eindhoven, in the initial application design (D3.1), the end-user was identified as cyclists and motorists. Furthermore in the project, on the T4.3, the user's profiles have been validated and the cyclists continue to be the target group that will benefit more from the application. Regarding the secondary stakeholders, the municipality, authorities and mobility and sustainability policy advisor, were identified as relevant for the pilot. These stakeholders will be benefited in terms of historical count / number of cyclists and create regulations or restrict parking when pollution is too high.
Preferred features (functionalities to keep or add)	• Speed advice to make it to the green light; • Priority for platoons of cyclists; • Priority for a series of traffic lights in a row; • Adequate bike parking in the city center.
Least attractive features (functionalities to change)	• General informative messages needs to be really good, maybe about comparing things like noise, air to norms; • Adapting to specific circumstances (weather, rush hour). • Waiting time information for cyclists, speed advice for cyclists and extended green time for cyclist groups.

Major issues of the pilot solution (functionalities that are missing)	General information: e.g. about the number of cyclists that have passed, does not add much to the end-user experience;
Suggestions for improvement	- Adequate bike parking in the city centre; - Use light to create more visibility for road users; - Maps to guide the end-user on a suggested route; - Alternative routes for instance for faster cyclists, recreational rides, and others; - Priority if it rains so the users don't have to wait in the rain; - Dim lights to adjust behavior/ traffic speed; - Use Ring to create awareness for alternatives; - On site infrastructure needed - resource intensive (time & money);

Table 6 Conclusions and insights from user interaction with Santander's "Park & Move".



Figure 27 Eindhoven's finished product: Road-Side display, showing the time to green use case for passing cyclists; AUDP – Home and Map Dashboard

The activities performed with end-users and stakeholders showed that smart solutions are **perceived as helpful in achieving some improvements** on mobility and cycling themes. According to the team, the validation process resulted in the addition of a new functionality. By applying the questionnaire, the team revealed they struggled to implement changes due to *“lack of development team available to implement the changes/improvements”*. Also, the team reveals that there was *“no room for improvements or changes (The pilot solution was already developed. There was no turning back)”*. They considered the validation methodology *“very helpful, however inherently this is generic so some modifications had to be made to accommodate our pilot approach”*.

For future improvements, the city of Eindhoven will be involved in shaping a further upscaling over the remaining part of the 12 km long urban ring road and other cycle routes and analyzing the data for better insights. Regarding the citizens' involvement for shaping and improving the pilot solution, the team shared they expect to continue working with co-creation and iteration methodologies.

3.4 Helsinki's Reference Zone methodology implementation and validation

The city of Helsinki is involved in the pilot area of Multimodal transportation with Clean Air Journey Planner. The main goal for Helsinki's pilot is to extend City journey planning application by adding environmental parameters - air quality and noise.

Air quality has been a prominent theme in the past years. Even though air pollution is not a major problem in the Helsinki city area, the pilot offered a good opportunity to test the concept and implementation of an already existing and widely used routing service. People with breathing difficulties or severe allergies are disproportionately affected by changes in air quality, thus making this issue something that has to be addressed.

Regarding this pilot solution, the city of Helsinki employed **60% of the tasks** from the T4.3.

The pilot team completed enough activities from the T4.3 to do a deep analysis:

- interviews and surveys with cyclists and people with small children, that showed interest in clean air optimization services;
- persona and stakeholder mapping to understand who the key stakeholders are, what are their value exchange and how is their relationship towards the service: dissemination and communication on social media and general media;
- analysis of the context with the evaluation of competition, and usability testing to test the user interface and experience of the application.

The team identifies that there are other solutions that provide routing and air quality mapping, but with separate solutions.

The following points indicate the main conclusions of initial T4.3 activities:

- A marginal amount of respondents didn't see air pollution as a factor in his/her life and didn't see him/her using the feature at all.
- According to the information gathered both from the social media responses and from the field interviews, the originally identified target groups (e.g. parents with small children) are the first choice among responders as well. Also, people with respiratory problems are identified;
- Overall, the concept testing phase seems to confirm in part the hypothesis. Even in a city with relatively clean air, people with small children (parents, grandparents), people with respiratory problems and cyclists are open to the idea of using clean air routing on a daily basis.

The table below summarizes the main findings of the concept, product and service of the Clean Air Journey Planner:

Users and stakeholders	The users and stakeholders were iterated several times according to the results from co-creation activities done throughout the project. In the case of the city of Helsinki, in the initial application design (D3.1), the end-user was classified as commuters, travelers and visitors. Furthermore, in the project, after applying the <i>WP4 T4.3 Toolkit</i> activities, the team discovered that application would be more
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	beneficial for different types of users: the main target groups include cyclists, parents with small children and people with health problems like asthma. Also, the team identified that the municipality, as a secondary stakeholder, not only plays a role of enabler but also benefits from the solution by increasing citizens awareness about environmental conditions and therefore provide better services for risk groups, and in the long term impact citizens choices in order to improve air quality and comfort.
Preferred features (functionalities to keep or add)	• Most people reacted positively about the clean air routing feature; • People with small children doing outdoor activities reacted very positively, even slightly active cyclists reacted positively. • ” Very useful service for people with asthma. I would gladly bike around a spot if it meant preventing an attack”;
Least attractive features (functionalities to change)	• The suggested route becoming longer was seen as a problem when in a hurry; • “Beads” in route should be taken away. Makes the visualisation unclear, it loads slowly and uses unattractive colors;
Major issues of the pilot solution	• Being in a hurry; • Longer route; • Possibly age;
Suggestions for improvement	• “Air quality shouldn’t be considered as a thing people need to dodge. Pollution should be addressed in a way that even the straightest route is pleasant and safe”; • It would be nice, if in addition to the route suggestion, the map interface would show the views along the route and some other information (“something that would say what would be a nicer walking route anyway”);

Table 7 Conclusions and insights from user interaction with Helsinki’s “Clean Air Journey Planner”.

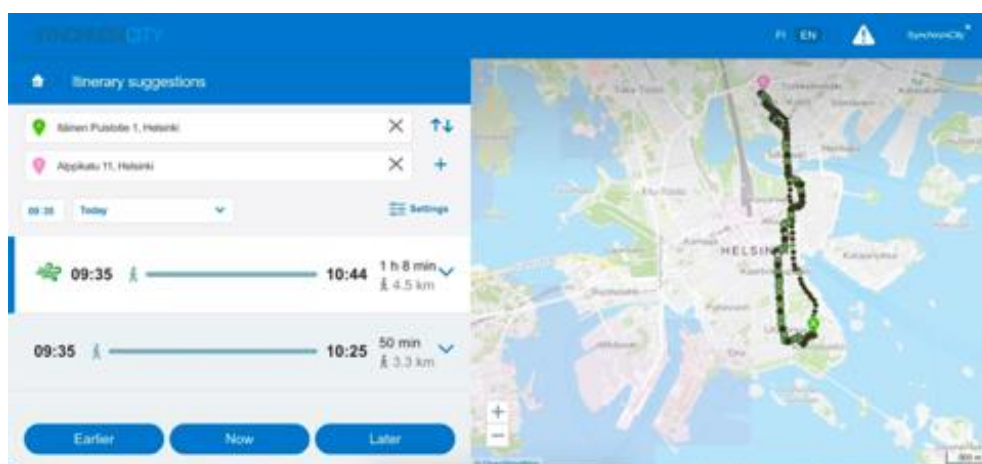


Figure 28 Screenshots of Helsinki’s Clean Air Journey Planner application.

Clean Air Journey Planner was developed as a plug-in for an existing routing application for public transportation that is made available as a city to citizen solution. The team identifies the possibility to make technology transfer to other projects developed by local stakeholders developing similar services.

The pilot concept was tested by monitoring responses in social media regarding news on the service, which was reported in several articles. Additionally, more than a dozen interviews were conducted in two occasions: the clean air routing service was introduced and demoed, after which a structured although free flowing conversation was conducted and documented.

The criteria of pilot success was to test and prove this new model of people's behaviour based on **increased environmental awareness and productify** initial services by including this feature permanently into Journey Planner application.

3.5 Milan's Reference Zone methodology implementation and validation

The Municipality of Milan is involved in two pilot themes: Human Centric Traffic Management and Multimodal Transportation. The Human Centric Traffic Management pilot application is named "Decision support system for bike planning" and the Multimodal Transportation pilot application is named "Mobile navigator for disabled people".

For the "Decision support system for bike planning" application, the city of Milan employed **60% of the tasks** from the T4.3 with activities such as:

- Persona and stakeholder mapping to understand who the key stakeholders are, what are their value exchange and how is their relationship towards the service and analysis of existing solutions;
- Value proposition and market trends, paradigms and tendencies.

This application is being developed as a need from the municipality, aiming at supporting bike planners to improve the cycle network by integrating useful information layers and make the cycling network safer.

Cycling is a growing trend in Milan and the city has several different bike-sharing providers. There was no data integration for cycling planning. Previously, when data was needed, it was necessary to reach different stakeholders (different departments of the Municipality, Mobility Agency, Municipal Police, bike-sharing operators), and, sometimes, there was no information about where to find data. This integration challenge has labour time costs to the Municipality, which can be reduced. According to the team, implementing this solution will also provide "a decision support tool based on updated data that can help create a more effective cycling infrastructure", having mobility and environmental impact. As the value proposition of the solution is highly dependable on data, its quality, reliability and existence are seen as the main threats of the solution.

The user interface exploits the Municipality [geoportal viewer](#) to show the information layers created integrating data from the SynchroniCity Platform and other data sources when available.

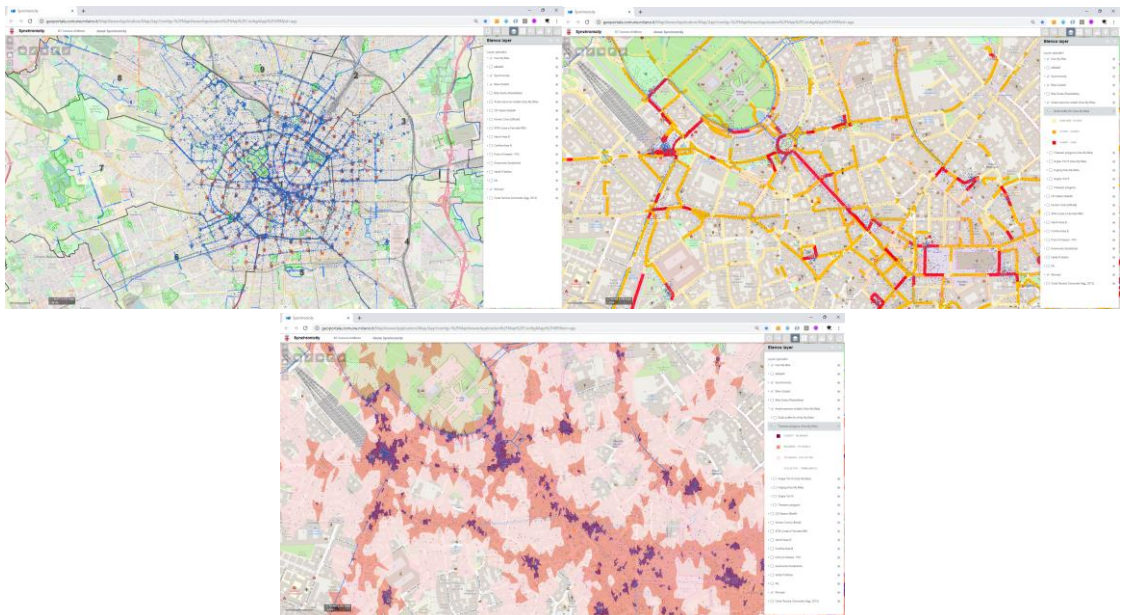


Figure 29 Milan's Municipality geoportal viewer.

The application intends to use traffic data, bike-sharing stations, parks, restricted traffic areas, public transport network (e.g. tramways), obstacles along the sidewalks (such as newsagent or flower shops) to **improve cycling mobility schemes and services in the city**. When localization of road accidents data will be available, also accidents black spots will be integrated. The solution will be used by personnel in the Municipality of Milan (around 30 people) that work for cycling planning for the Mobility Agency.

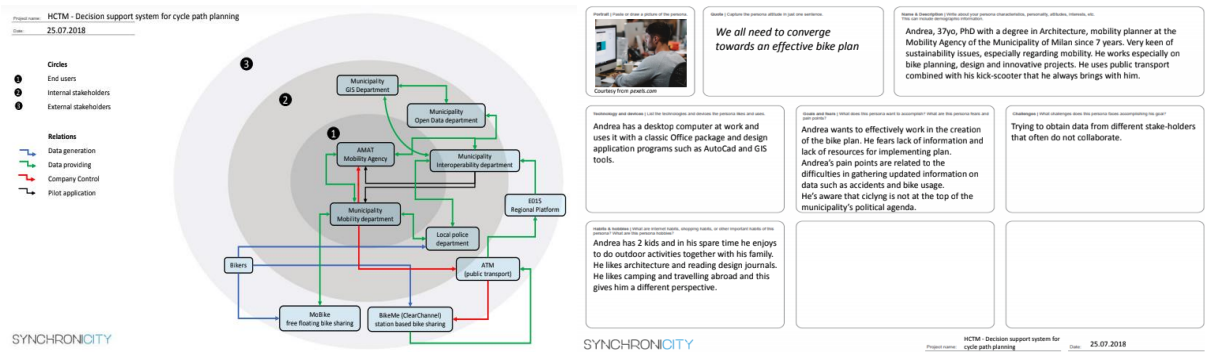


Figure 30 Stakeholders and personas for Milan's "Decision support system for bike planning".

The table below summarizes the main findings of the concept, product and service of the solution:

Users and stakeholders	The users and stakeholders were iterated several times according to the results from co-creation activities done throughout the project. In the case of the city of Milan, in the initial application design (D3.1), the end-user was identified as cyclists, pedestrians and motorists. Furthermore in the project, after applying the WP4 T4.3 Toolkit activities, the team discovered that application would have an impact on the end-user before identified but the main beneficiary would be the traffic manager of the municipality: the Planner. The Planner
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	represents the Municipality of Milan in charge of managing the cycle path. Other secondary stakeholders were identified as part of the application maintenance.
Preferred features (functionalities to keep or add)	• Visualize and analyse all the data available from multiple sources in the same platform; • Better and safer cycle infrastructure planning (better use of resources); • Provides a full picture and usage patterns; • Provide the possibility to make data-driven decisions on cycling planning;
Least attractive features (functionalities to change)	• Not specified
Major issues of the pilot solution	• Lack of resources for improving the cycle network
Suggestions for improvement	• Contact the users to make them aware of the service provided

Table 8 Conclusions and insights from user interaction with Milan's "Decision support system for bike planning".

The pilot team indicates that this solution's sustainability model is developed on a city to city basis. During the validation process, new stakeholders were identified, and their feedback was considered in the evolution of the solution. According to the team, the **pilot solution improved ("improvements needed") some functionalities and features** in the user, stakeholder and market perspective, by applying the T4.3 methodology. The application will be extensively used for a long time by the Mobility Department of the Municipality of Milan, as it will be based on the already existing internal geoportal.

4 Replicability

Collecting experiences and identifying patterns amongst the pilots developed by RZs and by the Open Call pilots, it demonstrates how the SynchroniCity principles were adopted.

In this section, a collective analysis on User, Stakeholder and Market Validation results is performed in order to share the main insights about engagement with SynchroniCity, but also, how these pilots will potentially evolve.

Considering all the results collected and a Questionnaire⁸ that was performed next to RZs and SMEs at the end of the validation methodology application, an evaluation was performed to understand the perception of the pilots' evolution.

This analysis will develop in the following topics:

- 4.1 User, Stakeholder and Market Validation Methodology adoption
- 4.2 Citizen as the main beneficiary
- 4.3 Adoption of the citizen-centered approach
- 4.4 Usability as a feature
- 4.5 Data as value-added or the main barrier
 - Shared data
 - Communication
 - Digital Gap
- 4.6 Business Model Sustainability
- 4.7 Future connections to cities and SynchroniCity

⁸ Validation Toolkit's Market Validation Questionnaire, Part II (Annex 1).

4.1 User, Stakeholder and Market Validation Methodology adoption

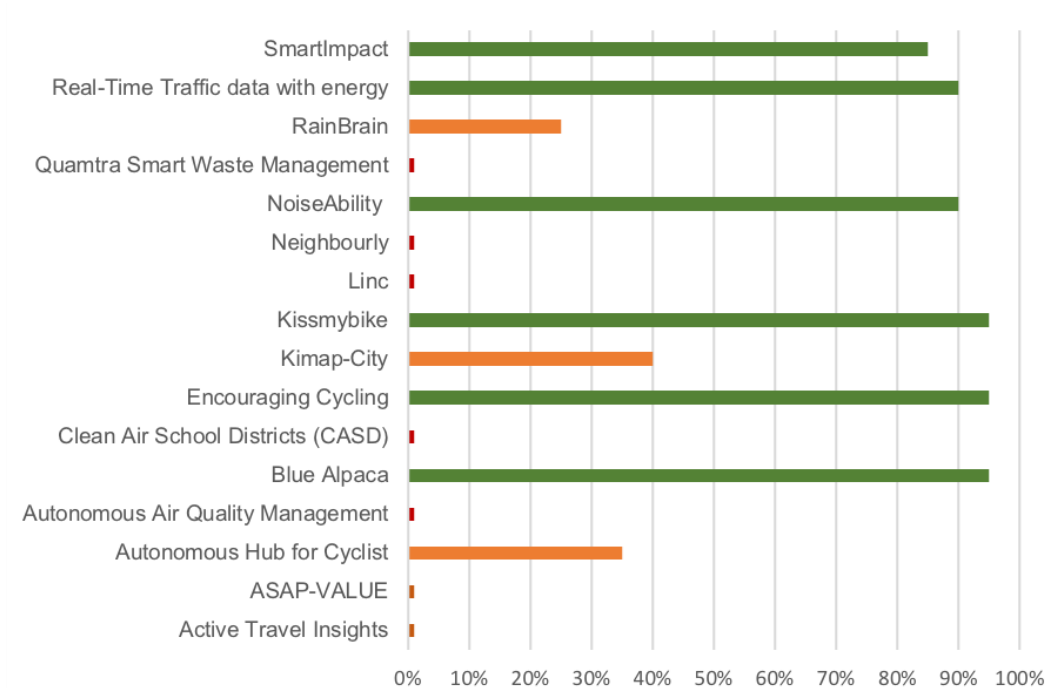
RZs implemented the User, Stakeholder and Market Validation Methodology proposed as explained in Section 3. Validation methodology per Reference Zone deployment.

Based on the same logic, the Open Call pilots also applied the validation process to help validate their pilot solutions and understand the problems they are trying to solve in each city, as well as the potential market. All the Open Call pilots were involved and encouraged to apply the tasks proposed in, at least one city per Pilot. The process was run by consortium leader SMEs.

	Training	Toolkit														
		Market research				Engage with end-users				Test and iterate	Implement					
	Synchronicity London Bootcamp	Market Validation Questionnaire Part I	Market Validation Questionnaire Part II	Identify the competition	SWOT analysis framework	Stakeholders maps	Online questionnaires	User Interviews	Personas	Exploratory workshop	Co-creation workshop	Usability test methods	Perceptual mapping	Value Proposition Canvas framework	Business Model Canvas framework	Impact Mapping framework
Active Travel Insights		x		x	x	x	x	x	x	x	x	x				
ASAP-VALUE																
Autonomous Hub for Cyclist																
Autonomous Air Quality Management																
Blue Alpaca																
Clean Air School Districts (CASD)										x	x	x				
Encouraging Cycling								x			x					
Kimap-City																
Kissmybike																
Linc																
Neighbourly																
NoiseAbility		x														
Quamtra Smart Waste Management																
RainBrain							x	x	x	x	x			x	x	
Real-Time Traffic data with energy																
SmartImpact																

Table 9 Tasks performed in the validation process of the Open Call Pilots (grey - documented; x - tasks referred to as performed but not documented)

The results provided by the teams performing the validation of the Open Call pilots were collected and evaluated.



	The Open Call Pilot exceed the percentage of minimum accomplishment tasks to be done in the validation.
	The Open Call Pilot presented a reachable percentage of accomplishment tasks of the validation process.
	The Open Call Pilot presented a low percentage of accomplishment tasks of the validation process.

Figure 31 Percentage of Toolkit tasks' accomplishment for Open Call pilots

When asked via questionnaire (see Annex I), 70% of the internal and external pilots teams were **satisfied with the application of the methodology** to their solutions. Yet, they reported that the main goals they had for the pilot validation process were to **prove technological feasibility** (72%), **develop a new product or service** (63%), **connect to new potential markets** (36%) and **reduce a problem by increasing efficiency** (18%). These results conclude that the main objective for the pilot teams **was not to develop a product or service, but to prove technological feasibility**. Along the process of pilot deployment, conditions might have changed, as almost all the teams that answered the questionnaire have the perception of not having implemented the pilot as it was designed at first, with a percentage of completion below 100%.

Based on the internal and external pilot comments during in-person interviews and questionnaire⁹ responses, we can conclude:

- The success of the validation methodology process would be higher if it would be applied earlier in the SynchroniCity project;
- Some of the pilots were already in the final phase of development so there was no room for improvement or change;

⁹ Validation Toolkit's Market Validation Questionnaire, Part II (Annex 1).

- The Technical SynchroniCity partners were longer available to iterate the pilot solution;
- The open call pilot teams claim that some of the requirements were established in the beginning of the project so there was no possibility to adapt the pilot solution to fit or adapt to the user, stakeholder and market validation conclusions.

4.2 Citizen as the main beneficiary

Even though many stakeholders are identified as intervenients in the development and maintenance of the piloted solutions, it is common to all the evaluated internal and external pilots that the **citizen** is at the center of the solutions designed and developed. For every pilot, the solutions were designed to address the challenges identified in cities, implying a **problem impacting mainly the citizens**. Three more types of end-users are identified: municipality or civil servants, citizens in general or specific end-user. The end-users have specific profiles, such as disabled people, asthmatics and cyclists¹⁰.

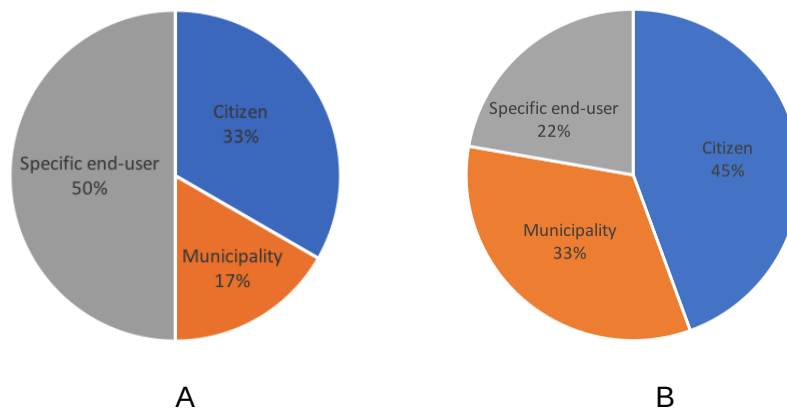


Figure 32 A: Internal pilots end-users analysis; B: External pilots (Open Call) end-users analysis.

The pilots are surrounded by various stakeholders (individuals and/or groups) with different levels of interest and importance towards the pilot solution. For every pilot, the following key stakeholders are identified:

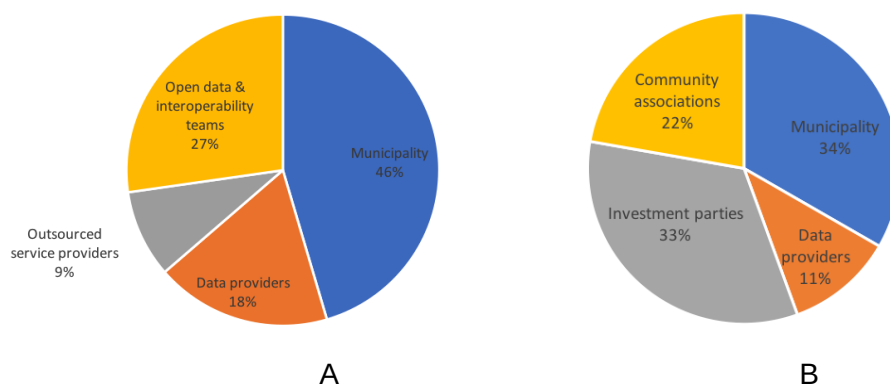


Figure 33 A: Internal pilots stakeholders' analysis; B: External pilots (Open Call) stakeholders' analysis.

These are the key stakeholders that were considered in the context of the pilot solutions and that are being affected by the pilot solution actions, objectives and policies. As shown in Figure 33,

¹⁰ Validation Toolkit's Market Validation Questionnaire, Part I.

the **investment providers and the municipalities are of great importance**, in both internal and external pilots ecosystem. Other stakeholders were considered, such as community associations, data providers and outsourced service providers, but were not so relevant for the pilot solution development and implementation.

The perception of the teams behind these pilots, show that the solutions go beyond technology, addressing **real needs that impact citizens** in cities.

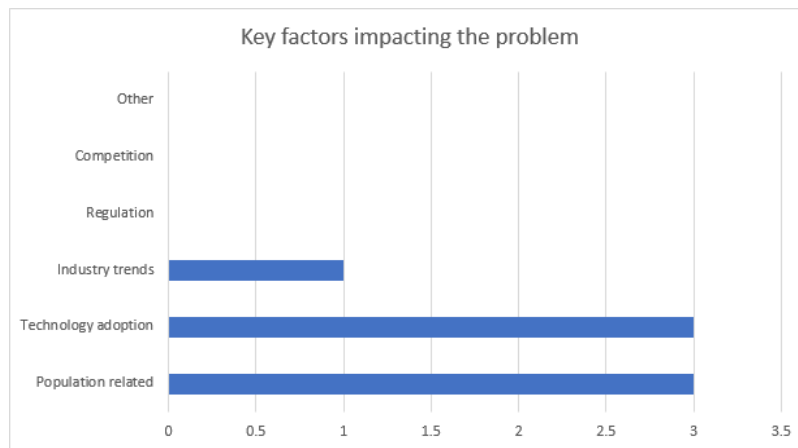


Figure 34 Key factors impacting the problem, both for internal and external pilots.

As results of end-user interviews and online questionnaires, the teams identified particular findings about users' lifestyles, behaviours and attitudes related to the problem. In general, the main conclusions and recommendations that have the **greatest potential to resolve end-users' problems** and improve satisfaction are based on the following words:



Figure 35 Key factors impacting the problem, both for internal and external pilots.

The key factors and insights collected through end-user interactions are mainly related to **shared data, information delivered in real-time** and with **high reliability and efficiency** to the end-user. When analyzing these results, we found that all the pilots have several common factors that should be considered in the development and implementation phase. The factors are mainly related to **digital transformation and how this will improve their quality of life**. More than 50% of the interviewed users have reported **similar problems and challenges**.

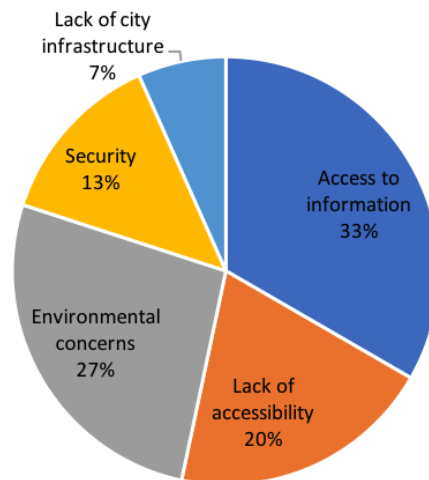


Figure 36 Key factors impacting the problem, both for internal and external pilots.

The problems/challenges reported are overall related to **access to information** (Figure 36). This need is essential to be tackled in the city and citizen perspective. Allowing people to seek and receive information serves as a critical tool to enable citizens to be more aware, participative and efficient in their daily activities. Access to information allows them to be more conscious in their decisions and establish trust with the usage of public and private services. Information can come in many different forms of varying relevance, accessibility and quality. It is essential to **create and strengthen communication channels to raise awareness** on rights to official information and strengthening mechanisms to provide access information between citizens, companies and cities.

Environmental concerns are also raised by end-users. During user interviews and workshops, the pilot teams identified **pollution in cities and climate change** as frequently mentioned issues. We can conclude that most of the end-users strongly believe that they can help to protect their environment and consider the protection of the environment is highly important. The end-users feel the need to use environmentally friendly products and services to help them to be more aware about the impact of their actions.

Finally, one more challenge was detected by the pilot teams, related to the **lack of accessibility** in cities, in terms of physical infrastructure and product and services interaction. Improving access and mobility of people with disabilities was one of the focus of some pilot solutions teams. The end-users believe that technologies and products, like the ones developed with the pilots, can potentially help open up cities to people with disabilities, making independent living much easier.

The insights introduced above was being collected from user interviews, online questionnaires and workshops¹¹ results shared by the RZ's and external pilot teams.

¹¹ User, stakeholder and market validation Toolkit, Part I & II.

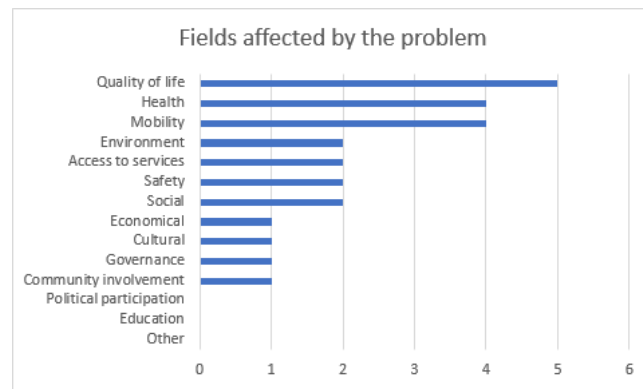


Figure 37 Key factors impacting the problems addressed by the pilots.

When questioned¹², cities identify **Quality of life** as the main factor to be addressed. The answers show the perception of the problem being affected by human factors as much as technological factors. More and more the quality of life of citizens is based on digital connections and easy & fast access to information to ensure communication, security and comfort. Access to digital services and connections supports social and economic inclusion and provides opportunities to **improve Quality of life**.

Yet the results of these activities show the digital and information gap is increasing the opportunity to improve the quality of life of the citizens and the city in general. So, we conclude that citizens with access to digital solutions have more potential of satisfaction with life in the city and feel less isolated and more served. As seen, the citizens are considered key stakeholders across SynchroniCity. This fact is also confirmed with the SMEs' perspective. Companies involved in the Open Call also see citizen engagement as a strength for their solutions. Also, they see the interest cities have for citizen engagement as an opportunity.

4.3 Usability as a feature

Figure 38 represents the percentage of common conclusions on the external and internal pilot solutions as a result from user testing task¹³.

¹² Validation Toolkit's Market Validation Questionnaire, Part I

¹³ User, stakeholder and market validation Toolkit, Part II.

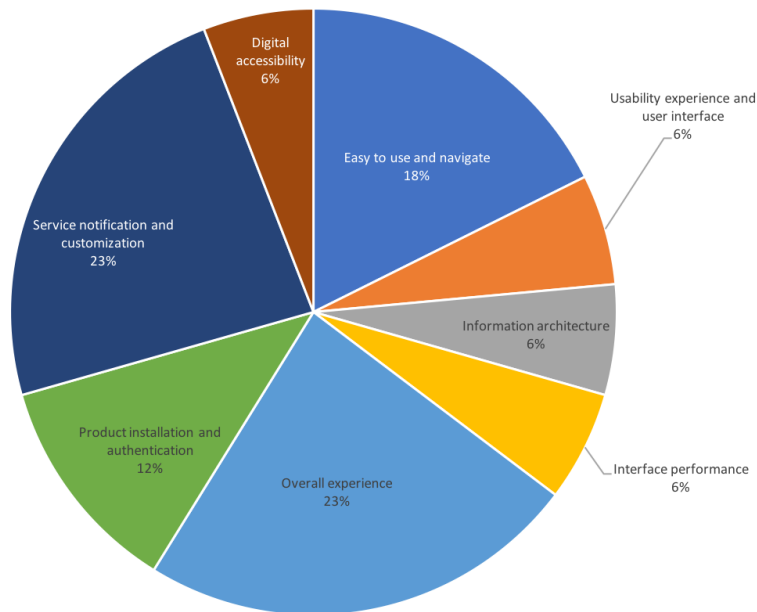


Figure 38 Main conclusions from user testing task of User, stakeholder and market validation Toolkit Part II.

In general, the end-users reported to have a good **overall experience (23%)** when interacting with the pilot solutions during user testing. The overall experience can be related to the satisfaction and the value that the product or service offers to the end-user in terms of learnability, usability and performance. End-user perception regarding the impact of the pilot solution is correlated to the purpose and the environment where the solution is implemented. More specifically, it was identified that end-users evaluate the **service notification and customization (23%)** and **usability (18%)** as something positive but with room for improvement. In more detail, the end-users were looking for a product or service that is **pleasant to be used and feels intuitive** and, more importantly, **easy to learn**. The customization of the product or service seems an essential feature in the pilot solutions, where end-users can easily customize the product to the way it fits their needs.

The activities involving end-users (workshops and usability tests) revealed a range of overall insights regarding the internal and external pilot solutions. In more detail, the following points represent the main changes and considerations that the end-users indicated as important and relevant in a smart city solution, in order to make the product or service successful:

- The solution must deliver **significant value** (intangible or tangible) to the user;
- The solution should deliver system information and options in an **easy & quick to read and understand** way;
- The solution should consider **multichannel** services and systems;
- The solution should **improve city services** and **network connectivity**;
- The solution needs to create more **accessibility** to the urban space;
- The solution must consider the use of **big data**;
- The solution should consider a **friendly user interface** and user experience.

The results considered in this section, reveal the importance of usability as basis for a great user experience, to build products and services more inclusive, efficient and easy to use.

4.4 Data as added value or the main barrier

At the beginning of the piloting process, three out of the five RZs pilots under evaluation considered that the solution designed was not addressing all the requirements identified at first¹⁴. Data availability and technical constraints are mentioned as the main reasons.

When analyzing the competition identification results and the SWOT analysis (Strength, Weakness, Opportunities, Threats) for each one of the internal pilots, it may seem a contradiction, but data is often referred both as a strength and as a weakness for these solutions.

Being able to provide reliable, real-time information using the SynchroniCity framework is seen as a strength for solutions like Porto's. Being able to provide more information than the competition is seen as a competitive advantage by Eindhoven and Santander. On the other hand, quality and availability of data are seen as threats for solutions that are meant to be agile and updated: "Not much data available"; [The application] "depends too much on third-party data owners"; "Bad quality data"; "Using bad/inaccurate data can lead to assumptions and outcomes".

The teams behind the pilot solutions (internal and external pilots), shared some common problems and challenges related to the development and implementation of the pilot solution¹⁵. The following figure shows the relevance of each identified challenge faced by the teams.

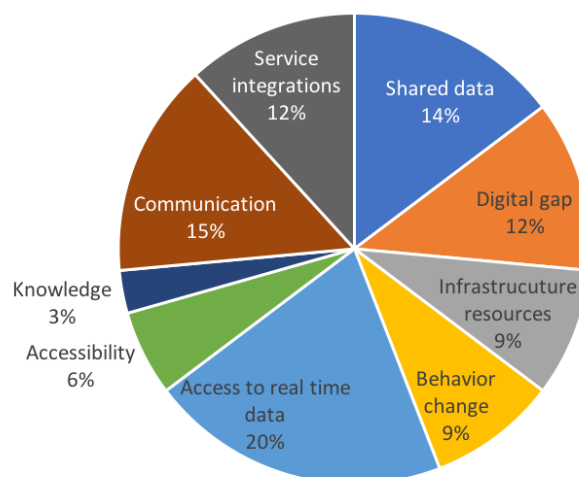


Figure 39 Common challenges collected in the Marker Validation Questionnaire Part II.

"Insufficient coordination among operators and administrators of urban and regional transport."

"Digital gap of many people whom are not able to use new technologies."

"Lack of data on which basing decisions"

"We would need to visualize all the data from multiple providers in the same platform to understand the full picture."

"Too much time to find data from different data providers"

¹⁴ Validation Toolkit's Market Validation Questionnaire, Part I.

¹⁵ Validation Toolkit's Market Validation Questionnaire, Part II.

Internal and Open Call pilots identify¹⁶ **access to real time data and information transparency** from different stakeholders as a challenge for pilot implementation. On a scale of 1 to 5, the participants defined **3.8** as an average to how **challenging it was to have access to data** during SynchroniCity. This challenge comes from the **lack of collaboration between stakeholders** in each ecosystem, mainly because of technical issues and organizational policy and culture, as shown in the following figure (Figure 40).

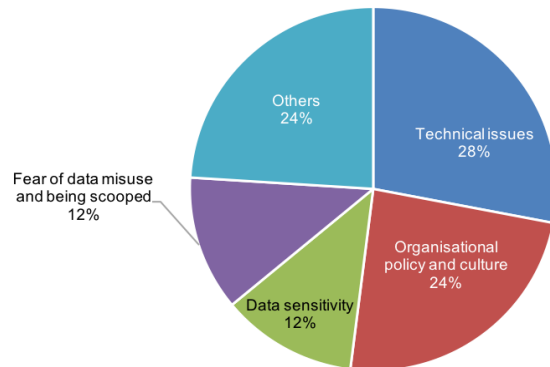


Figure 40 Main challenges accessing real time data from other stakeholders (Annex 1).

Some suggestions and recommendations for future projects were shared by the pilot teams:

“...work more on changing culture regarding sharing data.”

“Work on the three levels separately, before developing applications. First technology, then data and only after applications.”

“Make sure to have a Plan B if the data transmission does not work.”

“Start from available data since the project proposal”

Access to data allows individuals and organisations to develop new insights and innovations that can improve the quality of life of users and help to improve the flow of information within and between citizens. **Real-time data improves end-user experience** and it is very relevant for today's services, products and businesses. This feature increases motivation to all stakeholders delivering the service, helps them knowing what is going on at a glance and improves operational efficiency. Increasing the visibility of key metrics and information enables services and businesses to respond quickly to different issues, improves efficiency levels, and gives the ability to spot possible system issues before they have an impact on the end-users experience. Real-time data and information should be delivered by sophisticated electronic communications tools such as mobile applications, digital signage and data dashboards, to remain appealing to today's service managers and end-users.

Shared Data

All the pilot teams shared¹⁷ that they had difficulties to have access to data from partners and other stakeholders involved in the pilot solution's development process. The lack of time to dedicate to this topic was one of the greater concerns. The uncertainty about copyright and licensing along with the widespread concerns about organising data in a presentable and useful

¹⁶ Validation Toolkit's Market Validation Questionnaire, Part II (Annex 1)

¹⁷ Validation Toolkit's Market Validation Questionnaire, Part II (Annex 1).

way, were also mentioned. Also, the organisational policy and culture from some partners and stakeholders were a barrier in the process of sharing datasets. Some organizations still struggle with understanding the importance of open data. Today, citizens expect to be able to **access information and services electronically when and how they want**. In this new era, end-users, civil servants and businesses want to use open data to generate insights, ideas, and services to create a better quality of life. The use of open data increases transparency and enables end-users to make better and more informed choices about the services.

Communication

The pilot teams identified¹³ **communication between partners and stakeholders** as a barrier to the development and implementation process of the pilots. Communication works as a key factor in complex projects such as SynchroniCity and promotes motivation by informing and clarifying stakeholders. The communication issues identified by the teams are more related to external stakeholders' interaction. To avoid this type of barrier, the right attitude must be fostered, developing an effective communication system inside and outside the organization.

Digital gap

Technology is advancing quicker than people are acquiring the skills and competences to use it. This factor creates a digital gap between users and technology. New businesses and services expected people to use the same technology in a similar way. This is a challenge that some of the teams are facing in delivering new technology to their users and stakeholders.

4.5 Business Model Sustainability

Finding a sustainability model will guarantee that each one of these solutions will generate and deliver value to the citizens and all the other stakeholders in the long term.

From a first questionnaire¹⁸ developed with RZs in the beginning of the Piloting process, four out of five pilots consider the problem was being addressed before by other solutions developed by the city or other public organizations. The business models behind these solutions are identified to be funded as part of EU projects (Porto), by the city (Helsinki, Santander, Eindhoven) or not having a clear sustainability model, most certainly being funded by the city as well (Milan). The questionnaire also shows that the sustainability model of the five solutions will be assured by cities after the pilot phase ends.

As explained in *section 2 - User, stakeholder and market validation methodology*, solutions were validated up to problem/solution fit. RZs that were able to present a business model after Pilot implementation, mainly show the interest of the city to fund future developments of the projects so they can provide the services to their teams or citizens. On the other hand, there is also interest in transferring technology to third parties for future projects development.

Open Call pilots were implemented by consortiums and led by SMEs with experience in the market. Only solutions that would address an existing need identified and validated by the city (potential customer), would be selected within the Open Call process. Also, the investment of the

¹⁸ Validation Toolkit's Market Validation Questionnaire, Part I

city teams applying resources in the implementation of one pilot instead of another, shows potential problem/solution fit. The process itself puts the solutions being implemented closer to product/market fit.

In the table below, some of their business models are mapped, considering the common types of Urban Data Business Models presented at “An Urban Data Business Model framework for identifying value capture in the Smart City: The case of Organicity¹⁹”.

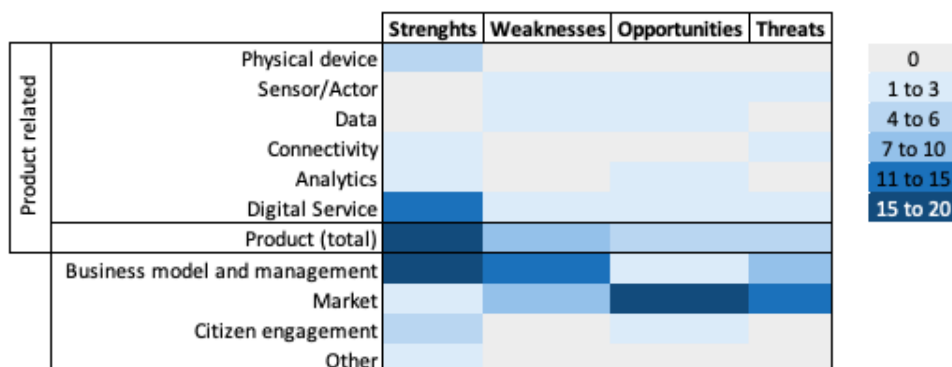
	Business to City	Business to Business	Business to City to Citizen	Business to Business to Consumer
Sensing as Service	Clean Air School Districts	Clean Air School Districts		
	Quamtra			
Prescriptive Insights as Product	NoiseAbility			
	Neighbourly			
Analytics as a Service model	Encouraging Cycling through the use of Crowdsourced Data-Drive Insights (SeeSense)	LINC		
	LINC			
	RainBrain			
	Smart Impact	RainBrain		
Recognition as a Service	Quamtra			
Automated Service Interaction			Blue Alpaca	
Crowdsourcing community platform model	Kimap-City	Kimap-City	Kimap-City	Kimap-City

Table 10 A summary of the Open Call pilots potential Business Models

Only six of the Open Call Pilots were able to provide a potential Business Model considering the learnings they collected during User, Stakeholder and Market Validation. Nevertheless, all these pilots were successfully implemented in at least two cities. Some of these SMEs already had cities or other companies as customers. If the business models are validated, SynchroniCity does not represent a barrier for the development of a wide range of businesses based in data.

4.6 Future connection to cities and SynchroniCity

A number of nine SWOT Analysis received for Open Call Pilots was analysed to understand their positioning in the market and to understand some potential patterns of connection to the SynchroniCity context in the future. The frequency of references to strengths, weaknesses, opportunities and threats was quantified and distributed in different categories, as shown in Figure 41.



¹⁹ McLoughlin, S., Puvvala, A., Maccani, G., Donnellan, B., (2019) An Urban Data Business Model framework for identifying value capture in the Smart City: The case of Organicity, LERO, Technology Adoption Group, Business School, National University of Ireland Maynooth

Table 11 Evaluation of the SWOT analysis for Open Call pilots.

Strengths	Weaknesses
Companies identify strengths in their products, ranging from the physical device's competitive advantages to the digital services. SMEs also identify competitive advantages in their business and management characteristics, referring to their partnerships, pricing models, quality of the team and some scalability strategies.	Weaknesses are also more related to business structures, mainly on scalability processes.
Opportunities	Threats
External factors connected to market trends are seen as presenting more opportunities for business expansion than factors connected to product development or business adaptation. SMEs identify opportunities in connecting and working with cities, namely through the SynchroniCity ecosystem: <i>"Much attention to the market of climate adaptation in the EU."</i> <i>"Increasing trend in the use and development of new technologies by citizens and companies."</i> <i>"Strong push by public administrations to make digital services offered more accessible"</i>	External factors present bigger threats to SMEs than internal ones. Even though cities represent strong potential as seen in "Opportunities", the cities market characteristics are currently pointed as a threat by SMEs. <i>"Lack of public funds devoted to..."</i> <i>"Cumbersome procurement process in the public administration."</i> <i>"Limitations of the budget in the public administration"</i> <i>"City administrations are not reactive on the topic of..."</i> <i>"Local policies"</i> On the other hand, SMEs feel confident about their products that seems to present some weaknesses, but not so many threats.

Table 12 Evaluation of the Open Call pilots SWOT analysis.

The absence of standards, that SynchroniCity is tackling, is presented as a current competitive weakness by these SMEs:

"Use of different formats/interfaces by different client's harms replicability/scalability."

"Lack of standardization: difficulty of operating with low costs in different cities."

"Lack of interconnection of city services"

"Each implementation needs to be tailored to each location, i.e. city regulations, supply chain, local installation availability, street configuration, etc."

SynchroniCity, and the involvement in the project, are referred four times as presenting a strength or an opportunity for these companies:

Opportunities:

“The exposure via the SynchroniCity framework and the ever-growing capabilities of the hardware and software components placed at the edge, make this solution attractive for other use cases (...).”

“Recent market exposure and this ongoing participation in the SynchroniCity project has confirmed the willingness of other municipalities and external stakeholders to acquire this solution.”

Strengths:

“SynchroniCity support: resources and advice to set up prototypes and first deployments”

“Support from SynchroniCity consortium (structure, investments, etc.).”

In a final note, there is also the concern of not being able to avoid competition with the non-lock-in model that SynchroniCity is promoting:

“Given that this solution is based on an open platform, where the sensors and processing are separated, any other specialized and self-contained solution might come as a possible alternative to ours (...).”

5 User, stakeholder and market validation methodology: Final proposal

The User, Stakeholder and Market Validation Toolkit²⁰ (final proposal) provides guidance for IoT and technology-based projects to engage with **an open and citizen-centered approach for innovation** in the development of new products or services. The tools and methods presented in this toolkit are based on a design process such as living lab, design thinking, service design and customer development, aiming to support the teams better understand the different co-creation and research methodologies available and why/how to adopt them in their projects.

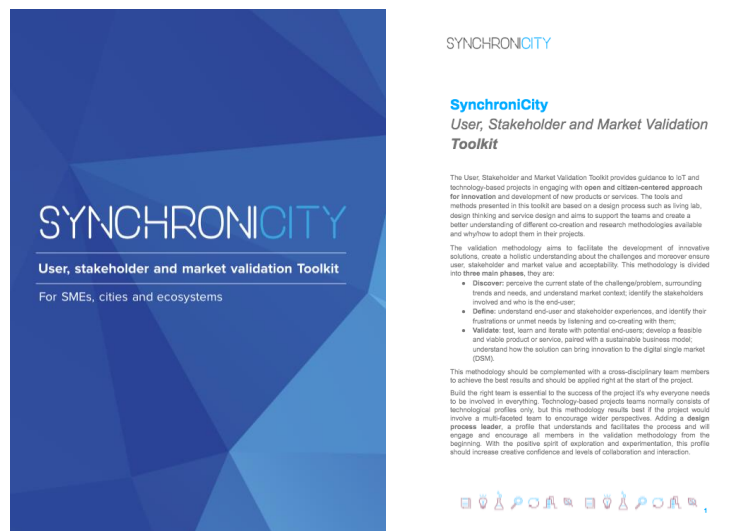


Figure 41 User, Stakeholder and Market Validation Toolkit (final proposal).

The implementation of these tools will ensure user, stakeholder and market value and acceptability. According with the insights and conclusions reported²¹ by the internal and external pilots regarding the implementation of the *WP4 T4.3 User, Stakeholder and Market Validation Toolkit Part I & II*, they considered **satisfactory** the overall experience. However, applying the tools and methods was considered **neutral to difficult**.

Considering the feedback and the learnings, an evolution of this methodology will be hereby presented.

This methodology is divided into **three main phases**:

- **Discover:** perceive the current state of the challenge/problem, surrounding trends and needs, and understand market context; identify the stakeholders involved and who is the end-user;
- **Define:** understand end-user and stakeholder experiences, and identify their frustrations or unmet needs by listening and co-creating with them;
- **Validate:** test, learn and iterate with potential end-users; develop a feasible and viable product or service, paired with a sustainable business model; understand how the solution can bring innovation to the digital single market (DSM).

²⁰ User, Stakeholder and Market Validation Toolkit (Annex 2).

²¹ Validation Toolkit's Market Validation Questionnaire, Part II (Annex 1).

This methodology should be implemented by **cross-disciplinary team members** to achieve the best results and should be applied right at the beginning of the project, even before technological development.

Technology-based projects teams normally consists of technological profiles only, but the proposed methodology achieves better results if the project involves a multi-faceted team which will provide a broader perspectives of the project/challenges. Adding a **design process expert** is advised, a profile that understands and facilitates the process and will engage and encourage all members in the validation methodology from the beginning. With the positive spirit of exploration and experimentation, this profile should increase creative confidence and levels of collaboration and interaction.

This validation methodology is a **non-linear and iterative process** and should be seen by every member of the team as an active instrument, which will help everyone achieving higher performance. As already stated, the methodology should be apply from “day-one”. By including an interactive and adaptive validation process that the one proposed, we are contributing to increase the efficiency of the development process, and also contributing to increase the quality of the final product. The validation methodology can be integrated with different project development processes. The image below shows an example of validation methodology in an IoT and technology-based project, as well as when and where the Toolkit methods can be applied.

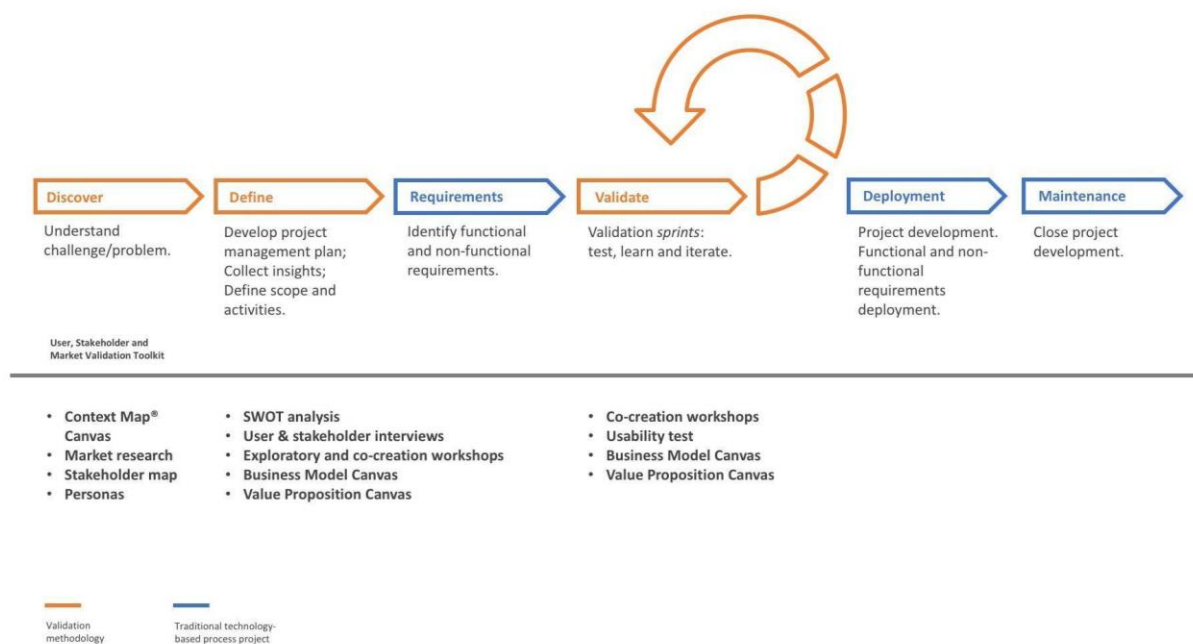


Figure 42 Validation methodology process of User, Stakeholder and Market Validation Toolkit.

Some methods and tools from the toolkit should be iterated according to the results of the different activities. In the validation phase, the **iteration process** is represented as a **cycle**, and consists of the repetition of some methods, such as co-creation workshops, usability tests, business model canvas hypothesis and value proposition canvas definition. The iteration process cycle should be repeated in several cycle rounds, until arriving at a decision or a desired result towards the user and stakeholder needs and meeting a market fit.

The User, Stakeholder and Market Validation Toolkit is available in Annex II of this document and will be open to be used by SMEs, cities and ecosystems.

6 Conclusions and lessons learned

Cultivating an innovation mindset among stakeholders is essential to obtain an innovative, effective and efficient product or service (pilot solution). Innovation practice is a collaborative process. People, including end-users, internal and external stakeholders, with different backgrounds, must be involved in the process of developing solutions, to make the projects inclusive and valuable to those involved. Throughout the SynchroniCity project, we can easily identify that co-creation and iteration processes have been applied in different phases, involving stakeholders along the solutions development.

The information gathered from RZs and SMEs with the implementation of the WP4 Task 4.3 User, stakeholder and market validation methodology was evaluated and feedback was collected. The deployment of the T4.3 methodology, a citizen-centered design process, was intended to support teams building a holistic understanding of users' behaviour and market context. Thus, the Task 4.3 was developed to ensure that SynchroniCity's solutions would be implemented in an **iterative and co-creative way**. With the support of a Toolkit, pilot teams validated their pilot solutions, understanding the problems they were addressing, evaluating potential business models, defining the value to be delivered to the end-users and, consequently, the value to be delivered to the different stakeholders.

The implementation of innovative technology-driven projects is challenging. The integration of a user-driven innovation strategy is demanding and even more when teams are mainly composed by technological profiles. **Placing the user at the core of a project** focused in technology entails several concerns and management decisions. Transitioning from low user and stakeholder involvement requires an organizational structure shifting. For future projects, teams should be better prepared to address more than technology, to think and implement strategies that allow and facilitate co-creation processes, so it becomes more natural and seen as an added value task. The implementation of this type of methodologies results best if can involve a **multi-faceted team** to encourage wider perspectives. Adding a design process leader, a profile that understands and facilitates the process and will engage and encourage all members in the validation methodology from the beginning.

The success of the validation methodology process would be higher if it would be applied earlier in the SynchroniCity project. Some of the pilots were already in an advanced development phase when the validation methodology was implemented, so there was **no room for improvement** or change considering the project strict timeline. Also, when insights that could be translated into iterations in the products were collected, the technical development teams were longer available to iterate the pilot solutions. Further evolution is due after the end of the project.

When it comes to business, cities are willing to invest in solutions based on SynchroniCity principles and SMEs are interested in joining the ecosystem to prove technology and to reach new potential customers. SynchroniCity was proven to be able to support businesses and city projects based in IoT and data, as long as data is available.

Data is a critical factor to guarantee the value proposition of these solutions. Therefore, technological solutions that are in a position to facilitate access to data in a usable and agile way, are most certainly able to achieve stronger products and services based on SynchroniCity principles. However, there are still restrictions to the development and implementation of these solutions that are non-technological. Building a **strong relationship with partners** or other

stakeholders, and deliver relevant and significant value to everyone, is **essential to get viable data**.

For future projects, it is recommended to **increase data management**, support and educate to create faster and easier routes to get and share data.

There are some other barriers pointed, connected to communication. To avoid this type of barriers, it is suggested to create the right attitude towards a common situation and to maintain an effective communication system inside and outside the organization. In general, the end-users want to achieve a **seamless experience** when using new products and services. It is essential to **create and strengthen communication channels to raise awareness** and strengthen mechanisms to provide access to information for citizens, companies and cities.

Designing for emerging IoT technology solutions for city marketplace is inherently a complex task. This complexity mostly comes from the current state of technology maturity and immature understanding of end-user challenges. The insights and conclusions taken from the previous analysis are examples of the existing gap between designing a great connected product or service and developing a technological IoT solution. Designing a product or service requires a holistic approach to user experience and cross-discipline collaboration between user research, design, technology, and business.

ANNEX I

Toolkit Market Validation Questionnaire - Part II

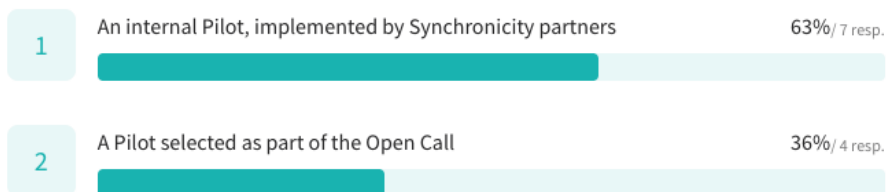
SYNCHRONICITY

WP4 Pilot Validation Methodology Questionnaire Part II

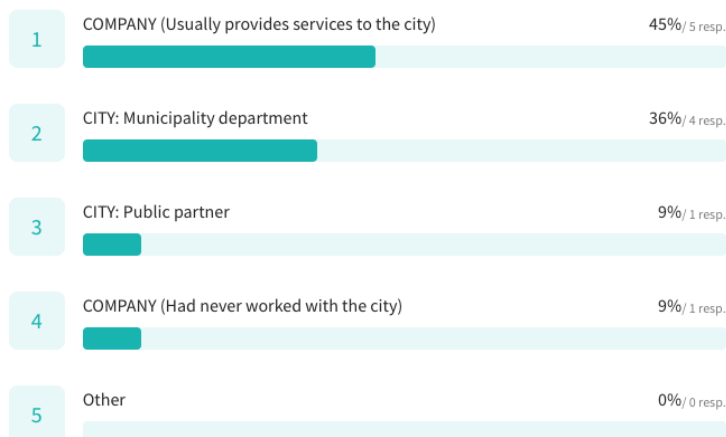
This questionnaire was developed to support SynchroniCity's User, Stakeholder and Market Validation. By answering this questionnaire, you'll support the understanding and improvement of this validation process.

1. IDENTIFICATION OF THE STAKEHOLDER, THE CITY AND THE PILOT

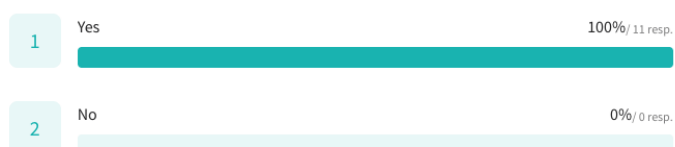
1a. Considering the pilot(s) solution(s) of Synchronicity, it was developed as:



1b. Your role in the Pilot:



1c. Did you apply the WP4 Pilot Validation Methodology Toolkit in any of your pilot solutions?

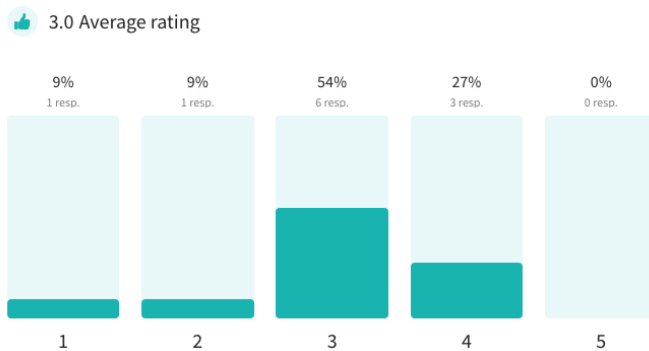


1d. Name the Pilot where you implement the WP4 Pilot Validation Methodology

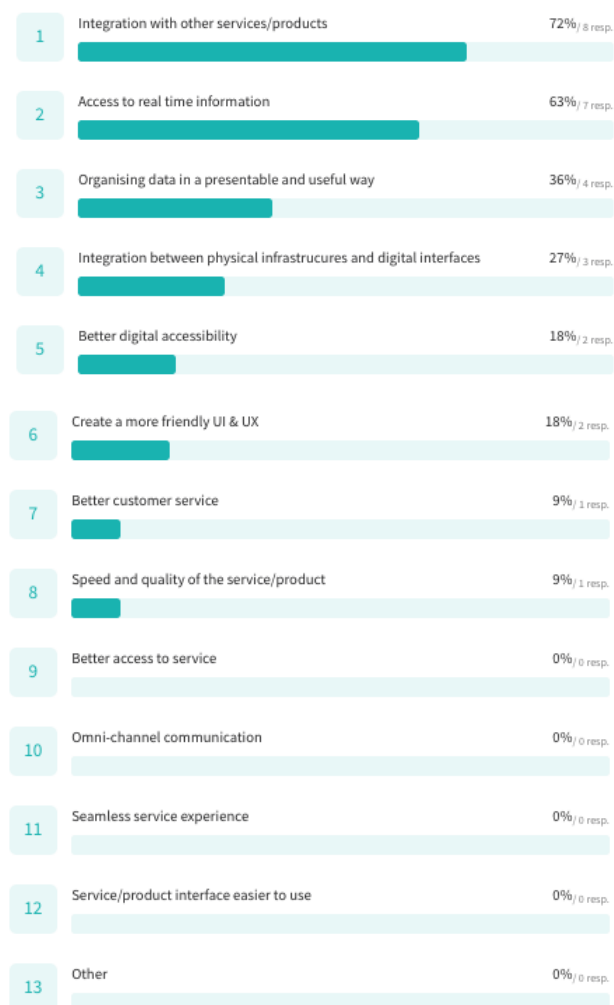
1e. In which city/cities was it implemented

2. SYNCHRONICITY AS A PLATFORM

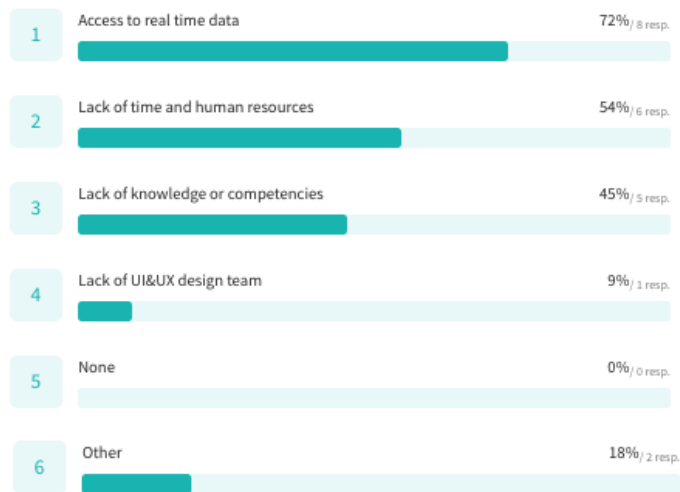
2a. Please rate how did Synchronicity platform help improve or develop your pilot solution in the **frontend end-user interface?** (1-5)



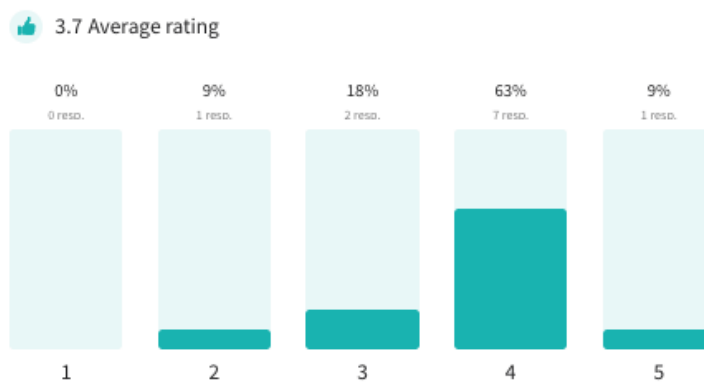
2b. How did Synchronicity platform help improve or develop your pilot solution in the frontend end-user interface experience?



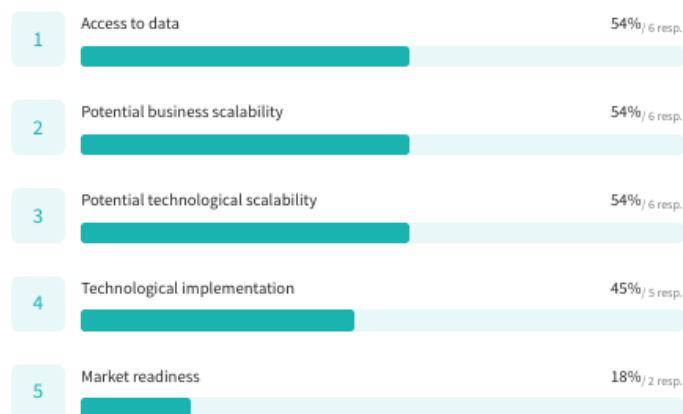
2c. Please select the main problems/challenges you faced during the Synchronicity-related project implementation that would directly affect the end-user of your pilot solution:



2d. Do you believe that Synchronicity, as an ecosystem, is providing you advantages when compared to solutions competing with yours? (1-5)

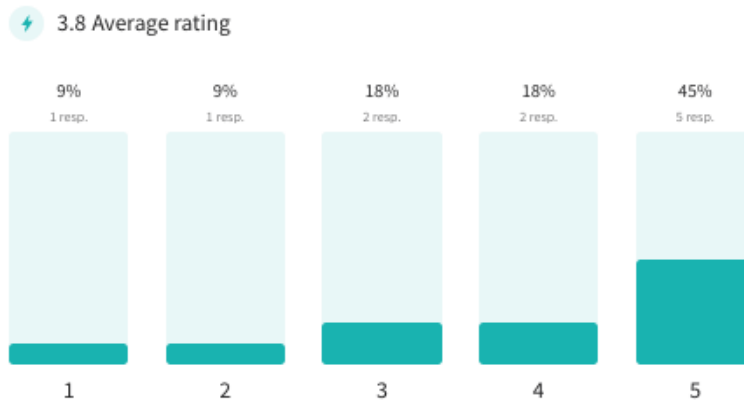


2e. Considering the implementation and the future of the solution, in which fields can you identify those advantages?

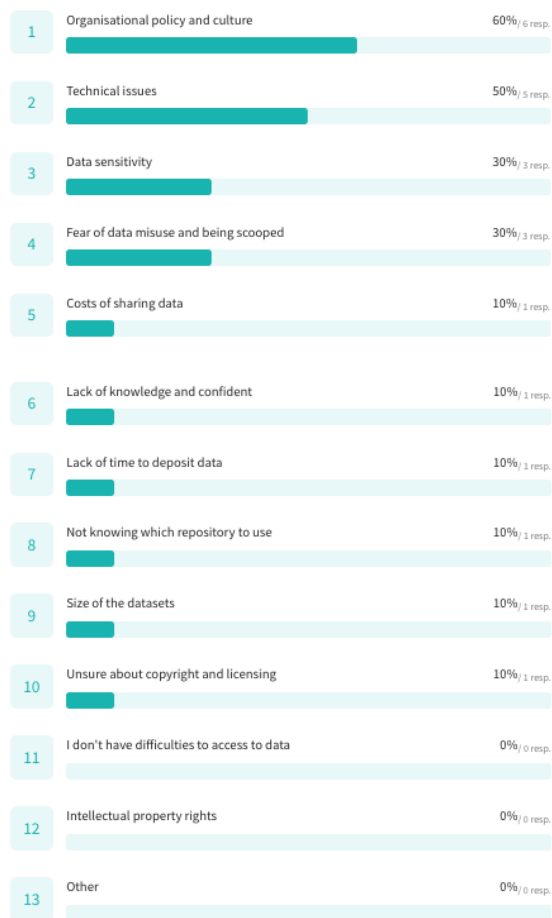


3. DATA SHARING BEHAVIOURS AND CHALLENGES

3a. Please rate how challenging was to have access to data during the Synchronicity project? (1-5)



3b. What were the main challenges accessing real time data from other stakeholders?



3c. Do you have any suggestions or recommendations for future projects about this topic?

"Work on the three levels separately, before developing applications. First technology, then data and only after applications"

"Start from available data since the project proposal "

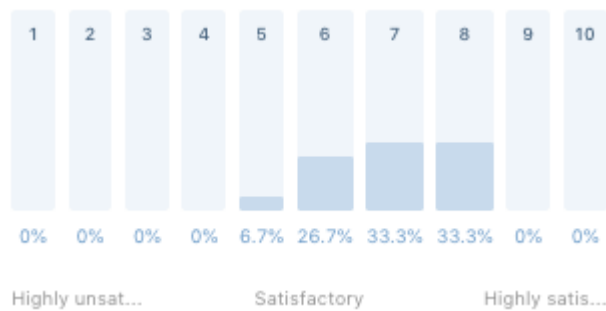
"Work more on changing culture regarding sharing data"

"Clear agreements with all stakeholders"

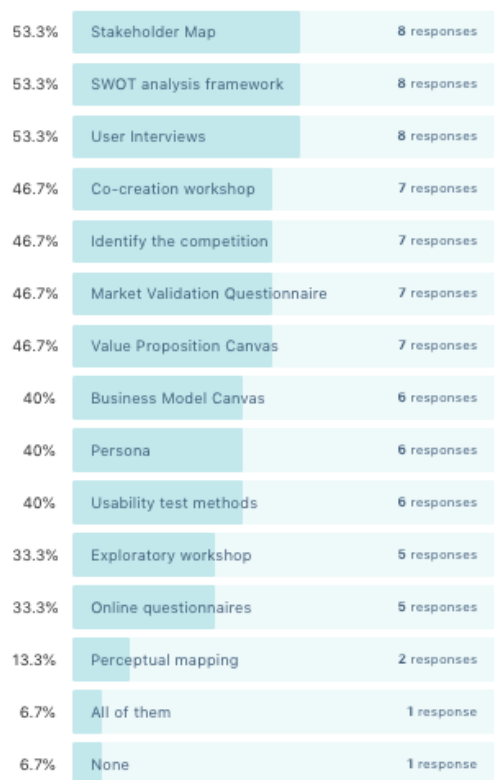
"Focus on clear roles in the consortium including technical specs"

4. WP4 VALIDATION METHODOLOGY EVALUATION

4a. How would you rate the overall experience of applying the WP4 Validation Methodology? (Avg. 6.9)

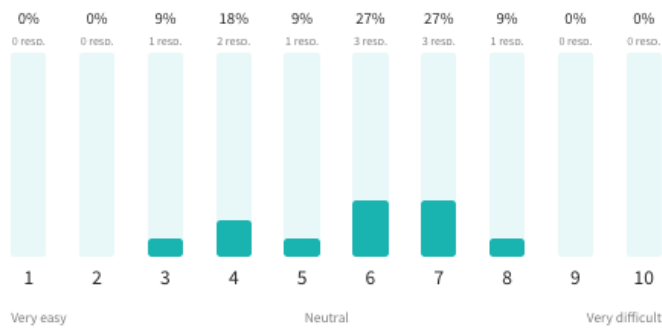


4b. Which tools and techniques did you perform from the WP4 Validation Methodology?



4c. How easy or difficult did you find the activities of the WP4 Validation Methodology? (Avg. 5.3)

5.7 Average rating



4d. What were the main advantages and disadvantages of applying the WP4 Validation Methodology to your pilot solution?

Structure validation

Advantages: including the stakeholders point of view in the pilot implementation Disadvantages: no specific resources on this task where planned in the project proposal

The main advantages consisted of getting to know better end-users expectations and structuring correctly the work to perform

Combining with our own usual validation

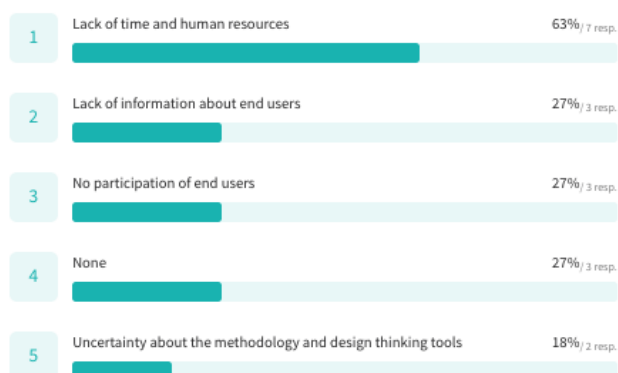
Being able to step back and see the bigger picture

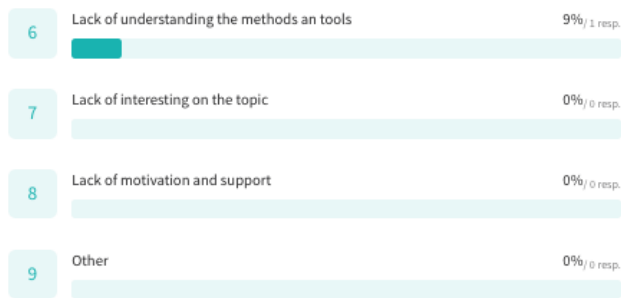
Clear framework provides structure. Inherently, the framework is generic so some adaptation was needed to fit the pilot approach

It was out of scope of the approved DoW. We had 3 pilots and we had to provide more resources to finish the validation

Structured method is very helpful, however inherently this is generic so some modifications had to be made to accommodate our pilot approach

4e. Please select the main challenges you faced during the WP4 T4.3 Validation Methodology application:

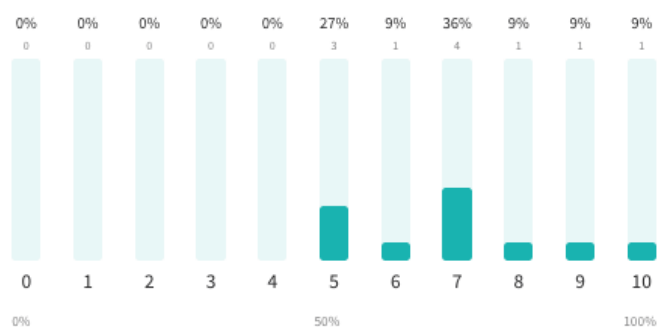




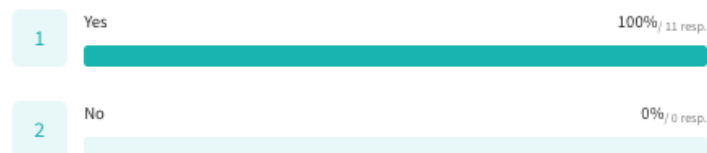
5. PILOT SOLUTION WITH WP4 VALIDATION METHODOLOGY

5a. What percentage of accomplishment does your pilot have when compared to first plans?

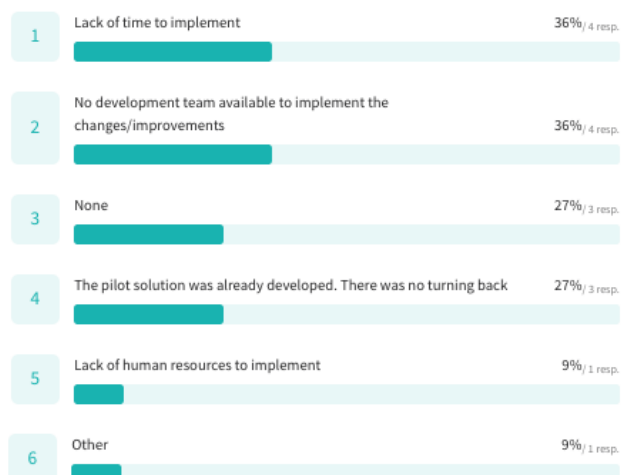
6.9 Average rating



5b. Did you consider any results and learnings that came from the WP4 T4.3 Validation Methodology to adjust your pilot solution?



5f. Please select the main challenges you faced during the implementation phase of the WP4 T4.3 Validation Methodology?



5g. How many features or functionalities did you add to your pilot solution to fit end-user needs?

0|0|0|4|1|1|1|1|5|3|1

5h. How many features or functionalities did you change or improved in your pilot solution to fit end-user needs?

4|0|0|9|1|0|2|1|2|1|1

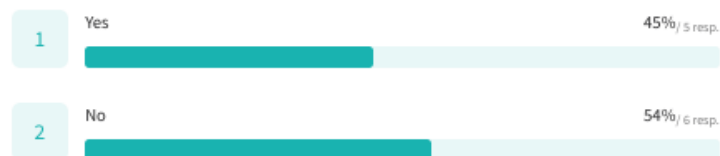
5i. How many features or functionalities did you eliminated from your pilot solution to fit end-user needs?

10|0|0|0|1|0|0|1|0|0|1

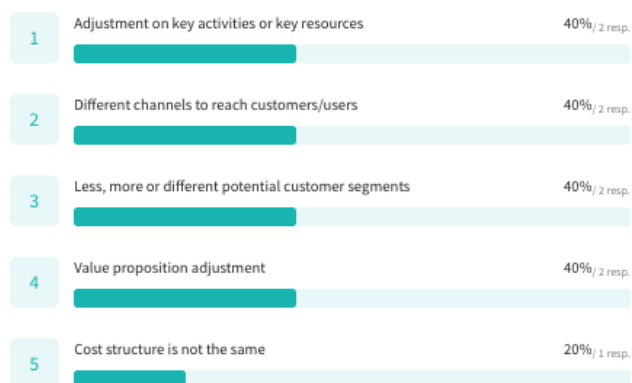
5j. Have you identified new competition, partners, potential customers or users during the validation process?

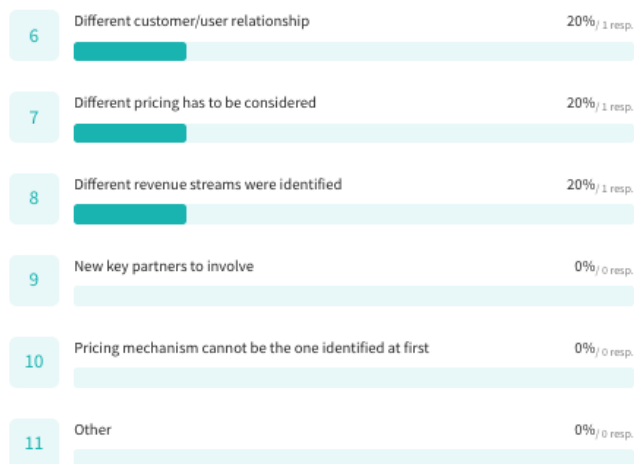


5k. Considering the business or sustainability model you had planned before pilot implementation, did you or will you have to make adaptations?



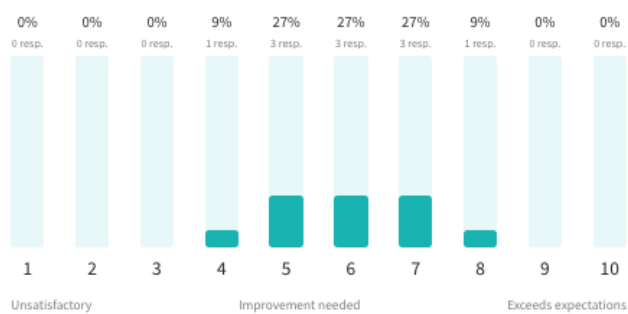
5l. In which fields?



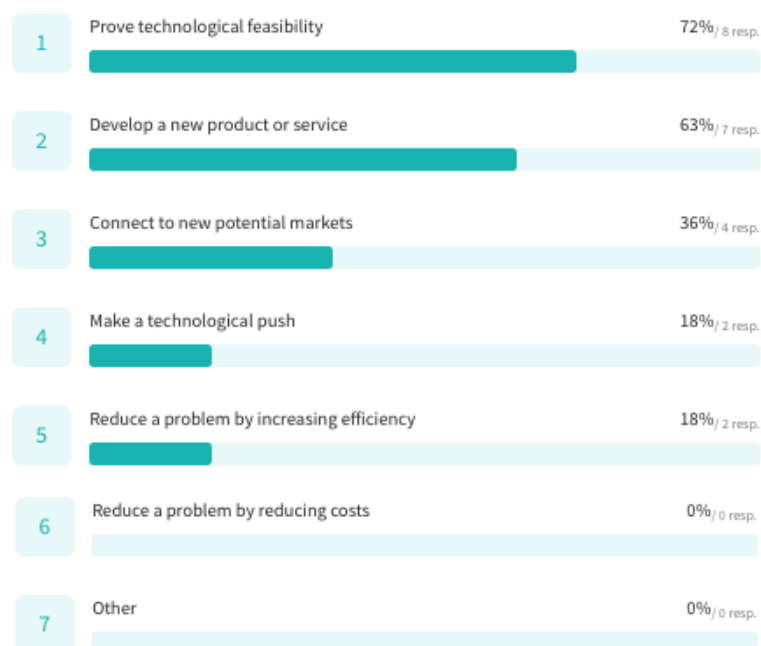


5. How do you rate the improvement of your pilot solution after the WP4 T4.3 Validation Methodology?

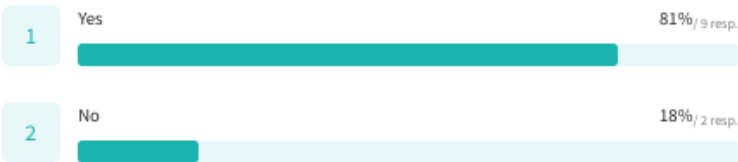
6.0 Average rating



5n. What goals did you have for this pilot process?

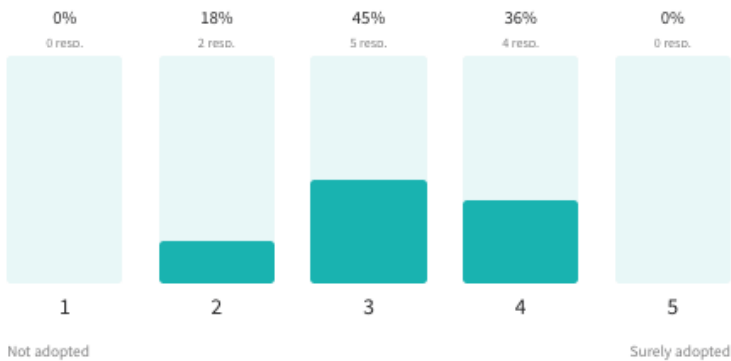


5o. Were you able to achieve the goals you had established?



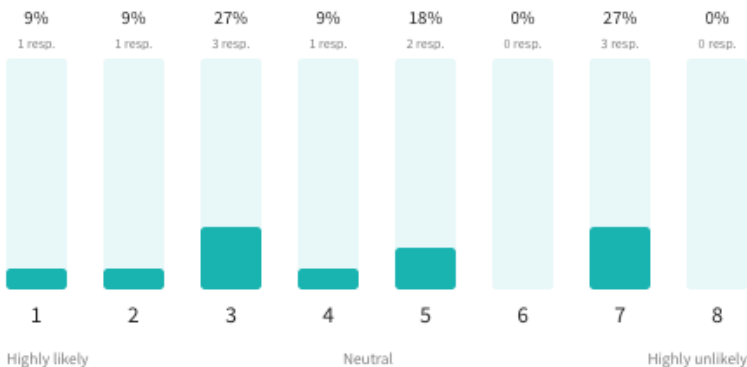
5p. From your evaluation, how likely is it for the solution to be adopted in the city where you've piloted?

3.2 Average rating



6. How likely is it that you will apply the same methods and tools of the Validation Methodology in future technologic projects?

4.3 Average rating



7. What were the main reasons why you decided not to apply the WP4 Validation Methodology?

8. Do you have any suggestions for improving the WP4 Validation Methodology?

None

ANNEX II

The content of the Annex II can be viewed in the following link:

- User, Stakeholder and Market Validation Toolkit, Final version: <https://bit.ly/2OtBubk>

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