This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768908

freeWheel

TECHNICAL AND SERVICE OBJECTIVES AND KEY RESULTS + KPIS

D2.3

Keen Bull

EXECUTIVE SUMMARY

The work for developing this “Technical and Service Objectives and key results + KPIs” deliverable has been distributed all along the human-centered research activities and the technical feasibility studies performed during the WP2. Previous deliverables as such as the Experience Maps and the FreeWheel Stories Repository have strongly contributed in outlining the various pieces of information contributing to this document.

Additionally, we were successful in including and harmonizing the Overarching Goals and the Quantitative Technical Objectives already introduced in the project proposal while submitted almost a year ago.

In picturing the project evolution and trying to facilitate the results exploitation after the project timeframe, we decided to create a flexible framework for adapting the objectives with new knowledge and information. We have now a **hybrid and dynamic SMART objectives framework**.

With this deliverable we achieved a clear and shared understanding of the performances the product and the service must point to. We have a set of **nine Technical Design Objectives** and **six Service Design Objective** that are a solid reference for the work the whole consortium will engage into from now on.

Main steps for achieving this deliverable

We firstly analysed all the **FreeWheel Stories Repository** for pulling out the desirable outcomes and for transforming them into first level performance indicators. The Repository has been continuously built upon from day 1 of the project from consortium partners and contains **130 structured Stories** telling:

1. The perspective about FreeWheel from various stakeholders:
    a. The Client
    b. The Accompanying Person
    c. The Module Manufacturer
    d. The Service Provider
    e. The Third-party Service Provider
    f. The Add-on parts Manufacturer
    g. Anyone else interacting with FreeWheel
2. Different topics concerning the product and the service:
    a. Renting the module
    b. Connecting the module
    c. Buying the module or some related components

d. The module in motion
e. Customer feedback
f. How to use the module
g. Accompanying person role
h. Manufacturing requirements
i. Using the app
j. Module and Service Maintenance
k. Using the module

The Stories are statements of intent written as meaningful people outcomes. They tell project's partners where to go, not how to get there, empowering our team to explore breakthrough ideas without losing sight of the goals. The statements contain the **Who**, the **What**, and the **Wow**.

This is just an example of one Story in our repository:
A client can **detach and attach again the module** even if it **is not on the rack.**

Then we cross referenced the Stories with information included into the internal deliverable named "**Categories of Disabilities**". This document outlines the spectrum of disabilities to consider while designing the service and the product and, as a consequence, it adds more constraints while defining the design objectives.

The permanent motion disabilities we take into consideration, while designing for FreeWheel are:

- all kind of lower limbs medullary lesions (paraplegia);
- incomplete lower and upper limbs medullary lesions (tetraplegia)
- all kinds of neurodegenerative diseases (at the initial stage)
- poliomyelitis
- all kinds of lower legs amputations
- all kinds of neurological disorders affecting movements (evaluated every time)

Regarding the temporary motion disabilities, we consider:

- all kinds of lower limbs injuries
- mono upper limbs injuries (and sometimes both limbs)

The cross-reference between the Categories of Disabilities and the Stories we started to narrow down the ideas around how the module and the service will work and for whom.

The following step was to use the two FreeWheel Experience Journey Maps to refine the expected features and performances in specific contexts (the locations demos: shopping mall and archeological area).

The Experience Journey Maps (more commonly Experience Maps) have been outlined during the human-centered research phase of FreeWheel. Before the Experience Maps we produced another deliverable (Public Deliverable D12) named "**Behavioural Archetypes**" to start having a more precise idea about the needs of people with disabilities in the two specific contexts.

FreeWheel project follows the main steps of a human-centred design methodology. Specifically, the WP2 has the main objective of collecting and analysing data about behaviours, people needs, pain-points and contexts constraints and transforming the distilled insights into product/service features and specific design requirements. We identified four main behavioural archetypes: the **soloist**, the **energy saver**, the **would-be** and the **denier**.

We used the information in this additional deliverable for refining the ideas about features and requirements by cross-referencing them with all the previously aggregated knowledge.

Keeping in mind all the newly acquired knowledge in WP2, we looked at the information already in FreeWheel's project proposal with the aim of aligning and creating an updated set of reference for building the Technical Design Objectives and the Service Design Objectives upon.

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INTRODUCTION

Referring to the FreeWheel experience map (Deliverable D2.2), we have defined two series of high-level design objectives (DOs) and related KPIs for tracking and evaluating the progress towards the design, implementation and testing process for the pilot implementations.

The two series of DOs are:

- the Service Design Objectives (SDOs)
- the Technical/technology Design Objectives (TDOs)

We have preliminarily defined two formats giving us structure and horizontal coherence between partners in the consortium: the MECE and the SMART formats.

MECE framework refers to “Mutually Exclusive and Collectively Exhaustive”, meaning that we do not have objectives with overlapping domains and that all the objectives together will draw an exhaustive set of indicators to drive the project on the right path.

Using the SMART framework, we created crystal clear objectives that are Specific, Measurable, Agreed between all the partners, Realistic and Time-based.

Both series of high-level DOs will be formalized into a tracking spreadsheet owned by the Technical Coordinator, having the role of evaluating the progress towards their completion over time.

Additionally, during the “Task 2.5: Technology and service requirements list definition” we are going to create and update a **RACI matrix** connecting the DOs with the requirements lists.

A hybrid SMART framework

We strongly rely upon a comprehensive network of objectives as a shared and easy tool for committing and following the development of our project. For this reason, we are introducing an additional element, coming from the OKR. OKRs are usually helping to align and focus people on objectives and measurable results with an atomization approach. This atomization approach has been used in our work to define DOs. Basically, we introduced the Key Results element into our SMART Objectives as a practical and more effective reference than traditional KPIs.

Objectives and Key Results example with a soccer analogy:

Who	Objective	Key Results
General Manager	**Make $20M Net revenue 2018**	**Win Champions League**
		Sell matches tickets to 88%
Head Coach	**Win Champions League**	Make 2 scores each game
		1st ranked defence in Serie A
		53% ball possess/game average
Head of PR	**Sell matches tickets to 88%**	Hire 3 bright testimonials
		Get 2 interviews on TV shows
		Highlight key players on the web

The atomization goes on till lower levels. Technically, the upper level's key results are becoming the lower level objectives.

More importantly, during the Task 2.5 we are going to refine e detail all the DOs, continuing generating new Key Results, in order to make the objectives compatible with the pilots and the prototyping purposes.

FreeWheel Overarching Goals

Each series of DOs has one or more **overarching goals** (guiding references) coming directly from the Theory of Change and from the main proposal of FreeWheel project. Starting from the overarching goals, the DOs develops down.

In FreeWheel approved proposal we defined the following general goals:

1. **Promote social inclusion of disabled and elderly**
    a. developing a smart mobility platform based on a reconfigurable autonomous unit to ease individual mobility in an urban environment.
2. **Satisfy the need of customization** of both clients and for modules
    a. by implementing a modular reconfigurable concept based on standard low-cost modules and on ultra-customized interfaces to be produced by additive manufacturing.
    b. by using low-cost standard modules (engine, gears, control unit, HMI, etc.) and highly customized interface (body to unit, engine to unit, unit to infrastructure, etc.) [Modularity];

c. by allowing an easy re-use of standard modules in different products (e.g. same electrification module in different unit fleets, differently customized to the surrounding environment). [Reconfigurability].

3. **Make affordable the lifecycle cost of the above-mentioned mobility service/product**
    a. by implementing an innovative business model that offers the mobility as a service separating the use from the ownership of the units;
    b. by leveraging manufacturing dematerialization to reduce lead time and investment cost, in particular, Additive Manufacturing technologies to reduce the cost of person-to-unit personalization and of unit-to-infrastructure customization;
    c. by sharing investment, cost and revenues all along the relevant stakeholders along the mobility value chain: disabled, urban centre, infrastructure owners, vehicle integrators, service providers, components suppliers, Additive Manufacturing centres. An affordable synergetic investment in the infrastructure is necessary to make simple and affordable the positioning and navigation system;
    d. by leveraging product reconfigurability, achieved thanks to product modularity, to cover large production volumes through the sum of small batches.

Overarching Goals Analysis and Atomization

Overarching Goal	Atomization	Notes
Promote social inclusion of disabled and elderly	Develop a smart mobility platform	Based on reconfigurable autonomous unit
Satisfy clients needs for customization	Implement a modular reconfigurable concept, based on standard low-cost modules	
	Build ultra-customized interfaces	using Additive Manufacturing
	Use low-cost standard modules (engine, gears, control unit, HMI, etc.)	
	Use a highly customized interface (body to unit, engine to unit, unit to infrastructure, etc.)	using on-demand and custom interface elements design
	Allow an easy re-use of standard modules in different products	design for re-use and refurbish
Make affordable the lifecycle cost of the above-mentioned mobility service/product	Implement a mobility-as-a-service (MaaS) business model	
	reduce the cost of person-to-unit personalization	leveraging manufacturing dematerialization to reduce lead time and investment cost, in particular, Additive Manufacturing technologies
	Reduce unit-to-infrastructure customization	
	Share investment, cost and revenues all along the relevant stakeholders	
	cover large production volumes	leveraging product reconfigurability achieved thanks to product modularity

TECHNICAL CONTENT

Technical and Technological Objectives (TDOs)

FreeWheel proposal identified, at the time of its submission more than one year ago (January 2017), a set of **6 Quantitative Technical Objectives (QTO)**. We built the TDOs in connection with and taking into consideration them.

A summary of the original QTO list:

1. **QTO1** - Develop a mobility service based on a modular electric smart unit for wheelchairs with an autonomy > 30km (or, alternatively, in the case of full personalization, a full autonomous electric wheelchair with a weight < 50kg) with customization and personalization feature competing with the high end of the current market (weight of similar models is > 80kg). This objective can be reached after topological optimisation of the e-tractor (30% is the reasonable target for such reduction) and in the case of a full wheelchair of its structural parts.
2. **QTO2** - Favour Social inclusion of people with mobility impairments: the goal of the business plan is to offer an unprecedented mobility service to at least 5000 disadvantaged persons; the condition to reach the objective is the profitability of the proposed business plan, enabler for acquiring market shares and enough customers (see section 2, impact);
3. **QTO3** - Shorten time to market by 70% leveraging Workflow Platform and Additive Manufacturing technologies to cut lead time and shorten production cycles. This objective will be reached by setting up the manufacturing system to produce a personalised, customised wheelchair with no need for dedicated development nor a huge inventory. Indeed, most of the projects addressing individual customisation still require a handcrafted approach that is expensive and time-consuming, with an average time to develop a personalised wheelchair longer than 8 weeks. FreeWheel Workflow platform requires maximum a week for product configuration, optimization and for ordering customer-specific components to the Additive Manufacturing marketplace, which will be able to supply all the non-standard parts in less than 1 additional week.
4. **QTO4** - Reduce by 50% the cost of customised/personalised electric wheelchair down to 3100 € (same content of the 6000€ Sunrise-Jive). Additive Manufacturing will allow minimizing material consumption (-30% vs. total cost) and inventory cost (-20% vs. total cost). Moreover, FreeWheel warehouse stocks are minimal and will include only standard modules (e.g. electric engine, common frame, etc)
5. **QTO5** - Reduce by 50% the lifecycle cost of the mobility product/service. This objective will be reached thanks to reusability and re-adaptability of wheelchair components. FreeWheel wheelchair can be continuously updated, upgraded and repaired, replacing only components who really need intervention. In this way, the average conventional lifecycle of a high-end product, 4 years, will be extended to 8 and more years, accomplishing the goal.
6. **QTO6** - Reduce by 70% the Carbon Footprint because of the reusability and re-adaptability of the components of the personalised products: 40% is the contribution from the extension of the lifecycle, 30 % by the more rational and limited use of raw materials.

QTOs analysis and atomization for producing TDOs

ID	QTOs	ID	TDOs
QTO1	Create a module having >30km autonomy	**TDO 1**	Create a battery system that guarantees a full and continuous use of the module in the location of the service
	In the case of full personalization, a full autonomous electric wheelchair the weight is < 50 kg	**TDO 2**	The combined weight of the wheelchair and the module is < 50 Kg
	Make topological optimisation/reduction of the e-tractor by 30%	**TDO 3**	Make topological optimisation/reduction of the motor/engine component by 30%
QTO3	Shorten time-to-market by 70% leveraging Workflow Platform and Additive Manufacturing technologies to cut lead-time and shorten production cycles	**TDO 4**	The customised adapter connecting the module with clients' wheelchairs must be produced with AM in max 2 weeks
	Produce a FreeWheel manual wheelchair in less than 9 weeks	X	We are moving to a scenario where there is no need to create a FreeWheel wheelchair anymore. The affordability must take into consideration the manual wheelchair already owned by the client.
QTO4	Reduce by 50% the cost of customised/personalised electric wheelchair down to 3100 €	In the project proposal, this QTO has been defined achieved with the following two Key Results. We are transforming the KRs into TDOs.	
	By minimizing raw material consumption by 30% vs. total final product cost	**TDO 5**	Minimize raw material consumption by 30% vs. total final custom interface manufacturing cost
	By reducing inventory for assembling the module, to impact -20% vs. total cost	**TDO 6**	Reduce inventory for assembling the module, to impact -20% vs. total cost
QTO5	Reduce by 50% the lifecycle cost of the mobility product/service.	In the project proposal, this QTO has been defined achieved with the following Key Result. We are transforming the KR into TDO.	
	Extended the 4 years average conventional lifecycle of a high-end product to 8 and more years	**TDO 7**	Enable circular lifecycle by having 50% of module and rack parts for reuse, refurbish or recycle (circular economy).
QTO6	Reduce by 70% the Carbon Footprint	In the project proposal, this QTO has been defined achieved with the following two Key Results. We are transforming the KR into TDO. Additionally, this QTO can be defined as "indirect"; strictly dependent from other QTOs.	
	40% is the contribution from the extension of the lifecycle	**TDO 8**	This TDO is indirect, coming from the previous TDO7
	30% by the more rational and limited use of raw materials	**TDO 9**	This TDO is indirect, coming from the previous TDO5

The analysis process, with the related atomization, allowed a better understanding of a bias to build upon.

The final list of TDOs and Key Results:

ID	TDO	Key Results (KPI)
TDO 1	Create a battery system that guarantees a full and continuous use of the module in the location of the service.	The rack has a modular recharging system allowing 100% service provisioning. The battery should have autonomy up to 20 km (depending on ground surface, weight of user, temperature and topography)
TDO 2	The combined weight of the wheelchair and the module is < 50 Kg	The module in its full-featured status weights around 35 Kg
TDO 3	Make topological optimisation/reduction of the motor/engine component	Reducing by 30% the size of the motor/engine element for the module.
TDO 4	The customised adapter connecting the module with clients wheelchairs must be produced with AM	All the clients receive the custom adapter after maximum 2.5 weeks from the service subscription.
TDO 5	Minimize raw material consumption vs. the total custom interface manufacturing cost	The raw material consumption for creating a single custom interface is 30% less from the usual manufacturing process.
TDO 6	Reduce inventory for assembling the module	The use of modular or AM part is reducing the total module cost of production by 20%
TDO 7	Enable circular lifecycle by having the module and rack parts for reuse, refurbish or recycle (circular economy).	Enable a full service with 50% of elements that can be reused, recycled or refurbished.
TDO 8	-40% Carbon Footprint reduction from the extension of the lifecycle compared with a powered wheelchair	This TDO is indirect, coming from the previous TDO7
TDO 9	-30% Carbon Footprint by the more rational and limited use of raw materials	This TDO is indirect, coming from the previous TDO5

Service Design Objectives (SDOs)

This series of objectives defines and aligns the consortium members in designing, developing and delivering the ground elements for the provisioning of FreeWheel value proposition as a service.

During previous tasks in this Wp, we developed:

1. The FreeWheel Stories Repository, collecting the needs of all the stakeholders involved in manufacturing, provisioning and using the service.
2. Two experience maps for FreeWheel service (see example in Figure 1) in the two pilot locations.

The deliverables allowed the team to land on defining a series of Service Design Objectives.

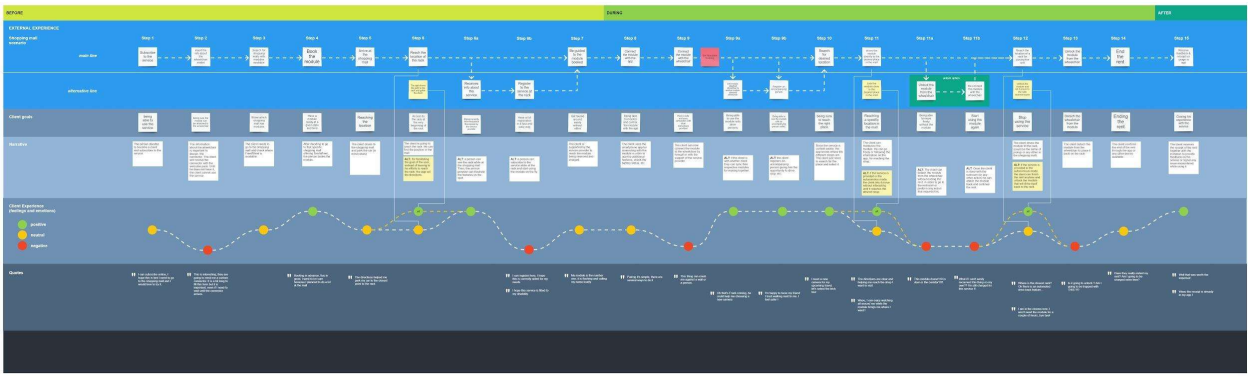


Figure 1. FreeWheel Experience Map - Shopping Mall

SDOs coming from the previous tasks and deliverables

ID	SDO	Key Result (KPI)
SDO 1	Develop a service pricing model in pay-per-use or subscription at a low monthly or yearly fee	Build a pay-per-use model with €0.20/minute
SDO 2	The whole service subscription process is easy, mobile only and paperless	Make the subscription process abandonment rate < 60%[1]
SDO 3	The training for FreeWheel service first-time use is easy to perform	The training for first-time use can be done in 10 minutes
SDO 4	The service platform guarantees location-driven value-added services	The service has APIs system for adding at least 20% of third-party features
SDO 5	The service can be operated by the client without any help from accompanying persons	The module drive rate by the accompanying person stays below 20%

[1] The average mobile cart abandonment rate, all sectors, in Q1 2017 is 52.3% - Source SaleCycle report from 500 leading global brands. Q1 2018 average, both desktop and mobile, is 75.6%

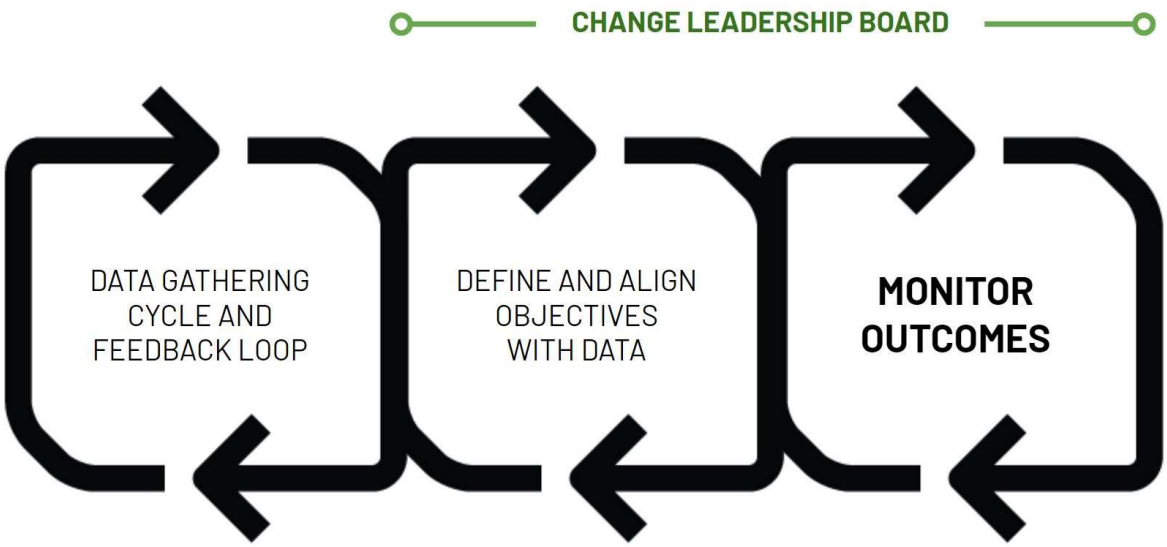
CONCLUSIONS

Both the high-level Technical Design Objectives and the Service Design Objectives should be flexible for better representing realistic indicators all along the project phase but even more after the project will end. The context of this applied research project and its intense customer-centred focus, requires to build both **a strong metrics framework** for assessing and evaluating performances (TDOs and SDOs) and **a smart practice** for evolving the framework itself. We need to have very precise rules, held lightly. We need to validate the objectives and refine them very frequently, in order to make them serve the project's outcomes and not the other way round (the project serving the objectives, even if not applicable anymore).

With the purpose of facilitating this, we are using the RACI Matrix and rely upon Project Coordinators experience and skills to continuously interconnect and evaluate it.

The Objectives Review Process

We are establishing a "Change Leadership Board" with complete oversight of introducing changes and evolving the Design Objectives and the Matrix. The members are: Ilaria Schiavi (IRIS), Anna Valente (SUPSI), Paolo Badano (Genny Angels), Tiziano Luccarelli (Keen Bull), Matteo Astori (MCH). This board will meet regularly for evaluating and introducing changes.



Connections with other WPs and Deliverables

The DOs are a reference for all the design activities in the project, and most importantly both WP3 and WP4. The objectives will be assigned to partners following the RACI matrix. Each partner will refine and add more Key Results in order to leverage in real-time the advantages coming from its own domain knowledge.

Connections with WP3

The objective of WP3 focuses on the design of the FreeWheel mobility mechatronic solution consisting of:

1. the active module (the motor),
2. the rack subsystem
3. the connector with the wheelchair and the motion system

The product design practice will also make use of data collection and synthesis coming from advanced sensing system nested in the FreeWheel solution.

The Technical Design Objectives are directly targeting the way to address points 1 to 3 of the mechatronic solution. Additionally, some of the performances of the interaction between the module, the rack, the connector and the stakeholders are outlined into SDOs (e.g. SDO5 about module operation without accompanying person).

As multiple times referred in this document, the relationships between deliverable 2.3 and the WPs are double ways. In this case, WP3 will fuel extremely valuable information into the Change Leadership Board in order to refine the TDOs and the SDOs. The partners performing the activities in the WP3 must take care not only to execute diligently the tasks but also to close the feedback loop with the Board in order to evaluate and refine (if necessary) the KPIs related with the mechatronics and technology developments.

Connections with WP4

Since the WP4 description in Section 3 of the project proposal explain that *"The current work package fulfils two main objectives: (1) designing FreeWheel service and (2) design and implement the digital touch points for the correct service provisioning."* it is directly clear that the SDOs will have a major connection with the WP4.

As already outlined in the Executive Summary, the intense and fruitful human-centred design phase has gathered a tremendous domain knowledge in all the partners involved and more importantly in the partner currently in charge of leading WP4 (Keen Bull).

For each of the SDOs we can envisage a double group of information: performance indicators FOR the service design phase and performance indicator OF the service in its operation phase. The latter are important to seed in the service and related touchpoint design.

Even if the most visible results of the WP4 will be the ones coming from task 4.4 (Android smartphone app and the rack's digital UI) the SDOs will guide the consortium partners involved in this work package all the way down to task 4.4. More in detail:

- Tasks "4.1 Service design challenges definition" and "4.2 Service ideation" are directly impacted by D2.3 because it will transform and build the elements facilitating the Key Results in for of "design challenges" and service features.
- Task "4.3 Service's features implementation roadmap definition" is indirectly impacted by D2.3 via task 4.1

Connections with Deliverable 2.4 "Social Impact Objectives and Evaluation Model Definition"

With the main objective of this deliverable as described in its opening statement *"With inputs from other consortium partners, FreeWheel Theory of change is developed as a way to capture a shared vision of the success of the project and define how the social impact of the service could be evaluated once it is fully operating."* the deliverable contains a clear vision about the future and specific indicators to track for checking if the desired (and designed) social impact is happening.

Of course, the kind of performance indicators in D2.4 are impossible to track during this project lifetime because are referring to real, lasting and tangible impact on people using the service. We can use the indicators, anyway, as a sort of multiplying effect while implementing SDOs and TDOs in our design activities. We can reference to them (the 2.4 indicators) as a polar star to abilitate while the project will lift-off in real market conditions. Our efforts must reframe FreeWheel physical devices and digital interaction touchpoints as mere tools for reaching the social impact on final beneficiaries.

This reframing will be refined during task "4.1 Service design challenges definition".