A GUIDANCE FOR INTEGRATING AND TESTING SCORE SOLUTIONS IN URBAN LIVING LABS

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Contents

List of abbreviations

LL	Living Lab
ULL	Urban Living Lab
SCORE	Smart Cities and Open data Re-use
WP	Working Package

1. BACKGROUND

Guidance for testing SCORE solutions in Urban Living Labs (ULLs) is a part of Working Package (WP) 5 "Demonstrate and Replicate solutions in nested living labs" in SCORE project that is led by Johanneberg Science Park in Gothenburg, Sweden. This report is tightly connected to Deliverable D5.1 "Develop integration and demonstration plan" of WP5. The aim of WP5 is to integrate, test and optimize solutions in ULLs and replicate the tested results in minimum of two other cities.

Testing in Living Labs (LL) indicates implementing in real-life ecosystems, in this case in a city. This is highly advantageous in SCORE as the solutions will immediately be experienced by end-users in an everyday setting, be connected to the city systems and undergo feedback rounds with developers.

This guidance is a working document for SCORE working groups to assist on setting up a LL procedure, important questions to think on, and evaluation of the results. Even if the document focuses mainly on WP5, testing and replicating of solutions in ULL, it is important to start thinking on the LL context already in the beginning of a solution development, so it will be successfully implemented into a LL. Therefore, objective of this report is also to contribute to a successful fulfilment of the Deliverables 3.7 of WP3 and 4.7 & 4.8 of WP4.

Briefly about SCORE Project

SCORE is a collaborative project between 9 cities throughout the North Sea Region to improve public service delivery based on smart, data-driven solutions. The project aims to increase the efficiency and quality of public service delivery and to reduce the costs on that by 10% (€50M savings for partner cities by 2020). In SCORE project cities co-define shared challenges to improve municipal services and thereafter pool resources and expertise to co-develop 12 innovative solutions. Solutions are categorised in four areas: mobility, water, environment, and meta. Solutions will be tested in one leader partner city and then replicated two times transnationally in existing ULL.

SCORE Partner cities: Amsterdam, Hamburg, Dordrecht, Gothenburg, Bergen, Bradford, Aarhus, Aberdeen, and Gent.

2. WHAT IS AN URBAN LIVING LAB?

The following definition of an ULL is written based on other research documents[1] and material from ENoLL (European Network for Living Labs) learning lab programme that took place last August 2018, in Vienna. There are many ways to describe ULL but in this document the leader of WP5 has identified the ULL as following:

Urban living labs (ULL) are forums for innovation that create the opportunity to develop the city together with residents and other stakeholders from multi-discipline. The aim of ULL is to co-develop innovative ideas, systems and solutions. ULLs are taking place in complex, real-life communities and settings and have a defined geographical area. As ULLs are innovation projects, it is important to evaluate the actions. The most important compounds of a ULL are visualized on the figure below (Figure 1).

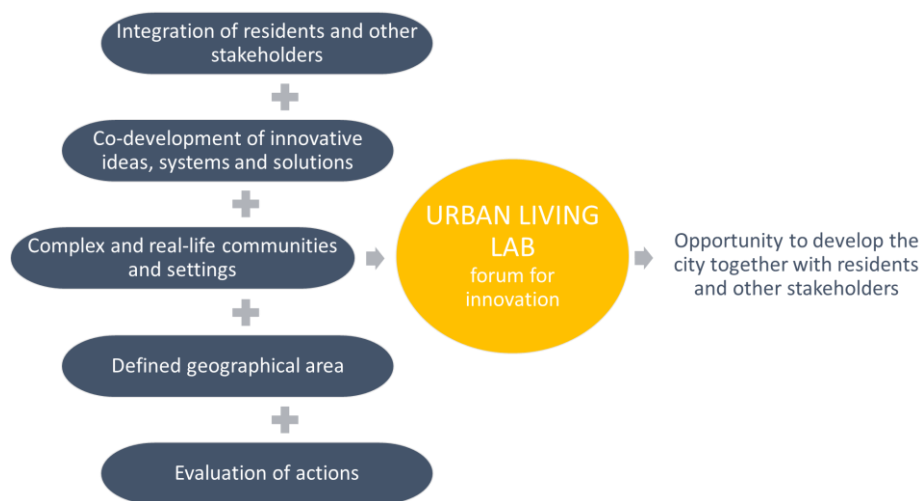*Figure 1. Definition of ULL*

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[1] McCormick, K. LU; Hartmann, C. (2017). The Emerging Landscape of Urban Living Labs: Characteristics, Practices and Examples. *The International Institute for Industrial Environmental Economics*

Steen, K.; Bueren, E. van. (2017). Urban Living Labs. A living lab way of working. *Amsterdam Institute for Advanced Metropolitan Solutions, Delft University of Technology.*

Residents of the urban area are acting as users in the lab, whereas **other stakeholders** are defined as researchers, public organizations and private companies. This four-part project team gives ULL flexibility to address multiple ideas and interests and to produce collective outcomes. Moreover, it is important that all stakeholders are included from the start of the project. Good collaboration between the actors is a key factor but also one of the biggest challenges for a successful ULL.

Co-development of innovative ideas, systems and solution requires to move from a hierarchical way of working to a network collaboration. Co-creation means that all stakeholders are making

decisions together, participate actively, state their opinions, listen to each other, and stay open and transparent. To achieve co-developing process, a suitable infrastructure for communication needs to be developed in the early stage when designing the process. Communication must be adapted to specific activities, interactions and conditions of the solution.

Testing in **complex and real-life communities and settings** makes ULLs different from other types of testing. In that way it is possible to follow the users in their everyday life where there are many more variables and influences than in traditional laboratory conditions.

Defined geographical area where ULL is taking place can be surrounding environment or several discrete areas in case when ULL is distributed in multiple places. ULLs are predominately not virtual platforms, but they can be a digital platform where defined users are located in defined areas.

Evaluation of actions aims to check whether the set goals have been achieved. It includes two levels: technical and conceptual. The technical evaluation focuses on the technical part of the solution: is it working? can it be used by users? are there any technical problems? etc. Conceptual evaluations focus on the aim of the ULL - trying to find out if the aim and the described problem description go together with the innovation; i.e. does the solutions have side effects? Will it be replicated and by whom? etc.

2.1 Important factors of Urban Living Lab

Important factors of ULL can be seen in the Figure 2 and are described below. A well-defined context is seen as one of the most fundamental factors for a successful LL process that needs to be in place before one can move on with developing the solution.

Figure 2. Important factors of ULL

Well defined context including goal, stakeholders, processes and methods
Before starting with an ULL it is important to understand the context where the lab is going to be implemented. The goals, stakeholders and methods should be suitable for the area or environment where the lab is going to take place. It can be helpful to learn more about the local challenges by reading previous studies, interviewing people and/or observing the area.

Context of the ULL should be defined in a way that all stakeholders have the same expectations as well as that every partners' need, and motivations are taken into consideration. It is also common to adjust or reformulate the visions during the process, when more information is coming to be available or after facing some challenges. However, it is important to update all the partners of any type of changes and/or decision.

To identify the right users and stakeholders in the early stage of the process is crucial. Moreover, it is not always possible to include all users. The knowledge and activeness of the right group of users influences a lot the outcome of the learning and testing process.

Leadership and ownership

Even if within ULLs collaboration and co-development is a main component, there should be a well-defined ownership and leadership defining by whom the LL processes will be led and managed. Furthermore, other roles and responsibilities should be divided across the whole LL lifecycle for a good and active collaboration.

Frequent and transparent communication

All accurate and important information should be communicated in regular intervals, including the changes of the project and a clear motivation for it. Make sure that there will be a communication platform or tools that everyone can use to make the communication easy and efficient.

Active collaboration and active partners throughout the process

Active collaboration requires active partners who all have the same understanding of the process and who all have the right motivation to be part of the project. Moreover, it should be clearly stated what is expected from each partner. However, also specific methods for interaction and communication must be suitable for this specific area, participants, area and topic. Both face-to-face and online methods for communication should be used so that all interested partners can participate.

User's participation in the early stage of development

Users (citizens) participation already in the early developing stage is important to define the challenges that are really concerning them. For example, when forming a challenge, it could be a good idea to ask users to define the problem or how the current solution can be improved. In this way, it is possible to avoid developing solutions that are not addressing the real problems or/and that will not be used by citizens.

Since ULLs are innovation projects, they have a big chance not to achieve their goals and possibly go through big changes during the working process. This should be not seen as a direct failure but could be used as a valuable **learning** point and possibility to **exchange knowledge** with others. In addition, gathering **feedback** from users is a valuable input for future development.

Suggested documents about ULLs for further reading can be found below:

- McCormick, K. LU; Hartmann, C. (2017). The Emerging Landscape of Urban Living Labs: Characteristics, Practices and Examples. *The International Institute for Industrial Environmental Economics*.
  Online
  https://lup.lub.lu.se/search/publication/77262ed5-1219-4798-89d9-872286efdb7b
- Steen, K.; Bueren, E. van. (2017). Urban Living Labs. A living lab way of working. *Amsterdam Institute for Advanced Metropolitan Solutions, Delft University of Technology.*
  Online
  https://lup.lub.lu.se/search/ws/files/27224276/Urban_Living_Labs_Handbook.pdf

3. EXISTING ULL IN SCORE PARTNER CITIES

Today the SCORE partner cities that have ULL in place are: Aarhus, Amsterdam, Ghent, Bergen, Hamburg, and Gothenburg. Characteristics of those ULLs are concluded in Table 1 that can be used to find a suitable ULL for a specific SCORE solution. Notice that not all ULLs are directly open to SCORE solutions and some of them function more as a visualization platform (i.e. Amsterdam Smart City). A more detailed introduction of each ULL can be found in Annex 2.

Table 1. Existing Urban Living Labs in SCORE partner cities

Name	Location	Sector	Nr of projects	Openness
MUST	Norway, Bergen + 35 surrounding municipalities	Mobility, transport	1 ongoing	Everyone connected with the sector (public, private)
Aarhus Smart City Lab	Aarhus city centre, harbour area, including university, hospital and Agro Food park and a street between them	Not specified	1 ongoing	Currently open for everything
Amsterdam Smart City	Amsterdam, an online community platform -not defined geographical area.	Digital city, energy, mobility, circular city, citizens & living, governance & education	>70 projects & initiatives	Everyone working with smart urban development can post their project in the platform.
Ghent Living Lab	Ghent, but non-defined geographical area	Not specified	-	Preselected by Ghent
ElectriCity	Gothenburg, Sweden	Mobility, public transport solutions, other environmental solution	>20 innovation & research projects	Not open to everyone, but possible to test if the project has collaboration with one of ElectriCity partners. Johanneberg Science Park and Gothenburg City are partners.
TAVF	Hamburg, Germany	Automotive and connected driving	-	Everyone connected with the sector (public, private)

Table 1. Existing Urban Living Labs in SCORE partner cities. (Continued)

Name of ULL	Standardized processes	ICT Infrastructure	Currently existing open data	Owner of the data tested
MUST	1. Innovation lab 2. Datalab 3. Living lab	AZURE Microsoft in Datalab	Public transport (stops, routs, peoples flow etc.) City bikes Traffic sensors (number of cars of the road) Air pollution	Owner of the project
Aarhus Smart City Lab	None today	Big screen in the harbor Sensors about wind, rain, sea-level, water temperature	Data about wind, rain, sea-level, water temperature. Data owned by the city	Owner of the project
Amsterdam Smart City	None today	None	No directly - only through specific projects	Owner of the project
Ghent Living Lab	None today. Every project will be evaluated separately and will have their own specified process	No central testing infrastructure provided today	-	-
ElectriCity	None today. Every project will be evaluated separately and will have their own specified process	Ericsson Innovation cloud, but not open to external use	Today there no open-data available because of GDPR but they investigate opportunities	Owner of the project
TAVF	None today	37 traffic lights equipped with communication systems ITS-G5: wireless communication between vehicles and the traffic infrastructure More ICT infrastructure to be added.	-	-

Table 1. Existing Urban Living Labs in SCORE partner cities. (Continued)

Name	Suggestion to/ connection with SCORE	Contact information
MUST	SCORE solutions could be one of the themes is Innovation lab and develop them further, find collaboration partners	Tom Osnes Svellingen Tom.Svellingen@bergen.kommune.com
Aarhus Smart City Lab	Every solution is welcome to come and test. Could be a win-win situation for both sides: SCORE solutions could be validated, and City Lab could get back the information how to develop their lab (what services, tools are needed)	Kim Stannov Søvsø kstsv@aarhus.dk
Amsterdam Smart City	Not specified	Cornelia Dinca cornelia@amsterdamsmartcity.com
Ghent Living Lab	All SCORE solutions will be looked through to see their potential to be tested in Ghent with their help	Tim Van Achte Tim.VanAchte@digipolis.gent Justine Ottevaere Justine.Ottevaere@stad.gent
ElectriCity	Air quality, traffic situation in the city, real time travel information	Evdoxia Kouraki evdoxia.kouraki@johannebergsciencepark.com
TAVF	Are closely working with Hamburg solution group, GeoNetBake	Samaneh Beheshtikashi samaneh.beheshtikashi@lsbg.hamburg.de

4. CONNECTION BETWEEN EXISTING ULLs AND SCORE SOLUTIONS

 In SCORE project, the aim is to test each developed solution in one existing ULL and thereafter replicate it in two other locations of followers or co-developers. Having an existing ULL is an ideal situation, however, it is not always the case. Reasons for that can be no available or suitable ULL in partner cities or criteria that do not match with the solution. In this case, the solution group needs to develop their own small scale ULL. A checklist to check if the solution is suitable for a small scale ULL can be found in Annex 1.

On the figure below (Figure 3), two different situations are illustrated; a) when there is an existing ULL available (left) and b) when there is no ULL in place (right). An existing ULL acts as a platform that can provide access to a network or infrastructure that makes developing field-test easier. In that case, the geographical area will also be defined by the ULL.

If there is no ULL in place then the network of users, suitable infrastructure and geographical area will be defined by the solution group itself. This process could be made easier with help from a relevant department of the city government which can assist with legal aspects and finding the suitable geographical areas or network.
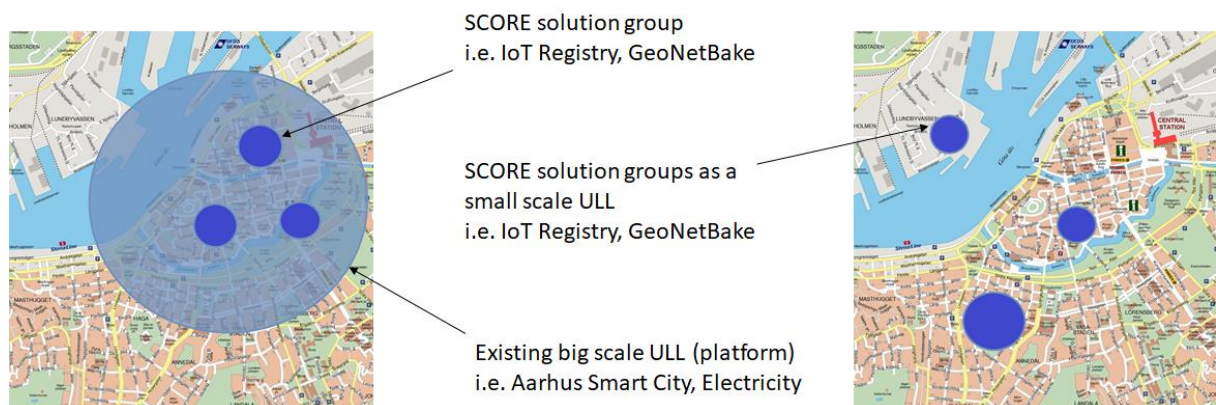

Figure 3. SCORE solution groups with and without existing big scale ULL (platform)

Current solution groups in SCORE project can be divided into three categories based on their potential to be tested in ULLs (Annex 1). This categorization was done based on important factors of ULLs introduced in Chapter 2 in this document in April 2019 and can change over the course of the project.

1. **Solutions with no potential**

In this category, the solution groups have aimed to visualize the data and leaders have taken an approach not to open the solution for testing in ULL nor gather feedback from users.

Examples of current SCORE solutions: Challenge Visualiser & Explorer (Ghent & Digipolis Ghent) – A visual tool for defining common challenges and help to form solution groups

2. **Solutions with low potential**

Solutions that have a low potential to be tested in ULLs are mainly meant for internal use and do not aim to work with citizens. This category can also involve solutions that are missing one or more important characteristic of ULLs and need to be developed further to be suitable for ULL. Most commonly those solutions are missing the connection with citizens in co-developing and evaluation phase, as well as, testing in real-life settings. To improve the solution to a level where it can be tested in ULL, it is important to go back to a stage where the aim and users were defined.

Examples of current solutions: GeoNetBake - Intelligent roadworks vertical panels

3. **Solutions with high potential**

Solutions in this category have fulfilled all the requirements for ULL or are missing one of the characteristics. It can also include the groups where the owners of a solution have an idea to test it in the real-life settings but have not found a suitable ULL yet or need to make small adjustments to meet criteria of an existing ULL.

Examples of current solutions: Citizen Science as Service - for Flooding.

5. 8 STEPS TO INTEGRATE AND TEST SCORE SOLUTIONS IN ULL CONTEXT

In the following chapter, guidelines for integrating and testing SCORE solutions in ULL environments are presented. The guide includes 8 steps; , the focus of this document lies on Steps 2-4 that are connected to integration, testing and evaluation. Step 1 is covered mainly by WP3 and WP3 (Defining Challenges and Solutions, and Solution Development) and is an introduction to WP5. 5-7 will be covered in another document while Step 8 is an exit from WP5 to WP6 (Scale up).

The guide is set up by providing important steps that need to be undergone for a successful LL test and that are complimented by questions that should be answered before moving on to next steps. Each action should be documented for future evaluation as well as for a good project work. It is important to mention that the steps and questions should be taken as general guidelines and smaller adjustments might be needed to fit it for a particular solution or working group.

The guide is meant to be used in situations where there already is an existing ULL in place. However, as discussed in the previous chapter, there is no big difference between having an existing ULL or developing one. Only that in the latter one, it is especially important to have a city government in the project team who can help with legal aspects and permissions.

The estimated time to undergo integration, testing and evaluation (Steps 2-4) is approximately 1 year, depending on the exact solution and how long the test period will be.

Before starting with the guide, it is recommended to go through all the steps together with the whole working group to see how the process will look like and to define the responsible person(s) to follow the process and/or plan ahead. It is also recommended to establish a contact with the leader of WP5, Johanneberg Science Park, who can assist the process and act as an external evaluator.

Other related documents:

- **D3.1 Guideline for Smart City Challenge detection and Solutions Selection, WP3**

This guideline will be used in WP3 and should be finished before moving to next working packages. The whole process of the guideline is based upon a Design Thinking double diamond design process and should enable partners to go from a more linear approach in defining challenges and selecting solutions to an iterative process in small loops to fine-tune towards well defined technical solutions.

- **Key Performing Index**

Monitoring system for user satisfaction and cost of service delivery. The documents developed by Aberdeen should be used as a supplement to this document to define time frame and to identify and measure KPI's in Step 2 and 4.

Figure 4. 8 steps to integrate and test SCORE solutions in Urban Living Lab context

8 STEPS TO INTEGRATE AND TEST SCORE SOLUTIONS IN URBAN LIVING LAB CONTEXT

Active partners. Active collaboration. Regular meetings. Transparant communication. Good documentation.

City government

Private actors

Citizens

STEP 1. INITIATION AND DEVELOPMENT OF SOLUTION (WP3 & WP4)

Research institutes

Well defined context of a field-test, including users, methodology, process and evaluation of feedback. Idenifying and connecting with local ULL.

Actions to take: Finding a suitable ULL, Defining users, Defining field test, Making an evaluation plan

STEP 2. DEVELOPMENT AND PREPARATION OF LL FIELD-TEST

CO-CREATION OF SOLUTION

CONNECT/ CREATE ULL

From challange groups to solution groups (leaders, developers, followers). Well defined context (goal, stakeholders, processes, methods) of the solution.

Important to think of: Stakeholders involvment, aim and objective of the solutions. Are you planning to test your solution in ULL context?

STEP 3. FIELD-TEST

Taking the solution out to real-life context.
Actions to take:
1. Design the task for users
2. Define the time frame
3. Select the user group
4. Conduct a workshop and baseline evaluation
5. Narrow down the users group
6. Testing the solution
7. Continuous data collection
8. Midterm evaluation and improvement
9. Closing the test & final user experience

STEP 4. EVALUATION & DOCUMENTATION

Including all partners and documenting the results in a transparant and accessible way.

Actions to take: Conceptual and technical evaluation, working group evaluation, documentation

STEP 8. SPREAD RESULTS & SCALE UP (WP6)

STEP 7. FINAL EVALUATION & DOCUMENTATION

STEP 5. IMPROVMENT OF THE SOLUTION

STEP 6. REPLICATION & REFLECTION

STEP 1. INITIATION & DEVELOPMENT OF SOLUTION

The aim of Step 1 is to define common public service delivery challenges that cities are facing today and to formulate solution groups. In SCORE project, Step 1 belongs under WP3 and WP4 and is led by Ghent Stad and Amsterdam and therefore not discussed deeply in this document. Further information and guidelines can be found in SCORE community webpage (*D3.1 Guideline for Smart City Challenge detection and Solutions Selection*).

From the LL perspective, it is important to have a well-defined working group and a well-defined context of the solutions (goals, other stakeholders, processes and methods). More information about ULLs can be found in Chapter 2.
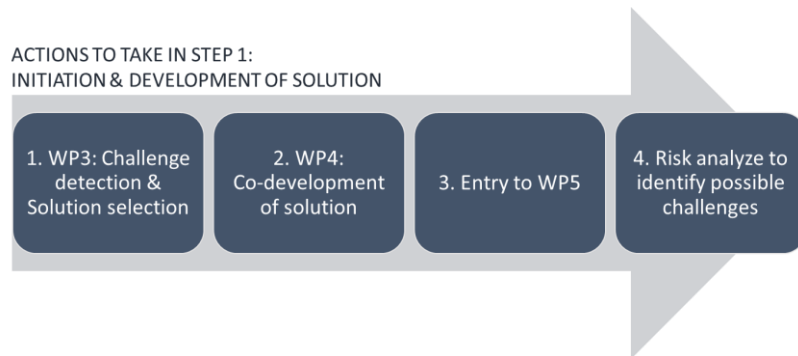

Figure 5. Actions to take in Step 1

Step 1 includes four actions as illustrated in the Figure 5: Challenge detection and solution selection, Co-development of solution, entry to WP5 including the question about ULL, and risk analyse to identify possible challenges.

Important questions to answer and to document in Step 1:

ENTRY TO WP5

The main question to be answered is following:

Have you planned to test your solution in an Urban Living Lab (ULL) context?

a. If no, why or in which other context are you going to test your solution?
b. If yes, have you identified existing ULLs for testing your solution within your solution group cities?
  i. If yes, which ones?
  ii. If no, is there a plan to create your own small-scale LL test?

Additional questions:

a. What is the aim and objective of the solution and does everyone agree with that?
b. What problems the solution will solve in the society? How is it useful for citizens/users?
c. Who will be: the owner of the solution, co-developer(s) and/or other following partners?
d. Who is responsible for further development of the solution/ responsible for scaling-up?
e. Which stakeholders are you going to include and how? (Private actors, city government, research institutes, citizens)

RISK ANALYSIS

With every innovation project there are many risks involved that can lead to a "failure" of the project. However, it is important to mitigate those risks and challenges by avoiding them already in the beginning of the process. Based on the literature, the most common challenges of living lab field tests are for example formalization of collaboration, legal and ethical challenges, engaging people and partners, extra unnecessary work for end-users because the field test is in progress, biased follow-up and evaluation. Before moving on to Step 2 it is recommended for a working group to make a risk analysis and see if there are any risks that are possible to identify before solution field-test. Template for risk assessment is provided in Annex 3.

a. What are the risks and challenges to test the solution in a field-test?
b. Are all the legal and ethical aspects considered?
c. What are partners' motivations to be part of the solution group? Do you share the same vision and goal?
d. What are the responsibilities of each solution group member?
e. Are there regular meetings and communication?
f. Are there open and transparent communication methods and tools available?

STEP 2. DEVELOPMENT & PREPARATION OF LL FIELD-TEST

Theoretical preparation for integrating and testing in a LL is crucial for achieving the wanted outcome of the field test and for creating a good baseline before approaching out to real-life settings. In this step, the aim is to define the context of field-test that includes defining users, methodology, process and evaluation process. In addition, an existing ULL will be identified and contacted in this step (the list of existing ULLs in partner cities can be found in Table 1).

Step 2 can be done in parallel with co-developing technical aspects of the solution. It includes 4 actions: finding a suitable ULL, defining users, defining field test and creating an evaluation plan. The suggested time frame for this step is 1-3 months. It is suggested to make a good and transparent documentation for a better follow-up and evaluation in the later steps. Do not forget to think of data protection during field tests and when spreading information or results.
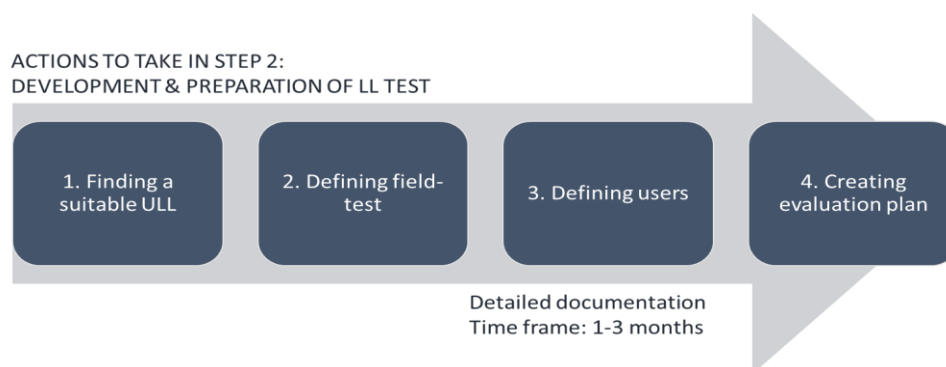
ACTIONS TO TAKE IN STEP 2:
DEVELOPMENT & PREPARATION OF LL TEST

| 1. Finding a suitable ULL | 2. Defining field-test | 3. Defining users | 4. Creating evaluation plan |

Detailed documentation
Time frame: 1-3 months

Figure 6. Four actions to take in Step 2

There are three layers of aspects that are influencing the outcome of the ULL test and should be taken account when defining users and field test:

- Social aspects related with end-users: resources, attitude, knowledge, personal characteristics
- Technical aspects related to the developed solution: user friendliness, technical problems and challenges, usefulness to users (Does it really solve the problem?)
- Socio-technical aspects related to process: timing and design of the task, interaction between actors and/or developers.

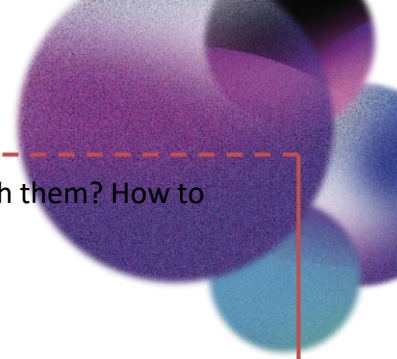**Important questions to answer and to document in Step 2:**

1. URBAN LIVING LABS
   a. How to include the local ULL in your solution development process?
   b. What resources are there already available in the existing ULL and how would it be possible to use them?

   Resources in existing ULL can be for example available open data, network, sensors, and defined geographical area. Make sure that available resources will match with the aim of your solution. For example, that the defined geographical area has users that are needed for field-test.

   c. If there is no ULL available, consider creating your own small-scale LL. See Chapter 4.

2. FIELD TEST
   a. Is the timing right for field testing?
   b. What is the aim of testing?
   c. Will the test be conducted in physical or digital environment?
   d. What be the geographical area or the field test?

   Geographical area can be defined already by an existing ULL or will be defined after defining users. Tests can be held at people's home or workplaces or at public places.

   e. What methods are you going to use for field test and how?

   Field test can be carried out by using digital methods, interacting directly with users, or using sensors, cameras, apps.

   f. How the interaction with users is carried out?

3. USERS
   a. Who is your target group and why? What is the aim of including those users/citizens?

   When identifying appropriate users, find a balance between visible characteristics such as gender, age and education and invisible traits such as personal value and technical skills. On one hand, it would be good to select users randomly, on the other hand, selecting users consciously makes it easier to meet the aim of field-test. The more random is a user group, the bigger is the chance that there will be people with lower technical skills and the outcome of the field test and evaluation will not be as planned.

   b. What is the size of the user group? How many users should be involved?

    c. Where and how to find users? What channels will be used to reach them? How to approach them?

    d. How to involve citizens? How to motivate them to join?
        What is it in for users? Why is it beneficial for them?

    e. What is required from the end-users?

4. EVALUATION
    a. What is the aim of the evaluation?
    b. What are the Key Performance Indexes (KPIs)?
        Guidelines can be found in a separate document under WP5 and are developed by SCORE project partners from Aberdeen.

    c. What methods are you going to use to collect feedback from users?
        Data collection methods can be e.g. questions popping up in the app, participant's diaries, observation, individual or group interviews, email or other online platforms, post-test questionnaire.

    d. How will the evaluation of the user experience be held?
        Guidelines can be found in a separate document under WP5 and are developed by SCORE project partners from Aberdeen.

    e. What can be learned from received feedback?
    f. How often the evaluation will take place?
    g. Will there be a midterm evaluation?

STEP 3. FIELD-TEST

The aim of Step 3 is to implement and test the solution in real-life context, collect feedback and data and make a user experience evaluation. In the beginning of this step, there should be a clear vision of how the field-test will be carried out: the geographical area should be defined, and the technical development should be finished.

Step 3 includes 9 actions (Figure 7) and will begin with designing the task for user. It is followed by defining the time frame for testing and selecting the user group to conduct a first workshop. Thereafter, it is suggested to narrow down the user group for a test phase. During the test phase the data will be collected continuously for a midterm and final user experience evaluation.
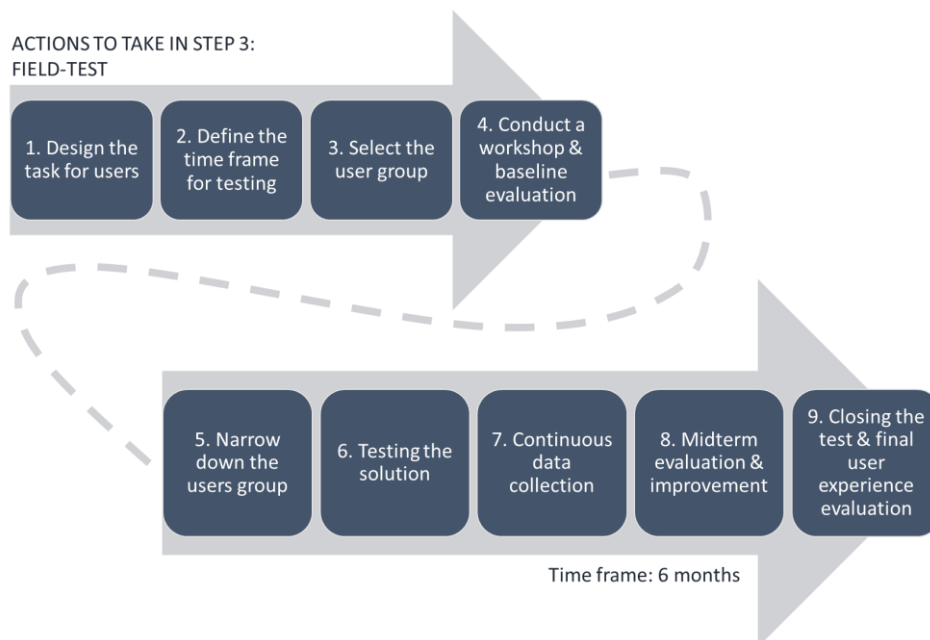

Figure 7. Actions to take in Step 3

Description of actions and important questions to answer and to document in Step 3:

1. DESIGN THE TASK FOR USERS
    The task should be easy to use and easily understandable and designed in a way that unnecessary data transmission with the user's device is avoided as far as possible. When designing the process, it is important to make clear instructions for users, including what is required from end-users (time, technology) and what are the

benefits for users (Step 2). In addition, make it clear how the data will be collected and how the feedback/user experience will be carried out.

   a. Is the task designed in a way that it is understandable for every user?
   b. Is the task designed in a transparent way so that the user know about what data is collected?

2. DEFINE THE TIME FRAME FOR TESTING

When defining the time frame, it is suggested to set up one long test period for users but divide it internally into two shorter periods to make a midterm evaluation and have a possibility to make improvements to the solution. If the testing period is long, prepare some reminders for users or think how to interact with them over the whole period to avoid losing interest by users.

   a. How long is the test period?
   b. When is the midterm evaluation?

3. SELECT THE USER GROUP
   a. Does the selected user group have the technological skills and knowledge that are required for testing the solution?

4. CONDUCT A WORKSHOP

After selecting a user group, it is suggested to make a first workshop to introduce the solution and see if selected users are the right target group. It can be good to include more participants than it is thought to include in field-test. In that way it is possible to select people who are actually interested in committing time and resources to test the solution. During the workshop make the first baseline evaluation.

5. NARROW DOWN THE USER GROUP

The smaller the group of users is, the better are the conditions for communication and interaction. If the participants can sign up by their own, it is a lower chance that they drop out or lose interest. When accepting people to field-test it is also important to think of their personal characteristics, if they have for example technical skills for the test because it will influence the outcome of field-test and the feedback that is given.

   a. Are the selected users along the aim of field-test?

6. TESTING THE SOLUTION

When testing the solution, it is important to think on user's data protection, perhaps by allowing participants to delete or hide their personal data might increase the likelihood of long-term and stable user involvement. Also define the methods how users can communicate and create a good interaction possibility.

a. Do you have all the resources for the operation of the ULL (e.g. personnel, knowledge, materials)?
b. Do you have a communication method between users and developers? If yes, who is responsible for it?
c. Is your test following all the legal aspects?
d. If there are any urgent problems coming up during the test period, who is the person responsible for solving them?

7. CONTINUOUS DATA COLLECTION

Every kind of feedback and data should be considered, not ignored. Make sure that you are following GDPR.

8. MIDTERM EVALUATION

If the test is carried out in two or more phases, make an internal evaluation with all co-development partners and go through if the technical aspects are functioning well, if the user group is right, if the testing is fulfilling the aim of the field-test etc. (Step 2). Maybe there is something that needs to be change immediately, for example if the task for users was not clear enough or many users are using the solution in a wrong way.

9. CLOSING THE TEST & FINAL USER EXPERIENCE EVALUATION

Right before or after closing the test, make the final evaluation of user experience. It is suggested to make it when the users are still engaged with the task to have a higher rate of people answering. Also inform participants about their influence on a solution and what will be your next steps. It is good to leave the door open for users to come back with ideas or feedback.

STEP 4. EVALUATION OF THE FIELD-TEST & DOCUMENTATION

Evaluation is one of the most important characteristics of ULLs and should include both, technical and conceptual aspects (more in paragraph 1 - *What is Urban Living Lab?*). The evaluation process should be done by including all partners and all the results should be documented in a transparent and accessible way. Evaluation should include both positive and negative feedback as well as analysis of the results and the steps for future work. Step 4 provides a good opportunity to evaluate the working group: communication, involvement of all stakeholders (research institutes, city government, and private actors), leadership and ownership.

Step 4 includes 4 actions: Conceptual evaluation, technical evaluation, working group evaluation and detailed documentation. To take those actions, it is suggested to compare the results with the baseline set under Step 2.
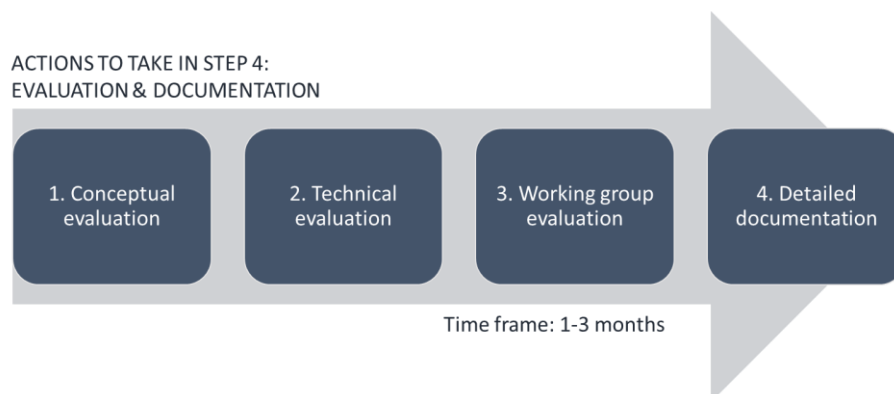
ACTIONS TO TAKE IN STEP 4:
EVALUATION & DOCUMENTATION

| 1. Conceptual evaluation | 2. Technical evaluation | 3. Working group evaluation | 4. Detailed documentation |

Time frame: 1-3 months

Figure 8. Actions to take in Step 4

Important questions to answer and to document during Step 4:

1. CONCEPTUAL EVALUATION
   a. Did the test fulfil its goals?
   b. Were the methods chosen for the test right foe the users?
   c. Was the target group size appropriate?
   d. Did people use the solution?
   e. Did the solutions solve the public service delivery problem for the users? Did it cause any unwanted problems?
   f. Were all the legal aspects and data protection requirements followed?
   g. Were data collection and feedback methods suitable for the solution? And did we get the necessary feedback?
   h. Are there any conceptual changes that need to be addressed? And who is going to be responsible for it?
   i. Will the solution be replicable? If so, under which conditions, on which scale, and by whom?

2. TECHNICAL EVALUATION
   a. Did the technical aspects work as expected?
   b. Could people use the solution? Were the instructions clear and understandable for users?
   c. Did people have any technical problems that restricted the usage of the solution?
   d. Did people use the solution in the way it was expected?
   e. What technical changes need to be done? And who is going to be responsible for it?
   f. Is the technology developed by the solution group suitable for the local community?

3. WORKING GROUP EVALUATION
   a. Has the communication been regular and transparent?
   b. Are there any communication methods that need to be improved or changed?
   c. Have all the solution partners been involved and active?
   d. Does everyone have the same understanding of the project (vision and goal)?
   e. Are there any structural changes in the group? Is there any stakeholder who is missing?
   f. Are there any changes in leadership and ownership?
   g. Is everyone motivated to take the solution further (replicate and scale up)?

ANNEX 1: Checklist for Urban Living Lab suitability

Before moving to WP5 and start working with guidelines to integrate and test the solution in ULL context it is recommended for each group to think if their solution have the potential to be tested in ULL or are they missing some important factors. If there is a suitable ULL then those missing factors can be complemented with the help from the ULL. For example, if the group hasn't defined a test area then the ULL platform might have a suitable place for testing the solution. If there is no suitable ULL in the city where the solution group wants to test their solution, then it is good to go through the factors and see if there is something that needs to be complemented or added.

Checklist for the leader (or co-developer) of each solution working group to use.

1. **Does your solution have a potential to be tested in Urban Living Lab (ULL)?**
   In the table below, it can be seen potentials of SCORE solutions to be tested in the ULL environment in April 2019. The evaluation of the groups is done based on the important factors of ULL and can be changed over time since the solutions are under development phase.

Table 1. Potentials of SCORE solutions to be tested in ULL environment, April 2019

Active (or ready to be formed) solutions	Leader	Solution's potential to test in ULL	Existing ULL in the city	Comments
IoT Registry	Amsterdam	Low	Yes – AMS Data Lab	Even low but if redefined and include citizens then high potential.
Citizen Science As Service-for Flooding	Bradford University	High	?	A new ULL needs to be developed
Drukteradar/Congestion Radar	Amsterdam (?)	-	Yes – AMS Data Lab	
GeoNetBake	Hamburg		? (CSTI, Automated Connecetd Driving)	A testbed is in place – potential to transform into ULL
ROADS	Hamburg		?	
Environmental multimedia citizen reporting system – Open 311	Ghent & Digipolis Ghent	High	Yes- Ghent Living Lab	
Challenge Visualiser & Explorer	Ghent & Digipolis Ghent	Really Low	Yes- Ghent Living Lab	A visual tool for common challenges, Not aimed to be tested in ULL.
Linked Open Data Taxonomy Manager	Ghent & Digipolis Ghent		Yes- Ghent Living Lab	

2. **Does your solution fulfil the following factors?**
(Mark the ones it fulfils in the table below). If there are any factors that are missing, discuss with the working group how they can be included to your working process.

Table 2. Checklist for solution groups to check their compliance to ULLs

ULL important compounds:	Yes/no/unclear	Comments:
Integrating residents and other multi-disciplinary stakeholders *(i.e. users, public actors, private actors, knowledge institutes)*		
Co-development of innovative ideas, systems & solutions *(i.e. ULL utilizes citizen participation methods, various co-design methods for understanding the needs, generating solution ideas and evaluating the solutions in practice)*		
Complex and real-life communities and settings		
Defined geographical area *(i.e. surrounding environment or several discrete areas if the ULL is distributed in multiple places. Can be also a digital platform where the users are in some defined area)*		
Evaluation of actions *(i.e. actions or processes including evaluation of ideas, solutions being developed)*		

ANNEX 2: Description of ULL in SCORE partner cities

Amsterdam Smart City

Location: Amsterdam, Netherlands

Sector: Digital City, Energy, Mobility, Circular City, Governance & Education, Citizens & Living, Governance & Education, Citizens & Living, Smart City Academy.

Amsterdam Smart City[2] is an innovation platform that brings together proactive citizens, innovative companies, knowledge institutions and public authorities to shape the city of the future. Amsterdam Smart City is working with the following themes:

The core values of Amsterdam Smart City is to cooperate to create public value and work from a social, economic and ecological perspective. Residents play a crucial role in the development of the city. Amsterdam Smart City engages them via its partners, via online community and offline events. The aim is to continuously learn how transitions develop and try to do right interventions. Organize public dialogue and stimulate cooperation between public organizations and public-private partnerships. The platform is open and transparent to everyone and partners often communicate about their activities and results. Investigating conditions and regulations that are necessary for new solutions to succeed.

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[2] Amsterdam Smart City. Online. https://amsterdamsmartcity.com/

Aarhus Smart City Lab

Location: Aarhus, Denmark

Sector: Currently open to everything

Aarhus City Lab[3] is a digital test centre for smart city solutions and a showroom for smart initiatives. The City Lab creates a digital playground for Smart Aarhus, but also for partners who can investigate and develop new solutions directly into the real-life case area in the centre of Aarhus. Geographically Aarhus City Lab stretches from Agro Food Park in Skejby to Dokk1 in the city centre of Aarhus. The epicentre for most initiatives will be found at the harbour front between Navitas and Dokk1. The city lab will also include Aarhus University and hospital, as well as food innovation centre Agro Food Park.

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[3] Aarhus City Lab. Online. https://www.smartaarhus.eu/node/196

MUST - a mobility laboratory for the development of smart transport solutions

Location: Bergen + 35 municipalities around, Norway

Sector: Mobility, transport

MUST laboratory[4] will be a catalyst for technology development, commercial development and social development in relation to mobility and transport by finding the solutions of the future. MUST is a collaboration between Hordaland County Authority/Skyss, the City of Bergen and the other municipalities in the region, and the Norwegian Public Roads Administration. The aim of the laboratory is to connect businesses, universities and public sector connected with mobility but also people outside of the sector to get different viewpoints.
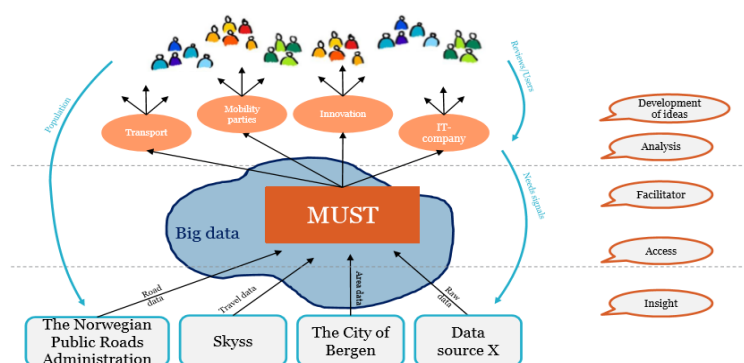
MUST laboratory include three labs that act as stages. The idea can enter to MUST and go through all the stages but can also jump over for example directly to Living Lab or move back to the previous stage.

- Innovation Lab
  The aim of the lab is to create and develop ideas and matchmake them with right collaboration partners. But also, to help to get contact with right city departments who could help for example with permits or local public transport. The themes for workshops are decided by partners.

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[4] Skyss. (2018). MUST. Online. http://informnorden.org/wp-content/uploads/2018/11/2.4-Hanne-Alver-Krum-Skyss-Bergen.pdf

- Datalab
  The aim of the lab is to make a data analysis, simulation of the idea and verification.

- Living Lab
  In that part of the laboratory it is possible for projects to test in real-life conditions.

After testing in LL environment, the project needs to find another place for scaling up. MUST is not meant for this today. Today there has been two workshops in MUST innovation laboratory there one project has grown out and is stepping further to stage 2, Datalab.

ElectriCity

Location: Gothenburg, Sweden

Sector: Mobility, public transport

In Gothenburg, Sweden 15 partners from industry, academy and society are now working together to develop, test and demonstrate new solutions for the future. This cooperation goes under the name of ElectriCity.[5]

The testing and evaluation of electric bus operations is a central part of ElectriCity. Since June 2015 electric buses have been operating on route 55 between the two campuses of Chalmers University of Technology in Johanneberg and Lindholmen districts. As part of ElectriCity we are also creating a platform for the development and testing of services and products that

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[5] ElectriCity. Online. https://www.electricitygoteborg.se/

can contribute to more attractive public transport. For example, new bus stop solutions, traffic management systems and safety concepts as well as systems for energy supply and

energy storage. What is more, new business models for sustainable mobility in the city will be tested. The idea is that these should be able to be scaled up outside the demo arena.

When an all-electric bus moves in the urban environment, stops and recharges indoors, new situations arise that are of considerable interest to the research fraternity. For instance, how pedestrians and other vulnerable road users are affected by a bus that moves almost silently, or how passengers perceive and use the new solutions that come with the new bus service. Indoor bus stops are an entirely new phenomenon.

ANNEX 3: Template for Risk Assessment Matrix

A risk matrix is used during the risk assessment in Step 1, action 4, to identify the level of risk by considering consequences and likelihood of potential "failure" aspects in ULL test. To make the risk matrix, it is needed to list all the possible risks, including technical, conceptual, and to grade them based on the scale provided on the Figure 1 below. After assessing the risks, it is suggested for the working group to also create a list of actions to mitigate them.

Two key questions to be asked when using a risk matrix are following:

1. Consequences. How bad impact has the factor on the outcome of ULL field-test?
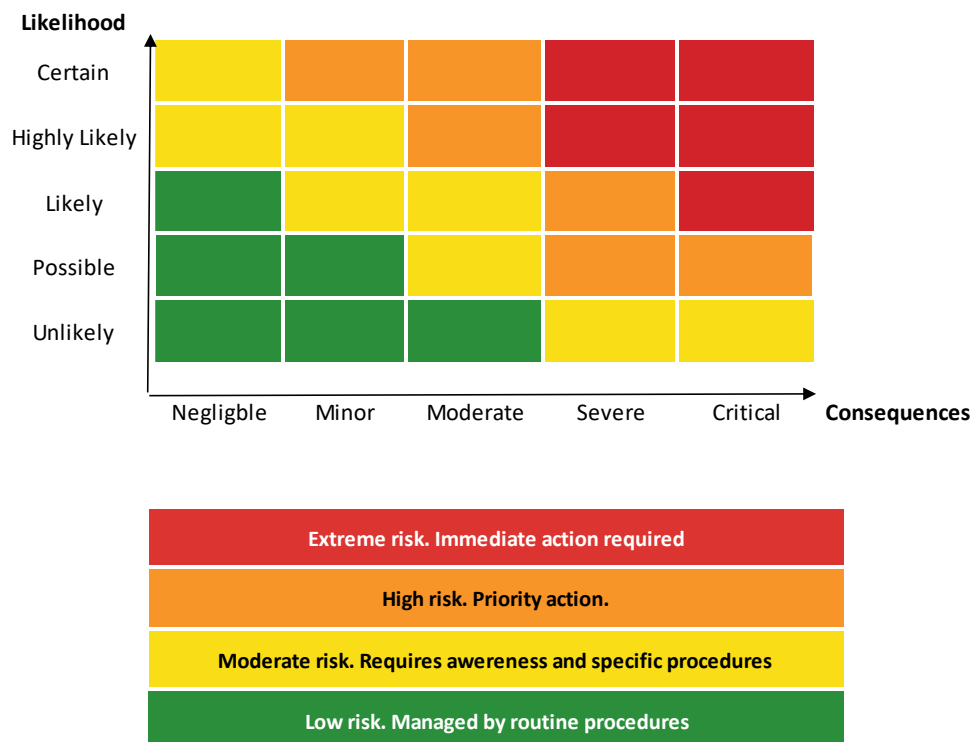2. Likelihood. How likely the factor is going to appear during ULL field-test?

Figure 1. Risk assessment matrix