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Workshops on User Acceptance

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1. EXECUTIVE SUMMARY

This document summarises the content of the work undertaken with the five large-scale pilots (LSPs) projects currently funded by EC under the Internet of Things (IoT) European Large-Scale Pilots Programme [1], on user acceptance, through workshops, as well as one-to-one support to develop and apply a common user acceptance framework.

In general terms, users are only willing to accept innovations if these innovations allow them to achieve their goals in a better way than existing solutions. The definition of "better" will be determined by context and include a range of factors relating to the technologies in question. While the exact definition of the criteria to determine acceptance varies across each of the LSPs, it is possible to provide a common framework to design, measure and track the not just the degree of user acceptance among the different user groups, but also to identify opportunities for collaboration and exchange of good practice. To this end, a user acceptance Board has been used by the LSPs to share information on the user acceptance testing and its results.

It is worth noting that the application of a STARTS ((S+T)*ARTS - Innovation at the nexus of Science, Technology, and the ARTS) [1] methodology, such as Open Prototyping, can make a distinctive contribution to testing user acceptance by helping to enhance users and LSPs creativity in conceptualizing new problems and corresponding solutions.

Most of the large-scale pilots have completed the user engagement phase of their pilots to confirm the initial design requirements. The next step is to translate these activities into defined and measurable user acceptance criteria. While this process has commenced in all LSPs, those that have a more devolved structure and/or are larger have found it more complex to define criteria in sufficiently meaningful detail and/or attach target values to KPIs. Other common challenges faced by the LSPs and explored through the workshops include:

- Agreeing target values across pilot sites
- Implementing and managing user acceptance testing
- Aggregating data
- Managing unique user acceptance testing events
- Minimising direct user input.

Some of the more successful strategies used to solve some of these issues include:

- Use of data generated by the devices: rather than ask users for feedback, LSPs can use the data provided by the device itself to measure frequency and length of use, for instance.
- Optional use of device: where this is an option, a true measure of user acceptance is the degree to which a user is free to choose to use the device or not.
- Simulations of singular events: where events are infrequent, one of the LSPs enlists the help of student to run mock events and test user acceptance.
- Use of surveys: where users must necessarily be asked to participate in surveys, the length of the survey must be kept to a minimum with only directly relevant questions.
- Centralised user acceptance teams: incorporating members of local pilots thereby facilitating the consistent application of criteria across the pilot sites.
- Cultural diversity: creation of Ethics boards or similar bodies that can design a consensus position that can be applied across the pilot sites.

Finally, it must be remembered that most user testing has still to take place. It is therefore imperative that the LSP remain engaged and continue to use the tools that have been developed to guide continued cross-fertilisation and shared learning to maximise user acceptance across all domains.

2. INTRODUCTION

2.1 Purpose and target group

This document provides an overview of the work completed to date in relation to agreeing a common framework for user acceptance testing and starting to implement a variety of methodologies across pilots and use cases.

This first year has been a year for fine-tuning the implementation of the LSPs and, for the most part, the large-scale use cases are still to be initiated. This has enabled us to work with the LSP in a collaborative manner, explore the different parameters that are common across all LSPs and set up a framework that enables them to learn from the user acceptance testing that will take place on an ongoing basis until the LSPs are fully deployed. With this in mind, a dynamic content tool has been designed to ensure that LSPs can share the results of the testing in each of their most relevant use cases and learn from the results of user acceptance testing conducted across other LSP domains.

Section 7 offers a novel approach to integrating the arts into future testing through STARTS as an alternative to some of the other more social science or purely data-led methodologies.

This document will be of use to:

- Partners in the LPSs involved in designing user acceptance testing, as a record of their inputs to date and the best practice gathered from discussions with other LSPs.
- Partners in the LSPs who may not have directly participated in the definition of the user acceptance testing methodology but who may need to act upon the results of the tests (e.g. technical partners involved in the design of the solution).
- Other stakeholders and parties who may be interested in increasing the degree of user acceptance by taking into account the results of the tests and the remedial action taken in similar IoT contexts and domains.

2.2 Contributions of partners

This report has been written by the main partners of the CREATE-IoT consortium that participate in WP03:

- BLU: responsible for preparation and overall design and delivery of the workshop, co-ordinating the ongoing work with the IoT LSPs to define and learn from each other's user acceptance test and drafting this report
- FE: responsible for providing the content illustrating how the Arts and the creative industries can contribute to improving user acceptance.
- IDATE: responsible for providing input to the review of the content.

2.3 Relations to other activities in the project

The work on user acceptance testing was launched at the Geneva workshop in June 2017 (please see methodology at Section 3, below). The workshop provided the first real opportunity to come into face-to-face contact with members of the LSP consortia and to understand the stage of development of each of the initiatives. As such, the preparation for the delivery of the workshop itself revealed the need to take into account varying stages of development in each of the LSPs, as well as the differences in the organisational structures for deployment and delivery mechanisms.

As the LSPs have matured, so the workshops on user acceptance have been able to become richer in content and increase in value to participants and contributors.

It is also worth noting that the work on user acceptance can feed into other CREATE-IoT work packages:

Table 1: User acceptance and other activities in CREATE-IoT

No	WP	Relation
01	Coordination and Support to the IoT Focus Area	• The workshops enabled the teams involved in WP3 to gain a greater understanding of the LSPs with a view to developing effective support tools and begin to establish direct channels of communication.
02	IoT Large Scale Pilots Ecosystems Arena for Sharing Common Approaches	• The workshops have enabled discussion on how the LSPs might begin to work with each other; information on deployments and ecosystems have be integrated into a map that can be used for identifying events in which LSP Users are close either in terms of geography or profile.
03	Creation, Innovation and Adoption	• The WP under which the workshops have been prepared and delivered.
05	IoT Policy Framework - Trusted, Safe and Legal Environment for IoT	• Trust, privacy and security are factors that impact upon user acceptance and therefore are expected to form part of the user acceptance tests. This is an area in which the STARTs methodologies (Section 7, below) might be particularly relevant.
06	IoT Interoperability and Standardization	• In certain context, the degree to which the IoT solutions can be easily integrated into existing work/life habits will affect adoption and acceptance. It is likely that interoperability will play a role in user acceptance testing and assessment.
07	Communication and Collaboration Strategy, Dissemination and Events Management	• User acceptance testing enables direct two-way communication with a wide range of ecosystem stakeholders. • Testing events can also be used as a direct way to monitor the value of IoT across use cases to different user groups and highlight the role of CREATE-IoT and the LSPs.

3. METHODOLOGY

3.1 Methodological overview

The methodology for developing a common methodology for user acceptance testing and sharing results has had collaboration and sharing of information and insights as its primary aim and has involved the following five stages:

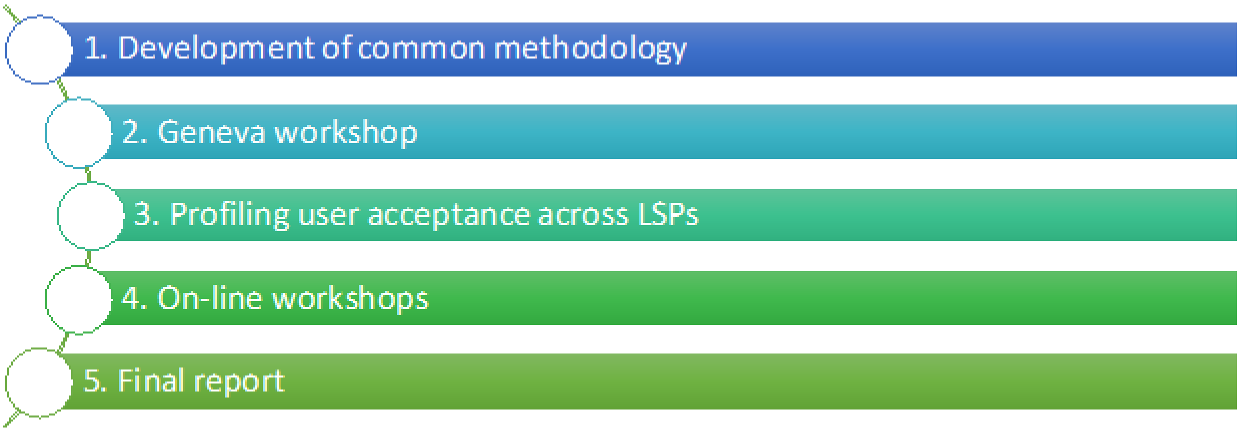

Figure 1: Methodology for developing user acceptance testing in the IoT LSPs

The focus has been on:

1. Understanding how IoT LSPs planned to address user acceptance,
2. Exploring the possibility of developing and adopting a common methodology
3. Setting the ground and establishing the tools for sharing results and concrete ways in which user acceptance could be tested.

3.2 Development of common methodology

The first step for the development of a common methodology has required an analysis of current literature on:

- The factors that impact upon user adoption in IoT contexts
- Existing methodologies for determining and testing user acceptance
- Potential key performance indicators that can be used to measure and act upon user acceptance.

Of particular interest has been the work of the Unify IoT consortium. It has offered a simple categorisation of factors that impact upon IoT adoption. A full list of the sources consulted is provided in the bibliography at the end of this report.

3.3 Geneva Workshop

The Geneva Workshop was held on 9th June 2017 alongside IoT Week. The workshop was first real opportunity to come into face-to-face contact with members of the LSP consortia and to understand the stage of development of each of the initiatives. As such, the AG04 Ecosystems Accelerators and Marketplace representatives were asked to provide certain basic information on the ecosystems, user groups, use cases and needs analysis that had been performed in the design and definition of the pilots. The information provided was then analysed and incorporated into the workshop material, including an interactive map, to explore user acceptance and provide a

basic common conceptual framework that can be further adapted to the IoT ecosystems and use cases.

The objectives of the workshop were to:

- Understand what, where and how the IoT LSPs are being deployed and how their value to users can be tested.
- Identify the ecosystem and user groups with a view to finding common ground across the LSPs.
- Exchange best practice to date in involving users in the design phase.
- Understand the value of including an artistic (STARTS) perspective to fast-track acceptance and adoption in the future.
- Define how user acceptance will be determined for each LSP and establish a roadmap for testing.

3.4 Profiling user acceptance across the IoT LSPs

User acceptance has been explored in greater detail across the LSPs on two levels:

- One-to-one sessions with each LSP representative or group of representatives
- Activity Group 4 Accelerating IoT Ecosystems monthly meetings

3.4.1 One-to-one sessions with LSPs

Following on from the Geneva workshops, the BLU team held individual sessions to support the application of the methodology across the IoT LSPs. These sessions were focused on starting to explore the opportunities with each IoT LSP that could be used for testing user acceptance and more specifically:

- The context in which the testing will take place
- User groups involved
- Devices deployed
- Parameters to be tested
- Results expected (KPIs)
- Test results
- Remedial action to be taken

A google shared sheet was developed that enabled the IoT LSPs to input their information and see how user acceptance would be approached in each of the other IoT LSPs. On average two follow-on sessions have been held with the IoT LSPs, punctuated with reviews of any information included in the shared sheets.

3.4.2 AG4 meetings

In addition to the individual work to support the IoT LSP, AG04 on Accelerating IoT Ecosystems has served as a focal point for sharing updates on user acceptance and ensuring that the work progresses at a steady rate. A total of seven AG04 meetings have been held with 8-12 participants present at each of the meetings.

3.5 On-line workshops

Following the work performed individually with the IoT LSPs, two on-line workshops were organised by BLU to share experiences and approaches on the three stages involved in testing user acceptance:

- Stage 1: Planning
    - Description of key users in each IoT LSP

    - Definition of user acceptance scenarios/use cases
    - Definition of user acceptance criteria
- Stage 2 – Execution
    - Testing locations
    - Testing methodologies – in-person, online, passive data collection
    - Supporting user problem reporting
    - Proposed timetable for testing during pilot implementation – key stages
    - Tester profile and capacities
    - Internal communication strategies
    - Knowledge sharing protocols
- Stage 3 – Analysis and Response
    - Documentation of test results and data management
    - Description of potential quantitative and qualitative data
    - Supporting the agile translation of results into development

The first on-line workshop, held on the 4th December 2017 involved a total of 8 participants from ACTIVAGE, AUTOPILOT, MONICA and SYNCHRONICITY and CREATE-IoT. The second on-line workshop was held on 19th December 2017 with a total of 11 participants from ACTIVAGE, AUTOPILOT, MONICA and SYNCHRONICITY, U4IoT and CREATE-IoT.

3.6 Final report

The final reporting stage has been focused on bringing together the results of the previous stages and documenting the main factors that impact adoption, describing the common methodology and providing an overview of how user acceptance will be carried out in the each of the IoT LSPs

4. THE CONTEXT FOR IOT ADOPTION

4.1 Key stakeholders in IoT adoption

Much research has already been performed on the principal factors that affect user adoption of IoT technologies. Among the most practical recent documents is the "Report on the factors of user's acceptance framework and societal and education stakeholders" [1] completed under the H2020 Supporting Internet of Things Activities on Innovation Ecosystems, UNIFY-IoT Project.

The report distinguishes between four main stakeholder groups:

- **Technology providers and developers** that integrate and offer IoT technologies to the market; they operate across the value chain from research to industry;
- **Services and business providers** that provide goods and services that are themselves built upon IoT deployments; these include data management, communication or processing services, among others;
- **End-users and consumers of IoT solutions**; research shows they are particularly concerned with issues regarding the safety and privacy of their data.
- **Policy makers** who influence IoT deployment through the development of appropriate policies and regulations, as well as through initiatives that stimulate collaboration between the different ecosystem actors.

Each of these stakeholder groups are driven by different incentives to adopt IoT solutions. The barriers they encounter might also differ significantly, although there are some areas of overlap. In any case, the focus of the CREATE-IoT consortium on this topic will focus primarily on the user acceptance of IoT technologies in the context of the IoT LSPs.

4.2 Main factors impacting on IoT adoption

The work undertaken by the Unify IoT consortium has offered a simple categorisation of factors that impact upon IoT adoption: technological and business.

The technological factors include:

- **Energy and power supply** that will enable edge devices in the field to become more sustainable; essentially this means that electricity supply must be guaranteed and/or battery resilience and life must be appropriate for the intended use: this factor is particularly relevant for deployments in rural areas, in farms or in cities.
- **Accuracy and unambiguity of data**. This can be dependent on the quality of the sensor itself but in any case, the data must not only be collected but also processed prior to a given action being performed. This may also require data to be collected in real-time and analysed rapidly. This factor is relevant across all IoT LSPs but the consequences of inaccurate or ambiguous data would be particularly severe in the context of health or autonomous driving deployments.
- **Connectivity and interoperability** refer respectively to the capacity of the infrastructure to support the connection of millions of devices at the same time, and the capacity of those devices to communicate with each in accordance with established protocols[1] and can function in different contexts. Interoperability also refers to the ability of users (for instance industrial users) to integrate the IoT solution into their legacy technology seamlessly.

[1] Including Wi-Fi, Bluetooth low energy, ANT, ZigBee, RF4CE, LoRa or Sigfox

- **IoT Platform availability and sustainability** is another key factor for widespread adoption of IoT. There is a myriad of different IoT platforms available that enable the development on services, some are proprietary, other are open. In any case, the ease of use, availability and access of these platforms open up opportunities for new vendors of IoT solutions.
- **Privacy, data ownership and security**: the impact of GDPR on IoT is still to be seen but it is clear that the core issues of data ownership, privacy and control of data must be addressed at multiple levels of IoT deployments. Recent security breaches such as those caused by the Reaper Botnet have revealed how vulnerable IoT devices currently are. These breaches can significantly undermine user acceptance of the technology across all the IoT LSPs and must therefore be dealt with at design stage, both on a software and hardware level.
- **Regulation and standardisation**: competition, while introducing the element of choice for the consumer in the short term, can lead to excessive market fragmentation in the medium and longer-term. A challenge for the IoT LSPs is to manage the process of de-facto standardisation and ensure the interoperability of solutions across a wide variety of different contexts, devices and regulatory regimes, regardless of the architecture, programming language, communication protocol, network operator or analytical platform.

The business factors that affect IoT adoption include:

- **Ecosystem approach to IoT**: the traditional view of a linear, sequential value chain is ill-fitted to the IoT paradigm in which stakeholders interact with other on a connected network basis and in real-time, over multiple sites, platforms and devices/tools.
- **IoT Business cases:** an issue that is being addressed directly by each of the IoT LSPs as they deploy IoT technology in a wide range of use cases that are value rather than technology-driven. This in turn will drive adoption as other stakeholders are able to see the advantages of implementation, as well as being able to perform cost benefit analysis.
- **IoT Business models:** based large on new possibilities that arise from the exploitation of data, whether generated by private or public players. In an IoT context, the data may be generated by devices or machines. While some stakeholders may wish to retain a proprietary approach, others may find that the data they generate is of value to third parties and explore ways in which this value can be monetised. This is turn will have legal and regulatory implications.
- **Legacy technology**: there are risks associated with changing legacy systems and processes that may outweigh the unknown and unproven benefits associated with adopting IoT. This notwithstanding, there is an increasing body of evidence that suggest that the technology is mature enough for the risks to be lower than two or three years ago:
  - $178 bn IoT spend in 2016
  - 77% of business leaders say that IoT is ‘just beginning’, and will transform business as we know it [2]
  - 66% of early-movers in manufacturing say IoT is critical to competitive advantage
  - 88% report a return on financial investment [3]
- **Qualified IoT personnel and skills:** as with many ground-breaking technologies, the lack of specific IoT skills among the existing workforce, both at operational and management level, remains one of the biggest obstacles to full IoT adoption. This can be remedied through the provision of IoT training that is introduced into educational curricula, company training programmes and professional refresher courses.
- **Existence of IoT Ecosystems**: it is important that businesses have access to IoT ecosystems that are able to offer value across IoT architectures, platforms and business

contexts. A platform approach with standardised identifiers, protocols and architectures can help solve important technical challenges in the different verticals and across verticals and enable new players to develop value-based solutions. There is, however, a danger that too many non-interoperable platforms are being developed with the consequent risk of fragmentation of the market and increased costs for developers of new value-added services.

- **Cost**: the cost of developing and deploying IoT solutions is becoming more accessible to a wider range of businesses. Due to the achievements in the last decade on cloud services and the proliferation of communication protocols, it is cheaper and faster to establish new solutions without expensive capital costs and maintenance while sensors only get cheaper, with the average cost of IoT sensors predicted to reach $0.34 by 2020, down from $1.40 in 2004. [4].
- **Government and public authorities**, strategy, involvement and public policy. Once again, in so far as end users see that the regulatory framework can protect them from potential misuse or abuse of their data, IoT adoption will be increased.

5. WHO IS THE USER? AN ECOSYSTEM APPROACH

5.1 Defining user groups

As stated earlier, the Unify IOT research has identified four major IoT stakeholder groups:

- Technology Providers
- 3rd Party Services
- End-users
- Policy-makers

Within the context of the IoT LSPs, however, the stakeholders form part of the ecosystem approach of the large-scale pilots and address a broader group than suggested above. For impact, adoption and eventual sustainability it is clear that for each pilot, the end-users are not the only groups essential to the uptake of the developed solution.

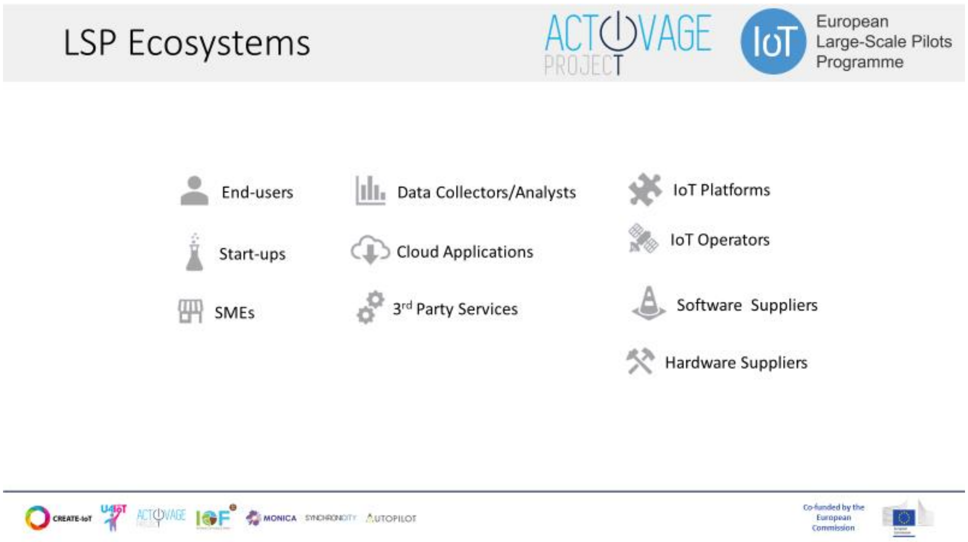

Figure 2: Stakeholder involvement in the ACTIVAGE IoT LSP

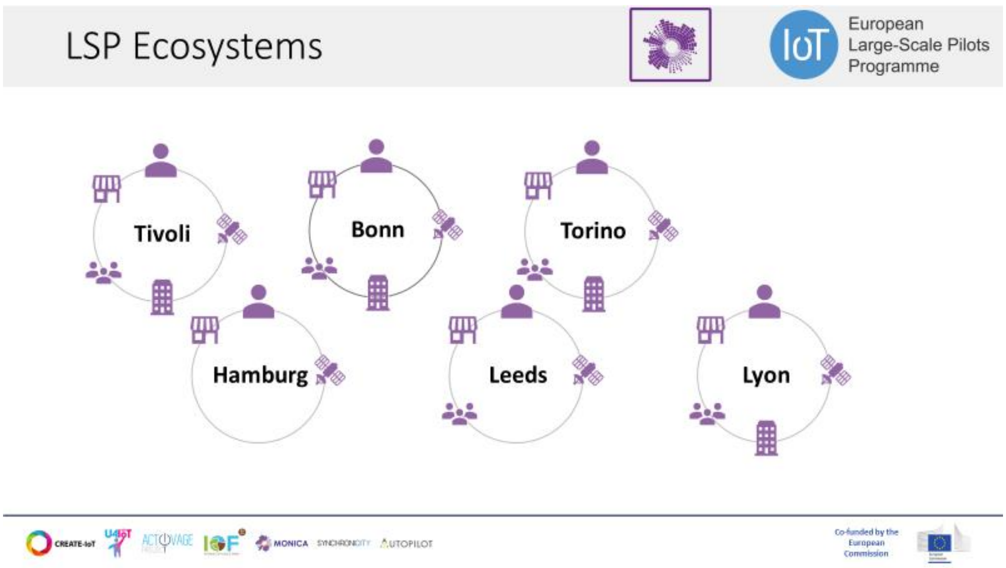

Figure 3: Stakeholder involvement in the MONICA IoT LSP pilot sites

By the nature of IoT, real integration of solutions requires various actors from the evolving value-chain to make it a reality and to truly secure its full potential for citizens and businesses [5].

These actors, or more appropriately stakeholders, all stand to benefit and contribute to the success of the IoT LSPs and come from the supply and demand side of the value-chain, and in often cases will behave as both suppliers and consumers i.e. acting of key enablers.

The ecosystem members who have been or will be directly involved in the IoT LSPs varies across the pilot sites, but the broader stakeholder group reflects this.

An example for the MONICA project, illustrates the different ecosystem members involved in the pilot sites, supporting not just end-user engagement but the broader approach.

5.2 Defining use cases

Each IoT LSP has defined themes that have been further explored and developed, with a local level use case definition and service design, tailored to the unique context and technological and social environments. This approach has resulted in a diversity of activities, actors and solutions, both within the IoT LSPs and across them

The diversity is particularly notable in ACTIVAGE and IoF2020, who demonstrate a broad number of solutions and piloting activities. In each case, key users have been involved for the purpose of measuring the user needs and acceptance of each use case. The results of this engagement have been translated into the service requirements and definition of the individual use cases that vary across the different regions and contexts in which the pilots are to be deployed.

These key users have been identified in advance of the initial design and investigation activities. Within each category of user, there may be further distinction where this distinction has a bearing on the specific IoT use case. For instance, ACTIVAGE elderly end-users are further categorised by the level of frailty which in turn creates unique demands and constraints on the services provided. The key user categories defined by each of the IoT LSPs are as follows:

Table 2: Key categories of users in the Large-Scale Pilots

IoT LSP	KEY USER CATEGORIES
ACTIVAGE	• Elderly end-users • Caregivers • Health and social professionals • Public healthcare service providers
MONICA	• Event organisers and managers • Event security personnel • Auxiliary services (first-aiders, police, fire services) • Event attendees • Neighbours and citizens • Municipal authorities
AUTOPILOT	• Private vehicle drivers and occupants • Shared vehicle (e.g. taxi) passengers • Fleet operators • Carpark operators • Municipal and public service authorities
SYNCHRONICITY	• Citizens and public transport users • Public sector employees • Transport providers
IoF2020	• Farmers • End consumers • Industry partners

It is worth noting that end-users have been involved in the definition of the local pilot use-cases through workshops, co-creation sessions, focus groups, surveys and interviews.

Co-creation methodologies (e.g. Lego Serious Play), in particular, have been employed within the ACTIVAGE, SYNCHRONICITY and IoF2020 in the use case definition and service design. This methodology brings together the key stakeholders as provided in the figure above, relevant to each theme. This is seen as a key step to the broader adoption of the IoT LSP solutions within which user adoption is a key success criterion.

Specifically, in the case of SYNCHRONICITY, this has resulted in the development of various stakeholder journeys (e.g. SME, city authorities, academia) that will act as maps and anchors for guiding the activities of the pilot from awareness to activation, ensuring that the focus on the ecosystem members and their important roles in acceptance and adoption is maintained, leading to successful market uptake of the developed solutions.

5.3 A consolidated initial view of the ecosystems across Europe

Through the contributions of the IoT LSP partners in the Activity Group 4, a consolidated view of the pilots and the ecosystem members has been possible. This is a useful tool for the identification for cross-over between each IoT LSP in terms of location and key stakeholders.

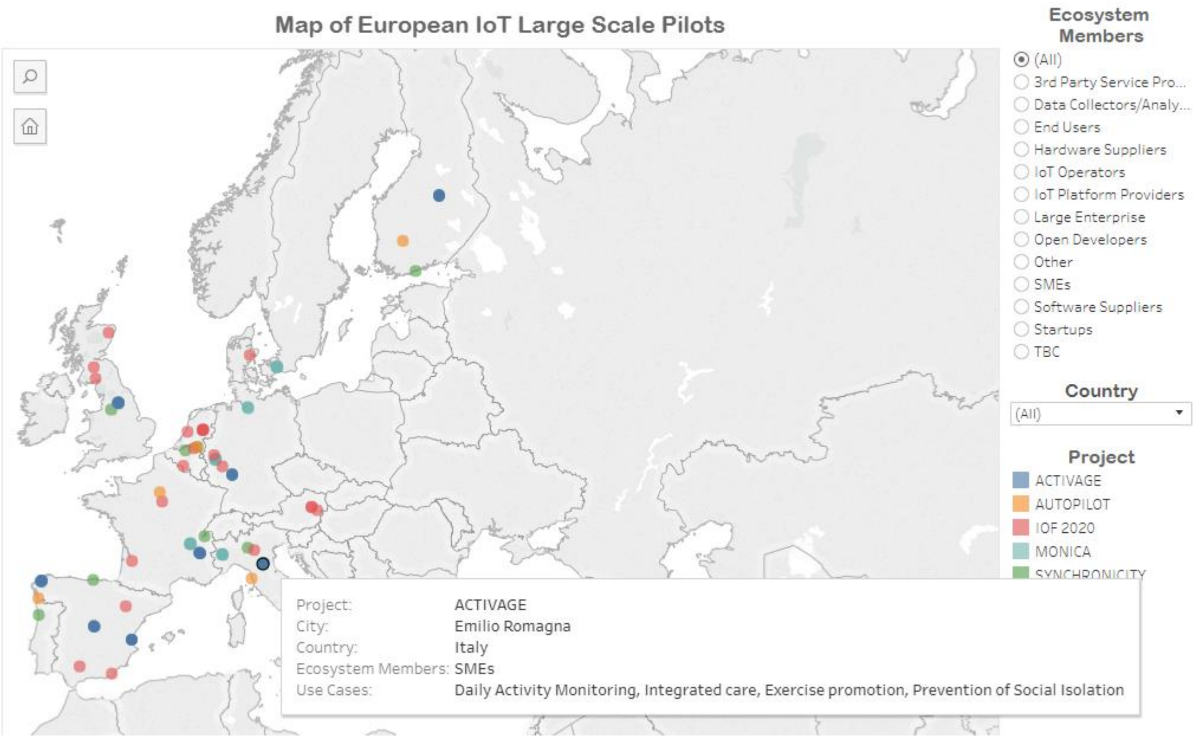

Figure 4: Dynamic map of IoT LSP deployments and ecosystem members

It can be observed that the sum of the pilot sites provides a concentration is specific regions facilitating the bilateral cooperation between IoT LSPs and supporting the bilateral activation of their key ecosystem members. For example, in regions such as Northern Italy, Southern Netherlands and Northern England and North-western Spain, SMEs are to be engaged by various IoT LSPs as adoption vehicles and the opportunity for joint activation of this ecosystem member groups is apparent for ACTIVAGE, SYNCHRONICITY, MONICA and IoF2020.

6. Testing User acceptance

6.1 What is user acceptance?

User acceptance is a simple term that describes a complex concept. In general terms, users are only willing to accept innovations if these innovations allow them to achieve their goals in a better way than existing solutions [6]. The definition of "better" will be determined by context and will encompass a range of intrinsic and extraneous factors relating to the technologies in question.

The Technology Acceptance Model (TAM) assumes that primary determinants are perceived usefulness and perceived ease of use for attitudes towards using a particular technology. towards using a particular technology [7]. This model has been extended to the Theory of Acceptance and Use of Technology (UTAUT), which argues that the user's behaviour towards a new technology is based on seven parameters:

- Performance expectancy
- Effort
- Expectancy
- Social influence
- Facilitating conditions
- Moderating factors
- Behavioural intention and
- Use behaviour.

According to Rogers innovation diffusion theory [8] [9], the take-up of new technologies can be determined by the five characteristics outlined in the following table:

Table 3: Characteristics of technologies accepted by users [10].

Characteristic	Description
1. Relative advantage	Extent to which it offers improvements over available tools
2. Compatibility	Consistency with social practices and norms among its users
3. Complexity	Ease of use or learning
4. Trialability	The opportunity to try an innovation before committing to use it
5. Observability	The extent to which the technology's gains are clear to see

User acceptance testing methods have been more traditionally used in the context of software development and have been directed at determining the adequate functionality of a given system. Within an IoT context, the concept of user acceptance is necessarily broader and takes into account a range of final users who may or may not be digitally literate.

Previously used frameworks [10], for testing acceptance include a waterfall approach that starts with unit testing:

- **Unit Testing**: undertaken by programmers to test the functionality of the technology, from on-off, and every other command in between, ensuring that the codes work correctly.
- **Integration Testing**: makes sure that the system interacts correctly with other units within the business. It is generally undertaken internally by system designers and architects.
- **System Testing**: is the first complete test of the technology and involves testing the relationship with external components. It should involve a level of input from users and will be led by system designers and architects.

- **User Acceptance Testing**: is the last stage and checks the ability of the solution to provide value to the user. It tests that the user's goals are being met and will generally be conducted in real or near real environmental conditions. The outcomes are no longer merely technological, but relate to the business or social purpose for which the user is employing the technological solution.

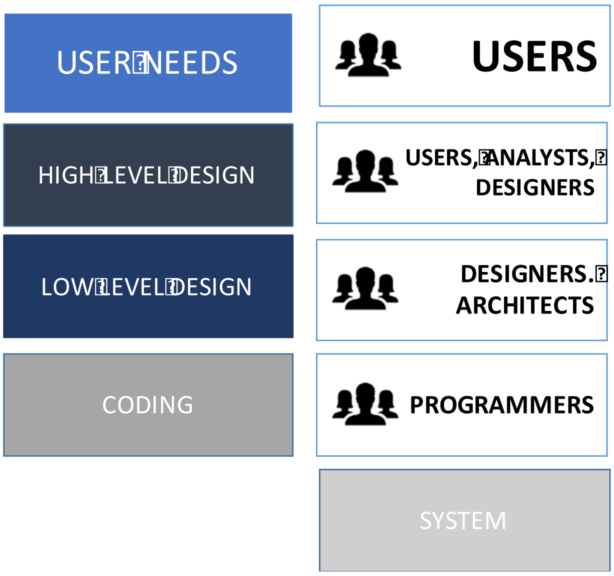

Figure 5: Testing framework from unit to user acceptance

6.2 Defining criteria to determine acceptance

While the exact definition of the criteria to determine acceptance varies across each of the IoT LSPs, it is possible to provide a common framework to design, measure and track, not just the degree of user acceptance among the different user groups, but also to identify opportunities for collaboration and exchange of good practice.

To correctly determine user acceptance, BLU developed a user acceptance Board that was used by the IoT LSPs to share information on the testing and its results. The Board is completed in three phases indicated in the following diagram:

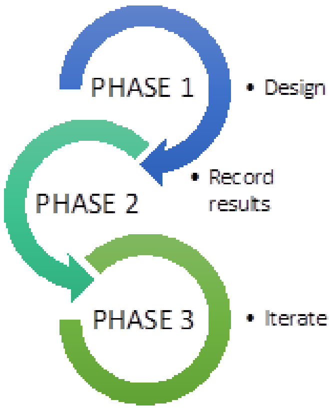

Figure 6: Developing a User Acceptance Board

The Board includes the following parameters:

- **Deployment**: refers to the specific implementation case in which the IoT solution is being introduced. It is in general use-case specific.
- **Context**: provides descriptive information on the deployment and allows any future deployers to view any qualitative information that may have an impact on acceptance.

- **User group**: refers to the concrete user group that will be employing the technology. Within an IoT context, there is usually more than one user group. Difference acceptance criteria must be established for each user group (e.g. patient, health professionals, carers.)
- **Test site**: defines the location of the test; a deployment may take part in several sites either sequentially or simultaneously and it is important to be able to identify possible environmental differences that lead to different results in user acceptance levels.
- **Number of users**: the number of users in each group that is participating in the user acceptance test in each given test site.
- **Device**: the specific type of IoT device that is to be tested. It may be necessary to test a range of devices (e.g. wearable wrist-bands, smartphones, tablets).
- **Method**: the methodology used to determine the outcomes of the user acceptance test. The methodologies may have a bearing on the reliability of the information and the degree to which results can be extrapolated to other contexts. In general terms, the methodologies will fall into one of the following categories:
    - Interviewing
    - Observation
    - Survey
    - Other
- **Test date**: the date on which the testing will take place.
- **Key performance indicators** (KPIs): the criteria used to determine whether a given user has accepted the IoT solution. The criteria must be adjusted to the deployment, context and user in question. It can be useful to establish criteria that relate to:
- **Use** and/or **Relevance**: includes indicators that refer to actual use of the device or solution and its relevance in terms of the objectives it is designed to accomplish.
- **Comfort** and/or **Convenience**: indicators relating to comfort may refer to a wearable but might also relate to the degree to which it is convenient to access the device or the data it generates
- **Trust**: indicators that refer to the users' confidence that the data generated by the IoT device will be used solely for the explicit purpose defined and agreed, that is will be kept securely and that will not
- **Willingness to pay**: in addition to the above, one of the IoT LSPs is also considering finding proxy indicators for certain users' willingness to pay for the IoT solution.
- **Target value**: the target value or objective is a numerical value, set by the deployer, that serves to indicate the degree to which the device or solution has been accepted by the user groups in question. Although it can also be expressed in absolute terms (YES/NO), assigning a target value allows for greater nuancing in the testing procedure and for monitoring progression with regard to subsequent iterations.

Table 4: Example User Testing Board. Phase 1: Design

<table>
<tr><th colspan="4">DEPLOYMENT</th><th colspan="4">CONTEXT</th></tr>
<tr><td colspan="4">Headingly Stadium- Rugby</td><td colspan="4">90 min match; staff arrive 2 hours before and leave 2 hours after; will test the stewards' wearable devices provided by MONICA and how useful the data is for managing security at the venue.</td></tr>
<tr><th>USER GROUP</th><th>TEST SITE</th><th>Nº of USERS</th><th>METHOD</th><th>TEST DATE</th><th>DEVICE</th><th>KPIS</th><th>OBJECTIVE</th></tr>
<tr><td>Stewards- mid-level responsibility</td><td>Leeds</td><td>10-40</td><td>Other</td><td>2018</td><td>Bracelet</td><td>USE: Stewards wear bracelets (i.e. not left in locker room)</td><td>80%</td></tr>
</table>

Source: BLU - draft information provided by Kingston University (MONICA IoT LSP)

Once the testing has been completed, the IoT LSPs record the following:

- **Result**: refers to quantitative results obtained in the user acceptance Test. This result must be compared to the target value previously determined for each of the user groups defined.
- **Action to be taken**: where the result is not satisfactory, it refers to the action to be taken to improve user acceptance.
- **Re-test date**: where necessary, this indicates the date at which the testing is to be performed again to check acceptance.
- **Possible barriers to adoption**: a qualitative field that provides greater insights into the tests performed and can be used by other IoT LSPs/ deployers to improve acceptance levels in their own IoT contexts or solutions.

Table 5: Example User Testing Board. Phase 2: Test

RESULT	ACTION TO BE TAKEN	RE-TEST DATE	POSSIBLE BARRIERS TO ADOPTION IDENTIFIED
50%	Hardware to be adapted		Bracelets are heavy and interfere with the agility required by event stewards

As of the date of writing this report, no user acceptance test had been completed. However, the user acceptance testing documents are on shared files which means that all IoT LSPs will be able to share their results and learn from the results of other IoT LSP user tests, where relevant.

6.3 Developing a user acceptance testing roadmap

User testing in particularly innovative or disruptive environment is an iterative process. The best results are achieved when the testing is planned in advanced. A simple roadmap can also ensure that that the results are integrated into the solution before the next round of testing takes place.

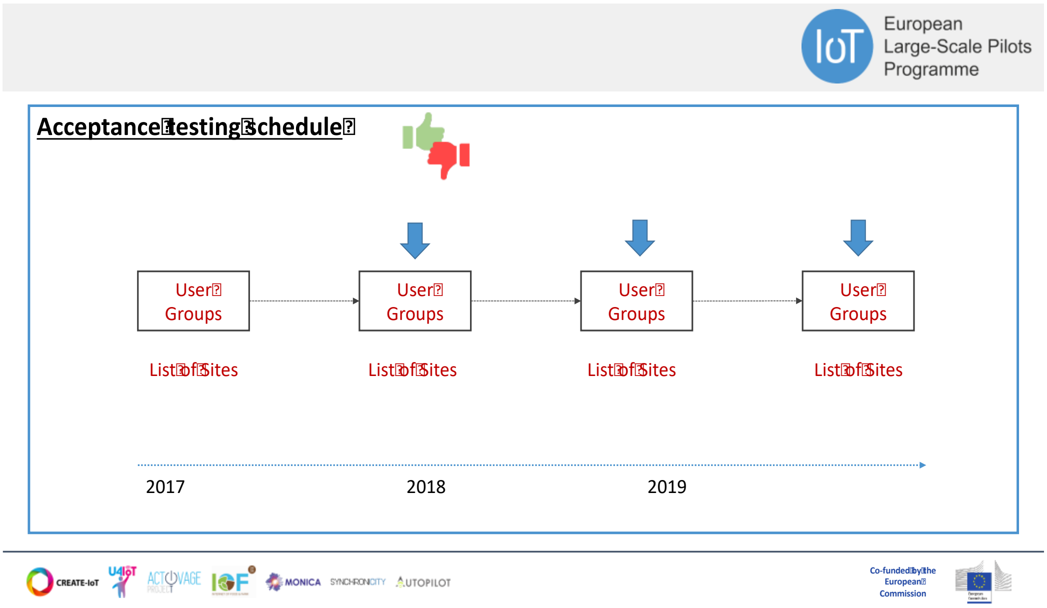

Figure 7: Scheduling user acceptance testing

7. A CREATIVE APPROACH TO TESTING USER ACCEPTANCE

7.1 Why is there a need for a creative approach to testing user acceptance?

There are challenges in testing user acceptance that a creative approach can help to overcome. Earlier chapters have looked at a range of contexts in which user acceptance may need to be tested. In many of the European large-scale pilot use cases, the user may be an expert user of a system. In other contexts, the user may be the citizen-consumer of an IoT enabled service, or a community representative concerned by issues of data governance, because of the way IoT technologies impact on the daily lives and environments of the general public. Factors impacting on user acceptance similarly vary, from usability issues, to security and privacy. This diversity of user, factors and contexts creates a need for a correspondingly wide range of approaches to testing user acceptance.

One barrier to testing user acceptance can be levels of awareness and understanding due to the complexity and novelty of next generation IoT capabilities. It is necessary to first demystify and navigate the IoT capability for the user before acceptance can be tested.

There are barriers to testing user acceptance at early stages in technology research and development, when users and use cases may be unknown. Furthermore, in a complex landscape of users, it may be difficult to test user acceptance for a product that the user may previously not have considered.

There are particular challenges in testing user acceptance among citizens and consumers where acceptance factors can be wider and hard to determine, often culturally specific and highly contextualised by circumstances that may not be immediately transparent to the researcher.

Creative approaches to testing user acceptance offer a set of methods and tools that can help to account for these challenges.

7.2 A creative approach to testing user acceptance building on the STARTS initiative

Art and creativity can make a distinctive contribution to testing user acceptance. Creative disciplines can be used to engage users to explore roadblocks to user acceptance, and whether solutions are acceptable and/or desirable. Artworks, games and participative experiences can be used as a part of a structured process to test user acceptance.

This is enabled, in the first instance, by novel approaches artists and creatives offer to represent data or communicate a technological capability. Art and creativity can be used to explore display, visualisations, sensory prompts, sound and light, human factors, even the persona of the device. Artists can illustrate technology concepts and capabilities through creative prototypes, interaction design and participative experiences.

Such art practice, works or experiences can expose and question aspects of technologies that may be a barrier to use for stakeholders and end users. This can include acceptance factors including security and privacy elements such as confidentiality, user data awareness and control, integrity, resilience and authorisation.

To address issues of user acceptance requires looking at how design choices in the infrastructural layer of IoT technologies impact on trust, security and privacy. Art practice, then, can be used to communicate a technology concept or capability, and enable the user to explore and investigate it in an experiential way. By manifesting these through public facing artworks, artists are ideally suited to enriching the technology innovation landscape.

An art installation engages the public, customers and stakeholders and enables them to explore and interact with the IoT system. An experience prototype or artwork can enable users (specialist or citizen) to grasp the IoT capability, and consider acceptance factors. An artwork can illustrate the range of data that can be captured and represented and thereby create visibility and literacy.

Artists are skilled in exploring and expressing difficult questions, to focus on ethical and social implications of technology development. Artists often express and explore social and ethical dimensions of technologies through their art practice. Art and creativity can create experiences around important social impacts and consequences of technology, and thereby enables citizens to question whether solutions are either, or both, acceptable and desirable.

Creative disciplines that can offer a distinctive and useful contribution to testing user acceptance include, but are not limited to: media artist, creative technologist, interaction designer, data visualiser, architect, game designer.

7.4 Methodologies for a creative approach to testing user acceptance

In Europe, the technology industry is starting to explore how artists can introduce creativity and additional perspectives into research and development in the sector. Research funding structures are also recognising the beneficial role artists can have in cross disciplinary environments.

For example, the European Commission is promoting the combination of Art and ICT as an approach to stimulate innovation and acceptance through STARTS, the Digital Agenda for Europe Initiative for Science, Technology and the Arts (an initiative of DG-Connect CONNECT) [1].

Methodologies for combining art and ICT in the IoT include Open Prototyping (OP). This describes a six-stage process, and each stage in the process can be leveraged to test user acceptance.

Table 6: Open prototyping contribution to user acceptance by stage

OP STAGE	CONTRIBUTION TO TESTING USER ACCEPTANCE
SCOPE	Artistic research and creative thinking can express and communicate IoT capabilities that are not otherwise transparent and legible to the user.
CONNECT	A knowledge exchange facilitated by artists can unlock new perspectives of user acceptance.
PLAY	The unique skills of artists can explore acceptance factors in technologies, ideas, materials and applications
PRODUCE	Artistic interfaces and expressions can give tangible form to acceptance factors in future technologies and scenarios.
DISPLAY	Art makes visible and legible systems that are hidden or complex, and enables a wide audience to experience future scenarios.
INTERPRET	OP can build transparency, judgement, agency and trust in the way people interact with data systems.

The OP framework provides a range of tools and modules which can be used to test user acceptance.

- DESIGN FICTION INSTALLATION

This approach can be used to test user acceptance for future technologies that do not yet exist (‘experiential futures’). Artists can be commissioned to develop a scenario (“design fiction”) around the barriers to user acceptance. The scenario will elaborate in narrative form issues and concerns, for example, around privacy, interoperability and trust in IoT tech and products. Based on this scenario, the artists then develop an installation or performance workshop, to give the citizen-consumer first-hand experience of these issues. Here, the citizen-consumers are taken on a journey in which they are place themselves in the position of consumers or operators of these systems, and are challenged to answer a series of questions about the experience.

- ART HACK

Creative disciplines can experiment with and illustrate the farthest potential of technology capabilities. The format could be a hack with the aim to expose flaws and limitations, or it could be a workshop to develop creative concepts or scenarios. Artists can create interfaces and interactions that can be used to demonstrate and test applications and features. This then provides a basis to engage users in trials to explore a wide range of acceptance factors.

- FESTIVAL AS LAB

This showcase event enables the public, customers and stakeholders to explore and interact with IoT technology and use cases. This provides a platform for large scale IoT art and design experiences, engaging large publics and generating visibility and market building. Public trials and demonstrations by artists enable co-creation and testing with a wide range of participants, and can help build visibility and engagement around a technology or theme. Art and creativity methods are integrated with qualitative and quantitative methods of evaluation to deliver assessments of user acceptance that can engage large numbers of citizens-consumers.

7.4 Case study on testing user acceptance through a creative approach

Chattr

Chattr is an art installation which tests user acceptance to a future digital service where access to the service is traded for access to personal data. As an artistic work, it was able to ask a deep question about our life online and the trade-offs in digital services – how much of our data are we willing to leak into the public online domain? Visitors to the FE and TodaysArt festivals are invited to accept a Data Use Policy to access a VIP lounge. People signing up to the service are required to wear a recording device, and spoken conversations occurring in public spaces are recorded, transcribed, and published as indelible text on the internet. Participants are able to confront the trade-off between digital interactions and a physical denial of service. By creating an immersive scenario, together with experts to contextualise the work, participants were able to understand, interpret and evaluate current concerns about privacy, ownership and data sovereignty. Ethnographers record the attitudes of people as their spoken word becomes a shareable, mineable dataset uniquely identified as a URL.

Figure 8: A FutureEverything and Creative Exchange project by Ben Dalton, Drew Hemment, Elliot Woods, Mel Woods, Joel Porter, Lara Salinas and Joeli Brearley. Presented at FutureEverything 2013 and TodaysArt 2014. Website: chattr.cc.

8. USER ACCEPTANCE IN THE CONTEXT OF IOT LSPS

Due to the broad nature and size of the IoT LSPs, there is a high level of heterogeneity in the ecosystems surrounding each of the individual pilot sites. In turn, this means that the specificities of the user acceptance testing must be explored in detail to enable collaboration across the various IoT LSPs. This is where the framework proposed at section 6 above facilitates the identification of instances in which users, locations and/or devices are similar or interrelated. This is a first step towards understanding and enhancing user acceptance of IoT within and across domains. By applying a common staging of the user acceptance testing process to the activities, the workshops have enabled the comparison of completed and planned actions within the IoT LSPs and identify common approaches, challenges and opportunities for further cross-fertilisation as the testing evolves. The stages explored in the later workshops were:

- Planning
- Execution
- Analysis
- Reporting

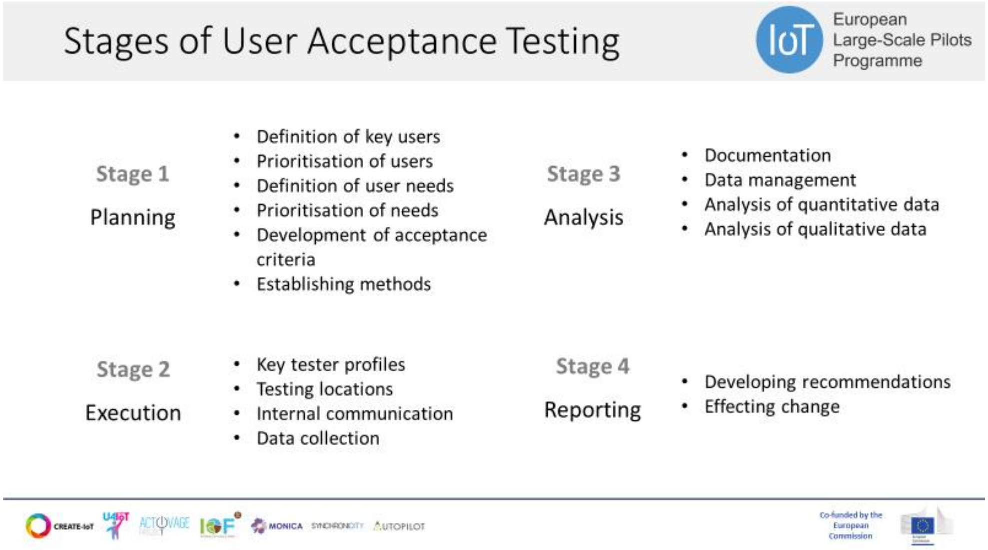

Figure 9: Exploring user acceptance testing in detail in the IoT LSPs

8.1 Stage 1: Planning user acceptance

8.1.1 Identifying key users for testing acceptance

The majority of the large-scale pilots are currently completing or have completed the user engagement phase of the project. This work has built on early efforts to engage users in the design of the use cases and increase the value ultimately provided, as well as maximising the longer-term impact.

Table 7: Stage 1: Planning user acceptance tests. Identifying key users.

IoT LSP	APPROACH
ACTIVAGE	The different pilots have employed a bottom-up approach in identifying the user needs with each pilot leader responsible for the process. The pilot sites have not tended to rely on the eventual end-users (the elderly and infirm) to gather needs, but rather on the experience of the local partners and stakeholders such as formal and informal caregivers. Key methods have been focus groups, interviews and workshops. Identifying global KPIs for all sites has been challenging.

MONICA	Six different cities are involved in the pilot across different themes (sound, security, health incidents, lost children) with each theme having a different set of users and thus requirements. Placing values on the criteria is also challenging. Key user groups, event personnel, organisers and city partners, have been included in focus groups, individual interviews and observations to identify key needs.
AUTOPILOT	The pilot is distinct from the other four, with limited engagement of real-users due to the legal implications of allowing non-professional drivers in autonomous vehicles. However, it has been envisaged that some potential end users (tourists) will have some engagement in a single site. A literature review has been carried out *in lieu* to identify the key needs for acceptance. Testing is all sites will occur in the third quarter of 2018 with retesting happening in 2019.
SYNCHRONICITY	Also structured around themes, the specific services serve mobility, multi-model transport and public services with key users involving public sector employees, transport providers and citizens. The pilot has coordinated their inputs through common co-creation workshop methodologies to develop stakeholder journeys. Currently in the process of planning user acceptance with no specific dates available yet.
IoF2020	Users (Farmers and consumers) are involved in various aspects of the pilot through co-creation workshops, interviews and observations with activities beginning in late 2017 and continuing through 2018. The needs analysis has been more limited than in other pilots due to the nature of the end users. This has meant that key intermediaries, such as associations and consumer groups have provided their experience, knowledge and previous studies to support definition of the key user needs. The pilot is currently in the planning phase of the user acceptance testing and is developing a framework to extract defined testing criteria.

8.1.2 Methods for testing user acceptance

The methods for testing user acceptance will vary both within the IoT LSPs and between them. Techniques vary from self-reporting, for instance, for measuring satisfaction levels to checking device connection times.

Table 8: Stage 1: Planning user acceptance tests. Methodologies.

IoT LSP	APPROACH
ACTIVAGE	Due to the distributed nature of the pilot sites, the key acceptance indicators are developed locally accounting for specific contexts. However, efforts are underway to develop global indicators applicable across the whole pilot which is proving a challenge for consistency. The main tools will be the use of simple self-reporting (happy, neutral, sad face interface), surveys and device statistics to measure usage. Indicators will be mainly related to the carer and municipal users.
MONICA	Certain sites, like the Tivoli gardens in Copenhagen, have many opportunities for the testing of users and user acceptance while others have only one or two events during the course of the IoT LSP's duration. In the latter case, simulations will be carried out in advance by university students, with the local partners observing the same acceptance criteria as for the real user-groups to support the data and prepare for the limited events. A desired aim is to use data from the devices and technology to measure specific user acceptance KPIs to avoid the need to survey large numbers of participants.
AUTOPILOT	The pilot has developed a common methodology that integrates user acceptance with technical and business validation. As discussed earlier, the key topics to be investigated are ease-of-use, comfort, security, usefulness, trust and 'willingness to pay' as a proxy for business validation through focus groups and surveys after participation. Target values are to be defined in the first half of 2018.
SYNCHRONICITY	Currently developing and reviewing a validation methodology with user acceptance at the centre of an impact assessment that has been coordinated across all sites. A core challenge is the complexity created by collecting data from different cities and ensuring consistency in the application of the methodologies.
IoF2020	A key challenge for the pilot is the scale both geographically and in use cases. User acceptance testing will be conducted once a year with the results feeding into an improvement cycle, providing an iterative approach towards the final solutions. A leading indicator will be the user satisfaction, around which the yet-to-be developed framework will centre.

8.2 Stage 2: Execution - Testers, Locations and Communication

8.2.1 User acceptance testing team and locations

User acceptance testing is to be included in the activities of each pilot but the locations and teams responsible for overseeing the testing varying across the IoT LSPs. While some IoT LSPs provide a central framework that is then used locally to collect data on user acceptance, others are employing a more distributed approach that relies on data flowing upwards.

Table 9: Stage 2: Execution. Testing teams and locations.

IoT LSP	APPROACH
ACTIVAGE	User acceptance testing and the resulting data will be collected by the local partner with a nominated coordinator with the support of local evaluation managers. The approach of each site is still being clarified but it will involve qualitative methods and the use of technology (e.g. login patterns), depending on the local evaluation manager approach. A further possibility arises in relation to user training. Until now, training users has only been conducted in relation to user interfaces but it may be interesting to introduce it to increase user acceptance.
MONICA	Validation will occur in real-life events which provides various constraints on the execution of the testing. Due to the fixed nature, language and limited resources, partners close to the events will conduct the testing with central coordination including common documentation formats. For consistency, training may need to be provided to the partners. An interesting issue relates to the cultural variations across different countries, an example being data protection and privacy, that will need to be accounted for in this standardised methodology.
AUTOPILOT	The impact assessment team will be responsible for conducting the user acceptance testing across all the sites and will work with the local site leader. This team has the language capacity to conduct the work in all the sites across the five European sites and the single South Korean without further assistance or need for training of local partners.
SYNCHRONICITY	A formal monitoring framework is to be introduced across all sites with local partners responsible for the testing which again, may result in different interpretations and values being recorded, particularly where the data is quantitative in nature.
IoF2020	The testing will be distributed in nature with a common framework developed to support the activities.

8.2.2 Communication of the user acceptance testing results and activities

The management of the user acceptance testing and the communication of the data and results is in evolution in all pilots. The main challenge that has been recognised across all IoT LSPs is the need to systematic, both in terms of data collection and analysis.

Table 10: Stage 2: Execution. Communicating and acting upon results.

IoT LSP	APPROACH
ACTIVAGE	The results of the user acceptance activities are being communicated on a local level with the technical providers to have an effective influence on the service delivery. A systematic communication structure is currently undecided and is an issue under discussion to be resolved imminently.
MONICA	The consortium has recognised that the internal communication structure surrounding user acceptance has been organic in nature and could benefit from a more systematic structure. This conversation is currently taking place. This work will feed into existing structures such as the Ethics board which takes an overarching view of how to deal with issues such as privacy, in a way that is compliant across all the pilot sites.
AUTOPILOT	Work package leaders are working directly with the local pilot site coordinators but the relevance of communication of all data and activities with all sites is still unclear. Apart from the impact assessment team involvement, a communication structure that draws in input from other relevant cross-cutting domains within the pilot may be necessary.
SYNCHRONICITY	The coordination and communication channels are evolving but is structured around the reference zones and weekly meetings.
IoF2020	The communication between the diverse sites and the central evaluation team is under discussion but local pilots have requested that direct user input is kept to a minimum.

8.3 Stage 3: Analysis - Data Management and Analysis

There is great diversity between the IoT LSPs regarding how the data will be managed and analysed at a project-level. Within each IoT LSP, approaches vary from more top-down approach to data gathering and analysis (MONICA and AUTOPILOT), while ACTIVAGE, SYNCHRONICITY and IoF2020 all face the challenges of aggregating the data from the bottom-up. This issue has relevance for cooperation between the IoT LSPs, although the consensus position is that it will not be possible to share raw data between IoT LSPs, given current data protection legislation.

Table 11: Stage 3: Analysis. Data Management and Analysis

IoT LSP	APPROACH
ACTIVAGE	Aggregated data will be provided at a project level from the local pilot sites. A data model and tool will be provided at individual site level but a further secondary tool will be provided to support the aggregated data collection at project-level to identify the impact of the large-scale pilot as a whole. A current challenge under investigation (December 2017) is the mixed-nature of this consolidated data and the removal or prevention of bias in the analysis.
MONICA	Data collection models will endeavour to include pre-existing data from previous events in order to maximise the quantity of available data. A refined model will be standard across all the sites. Parallel testing is also being considered to have counterfactual scenario that can provide more insights into user acceptance. Some testing has already occurred. One example is the Fan Phone which was used by event goes to report racist abuse. Locating the precise location of the caller was difficult and led to lengthy response times. The solution adopted was to incorporate GPS into the phone for greater location precision.
AUTOPILOT	The data will be mainly qualitative in nature relying on the small number of subjects, however some biographical data (age, sex, education level) and contextual data (road conditions, weather, traffic density, etc.) will be included. Within the qualitative data, certain discretion at each site will lead to some inconsistencies but there is the potential to have a standard model for coding to support the global assessment. Local data will be shared on a central server but with consideration for data protection and privacy measures, it is yet unclear exactly what data will be shared from each site. An opportunity for sharing externally aggregated data is acknowledged.
SYNCHRONICITY	It is too early to provide an exact procedure and the pilot is waiting to see the format of the data coming from each city before defining a protocol.
IoF2020	With such varied and wide-ranging use-cases and locations Still considering how to integrate individual use case data into an analysis and reporting format that can benefit the whole of the IoT LSP.

8.4 Stage 4: Reporting

The user acceptance processes in each of the pilots is not at a mature enough stage yet to provide productive insights into the reporting stage. Nevertheless, the shared reporting form provides a dynamic, real-time form for each of the IoT LSPs to share the results of their tests and, where necessary, the remedial action that is to be taken.

9. CONCLUSIONS

9.1 A common framework for user acceptance

The workshops at which the IoT LSPs have come together to share approaches and learn from the experiences of others in increasing user acceptance across the IoT use cases. Across the five IoT LSPs, the number, typology and level of involvement of users varies but there is a common consensus that the adoption and ultimate success of the pilots' activities relies on the user acceptance. For this reason, the IoT LSPs are all planning to incorporate user acceptance testing as part of activities that go from the initial design of the use cases to the final stages of impact assessment.

It is also worth remembering that, despite the provision of a common framework for user acceptance testing, the nature and size of the IoT LSPs inevitably means that there is a high level of heterogeneity in the planned user acceptance activities. This means that the opportunity to learn from the results of the tests performed across such a large number of sites and contexts can only be realised in so far as the partners in the IoT LSPs spend time on recording and sharing those results. That this opportunity exists there can be no doubt. The work undertaken to date has already revealed that there are use cases in which there are commonalities in terms of users, locations and/or devices.

9.2 Defining measurable user acceptance criteria

The majority of the large-scale pilots are currently completing or have completed the user engagement phase of the project. While these inputs have served to confirm the initial design requirements, there is still a need to the current need across all pilots is to translate these activities into defined and measurable user acceptance criteria. While this process has commenced in all IoT LSPs, those that have a more devolved structure and/or are larger have found it more complex to define criteria in sufficiently meaningful detail and/or attach target values to KPIs.

9.3 Common challenges

In addition to providing a common framework for user acceptance testing, the workshops have revealed a number of challenges faced by the IoT LSPs in designing and implementing the framework in such a way that it provides actionable insights. These challenges include:

- **Agreeing target values across pilot sites**: there is great diversity within and across the IoT LSPS so setting values that take into account context, as well as user diversity will provide richer opportunities for increasing user acceptance.
- **Implementing and managing user acceptance testing**: with more devolved models, a common challenge relates to managing the diversity in culture (e.g. approaches to privacy) and language at local pilot level and ensuring this does not impact adversely on the consistency of the methodology.
- **Aggregating data:** some IoT LSPs have already identified that there may be bias in the data due to differing expectations or ways in which data is collected across pilot sites.
- **Unique user acceptance testing events:** some IoT LSPs may have a single opportunity to test user acceptance due to the singularity of the events. In this case, the opportunity to iterate is substantially reduced.

- **Minimising direct user input:** although this may seem counterintuitive, a common problem is the need to reduce the amount of times users are required to respond to surveys or take part in focus groups.

9.4 Key learnings relating to user acceptance across the IoT LSPs

Finally, when it comes to user acceptance testing, there is no one size fits all. A variety of approaches may yield equally valid results. For instance, while MONICA uses standard forms for questionnaires, recording, and coding, AUTOPILOT questionnaires are in the local language which may increase the level of understanding but may also pose challenges when aggregating data from multiple sites.

Nevertheless, and with the above in mind, it is worth outlining some of the more successful strategies that the IoT LSPs are putting in place to solve some of these issues:

- Use of data generated by the devices: rather than ask users for feedback, IoT LSPs can use the data provided by the device itself to measure frequency and length of use, for instance (MONICA, ACTIVAGE).
- Optional use of device: where this is an option, a true measure of user acceptance is the degree to which a user is free to choose to use the device or not (MONICA).
- Simulations of singular events: where events are infrequent, one of the IoT LSPs enlists the help of student to run mock events and test user acceptance (MONICA).
- Use of surveys: where users must necessarily be asked to participate in surveys, the length of the survey must be kept to a minimum with only directly relevant questions. (IoF2020).
- Centralised user acceptance teams: incorporating members of local pilots. This ensures that problems that would affect the consistency of the methodology are identified early and resolved by the group. (AUTOPILOT, SYNCHRONICITY).
- Cultural diversity: creation of Ethics boards or similar bodies that can design a consensus position that can be applied across the pilot sites. (MONICA).

9.5 Moving forward

While the workshops have been useful ground for exploring a common framework, and initiating conversations to identify best practice and share learnings, the timing of the deployments has meant that the real opportunities to learn from the tests themselves have not yet arisen. This notwithstanding, some of the members of the IoT LSPs that have been involved in the workshops have identified specific instances for future collaboration that include:

- AUTOPILOT and ACTIVAGE: AUTOPILOT would like to include ACTIVAGE users from Galicia in some of the trials that target users with reduced mobility such as the elderly.
- MONICA will provide IoF2020 with the framework they have developed for assessing diversity in the longer- term impact on users.

It is also worth noting that the IoT LSPs may be able to adopt more creative methods for assessing user acceptance though methodologies such as Open Prototyping.

Finally, it must be remembered that at the time of writing this report, as stated previously, no user testing has taken place with activities due to start in 2018 with planning and preparation taking place. It is therefore imperative that the representatives of each IoT LSP remain engaged with the Activity Group and continue to use the tools that have been developed to support not just the design of the user acceptance testing procedure itself, but also the recording of the results of the testing and the iterations introduced into the IoT solutions and deployments in consequence.

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