D3.2 BEST PRACTICES FOR LARGE SCALE PILOTING V1

V1.0

15 December 2020

Abstract

This report corresponds to Deliverable D3.2 of the “WP3 - Large Scale Pilots Observatory” of the OPEN DEI project and suggests a cross domain approach, in terms of methodologies and tools, to be adopted both in actual and in future Digital Transformation projects. Projects characterized by a high number of Pilots, belonging to different domains and which have achieved remarkable results in the various application contexts, were selected and analyzed and described in Chapter 2 while in Chapter 3 the analysis of methodologies and tools adopted in the different phases of Pilots have been carried out including also a summary table with the pros and cons of each identified methodology.

In Chapter 4 the “OPEN DEI Recommendations” are reported with the identification of the most useful methodologies and tools identified in the previous section able to be adopted and integrated in other research projects.

This work will continue in the coming months extending the scope of the Research Desk conducted and enriching the cross domain approach with specific aspects characterizing the OPEN DEI domains.

REPORT TITLE

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EXECUTIVE SUMMARY

Within OPEN DEI, Task 3.2 aims at promoting methodologies and tools that cover the major steps of deployment, piloting and evaluation of piloting activities in European Projects, with the ambition at providing a reference framework to the projects supported by OPEN DEI in order to create a sort of benchmark to analyze their current practices on conducting pilots, trying to maximize the reuse of lessons learnt (but also methodologies and tools) derived from the experience of past projects facing the same challenges.

The starting point of this analysis will be the experience acquired by projects funded by IoT and Big Data programs, which have generated useful tools and methodologies. Results achieved in this task will define guidelines for current and future European projects that will be free to adopt all or part of them for their activities.

This document aims at highlighting the importance of standardizing research activities in projects characterized by a large number of Pilots and partners through the adoption of the same methodologies and tools.

The first set of analyzed projects have been selected taking into consideration:

- Coverage of a wide range of application domains, ranging from “Smart Industry” covered in Boost4.0 up to “Smart Agriculture” covered in DataBio;
- High number of Pilots and partners;
- Different state of progress of the Pilots.

For each project, an analysis of the methodologies adopted in all phases of the life cycle of the Pilots was conducted:

- Initialization phase: how to identify the KPIs of each Pilots, how to define use cases, how to establish common and specific requirements, how to facilitate the exchange of information between the different Pilots;
- Realization phase: how to coordinate hardware and software deployments in the different Pilots, how to standardize the procedures for validating the results obtained with respect to those expected in each Pilot;
- Exploitation phase: how to disclose the results obtained by each Pilot.

One of the strengths of OPEN DEI is having both an intra-domain and a cross-domain vision and, for this reason, a common strategy is proposed in terms of methodologies and tools to adopt in future projects, highlighting the role of this project to represent a point of connection between the domains and an ecosystem of approaches and solutions that can be universally adopted.

ACRONYMS

Acronym	Definition
AIOTI	Alliance for Internet Of Things Innovation
API	Application Programming Interface
BDVA	Bid Data Value Association
DoA	Description of Action
DT	Digital Transformation
ERL	Experience Readiness Level Protocol
FA	Focus Area
IoT	Internet of Things
IDSA	International Data Space Association
KPI	Key Performance Indicator
LSP	Large Scale Pilot
MIMs	Minimal Interaction Mechanisms
PPP	Public Private Partnership
OASC	Open &Agile Smart City
RCT	Randomised Controlled Trial
RE	Requirement Engineering
SLA	Service Level Agreement
TH	Trial Handbook
ToC	Table of Contents
TRL	Technology Readiness Level
UC	Use Case

1 INTRODUCTION

The Digital Transformation has increasingly become a pivotal element in the European Commission's strategy for generating smart, sustainable and inclusive growth in Europe. In 2016, the European Commission launched a strategic investment in the IoT as part of the "Digitising European Industry Policy" to identify the need to accelerate the Digital Transformation of the European industry and to overcome the digitisation gaps across industries and countries. The "Digitising European Industry" strategy is particularly focused on boosting the ability of traditional industries and SMEs to capture the opportunities of digital innovation through coordination of private and public initiatives, increased investments and the development of the Digital Single Market.

The main pillars of Digital Transformation defined in the European context are shown in Figure 1:

FIGURE 1: DT IN EUROPE: CHALLENGES, ACTIONS AND BENEFITS

The Digitization process passes through the adoption of innovative technologies (IoT, Big Data, Cloud,…), able to accompany organizations towards this change and, the role played by European funding programs over the years has been fundamental to allow an increasing number of public and private organizations to access new knowledge and skills that arise in a theoretical way and then need to develop in real scenarios.

In this perspective, the importance of having a considerable number of Pilots within the funded projects has emerged as a key feature. During the last years, an increasing number of Large Scale Pilots (LSPs) projects have been launched (see programs in Section 2.2) with the aim of evolving the concept of "pilot" towards supporting the creation of real ecosystems around cities, agricultural sites, hospitals and industries.

While this approach has favoured a considerable diffusion of the projects' results on the one hand, involving an ever increasing number of sites and organizations, on the other hand, has meant the development of differentiated solutions specific to each project, without that breath of integration and cooperation among projects, bringing greater chances to create higher impact. It is therefore necessary to overcome the silos vision of the solutions developed within individual projects, to cross the boundaries of ideas relegated to individual application domains and to aim at the creation of ecosystems characterized by an ever-increasing layer of interoperability, capable of adopting the same standards and the same procedures without having to start from scratch in each project.

It is essential to generate knowledge that starts from past experiences, highlighting their strengths and weaknesses and that can indicate the optimal paths to follow for obtaining the best results in all application domains.

This is the goal of the research carried out in this document.

1.1 Purpose and target group

According to WP3 overall objective, the purpose of this deliverable is to create awareness about the piloting activities of the Platform projects, to identify synergies and when possible standardize the way of doing things and to measure the global indicators (KPI) of the initiative going beyond individual platform projects. This activity will also look at applying lessons learned from previous and ongoing programs and initiatives and at deriving new best practices from the new projects. The principal objective is to favour collaboration and information exchange between existing IoT initiatives, Big Data and Digital Transformation projects and foster the take up of standard methodologies and tools in the context of European research.

The purpose of the ongoing work is to analyze and describe existing methodologies and tools already developed or used both in past EU projects and also in OPEN DEI projects, in order to derive lessons learnt which may be useful for the newcomers.

Doing so, this deliverable and the resulting analyzed Methodologies and Tools will serve current and future Innovation Actions when defining a common path to follow in the management of the different projects' phases as well as the constant monitoring of the performance and potential external impact on the wider ecosystem. In addition, this deliverable's results, and their subsequent updates, will also help all the actors involved in European Research Projects in gaining a comprehensive view on the different approaches followed in the research context and introduce a standard way to manage activities.

1.2 Relation to other activities in the project

Deliverable D3.2 is the result of the activities carried out during the first 18 months of T3.2 in WP3. This WP will act vertically on the large-scale pilots with the objective to generate awareness, identify synergies and measure global indicators (KPI) of the initiative **beyond individual projects**. In parallel WP3 will also look at applying lessons learned from previous and ongoing programs and initiatives (for instance Big Data and IoT Large Scale Pilots) and at deriving new best practices from the new projects, stimulating user engagement and technology acceptance.

Task 3.2 is strictly connected to the other two WP Tasks; the results produced will be integrated into the activities of T3.1 and T3.2 and from the activities of 3.1 the new pilots to be included in the second version of the deliverable will be identified.

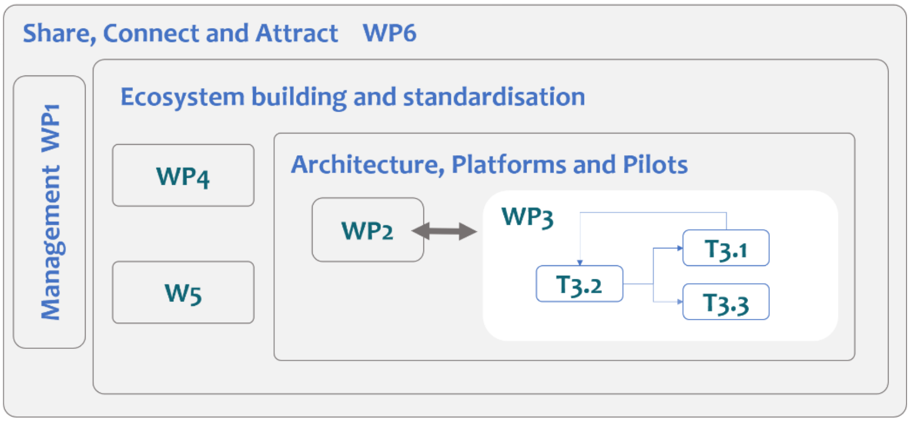

FIGURE 2: RELATION TO OTHER WPS AND TASKS

2 LARGE SCALE PILOTS IDENTIFICATION

2.1 Main challenges in managing large validation theatres

LSPs projects are specific initiatives that propose pilots targeting real-life challenges. They, generally, involve different kind of actors and contain key technological and innovation elements.

Main objectives of this type of project are:

- Integration, further research and development where needed of the most advanced technologies across the value chain (components, devices, networks, middleware, service platforms, application functions);
- Operation at large scale to respond to real needs of end-users (public authorities, citizens, businesses), based on underlying open technologies and architectures that may be reused across multiple use cases and enable interoperability;
- Validation of user acceptability by addressing, in particular, issues of trust, attention, security and privacy through pre-defined privacy and security impact assessments, liability, coverage of user needs in the specific real-life scenarios of the pilot;
- Validation of the related business models to guarantee the sustainability of the approach beyond the project and the provision of solutions based on open standards and platforms.

These projects represent important challenges in the context of European funding programs because they aim to directly involve entire cities, governments and ecosystems in order to achieve innovative solutions, not only in technological terms but also, for example in terms of emerging business models, which can then be widely replicated and adopted in other contexts with a minimal effort.

Such large and ambitious actions inevitably present difficulties and challenges that must be promptly identified and addressed in order to avoid having repercussions on the quality of the project and on the results obtained.

The main barriers that can be identified are of different nature and can be summarized as follows:

- Legal Barriers: having pilots in different countries it is inevitable to collide with legal and bureaucratic constraints linked to each individual country. The peculiarity of national jurisdictions can affect particular aspects of pilots and it is important to carry out feasibility studies in this area. An example could be the prohibitions on installing specific devices in some countries or difficulties in importing/exporting devices in some other countries;
- Environmental Barriers: the pilots are often kilometres away from each other and the climatic conditions that occur in the different sites can vary enormously. Think of a pilot in Norway and one in the south of Italy, they will certainly present profoundly different climatic conditions that must be considered in creating solutions that easily adapt to both contexts in particular if you refer to Agriculture in field applications, for example. Furthermore, adverse climatic conditions could make it difficult to reach specific sites and this aspect would also represent a difficulty to be overcome in the project;
- Technological barriers: the technological contexts of individual countries are characterized by a considerable variety; some countries are more technologically advanced than others and this implies that the starting status of the Pilots may be profoundly different.
- Social barriers: fundamental inside the same Pilot to speak the same language, where possible, to facilitate the collaboration with the local businesses for example and create an easy level of trust.

Alongside these aspects, it should also be considered that these projects are characterized by a very high number of partners, geographically distant and belonging to different application domains, for which communication in all phases of the project and proper management of time and costs are essential.

This deliverable was born, therefore, with the main intention of providing guidelines in the implementation and management of Pilots to be adopted from the beginning in order to avoid difficulties already faced and solved in previous projects. The goal is precisely to share the lessons learned in previous European experiences and make them available for future projects, outlining the best way for them to follow. Just started LSPs projects or at least at a very early stage of development will benefit from such Deliverable which learnt from very mature projects and transfers this knowledge inside the Ecosystem.

In the analyzed projects, described below, methodologies and tools relating to pilots have been divided into 3 main categories:

- Initialization: this category includes all the methodologies adopted in the initial phases of the project which involve the preparatory steps of the pilots, for example the collection of requirements.
- Implementation and Validation: this category includes methodologies adopted during the commissioning of the pilots and the validation of the obtained results.
- Exploitation: all the methodologies concern promotion and dissemination of the results of the pilots fall into this category.

2.2 Procedures and methodologies for reference projects selection

The projects analyzed within this task were selected from the major research programs funded by the European Commission in the field of Large-Scale Pilots (LSPs) with specific focus on Internet of Things (IoT) and Big Data technologies, namely:

1. LARGE SCALE PILOTS PROGRAMME

The IoT European Large-Scale Pilots Programme includes the innovation consortia that are collaborating to foster the deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational conditions.

The projects under this programme are targeted, goal-driven initiatives that propose IoT approaches to specific real-life industrial or societal challenges. They are autonomous entities that involve stakeholders from supply side to demand side, and contain all the technological and innovation elements, the tasks related to the use, application and deployment, as well as the development, testing and integration activities. The scope of this Programme is to foster the deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational condition. IoT European Large-Scale Pilots Programme includes projects addressing the IoT applications based on European relevance, technology readiness and socio-economic interest in Europe.

The projects together form the “IoT European Large-Scale Pilots Programme” and a coordination body ensures an efficient interplay of the various elements of the IoT-Focus Area and liaise with relevant initiatives at European Union, Member State and international levels. The coordination is implemented by creating activity groups that address topics of common interest across the large-scale pilots. Research and innovation efforts in specific IoT topics ensure the longer-term evolution of the IoT.

2. Big Data Public Private Partnership: Large Scale Pilot actions in sectors best benefitting from data-driven innovation (H2020)

The Big Data Value Public-Private Partnership aims at creating a functional Data Market and Data Economy in Europe, in order to allow Europe to play a leading role in Big Data in the global market. The Big Data Value PPP is a partnership between the European Commission and the Big Data Value Association (BDVA). The BDV PPP is developing an interoperable data-driven ecosystem as a source for new businesses and innovations using Big Data. To achieve this the BDV SRIA has defined four implementation mechanisms:

- Spaces, Lighthouse projects;
- technical priorities and coordination;
- coordination projects**.**

The PPP is being implemented in 2016-2020 through calls of proposals from the ICT LEIT (Industrial Leadership) part of the Horizon 2020 work programme.

In order to reach its objectives, the PPP will make use of four major instruments:

- Large-scale demonstrators ("lighthouse projects") in industrial sectors most likely to benefit from Big Data (e.g. transport/logistics, bioeconomy/agriculture);
- Data integration and experimentation actions (also known as "Innovation Spaces"): environments where infrastructure is made available to bring technology providers and end-users together to identify services, skills, business models and cross-border and cross-sector ecosystems in which novel technology and applications can be built;

- Technical projects, advancing key enabling technologies and filling gaps in knowledge and methodologies (e.g. in large-scale analytics, prediction, visualisation, architectures, algorithms etc.);
- Networking, community-building and policy support, to create a strong and active community of key actors working towards common technical, organisational and societal goals.

Projects analyzed in the following sections of this document represent success stories from which to extract best practices for current and future projects. The choice involved both ongoing projects (such as CREATE IoT) and completed projects (such as SynchroniCity) in order to evaluate the methodologies and tools adopted both for already consolidated results and for Pilots still in progress. The diversity of the application domains also represented a fundamental factor in the choice of case studies, involving different sectors ranging from the solutions for the “Smart factory” of Boost4.0 and “Smart City” of Synchronicity, to the “Smart Agricultural” solutions of DataBio passing through solutions related to “Big Data” of BDVe. The number of Pilots also represented an analyzed factor, in order to extract methodologies and tools to be used in different contexts it was necessary that these had already been used in numerous and non-homogeneous contexts.

2.3 Evaluated Innovation Action projects: a brief description

2.3.1 CREATE-IoT

CREATE-IoT (CRoss fErtilisation through AlignmenT, synchronisation and Exchanges for IoT) brings together 18 partners from 10 European countries. The project was funded under the IoT European Large Scale Pilots Programme and its aim is to stimulate collaboration between IoT initiatives, foster the take up of IoT in Europe and support the development and growth of IoT ecosystems based on open technologies and platforms. This requires synchronisation and alignment on strategic and operational terms through frequent, multi-directional exchanges between the various activities under the IoT Focus Areas (FAs). It also requires cross fertilisation of the various IoT Large Scale Pilots (LSPs) for technological and validation issues of common interest across the **various application domains and use cases. e.g. on Autonomous transport and Smart City.**

CREATE-IoT aligns the activities with the Alliance for Internet of Things Innovation (AIOTI) and will coordinate and support the upcoming Innovation Actions in sustaining the ecosystems developed during those projects through mapping the pilot architecture approaches, address interoperability and standards approaches at technical and semantic levels for object connectivity, protocols, data formats, privacy, security, trusted IoT, open APIs and share the road-mapping with international initiatives.

The project fosters the exchange on requirements for legal accompanying measures, development of common methodologies and KPI for design, testing and validation and for success and impact measurement, federation of pilot activities and transfer to other pilot areas, facilitating the access for IoT entrepreneurs/API developers/makers, SMEs, including combination of ICT & Art. CREATE-IoT builds strong connections with Member States’ initiatives and other initiatives and will transfer learning points to the broader IoT policy framework that include contractual PPPs (e.g. Big Data, Factories of the Future, 5G-infrastructure), Joint Technology Initiatives (e.g. ECSEL), European Innovation Partnerships (e.g. on Smart Cities) as well as other FAs (e.g. on Autonomous transport).

For more information about the project see: http://www.create-iot.eu/

2.3.2 SynchroniCity

The SynchroniCity (SynchroniCity: Delivering an IoT enabled Digital Single Market for Europe and Beyond)) project was a European Union Horizon 2020 research and innovation project, which ran from 2017- 2019. It brought together citizens and 34 partners from academia, government, and business in **21 cities**. The project developed and validated the SynchroniCity framework based on the OASC MIMs implemented through FIWARE technologies. The framework was piloted at scale in multiple cities around the world, where a variety of IoT services were deployed – demonstrating that a multivendor ecosystem is achievable. The project addressed how to incentivise organisations and citizens to actively participate, how to find common co-created IoT solutions for cities, which meet constantly evolving citizen needs and create an environment of evidence-based solutions that can easily be replicated in other regions. Technically, SynchroniCity is a mix of a very pragmatic approach (just make sure it works) and an ambition to build on consensus fora, best practice, and existing standards, applicable for all stages of the IoT-enabled service lifecycle, also long-term. Interoperability points are independent from the specifications and software components, the mechanisms, that realise them and can be implemented by cities and communities in different steps to reach different levels of compliance. The mechanisms are vendor-neutral and technology-agnostic, meaning that anybody can use them and integrate them in existing systems and offerings.

The project involved a total of 50 deployments of products and services across 21 cities. These were broken down into pilots, which were SME-led groups, with between one to six organisations working on the deployment of their solution within the group and also worked closely with the SynchroniCity cities they deployed in. They focused on citizen engagement, environment and wellbeing, and sustainable mobility. The pilots demonstrated that by using Synchronicity framework, it is possible to transfer social and environmental impact to local economic activity, as well as opening new market opportunities for both local authorities and technology service providers.

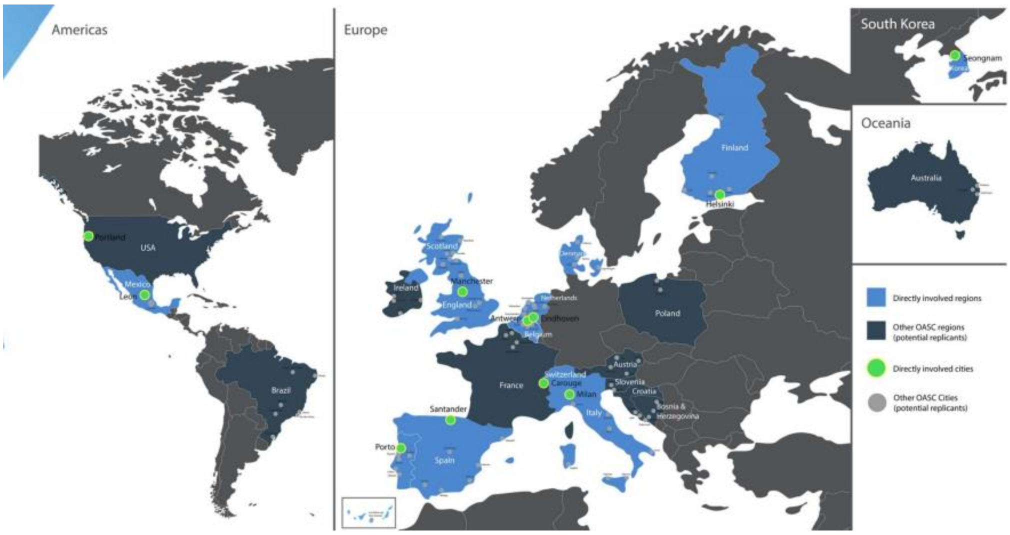

FIGURE 3: SYNCHRONICITY PILOTS

SynchroniCity represents the first attempt to deliver a Single Digital City Market for Europe by piloting its foundations at scale in reference zones across 8 European cities, involving also other cities globally. It addresses how to incentivise and build trust for organisations and citizens to actively participate, in finding common co-created IoT solutions for cities that meet citizen needs and to create an environment of evidence-based solutions that can easily be replicated in other regions.

For more information about the project see: https://european-iot-pilots.eu/project/synchronicity/

2.3.3 DataBio

DataBio (Data-driven Bioeconomy) is a H2020 lighthouse project focusing on utilizing Big Data to contribute to the production of the best possible raw materials from **agriculture, forestry, and fishery/aquaculture** for the bioeconomy industry in order to produce food, energy and biomaterials, also taking into account responsibility and sustainability issues. DataBio has deployed state-of-the-art Big Data technologies taking advantage of existing partners' infrastructure and solutions. These solutions aggregate Big Data from the three identified sectors (agriculture, forestry, and fishery) and intelligently process, analyse and visualize them. The DataBio software environment allows the three sectors to selectively utilize numerous software components, pipelines and datasets, according to their requirements. The execution has been through continuous cooperation of end-users and technology provider companies, bioeconomy and technology research institutes, and stakeholders from the EU´s Big Data Value PPP programme.

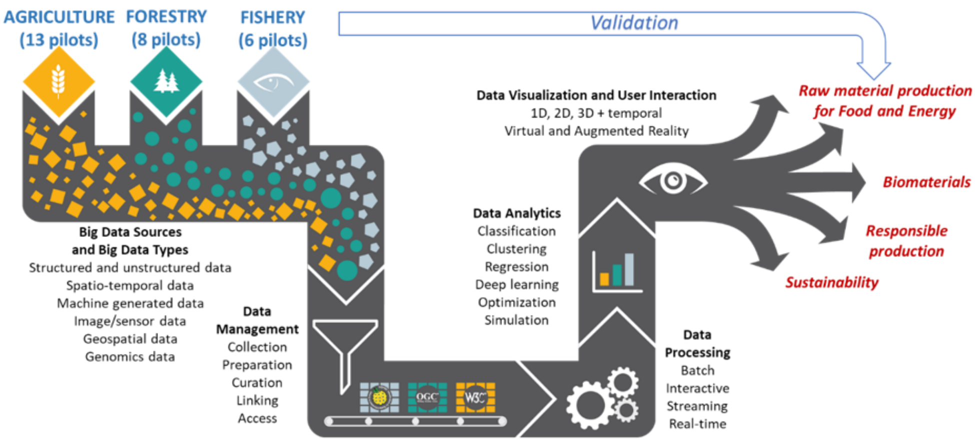

FIGURE 4: DATABIO CONCEPT

DataBio has been driven by the development, use and evaluation of 27 pilots, where also associated partners and additional stakeholders have been involved. The selected pilot concepts have been transformed into pilot implementations utilizing co-innovative methods and tools. Through intensive matchmaking with the technology partners in DataBio, the pilots have selected and utilized market-ready or near market-ready ICT, Big Data and Earth Observation methods, technologies, tools, datasets and services, mainly provided by the partners within DataBio, in order to offer added-value services in their domain. Based on the developed technologies and the pilot results, new solutions and new business opportunities are emerging. DataBio has organized a series of stakeholder events, hackathons and trainings to support result take-up and to enable developers outside the consortium to design and develop new tools, services and applications based on the DataBio results. The Pilots of this project are classified in:

(A) Precision Horticulture including vine and olives:
- Group A1: Precision agriculture in olives, fruits, grapes and vegetables
  - Pilot A1.1: Precision agriculture in olives, fruits, grapes
  - Pilot A1.2: Precision agriculture in vegetable seed crops
  - Pilot A1.3: Precision agriculture in vegetables -2 (Potatoes)
- Group A2: Big Data management in greenhouse eco-systems
  - Pilot A2.1: Big Data management in greenhouse eco-systems

(B) Arable Precision Farming:
- Group B1: Cereals and biomass crops
  - Pilot B1.1: Cereals and biomass crops
  - Pilot B1.2: Cereals and biomass and cotton crops 2
  - Pilot B1.3: Cereals and biomass crops 3
  - Pilot B1.4: Cereals and biomass crops 4
- Group B2: Machinery management
  - Pilot B2.1: Machinery management

(C) Subsidies and insurance:
- Group C1: Insurance
  - Pilot C1.1: Insurance (Greece)
  - Pilot C1.2: Farm Weather Insurance Assessment
- Group C2: CAP support
  - Pilot C2.1: CAP Support
  - Pilot C2.2: CAP Support (Greece)

For more information about the project see: www.databio.eu.

2.3.4 Boost 4.0

Boost 4.0, starting 1st January 2018 and with a duration of 3 years, is the biggest European initiative in Big Data for Industry 4.0. With a 20M€ budget and leveraging 100M€ of private investment, Boost 4.0 will lead the construction of the European Industrial Data Space to improve the competitiveness of Industry 4.0 and will guide the European manufacturing industry in the introduction of Big Data in the factory, providing the industrial sector with the necessary tools to obtain the maximum benefit of Big Data.

The main objectives of Boost 4.0 project are:

- Global Standards: Contribution to the international standardization of European Industrial Data Space data models and open interfaces aligned with the European Reference Architectural Model Industry 4.0 (RAMI 4.0).
- Secure Digital Infrastructures: Adaptation and extension of cloud and edge digital infrastructures to ensure high performance operation of the European Industrial Data Space; i,e, support of high-speed processing and analysis of huge and very heterogeneous industrial data sources.
- Trusted Big Data Middleware: Integration of the four main open source European initiatives (Industrial Data Space, FIWARE, Hyperledger, Big Data Europe) to support the development of open connectors and big data middleware with native blockchain support in the European Industrial Data Space.
- Digital Manufacturing Platforms: Open interfaces for the development of big data pipelines for advanced analysis services and data visualization supported by the main digital engineering, simulation, operations and industrial quality control platforms.
- Certification: European certification program of equipment, infrastructures, platforms and big data services for their operation in the European Industrial Data Space.

Pilots are divided into Lighthouse & Replication Factories

FIGURE 5: BOOST 4.0 PILOTS

The domains of 10 Lighthouse Pilots are: **Automotive** (6 Pilots), **Machine Tool** (2 Pilots) and **White Goods & Appliances** (2 Pilots) while the 3 Replication Factories concern **Textile sector, Ceramics end Elevation/ AERO**.

Based on the different big data backgrounds and the pilot domains from where big data solutions and platforms will develop business value and transformation, pilots will reach TRL8/TRL9 suitable system complete, qualified and proven in competitive manufacturing operational environment.

For more information about the project see: https://boost40.eu/.

2.3.5 Big Data Value Ecosystem (BDVe)

Effectively combining in a consortium Large Enterprises, SMEs and Academia the Big Data Value eCosystem Project (BDVe) provides coordination and support for the current and future H2020 projects within the Big Data Value Public-Private Partnership.

The mission of BDVe is to support the Big Data Value PPP in realizing a vibrant data-driven EU economy or said in other words.

The main and challenging objectives of this project are: (1) achieving a more competitive landscape of European Big Data providers, leading to bigger market share; (2) creating the context for a more competitive EU industry (transport, manufacturing, public sector, agri-food, media, energy,…) in the advent of a data-driven revolution where many traditional players will have to transform their processes and re-think their business if they want to remain completive or, in some cases, just to survive; (3) ensuring the sustainability of the investments and actions triggered by the PPP.

BDVe has broken down those high-level goals into 7 major priorities for the project:

- Being accurately informed about most important facts in Big Data so that we have a solid basis to support the decision-making process in the PPP;
- Supporting the implementation of the Big Data PPP from an operational point of view;
- Developing a vibrant community around the PPP;
- Supporting the development of a European network of infrastructures and centres of excellence around Big Data;
- Setting-up a professional Communications strategy;
- Setting up a framework that supports the acceleration of data-driven businesses, and;
- Ensuring the sustainability of the investments and actions triggered by the PPP.

The BDVe consortium includes a set of partners that have shown commitment and dedication to the success of the PPP for several years. They have already invested and they have committed to invest along the coming years. We believe that this CSA cannot be a neutral action that offers operational support without further commitment.

For more information about the project see: https://www.big-data-value.eu/

2.4 Literature review and Desk Research

The core of this deliverable is represented by Desk Research activities aimed at identifying the most used methodologies and tools in the context of LSPs research projects. The collection of the analyzed documentation was carried out through the internet sites of each selected project and through the web pages that describe the funding programs of which the projects are part.

A best practice present in all projects is the availability of very detailed deliverables which facilitated the analysis work. The material was easily available and consultable, and the documents covered by this Desk Research are reported below.

General documents:

- IoT European Large-Scale Pilots Programme Brochure
- IoT-_European-_Large-Scale_Pilots_Programme_eBook_CREATE-IoT_V02.pdf
- A-Vibrant-IoT-Research-innovation-Ecosystem-across-Europe.pdf
- CREATE-IoT-e-book
- Minimal Interoperability Mechanisms (MIMs)
- A Holistic Framework to Improve the Uptake and Impact of eHealth Technologies

Project deliverables:

- **CREATE-IoT**
  Deliverable 01.04 “Common methodology and KPIs for design, testing and validation”
  Deliverable 02.01 “IoT LSP handbook”
  Deliverable 02.03 “Common methodologies and KPIs for design, testing and validation”
  Deliverable 02-04 “Best Practice Guide and SME/Start-up toolkit”
  Deliverable 02.05 “Business and sustainability models for large-scale IoT scenarios”
  Deliverable 03-01 “Methodology for integrating ICT and Art”
  Deliverable 03-07 “Case study on LSPs”
  Deliverable 04.01 “IoT as a key pillar of the EU digital economy”
  Deliverable 07.01 “Communication Plan”
- **SynchroniCity**
  Deliverable 1.3 “Guidelines for SynchroniCity architecture”
  Deliverable 1.10 “First set of citizen-centred methods and tools”
  Deliverable 2.2 Guidelines for the definition of OASC Shared Data Models
  Deliverable 3.4 Common methodology and toolset for city service customization
  Deliverable 3.7 “Pilot deployment plan”
  Deliverable 4.1 “Validation Methodology Description”
  Deliverable 4.2 “Technical Validation (Phase 1)”
  Deliverable 4.3 “Technical Validation (Phase 2)”
  Deliverable 4.5 “Technical Validation of the SME projects”
  Deliverable 6.10 “1st report on communication, dissemination and marketing activities”
- **DataBio**
  Deliverable 1.1 “Agriculture Pilot Definition”
  Deliverable 1.3 “Agriculture Pilot Final Report”
  Deliverable 2.1 “Forestry Pilot Definition”
  Deliverable 2.3 “Forestry Pilot Final Report”
  Deliverable 3.1 “Fishery Pilot Definition”
  Deliverable 3.3 “Fishery Pilot Final Report”
  Deliverable 6.4 “Data-Driven Bioeconomy Pilots”
  Deliverable 6.7 “Final Report on Dissemination and Training”
- **Boost 4.0**
  Deliverable 1.1 “Project Management Plan and Fact Sheet”
  Deliverable 2.3 “Pilots description, adaptations and executive plans v1”
  Deliverable 10.5 “Annual demonstration plan and actions V1”

Pilot Factsheets

Guide for data gathering BOOST4.0 TRIAL HANDBOOK

- **BDVE**

  Deliverable 1.5 “Quality Assurance and SelfAssessment / KPI project framework”

  Deliverable 1.10 “Research Data Management Plan”

  Deliverable 2.1 “Report on high level consultation A (Big) Data Ecosystem in the making”

  Deliverable 3.2 “Value Proposition and Engagement Plan for Sectorial Communities”

  Deliverable 3.13 “Collaboration with EU initiatives”

  Deliverable 5.1 “Communication and dissemination strategy”

3 METHODOLOGIES AND TOOLS IN LSP

This section will illustrate the main results of the Desk research conducted on the selected projects. For each project, the methodologies and tools used to define the pilots' activities in the various phases of the process were analyzed.

3.1 CREATE-IoT

CREATE-IoT's main objective is to stimulate collaboration between existing IoT initiatives, foster the take up of IoT in Europe and support the development and growth of the IoT Ecosystem based on open technologies and platform.

To achieve this objective, CREATE-IoT promotes strategic and operational synchronisation and alignment between the different activities under the IoT Focus Areas and, in particular, across the Pilots that are part of the IoT European Large-Scale Pilot Programme.

In the initial phase of this project, a fundamental aspect was the identification of the methodology relating to the collection and definition of KPIs that represent the comparison tool for the different IoT solutions in the different projects.

The adopted methodology followed a collaborative and iterative approach divided into three phases: the initial list of KPIs identified at the beginning of the project was revamped and used to a more intensive degree in the subsequent phase.

The first step of the CREATE-IoTs team was to contact each LSP and obtain their existing list of KPIs as designed and devised by their own DoA and subsequent modifications. Upon receipt of the LSPs KPIs lists, a series of individual calls between CREATE-IoT and each LSP were organized to discuss the list and request clarifications, where necessary.

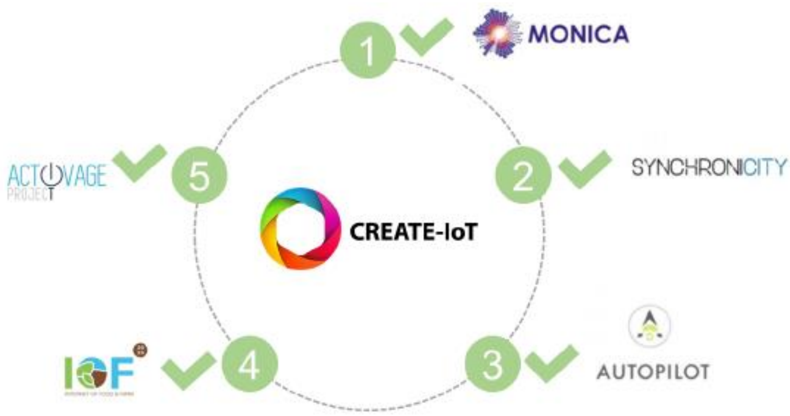

FIGURE 6: COLLABORATION WITH LSPS – FIRST STEP OF INTERACTION WITH LSPS

This produced an intelligible Excel document that highlighted:

- Common KPIs, that is KPIs that were identified at the 3rd level of the common methodological framework by CREATE-IoT and that are present across all pilots;
- Missing KPIs, that is KPIs that were identified at the 3rd level of the common methodological framework by CREATE-IoT and that are not present or considered by the pilots;
- Additional KPIs, that is KPIs that were identified by one or more Pilots but that were not initially devised by the common methodological framework produced by CREATE-IoT.

During the second step of this methodology to collect KPIs, a questionnaire was structured in a way to capture the latest developments in the update of the KPIs list by each Pilots with the aim to identify potential points of contact and exchange between the CREATE-IoTs general methodological KPIs framework and the KPIs devised by the Pilots in the other projects in order to finalize the general framework and make it beneficial for the Pilots and the overall IoT Programme. The last Third Step consisted in a face to face meeting between all involved partners to provide further update on the KPI development status and create a consistent Report.

At the end of this process, a clear way forward so as to agree on a common list of horizontal KPIs to be assessed throughout all Pilot projects has been provided.

The common methodologies and KPIs set forth in these projects are organized along three main types of indicators, each addressing a specific level of analysis and they are based on eight dimensions:

Type of Indicators	**Generic indicators** refer to areas of performance or evaluations that are common to all KPIs and all products, services and projects. These indicators will be applied to all Pilots and to the IoT European Large-Scale Pilots Programme as whole
	Cross-domain indicators operate at a lower level by intercepting those processes and features pertaining to more than one domain and therefore potentially referring to more than one Pilot but not to the Programme as a whole.
	Domain-specific indicators are designed for, and apply to, a single domain and are therefore used to measure the performance and impacts of one specific Pilots.
Dimensions	**Dimension 1**: Technology development measuring the type of support and the effects generated by the IoT European Large Large-Scale Pilots' Programme on ICT vendor and suppliers of IoT technology
	Dimension 2: Technology deployment and infrastructure measuring the degree of adoption, integration and performance of IoT technology across the LSPs and the whole Programme.
	Dimension 3: Ecosystem strategy and engagement measuring the extent to which an ecosystem strategy is in place and how well it is followed by the LSPs.
	Dimension 4: Ecosystem Openness and External Collaboration measuring the degree of openness and accessibility of the LSPs ecosystem for third parties outside the Programme.
	Dimension 5: Marketplace and business impacts measuring the LSPs' readiness for business transactions in terms of business effectiveness but also in terms of security and trust
	Dimension 6: Societal and economic impacts measuring the LSPs' societal and economic impacts in the short and long-term.
	Dimension 7: Policy and governance impacts measuring the LSPs impact to the existing national and European policy issues related to IoT
	Dimension 8: Community support and stakeholders' inclusion measuring how LSPs demonstrations are going to be actually adopted by the community in the long run.

Table 1: KPIs' features in CREATE-IoT

This methodology for the collection of KPIs has an average level of difficulty linked to the coordination of data collection from the different pilots, in fact different tools must be used based on the available data ranging from primary and secondary desk research to online questionnaires and one-to-one interviews to be submitted to each pilot.

However, at the same time, this complexity is also a positive element since once the structure of the categories and collection methods have been defined, the obtained list of KPIs can be generalized to many other projects which can therefore follow a proven methodology with excellent results.

Once the metrics were defined, the next phase of the CREATE IOT project aimed to measure the results obtained in the other projects of the Large Scale Pilots programme. For this purpose, a methodology called Experience Readiness Level Protocol (ERL) has been implemented.

ERL approach is based on the experimentation of a system from a technical perspective, and the quality of the experimenter's experience of the system when in use. ERL levels elaborated in CREATE IOT projects are:

- ERL 1 – Complex both conceptually and in technology. Hard to work or play with. Suggests rich area of questioning in areas of Why? What? and How?
- ERL 2 – Broad concept understood. Prototyping technologies, workflows and interfaces. Mechanical elements still at component stage. Discovering the What? and How?
- ERL 3 – Technologies are more modular and formed. Networks, interconnections and interfaces still being developed and extended. Prototyping with hard examples of usable technology possible, APIs under development and available, interconnectivity with other systems possible.
- ERL 4 – Total system ideated. Potential to reify end to end product. Playful tinkering with a well-formed system possible.
- ERL 5 – System or device robust and well defined. Well understood APIs and behaviour. Simple to use and integrate with other components / systems / networks.

The last phase of the project was the measurement of the compliance of defined KPIs with the results obtained in the individual Pilots of the projects analyzed and the application of the ERL methodology to specific cases to measure the actual level of maturity achieved by the IoT solutions developed.

The exploitation of Pilots' results is described through the **Dissemination Guidelines,** a document that was always produced at the start of the project and updated over the months establishing communications channels, website and formats for Press release and Conferences.

CREATE-IoT dissemination actions are available both through the project website and social media channels.

FIGURE 7: CREATE IOT WEBSITE

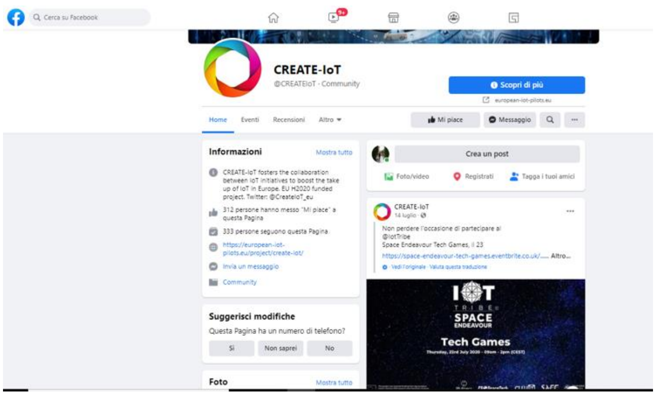

FIGURE 8: CREATE IOT FACEBOOK PAGE

In conclusion, for the Create IoT project the main methodologies and tools adopted are shown in the table.

	Initial Phase	Development Phase	Final Phase
Methodologies and Tools	KPIs' collection through iterative and collaborative approach: • Online survey, face to face interview, Primary and Secondary Desk research	Mapping of KPIs' and Pilots' results ERL approach	Dissemination of Pilots' results in • Project website • Social media channels:

TABLE 2: CREATE-IOT METHODOLOGIES AND TOOLS

3.2 Synchronicity

SynchroniCity represents the first attempt to deliver a digital single market for Europe and beyond for IoT enabled urban services by piloting its foundations at scale in Reference Zones (RZ) across eight European cities, involving also other cities globally. It addresses how to incentivise and build trust for organisations and citizens to actively participate in finding common co-created IoT solutions for cities that meet citizen needs and to create an environment of evidence-based solutions that can easily be replicated in other regions. The reference zones are based on cities which are at the forefront of smart city development covering different geographies, cultures and sizes. They include Antwerp (Belgium), Carouge (Switzerland), Eindhoven (the Netherlands), Helsinki (Finland), Manchester (the United Kingdom), Milan (Italy), Porto (Portugal) and Santander (Spain). These cities have adopted the Open & Agile Smart Cities (OASC) principles, implemented using FIWARE technologies, to build IoT ecosystems and integrated services based on open standards and existing datasets. Each of the reference zones (cities) had the responsibility to ensure that the SynchroniCity activities would be carried out in accordance with their needs, interests and regulations.

The complexity of the project, linked to the high number of solutions and pilots to be implemented, required, in the initial phase, the identification of the most functional methodology for defining the Use Cases (UC) and Scenarios.

Use cases are written for the purpose of extracting high level platform requirements and is done in by collaborating with city representatives involved in defining the overall SynchroniCity smart city platform. The process included a workshop led by DigiCat, where several rounds of brainstorms were conducted, ideas were discussed and grouped according to the different relevant topics to get a better understanding of how they related to each other. The initial stakeholder analysis has not included a prioritization phase, where specific stakeholders are given more or less influence over the project. This is also reflected in the derived use cases, where the prioritization will be made democratically by letting the stakeholders vote. The idea is that the perceived importance of each use case will be captured from the viewpoint of each specific stakeholder.

A template has been devised to gather all the relevant information needed. It was imperative that the template was simple enough for non-technical people to use, but also capture enough relevant information on stakeholders and their interactions that meaningful system requirements could be extracted. The template covers the existing practices, how they the use case proposes to improve them, and also a rating system to allow an easy scoring mechanism to sort the use cases based on relevancy.

The fields of the template include:

- Use case title and id
- Use case objective
- Primary stakeholder and its perspective
- Secondary stakeholder and its perspective
- Use case narrative
- Barrier to be overcome in current practice
- Relevancy rating

In the adopted methodology for defining UCs a further classification of them is based on the primary stakeholder and encompass the following:

- Cities - use cases cover how to unlock insights into problems using data source available on the marketplace, discovery of assets prior to procurement or the discovery of existing SynchroniCity compliant solutions that exist in other cities.
- Market place providers - use cases include the on-boarding of providers of data/services to the digital single market, data usage monitoring, ensuring compliance on standards and SLA and quality assurance.
- IoT device operators - use cases related to IoT device provisioning, their management, definition of access policies and SLAs.
- Service component provider - use cases addressing the definition of usage licences, access policies and SLA and service component registration.
- Data provider - definition of data license, data access polices and SLA, data cleansing, data source registration and compliance verification with respect to data protection rules.
- Data consumer - use cases include the discovery of data availability, understanding of metadata, data/API access and subscription, popularity/reputation of data sources, discovery of other data consumers for same sources and verification of data source compliance with respect to data protection rules.
- Infrastructure provider - primary use case is the discovery of complaint specifications to enter the DSM.
- Citizen/End user - use cases relate to the access to information about personal data processing and demands signalling.

Such a granular classification of UCs is fundamental in a project whose pilots, besides being numerous, also see different players involved in various capacities in the design phase and subsequently in the deployment of the project solution.

Use case id:	SUC-Solution-Discovery
Use case title:	Discovery of SynchroniCity Compliant Solutions
Use case objective:	Browsing, identifying and obtaining detailed information about previously developed solutions that were deployed in other cities and thus are considered as SynchroniCity Compliant and can be replicated and/or adapted for use in other cities.
Barrier to be overcome in current practice:	Current practice causes cities to incur in non-structured search for information and solution providers, that usually leads to proprietary solutions and information silos. Other barriers include: • Lack of city marketplaces • Heterogeneity of marketplaces, overcome by explicitly targeting cities • Compliance issues, which are minimized because the solutions on the market place are SynchroniCity compliant

FIGURE 9: SYNCHRONICITY UC EXAMPLE

In the initial phase of the Synchronicity project, the methodology for identifying and collecting KPIs was also defined. As in CREATE-IoT, also in this project the KPIs play a key role since they represent a measure of the conformity between obtained and expected results and represent a metric for monitoring the progress of each Pilots.

KPIs have been divided into categories and for each the parameters a description, the indicator unit and the expectations have been defined. A further fundamental aspect in this phase was the definition of the Requirements for all the cities involved as Pilots. The methodology adapted in this process was based on the use of ad hoc surveys created within the project, and on the creation of online questionnaires and face-to-face interviews. All results have been collected in a project Template fulfilled by partners and pilots 'owners shown in Figure 10.

Title	*The title of the requirement.*
Category	*A high level classification of the requirement.*
ID	*The unique identification code for the requirement.*
Requirement Type	*Typology of the requirement:* *Functional: it is a requirement that expresses a functionality of the platform that will be directly used by a user (human or external system).* *Non-Functional: this type of requirement is related with platform features that are not specific behaviours or functions, such as performance, security and interoperability.*
Requirement Description	*The description of the requirement.*
Rationale	*Motivations that justify the need for the requirement in the context of the project.*
Priority	*The priority level for the implementation of the requirement:* *High: the requirement has high priority and has to be implemented in the first version of the platform.* *Medium: the requirement has medium priority and should be implemented in*

FIGURE 10: SYNCHRONICITY REQUIREMENTS' TEMPLATE

The results from the online questionnaire have been very useful for better understanding the starting points of reflections about co-creation methodologies already in place in each city, their main objectives, the tools and the rewarding systems used, and the current phases of development.

In the Development Phase of the different Pilots, different methodologies were adopted as the nature of each pilot, his objectives and his expectations were radically different. Co-creation methodologies were put in place both to validate the services piloted in the reference areas, and at the level of users, stakeholders, SMEs and citizens.

To this end, some GUIDELINES TO IMPLEMENT CO-CREATION METHODOLOGIES were created in order to correctly described each methodology through the following parameters:

- Suggested time
- Level of difficulty
- Number of participants
- Steps
- Requirements

An example of Co- Creation Methodology guideline is reported for the Gamification aspects in the Santander Pilot:

Suggested time	From 10 days to months
Level of difficulty	Very high
Number of participants	From 5 to maximum 30
Steps	1. Learning outcomes: identify which are the objectives you aim to achieve through the approach learning by doing. These outcomes should be quantifiable. 2. Choose the idea: define a theme and a challenge to accomplish. 3. Select the process: create a storyboard of the game. 4. Identify the learning activities: choose which are the steps needed to realize the learning outcomes. 5. Define the team: the social part of learning is very relevant, for this reason the group participating in the game has to be formed by taking into account the expertise and characteristics of each player. 6. Apply dynamics: consider motivation, rewarding systems and challenges, but also leave some space for individual interpretation of the game.

Requirements	a) User involvement: gamification is essential to facilitate various target audience to be part of the co-creation process and for decision making. Is important to have a clear idea of the user groups that have to be involved since the beginning of the activities to increase the likelihood of adoption of products/services. b) Service and infrastructure development: gamification is very useful to identify user requirements which constitute the baseline for service and infrastructure development. Gamification processes implemented should take into account the individual differences and preferences of users to increase their satisfaction. c) Innovation outcomes: to develop a game from the scratch is very time consuming and expensive. This is the reason why gamification can only be effective for innovating products and services only if you provide the right environment for increasing collaboration rather than competition. To stimulate different groups to join forces amongst different groups is the perfect way to boost the potentialities of this methodology.

TABLE 3: CO CREATION METHODOLOGY EXAMPLE

The validation methodology adopted within the SynchroniCity is described as "The methodology will rely on a holistic approach taking into consideration that we are not just constraining the validation to technical concepts but also sociological considerations, replication capabilities business models and co-creation attributes." and a strategic overview, that can be easily replicated in different context and different pilots, is so defined:

FIGURE 11: STRATEGIC ALIGNMENT

1. WHAT is the high level problem or challenge that validation is intended to solve?

Validation is conceptually intended to ensure that the components and services have the result of meeting the operational needs of the users. The two key goals of this activity are to internally ensure that the different components meet the operational needs of the consortium partners and to demonstrate to external stakeholders that the correct requirements and specifications have been enacted. The validation will need to be sufficiently flexible to work within different city-contexts and with applications across the themes of the project.

2. HOW will resources / tasks be allocated to o accomplish the results and what approaches, processes and workflows will be followed?

The validation task has been divided by category, with technical experts in each area assigned to that validation. This document, recording the methodology, will communicate both internally and externally the approach to be taken.

3. WHY is the (validation) solution needed?

A cornerstone of success is to demonstrate through the validation that the new IoT services have been deployed in response to the genuine needs and challenges of pilots and end users involved in the project to prove solutions are being built in the right way.

4. WHO?

Validation activity were carried out by the consortium partners, in particular by technical experts in each validation area, but with support from representatives of each sites.

5. WHERE are the various geographical and logistical locations and how do they have impact on validation?

Validation applies across a multiplicity of services and cities.

6. WHEN - deals with the various time-based parameters, events, activities and how they will impact the validation activity.

Milestones have been set for some of the validation activities, however it is critical to keep in mind that these represent end points, or final reports, however in most of the cases that will be described the validation activities are continuous and feedback into the relevant project area.

The answers to these questions were associated with the different requirements and use cases by creating tables that easily allow to explore the solutions adopted and which can represent a coding system that can be easily and quickly adopted in other initiative.

Criteria		What	Why	Methodology
Needs and Requirements	Adaptability	Adaptability refers to the service provider response to customer needs, requests and behaviour.	To assess the flexibility and adaptability of the Platform and services to different contexts and needs of the stakeholders (tangibles and service performance).	Co-creation techniques Customer research Discover
	Usability	Usability is a concept in user interface design that refers to how **effectively** and **efficiently** a user can interact with a user interface.	To ensure that the end solution/system is easy to learn, efficient to use and pleasant features to increases customer engagement to the product and most of all to the service.	User satisfaction User validation Interface design Focus group, concept test
	User experience	User experience is the emotional response the user has to a service and product.	Focus on a deep understanding of users' needs (values, abilities and limitations) to improve the quality of the user's interaction	Methods: Focus group, user tests, hallway test, online test, prototype user tests and visual performing test..

FIGURE 12: SYNCHRONICITY USER AND STAKEHOLDER VALIDATION AREAS

The exploitation and dissemination of Pilots' results is described through the **Marketing and communications Plan,** which define marketing and communication goals and objectives and the exploitation and sustainability strategy for each Pilots.

Synchronicity project has an entire section of its site dedicated to pilots that can also be viewed according to the different categories and selecting a specific pilot it's possible to access to all relevant information such us involved cities and installed solutions.

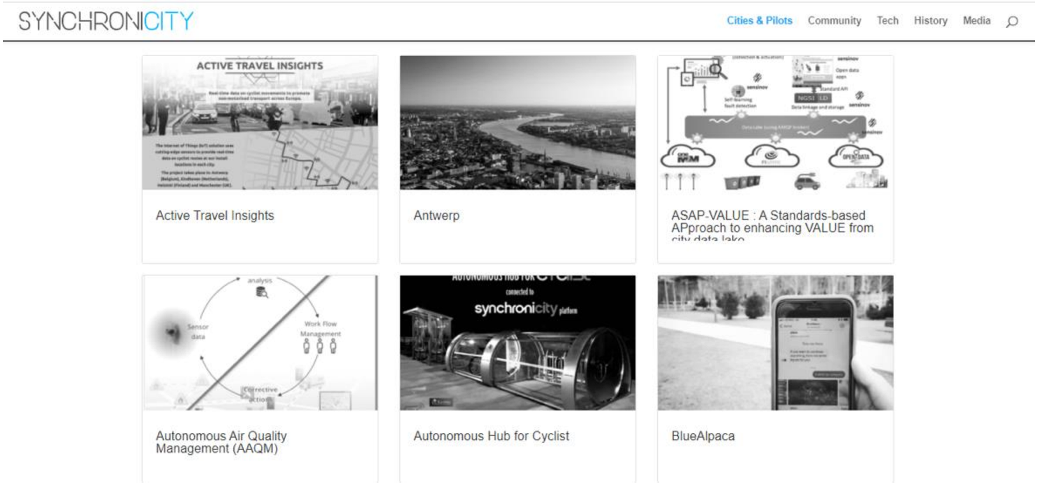

FIGURE 13: SYNCHRONICITY WEBSITE

FIGURE 14: SYNCHRONICITY KIMAP-CITY

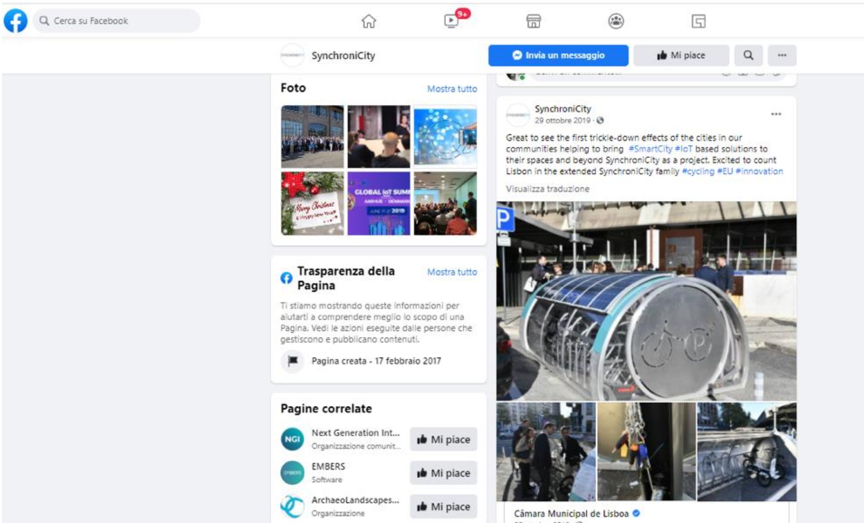

FIGURE 15: SYNCHRONICITY FACEBOOK ACCOUNT

SynchroniCity also has an entire dedicated YouTube channel (https://www.youtube.com/channel/UCycIOAj8BO1KUS0pTOiCMNQ) where it is possible to find specific videos of the pilots, here the case of Milan.

In conclusion, for the SynchroniCity project the main methodologies and tools adopted are shown in the table:

	Initial Phase	Development Phase	Final Phase
Methodologies and Tools	• Use Cases definition: Creation of a project template • KPIS: survey, online questionnaire, face to face meetings • Requirements identification: creation of a project Template	• Guidelines to implement co creation methodologies Report • Holistic validation Methodology	Marketing and communications Plan

TABLE 4: SYNCHRONICITY METHODOLOGIES AND TOOLS

3.3 DataBio

In DataBio project, the concept of a platform in a strict technical sense as a software development platform is expressed. With this, we refer to an environment in which a piece of software is developed to be deployed in hardware, virtualized infrastructure, operating system, middleware or a cloud. More specifically, the focus is on Big Data platforms, that deal with Big Data i.e., high volume, high velocity and high variety. We do not include into our platform term the broader concept of Digital service platforms, where various actors collaboratively create added value, primarily around data, according to common rules and agreements. DataBio provides a big data toolset which offers functionalities primarily for services in the domains of agriculture, forestry and fishery. The functionalities enable new software components to be easily and effectively combined with open source, standards-based big data, and proprietary components and infrastructures based on use of generic and domain specific components. The DataBio toolset supports the forming of reusable and deployable pipelines of interoperable components (mostly provided by partners) thus extending the impact of DataBio to new bioeconomy projects as well as to other business areas.

The overall methodology of the DataBio project is to build and pilot a big data technology platform, based on existing technologies and data sets, in collaboration with the end users and proceed to verify the concept through several piloting in the specific sectors.

In the Initial phase, a well-structured methodology for identifying and collecting end users requirements and user understanding has been used based on a co-innovative process for development, adaptation, customization and integration of a set of interfaces, platforms, tools and services utilizing existing technologies or very near-to-market technologies and piloting and validation of the concepts and services.

To guarantee user involvement and user/stakeholder understanding participatory design and co-creative conceptualising and prototyping methods are used (e.g. workshops, interviews, questionnaires) in the beginning of the project in the co-innovative preparation tasks and during the duration of the project in each pilot sector Agriculture, Forestry and Fishery.

The methodology for the analysis of the requirements would include a comparison of the requirements of different sectors Agriculture, Forestry and Fishery to establish the singular requirements of common Big DATABIO platform. The different big data solutions and data etc will be very different from the user perspective in different bioeconomy sectors but common enablers the big data components will be utilized behind the user interfaces of the Big DATABIO platform.

As the number of components in the platform is large, during the Realization Phase a methodology based on "pipeline creation" has been adopted. This process included as the first step the identification of components that can fulfil some of the pilot requirements. We called this process a matchmaking process. Matchmaking was a two-way process: component providers have expressed their interest for supporting pilots and pilots have expressed their interest for the different components according to specific features/capabilities. As a later step, the orchestration of some components into pipelines took place.

The provided template for the Pipeline definition contains:

- **General information** This section will include general information with regards the pipeline

- **Objectives** What is the purpose of this pipeline? Why it has been created?
- **Diagrams and views** this section contains the URL of the pipeline in DataBio Hub if exists otherwise the diagram(s) in Modelio
- **Associated pilot** What is the pilot name and identification this pipeline belongs to? + URL to the pilot design in DataBio Hub/Modelio diagram
- **Reusability State** whether this pipeline is specifically tailored to the pilot or can be reused in different settings
- **Interfaces** The interfaces into the pipeline and out of the pipeline (interfaces between the components in the flow are described later in a separate section).
- **Components involved**: Name and Interfaces between components
- **Experimentation** this section includes We anything we have with regards to tests made with this pipeline up to now
- **Deployment** Where the components are installed? Any relevant information re the invocation of the pipeline service should go here
- **Results** Results so far from testing
- **Next steps** What are the plans for next experimentation with this pipeline

By way of example, we report some sections of the pipeline created for Pilot B1.1 “Field data analysis and real-time alerting for decision making for precise agriculture”.

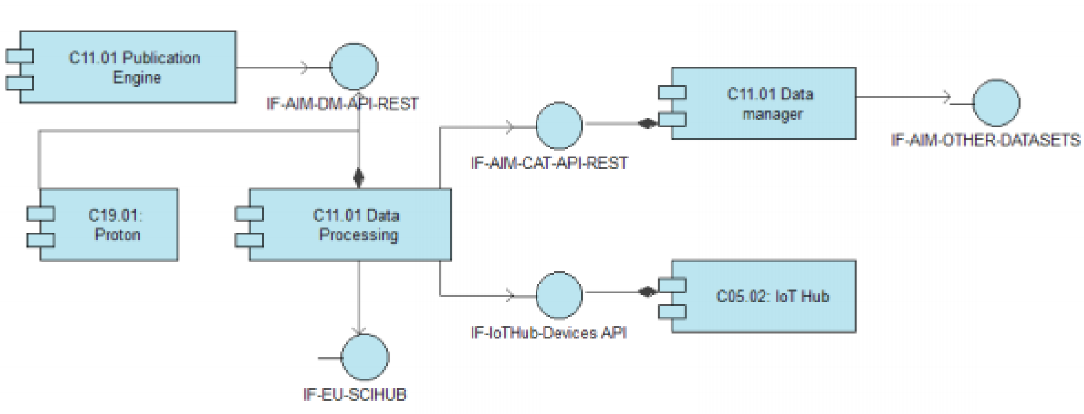

FIGURE 16: PILOT PIPELINE VIEW EXAMPLE

2.4.3 Components involved

2.4.3.1 Names

Three components participate in this pipeline:

PROTON from partner IBM (C19.01 URL: https://www.databiohub.eu/registry/#services?name=IBM).

FIWARE IoT Hub from ATOS:

https://www.databiohub.eu/registry/#service-view/FIWARE%20IoT%20Hub/0.0.1

Advanced Irrigation and Vigour Monitoring – Data visualization (C11.01):

https://www.databiohub.eu/registry/#service-view/Advanced%20Irrigation%20and%20vigour%20Monitoring%20%20-%20(AIM)%20-%20Data%20visualization/0.0.1

FIGURE 17: COMPONENT INVOLVED IN THE PIPELINE EXAMPLE

Moreover, a **Trial methodology** has been used successfully within the DataBio project where a total of 13 pilots have been completed testing Big Data technologies in key areas of interest including horticulture, arable farming, subsidies and insurance, with the ultimate aim of addressing different challenges facing the EU’s agriculture ecosystems.

To enable adapting DataBio tools and services to the pilot needs and reflecting the experiences from pilots in further development and integration of DataBio services the time frame of the project has been divided into the following stages:

- Preparatory stage was the phase where pilots and their needs were defined through a collaborative process between Pilots Work Packages and Technical WP. During this period the first version of DataBio platform was defined, the tools and services were adapted to the needs of pilots in the next stage "Trial 1". In this phase, the partners involved in pilots also defined the first version of their business plans.
- Trial 1 stage was the period where pilots were focused on using and testing the DataBio tools and services. Those components were developed or adapted to pilot needs in the previous preparatory stage. In addition to aiming to various technological or scientific goals, the pilots were also focused on exploring and increasing their market potential.
- In Trial 2 stage pilots used the updated DataBio platform and ran the second and final phase of their experiments. In this stage, pilots were also focused on their business goals and target markets.
- In the final period of the DataBio project, pilots, as explained in this document, were able to take advantage of their experience and results from the DataBio project and fully develop their market potential.

In the final phase of the project, the chosen methodology to share Pilots results was press release publication.

Starting the preparation of the press release, pilot leaders were requested to provide short texts describing their pilot that should be targeted at non-technical audience. The press release consists of two parts, the first part is a short description of the project and the pilot launching announcement and the second part includes the aforementioned pilot descriptions separated into three domains: agriculture, fishery and forestry. The first part alone could be used by media that could not publish the whole press release. The press release was promoted in various local and international dissemination channels (websites, e-magazines, newspapers etc.) by all DataBio partners.

Press release

7 August 2018

The DataBio project starts trials of 26 bioeconomy pilots

The development of a sustainable bioeconomy in Europe is expected to get a big boost from Big Data technologies thanks to a project co-funded by the EU's Horizon 2020 programme.

The European Union's Data-Driven Bioeconomy (DataBio) project has announced the launch of 26 different pilot trials, which are already underway in 17 countries. They will provide "real world" insights relevant for policymakers and producers – the farmers, foresters and fishermen engaged in Europe's bioeconomy.

DataBio is using Big Data technologies to support the growth of Europe's bioeconomy. More specifically, the project is handling massive flows of data collected through sensors placed in the soil and air, as well as from aerial and satellite imagery.

The DataBio consortium includes 48 partners from 17 countries and over 100 associated organisations.

FIGURE 18: DATABIO PRESS RELEASE ENGLISH VERSION

In conclusion, for the DataBio project the main methodologies and tools adopted are shown in the table:

	Initial Phase	Development Phase	Final Phase
Methodologies and Tools	• Co-innovative methodology to collect Use Cases • Prototyping Methodology to involve stakeholders	• Pipeline Methodology • Trial Methodology	• Classical dissemination methodologies through press release, conferences and project website

TABLE 5: DATABIO METHODOLOGIES AND TOOLS

3.4 Boost 4.0

Boost 4.0 "Big Data Value Spaces for Competitiveness of European Connected Smart Factories 4.0" would demonstrate, in a realistic, measurable, and replicable way an open, certifiable and highly standardised and transformative shared data-driven Factory 4.0 model through 10 lighthouse factories. Boost 4.0 will also demonstrate how European industry can build unique strategies and competitive advantages through big data across all phases of product and process lifecycle building upon the Boost 4.0 connected smart Factory 4.0 model to meet the Industry 4.0 challenges. Based on the different big data backgrounds and the pilot domains from where big data solutions and platforms will develop business value and transformation, pilots will reach TRL8/TRL9 suitable system complete, qualified and proven in competitive manufacturing operational environment.

Within this project, a Trial Handbook (TH) was defined**,** defining in full detail the whole process carried out throughout each trial case and the outcomes and results of the developed activities There are several prerequisites to create a TH:

- Identify the tasks and organisations interacting with the pilots.
- Develop a workflow and interaction chart.
- Structure the main "information gathering chapters" for the handbook.
- Specify the concrete chapters of the Handbook.
- Define the information needed from the trial and configure a table of contents for each chapter.
- Define concrete persons responsible to provide specific information.

The methodology used for producing the THs is composed by 3 main steps as depicted below.

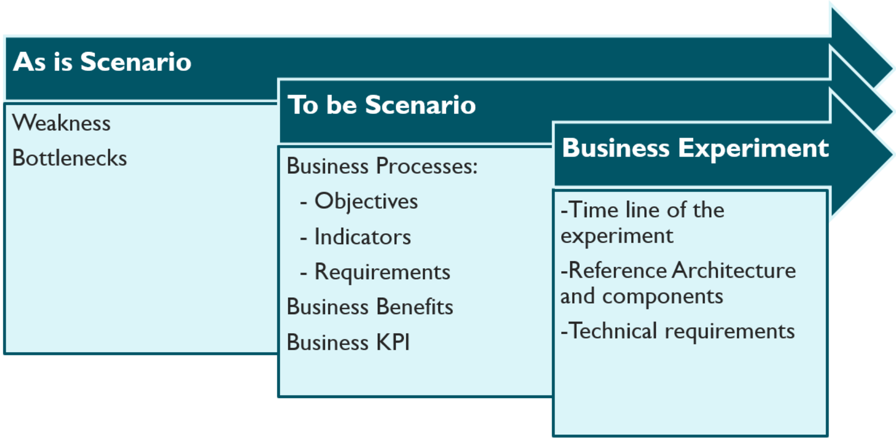

FIGURE 19: TRIAL HANDBOOK STEPS

The **scenario analysis** is the first step of RE (Requirements Engineering) processes and it consists by building up the weakness and bottlenecks of the actual (**AS IS**) situation, clarifying the strategic objectives of each Pilot in terms of improvement of processes. It also provides a proposal for the **TO BE** scenario trying to identify technical areas of intervention, as well as potential tangible and intangible benefits of its realization. The gaps identification between the AS IS and the TO BE scenario allows partners further defining all the pilots' requirements to be satisfied in order to facilitate the transition from the current to the desired situation, link them with objectives and related impacts.

During the analysis of LSPs' scenarios, the actual state (**TRIAL PRESENT SCENARIO**) is identified for each pilot through an in-depth analysis of the state of the art of the pilot in terms of technologies and processes in place. All the communication mechanisms, the tools already present on the site are analyzed and a modular inspection of all the areas and functionalities that will be the subject of the project is carried out. Within this scenario, the weaknesses and strengths of the pilot are also highlighted in order to prepare actions for the management of any future problems.

The second step is the future scenario analysis (**TRIAL FUTURE SCENARIO**) of the pilot, which describes how the solutions that will be developed as part of the project will impact on the site, how the different modules will be integrated into the current scenario and what will be the improvements made in terms of processes' optimization.

In the Boost 4.0[1] project the Scenario Analysis was conducted for each Pilot and here an example about Volkswagen Injection Moulding Plant is shown.

This way to characterize and analyse the status of each Pilot can represent a real and effective "modus operandi" for future DT and Big Data projects.

TRIAL PRESENT SCENARIO
In "Trial Present Scenario" analysis there is a description regarding how the production of light metal castings works following a conventional approach. A mould as a tool for the production of specific parts must be designed and manufactured, this tool is paired with a light metal casting machine which is used as a process step in an entire automotive manufacturing process. The VW scenario therefore deals with three main processes in the production of metal components: • The mould design and the manufacturing of the corresponding tool • The assembly and use of the component as well as the operation and maintenance of the associated machine in combination with the manufactured tool. • The production of the light metal components All these processes are described in detail and also the relationship between them is described, giving a compete overview about the actual status of the pilot.

TRIAL FUTURE SCENARIO
In "Trial Future Scenario" analysis there is a description regarding impacts of Boost4.0 project in Volkswagen production. In particular, Volkswagen will create new data sources and enable unified access to valuable data produced by products, machines and moulds so that the brownfield light metal casting processes are transformed into an Industrie 4.0 compliant data space. This is achieved through the unification of data protocols and the approach to diverse departments locally and at diverse locations and possibly even transferring related semantical unification to generate common communication protocols/languages (vocabulary, grammar) and allows an integrated approach for modelling information, gathering data, deriving information & knowledge as well as to transfer knowledge to first tier suppliers. The future state in Volkswagen realizes a zero-defects production that allows an evolutionary introduction in heterogeneous manufacturing environments. New assistant systems provide features for real-time continuous tool condition monitoring in the light metal casting process and simulated tool-health prediction models allow predictive maintenance.

The first two phases concern the characterization of the current and future scenarios, previously described with specific focus in the Weakness and Bottlenecks (As Is Scenario) in order to promptly put in evidence difficulties and opportunities of each pilot. In the "To be scenario" the focus is on achieving the objectives, defining the requirements and measuring the KPIs to assess the adherence between what was designed and what was actually achieved. In the last phase, "Business Experiment", all the development and commissioning aspects of the pilots are addressed based on a project timeline that allows the pilot's owners to monitor progress in terms of technological advancement and return on investments.

An important aspect of this methodology is the definition of the roles and responsibilities that each partner will have within each pilot. Multiple roles can be covered by more than one person who can deal with several responsibilities.

Here is a list of possible roles and responsibilities that can be defined in a project with different Pilots:

- TH Coordinator: is the role with the greatest responsibility in the management of the Trial and in the creation of the associated document. The coordinator is in charge of the definition of the participants of each chapter of the Trial Handbook document. He approves the general approach, and content of each chapter and he supports and urges, guarantees the homogeneity of TH as well as coordinates its evolution.

D2.3 – Pilots description, adaptations and executive plans v1 [1]

- TH Leader (Technology Provider of each pilot): is the person directly responsible for the pilot aspects, he is in charge of the ToC creation and of the identification of deliverables sections to be included in the Trial Handbook document. He coordinates the participation of contributors to the TH and keep it updated.
- Wave Leader: is the person in charge of the concrete participation of partners in pilots, he synchronizes and put together the ToCs' contributions and he informs the TH Coordinator of all progresses and Milestones.
- Chapter Leader: he is responsible for the chapters of the TH and he reviews and controls the content received.

TH is the main source of information for deliverables and all the main aspects addressed in each deliverable will converge in the TH, thus creating a single document that traces the history and progress of each pilot.

Generally, a TH document describes objective/benefits that the implementation of the trial is expected to provide at a general level. This description should detail expected benefits in competitiveness, labour security, reduction of costs, effectiveness of processes, enhancement of product quality, benefit in production, improvement in company image, etc. The TH could also describe the factory where the trial will take place and explains how the competitors in this sector are currently operating. A very important section of the document is the "Excepted Results" paragraph in which the expected results at the process level are described after the implementation phase of the Trial.

An example of the structure of a Trial Handbook is shown below:

1. Trial Overview
    a. Objectives/Benefits

    > Describe the general objective/benefits that the implementation of the trial is expected to provide at a general level. This description should detail expected benefits in competitiveness, labor security, reduction of costs, effectiveness of processes, enhancement of product quality, benefit in production, improvement in company image, etc. List at least 5 general benefits and describe its impact, justify in detail how the technology to be implemented will manage to provide these benefits. (between 1 page and 3 pages)

    b. General Description

    > Give a general description of the trial:
    > Describe the factory where the trial will take place,
    > Explain how the competitors in this sector are currently operating (between 1 and 2 pages)
    > Indicate and justify which application domain of trial (virtual, smart or digital) is going to take place

2. Participants
    a. End User Description

    > Provide a brief description of the company, including activities, history, company size, I+D experience, economic situation, etc.

    b. Technology Provider Description

    > Provide a description of the IT provider, including history, personnel capacities related to the technology of the trial, expertise, and previous projects or activities related.

3. State of the Art
4. TRIAL PRESENT SCENARIO

    > Give a description of the activities related to the trial and currently performed in the factory. Provide as well a flow diagram that explains the whole process

5. WEAKNESSES AND BOTTLENECKS

List and describe the main weakness and bottlenecks in the present scenario and possible causes.

6. TRIAL FUTURE SCENARIO

Give a description how activities will be performed in the factory after the Trial. Provide as well a flow diagram that explains the whole process in the future.

In the Final Phase, Pilots results have been advertised and disseminated across the project website and in particular, through the creation of "Pilot Factsheet" materials.

For each Pilot a specific brochure describes the pilot in general (Figure 20), the motivation (Figure 21), specific objectives (Figure 22) , Competitive Advantages Big Data Pilot Lifecycle Scope (Figure 23), an image of the site (Figure 24) and the implemented solution.

FIGURE 20: WHIRLPOOL PILOT DESCRIPTION

Factory 4.0 Big Data Pilot Motivation

- Spare part production and distribution is one of the most complex and important challenges of the after sales services
- Field Service Engineers do have the need to rely on a central warehouse where the right parts are available at the moment they need to make a repair
- Large number of different product families and huge number of different product codes with different components to be handled

FIGURE 21: WHIRLPOOL MOTIVATION

Spare part demand forecasting big data process

- Consumer Service Data Model Creation
- Spare Parts Demand, Forecast Generation, Inventory and Supply, Planning Optimization
- Cross Department Quality Monitoring and Feedback

FIGURE 22: WHIRLPOOL SPECIFIC OBJECTIVES

Competitive Advantages

- Spare Part Stock Reduction (-30%)
- Increase Inventory Turnover (+35%)
- Lead Time to Consumer (-25%)
- Plant Service Level (+1%)

Big Data Pilot Lifecycle Scope

Digital Engineering	○○○○○
Production Planning	●●●○○
Smart Operations	●○○○○
Smart Production	●●●○○
Smart Services	●●●●●

FIGURE 23: WHIRLPOOL COMPETITIVE ADVANTAGES BIG DATA PILOT LIFECYCLE SCOPE

Big Data Pilot Site

Whirlpool EMEA Hub for spare parts and accessories
Carinaro (CE) | Italy

FIGURE 24: WHIRLPOOL PILOT SITE

In conclusion, for the Boost 4.0 project the main methodologies and tools adopted are shown in the table:

	Initial Phase	Development Phase	Final Phase
Methodologies and Tools	• Trial Handbook Methodology	• Trial Handbook Methodology	• Pilot Factsheets

TABLE 6: BOOST4.0 METHODOLOGIES AND TOOLS

3.5 Big Data Value Ecosystem (BDVe)

The BDVe project is a coordination and support action with the mission to support the Big Data Value PPP in realizing a vibrant data-driven EU economy and community. It's a very complex CSA project: more than 50 projects along 4 years should be supported, each one with its own objectives and areas of interest. The Steering Committee, the Technical Committee and the Communications team gathers respectively the project coordinators, technical leaders and communication experts to find common actions and directions that help to position Europe in a leading position in the Big Data Value global scenario.

The project operates at three different levels: for the Organisations, for their products and for the people. For the Organisations the Big Data Landscape will include all the actors in the Ecosystem; for the products, the Big Data Marketplace will showcase the platforms and solutions coming from the different projects; and for the people the project will build an ambitious skills platform, including the academic offering, a recognition programme, an internship offer and demand platform and a Mobility Programme for experts around Big Data in Europe.

In the first phase of this project a methodology to capture the rapidly changing landscape of Big Data ecosystems by consultation and condensation of a myriad of sources, including recent high-level reports, journal articles, EU policy briefs, blog posts, surveys and interviews with BVD-PPP stakeholders. Big Data and data-driven innovation ecosystems are rapidly evolving and diverging phenomena has been adopted. Being potentially disruptive to current sectors and their accompanying business models, any attempt to capture an exhaustive list only once would not reflect the dynamics of this disruptive transformation. Instead, we propose to deliver periodic updates following a dynamic and iterative approach. The areas covered include policy, business and research updates on relevant aspects, fields or sub-domains of the European data ecosystem. The aim is to do so by looking into particular cases or sectors in which data-driven innovation is yet to take off, or is promising, but in full development.

In this reconnaissance phase study, interviews, and panel discussion at BDVe and other events were used to outline the provide:

- A high-level-analysis of key issues and challenges within the BDV. From a top-down perspective, this analysis will show how and where novel BD and DDI trends are emerging.
- Mapping this analysis onto the status quo. A bottom-up periodical update on big data value chain developments and initiatives within the EU.
- Engagement. A series of short-read insights and provoking thought-pieces by key players in the field on big data ecosystems throughout the project

Following a methodology presented by Lawrence Lessig (1999) in his publication 'Code and Other Laws of Cyberspace's, a complete overview of Big Data Ecosystem is provided across four dimensions: Markets, Policy, Architecture, and Norms.

Furthermore, a detailed analysis of the main Big Data application domains was conducted highlighting the Relevance of the Sector, Nature of Data Assets in the Sector and Impacts.

All collected information in the first phase of the projects are available through The Big Data Landscape tool, a visual representation of the location of major actors and elements of the Big Data community. The tool presents a map with superposition of layers where different entities will be represented:

- Big Data Actors: this layer refers to what we have just explained and could be considered somehow similar to existing initiatives. Both supply and demand will be represented- It will be possible to search by using different criteria.
- Big Data Enablers. We mean by enablers different entities that can help Organisations interested in Big Data in developing their projects, plans and strategies. Thus, they are intermediaries with a support function
- Pilots/Use cases. Finally, a third sub-layer will add to the others by providing a geographical distribution of the pilots implemented in the PPP. At this moment it is hard to find information about them; furthermore, this would require visiting each and every project website This information will help to exemplify the impact of the work

developed in the PPP and could inspire other use cases or promote the replication of existing ones both within and beyond the PPP boundaries.

FIGURE 25: THE BIG DATA LANDSCAPE TOOL

In the Final Phase, results of Pilots involved in the different projects under the BDVe have been advertised and disseminated across a collaborative environment represented by the project website, the BDVA communication Channels (Figure 26).

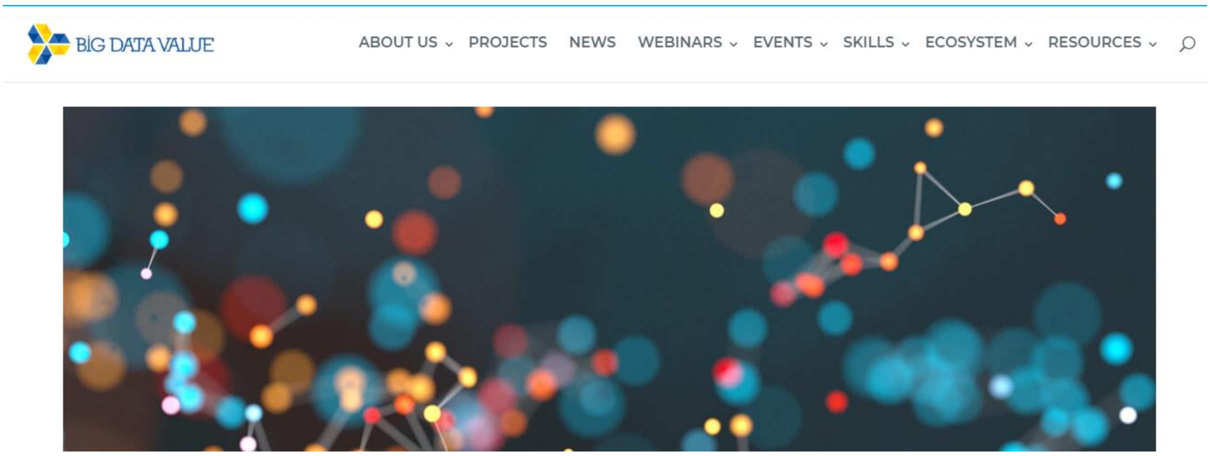

FIGURE 26: BDVE WEBSITE

In conclusion, for the BDVe project the main methodologies and tools adopted are shown in the table:

	Initial Phase	Development Phase	Final Phase
Methodologies and Tools	• Desk Research, survey, online questionnaire	• Big Data Landscape Tool	• Project website

TABLE 7: BDVE METHODOLOGIES AND TOOLS

3.6 Results

To conclude the Desk Research carried out, it is important to provide a final overview of the main methodologies and tools identified in the individual projects, presenting, for each of them, the positive and negative aspects intercepted.

Methodology	Pros	Cons
KPIs' collection through iterative and collaborative approach	• Direct involvement of all stakeholders • Periodic data updates • Easily usable in different projects	• A lot of information to be processed in a long time • Data collected in different formats

Mapping of KPIs' and Pilots' results	• Evidence of expected and obtained results • Easy to implement in different pilots	• Evidence of disparity of results in pilots • Need many KPIs to cover all Pilots
ERL approach	• Univocal definition of the level of maturity and usability of a solution present in the Pilots • Constantly monitoring of developed solutions • Direct involvement of Pilots owners and End User	• Time consuming as the pilots involved grow up • Evidence of the disparities between the different solutions installed in the pilots
Trial Handbook	• Clearly identification of roles and responsibilities • Direct involvement of all partners in the Pilots design and development • Clear and updated documentation always available • Easily usable in different projects • Clear vision who does what and when • Applicable in all phases of the project	• Greater number of meetings • More documentation to produce
Co-innovative methodology to collect Use Cases	• Direct involvement of all actors in the Pilot features definition • Different points of view and perspectives expressed	• Non-uniformity of the data collected • More information to process
Template for UC and Requirements	• Standard information collected • Easy to design and fulfil • Useful also for no technical people • high level of detail • easily usable in different projects	• Redundant information
Prototyping Methodology to involve stakeholders	• Useful to evaluate some parts of Pilots results before the developing • Suitable for projects whose prototypes can be deployed in different pilots	• Time and money consuming as the pilots involved grow up • Possible prototype failures
Pipeline Methodology	• Clear identification of rules, time and activities • Updated monitoring of activities carried out in each Pilots • Clear vision of what to do and when	• Management of overruns with respect to the pipeline • Risk evaluation
Holistic validation Methodology	• Validation from different points of view, not only the technical one • Direct involvement all partners with specific role and activities to carry out	• More time and effort
Dissemination via project web site	• Easy to adopt • Maximization of the visibility of the results of each Pilot • Always updated contents	• Abandonment of the site after the end of the project
Pilots factsheets	• Very professional presentation of the results • Suitable for a diversified audience	• To update it must be done again
Social Channels	• Diversified audience • Quick and concise content	• Contents must be updated frequently

4 OPEN DEI RECOMENDATIONS

4.1 OPEN DEI Vision

The digital transformation strategy of the European Union has, among others, a particular priority: the creation of common data platforms based on a unified architecture and an established standard. As part of the Horizon 2020 programme, the OPEN DEI project focuses on “**Platforms and Pilots**” to support the implementation of next generation digital platforms in four basic industrial domains:

FIGURE 27: OPEN DEI DOMAINS

The OPEN DEI project proposes a common conceptual framework where the domain-specific pilots need to be run. This conceptual framework is called **6Ps** methods and covers DT affecting:

i. **P**roducts: next generation products in Manufacturing, Energy, Healthcare and Agri-food require extremely high levels of digitalization including retrofitting and re-manufacturing of long lifetime complex artefacts such as power turbines, aircrafts and magnetic resonance machines;
ii. **P**rocesses: next generation digital processes require methods and tools for modelling and simulating both data and human/automatic activities, including definition and measurement of KPIs for critical vital processes such as planning, scheduling, optimization, forecasting
iii. **P**latforms: “next generation digital industrial platforms” is the battle Europe cannot afford to lose. CPS, IoT, Big Data, AI and Cloud-HPC technologies need to be integrated into traditional information systems such as Manufacturing Execution Systems, Hospital and Building Information Systems, Smart Grids Systems, Geographic Information Systems for precision farming.
iv. **P**eople: next generation jobs and competencies for workers, engineers and managers require new education and re- up-skilling activities. Digital Skills development firstly, as indicated by the Digital Skills and Jobs Coalition, but also domain-specific OT skills and transversal soft skills necessary in collaborative, participative and non-hierarchical innovation environments.
v. **P**artnership: next generation supply-distribution-customer networks are an essential element for DT. EU industries need to involve more partners in their critical decisions (e.g. in the prosumers roles) as well as to set up open innovation participative models
vi. **P**erformance: next generation indicators for industrial performance are needed, taking into account the new nature of business development and new service-driven business models. For instance, user experience, customer satisfaction, service level agreements, societal and environmental impact indicators need to acquire more relevance and complement traditional time-cost-quality indicators.

The OPEN DEI project, therefore, aims to fill the gaps in the European Digital Transformation process by defining a common strategy, common methods to plan, implement and assess Digital Transformation in the EU funding projects. As described in section Methodologies and tools in LSP, up to now different DT IAs are in fact proposing their tools and platforms in their Large Scale Pilots and measuring benefits and KPIs **independently**.

Open DEI will overcome these differences defining and proposing coordinated workflows of Platform/Pilots services creating a standard strategy for:

1. Pilot initialization activities: creation of a common strategy for the first phases of a pilot's activity, from the collection of requirements to the definition of KPIs
2. Pilot realization and validation activities: definition of a common strategy for the deployment of hardware and software components at the pilots and for the validation activities aimed at reducing the customization effort
3. Pilot exploitation activities: creation of a single communication plan that focuses on the Pilots, their characteristics and the results obtained

Starting from the results of the Desk Research carried out in this document, it is possible to outline a first version of the methodological plan that OPEN DEI will provide to current and future projects in the Digital Transformation, IoT and Big Data fields. The integration of four very different domains within the OPEN-DEI Project also emphasizes the need to identify a **cross-domain** approach that can be uniformly adopted by Pilots belonging to different realities and with different purposes. IoT and Big Data technologies represent the common factor for all domains, but it is important to highlight how each sector has its own granularities that must be considered and integrated within the cross-domain approach. The methodologies and tools proposed below must be based on the specific realities of the Pilots, enrich themselves with characterizing aspects, precisely define the scope of action and take into consideration the aims of each project.

4.2 OPEN DEI Methodologies and Tools

Defining common strategies in different projects, which integrate different and numerous Pilots, may seem an ambitious idea since each project can have its own granularity and peculiarities that differentiate it from the others in terms of ambitions, business models and technical aspects. The same if we consider touching different domains which for own nature are very different and sector-specific.

But this is precisely the turning point in research, learning from past experiences, extracting the best from the successful performed activities, transforming the obtained results in solutions available to ever wider audiences and disseminating the knowledge gained in the field by facilitating activities of the future.

The strength point of Open Dei it is just that: to have both an intra-domain vision, plus a cross-domains vision. Let's stress the concept that from other sectors it is possible to learn, in a co-fertilisation process which can enrich each single sector involved. How many sectors introduced discoveries/technologies born for other purposes (e.g. space, defence, etc) and identified as successful if applied outside.

For this reason, in this section a common strategy for the OPEN DEI projects, in terms of methodologies to adopt, will be proposed.

The identified path will pass through the 3 main phases of the life cycle of a Pilots and for each of them the methodology that, in the previous projects has proved to be the most effective, will be identified and a version based on the OPEN DEI reality will be described.

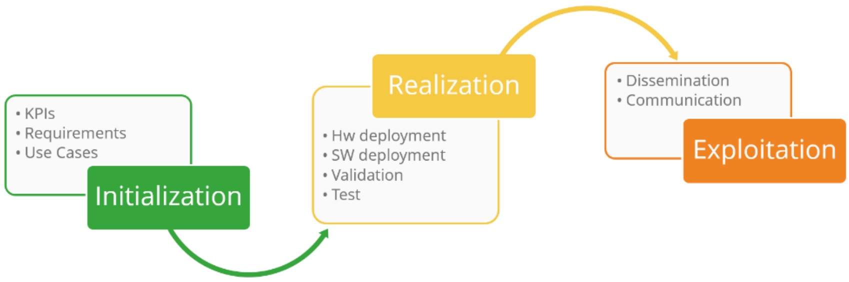

FIGURE 28: PROJECTS' PHASES

The success of a project involving many actors and different Pilots is determined already from the first phases of activity. It's in this moment, in fact, that the future path is traced and the guidelines that the project will follow are determined. The initial activities linked to the Pilots characterize their main aspects, define their peculiarities and outline the expected results.

Key Performance Indicators

Identifying KPIs and collecting them constructively is one of the first activities of a Pilot. The KPIs must, as much as possible, describe the general and specific aspects of each Pilot, focus on all the dimensions that characterize a Pilot and adopt concretely measurable and comparable metrics.

The best methodology to adopt at this stage is to use a collaborative and iterative approach to collect KPIs and classify them in specific domains and dimension.

This approach is based on online questionnaire, surveys and face to face interview involving pilots responsible, technical provider and end users. With this approach, all points of view will be expressed and all needs will emerge.

In the OPEN DEI project, the creation of a KPIs classification tool is very important since the domains embraced are different. The indicators will be divided into "domain-specific indicators", "generic indicators" and "cross-domain indicators" and for each category a number of more specific and circumscribed sub-areas (called "fields") will be assigned to each dimension to further narrow down, and better delimit, the impact spheres.

A first version of a shortlist of basic and generic KPIs, to be evaluated in each project that foresees and will foresee the involvement of large Pilots is shown below:

Name	Description	Metric
Alignment with standards	The number of relevant standards (specific to the domain and cross-domain) supported by platforms used the pilots	Number of relevant standards supported
Open Source platform	Open Source platform components supported by each Pilot	Number or Percentage
Privacy and security aspects	Checklist of GDPR compliance	Number
Number of IoT devices deployed	Counting the number of new IoT devices installed in Pilots	Number

Table 8: Technical KPIs

Name	Description	Metric
Established site enabling Discovery of data resources	Website enabling discovery of data resources (both data models and datasets)	Website, Number of Resource views
Number of open data models	Counting the number of public and royalty-free data models contributed to a relevant initiative for data models standardization[2]	Number
Number of shared data sets	Counting the number of shared data sets made available by solutions of Pilots (both open data sets and datasets accessible through specific terms and conditions)	Number (Open Data Sets) Number (Shared Data Sets)
Collaboration strategy	Ecosystem members	Number of stakeholders
Established site enabling Discovery of solutions	Website enabling discovery of solutions developed with the LSP	Website, Number of visits
Number of market-ready solutions	The number of products or services developed with the LSP that are finally made available on the market	Number
Established demonstration site	Visitable test sites that present implemented solutions to other interested end-users	Demonstration site, number of visits

Table 9: Ecosystem openness, development and value chain partners' involvement KPIs

Name	Description	Metric
Active users	Active users involved in Pilots.	Number
User involvement	Assessment of how endusers' feedbacks on accessibility are collected and how they are directly involved in accessibility improvement activities	Text

Table 10: General acceptability, user validation, perceived value and benefits domain KPIs

Name	Description	Metric
User impact	Pilots' ability to track how their services/products are impacting their Business customers' daily activities, with a list of KPIs and associated measurements	Text
Social impact	Pilots' ability to improve end users' quality of life, working conditions, health, lifestyle, etc	Text

Table 11: Business opportunities, economic, environmental and societal impacts domain KPIs

Further KPIs can then be added to this starting list, more specifically linked to the nature and characteristics of the Pilots which, however, must always have the fundamental characteristic of being able to be adapted and measured even in different Pilots belonging to the same domain, so in the OPEN DEI Manufacturing KPIs, Energy KPIs, Healthcare KPIs and Agriculture KPIs must be added.

For example, the definition of the KPIs in the healthcare sector requires a specific analysis. In fact, in this domain, KPIs need to take into consideration clinical results although they also include the evaluation of the interventions conducted, such as

[2] e.g. smart data models initiative (website: https://smartdatamodels.org/; GitHub: https://github.com/smart-data-models)

health technologies (for example, adoption, ease of use, usability), and the contribution to more systemic socio-economic objectives.

It is evident, how the **cross domain** approach represents the starting point and that the individual methodologies need to be split on specific use cases. This is why, alongside the generic indicators defined in Table 11, it is possible to define another and specific list of KPIs (Table 12), which can be universally used in further Healthcare Pilots

Pilot details.
• Technology adopted • Intervention details • Recruitment period • Follow-up period • Pilot country/region • Time Horizon for Analysis • Number of patients • Minimum/Maximum age participants • Patients per group [intervention, control]
Clinical outcomes
• Proportion patients in baseline state [intervention, control] • Proportion patients in disease/impairment state [intervention, control] • Transitions probabilities – incidence rate [intervention, control] • Transition probabilities – recovery rate [intervention, control] • Patient information and frequency of monitoring [daily, weekly, monthly] • Gender [general, intervention, control] • Comorbidities/conditions/risk factors Baseline [type, intervention, control] • Dementia/Cognitive Functioning Baseline [intervention, control] • IT Literacy Baseline [intervention, control] • Other characteristics to be added [intervention, control] • Planned patients visits [intervention, control] • Unplanned patients visits [intervention, control] • Unplanned hospitalizations [intervention, control] • Lenght of visits [intervention, control] • Adherence to treatment [intervention, control] • Improving healthy habits [intervention, control] • Transitions to higher risk strata [intervention, control] • Health related quality of life [intervention, control] • Other clinical outcomes to be added [intervention, control]
Healthcare cost
• Markov Model [number of states] • One-off costs [intervention, control] • Recurrent costs [intervention, control] • Healthtcare costs baseline [intervention, control] • Healthcare costs disease/impairment [intervention, control] • Societal costs baseline [intervention, control] • Societal costs disease/impairment [intervention, control]
Societal aspects
• Utility baseline [intervention, control] • Utility disease/impairment [intervention, control] • Technology acceptance [intervention, control] • Other societal outcomes to be added [intervention, control]

TABLE 12: HEALTHCARE KPIS

For the collection of Requirements and the definition of use cases, the best method to adopt is certainly represented by the use of Trial Handbooks. Thanks to these documents it is in fact possible to outline the current scenario of each pilots with all its main characteristics and define the future scenario expected by the project.

The Trial Handbook is the tool that most allows to identify roles and responsibilities and contains all the main information contained in the project deliverables and indicates the actions to be taken to achieve the expected results.

This methodology can also be followed in the next phase of Deploy & Validation, its adaptability ensures correct use and its characteristics guarantee that in a very delicate phase for each Pilots time, costs and role are respected.

The Trial Handbook, in this phase, must contain for each Pilots detailed information related to components to be installed, where when and who will be involved. In order to ensure that this methodology could be easily adopted by all pilots even if they are located in different sites and their nature is different, data must be provided in tabular form so information will be comparable and the way to collect data is uniform.

Some examples of table for Trial Handbook are shown below:

Per deployment site, it is asked to describe the site in terms of type (agriculture site, industrial site…), existing infrastructure (before the project), planned installations (during the project) .

SITE 1	
Site Name:	
Description of the Site	
Description of existing infrastructure	
Planned Installation	

FIGURE 29: SITE DESCRIPTION EXAMPLE

Per deployment site, it is also asked to describe all the components.

Deployed Component n. 1	
Name of the Component	
Description of the Component	
Purpose to use this component	
Supplier brand/company	
# of units	
Specifications	
Installation performed	
Installation Report	
Deployment Site	

FIGURE 30: COMPONENT DESCRIPTION EXAMPLE

Communication standards and formats used in the Pilot should be described respecting consistency in terms of names.

Interface Name	Standard(s)	Notes

FIGURE 31: STANDARDS DESCRIPTION

Together with the standards also the data collection methodology can be schematized by describing data that will be gathered and explaining the measurement technique in every deployment site with the association with data model/format in order to foresee the exchange of information between different Pilots

No	Data	Measurement Tecniques	Deployment site	Frequency of Data collection	Data Model

Figure 32: Data Collection Example

Finally, for each Pilot, the technical challenges that were encountered or foreseen are described:

Technical Challenge	
Technical Challenge	
Description of the Challenge	
Solution	
Progress in solution	
Acquired Knowledge	
Knowledge transfer/collaboration with other Pilots	

Figure 33:Technical challenge Example

The Trial-based approach is also adopted in the healthcare domain where the main focus is usually on clinical evaluation as even if the main gains of the innovation are at societal (efficiency, knowledge), business or individual satisfaction levels, it must at least prove that from a pure clinical perspective, it performs at least as well (or does not harm) than other more conservative approaches. Up to now, the validation requested to make use of Randomised Controlled Trials (RCTs). This approach aims to reduce certain sources of bias when testing the effectiveness of new treatments; this is accomplished by randomly allocating subjects to two or more groups, treating them differently, and then comparing them with respect to a measured response. One group – the experimental group – receives the intervention being assessed, while the other – usually called the control group – receives an alternative treatment, such as a placebo or no intervention. However, this approach is particularly expensive in the healthcare sector, as double costs are incurred for following patients and because Trials often need to be maintained for many years to be useful. Therefore, new evaluations methodologies which are better suited to rapid cycles of innovation are under observation in the healthcare domain, such us a "comprehensive evaluation strategy" that involves a continuing process of semi-structured interviews with key participants (qualitive data) as well as, the collection of quantitative data from questionnaire and existing data about service use and clinical effectiveness.

In general, to validate results the best way to proceed is to adopt the Holistic Methodology defined in Synchronicity project Thanks to this approach, each component in each pilot can be validated from different points of view effectively providing that unique ecosystem vision that is fundamental in LS projects.

Also in this Pilots' phase the cross-domain approach is the starting point on which to build and improve more specific methodologies, as in the Healthcare case.

Evaluation plays a fundamental role also in the development of healthcare projects, since it is what allows decision-makers to identify programs that obtain the expected results. For this purpose, the MAFEIP (Monitoring and Assessment Framework for the European Innovation Partnership) tool can be adopted to evaluate projects and interventions, by using a cost-effectiveness analysis. The MAFEIP-tool is originally developed to assess the impact and costeffectiveness of digital health interventions, but is highly promising to be used for different digital interventions as well.

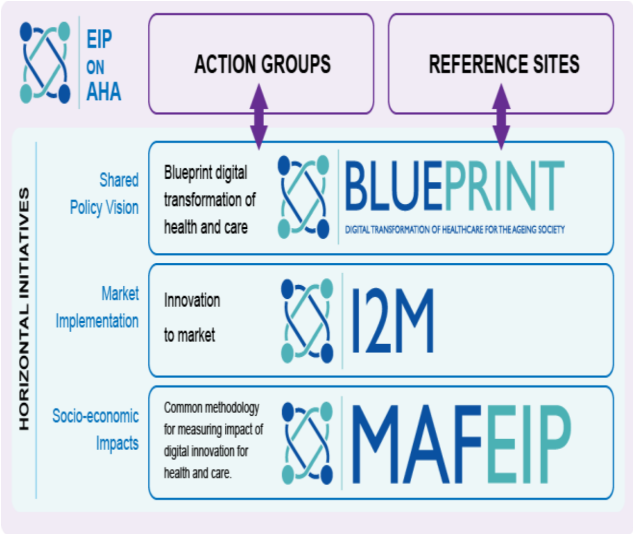

FIGURE 34: TOOLS ADOPTED BY EIP ON AHA

The purpose of the MAFEIP-tool is to estimate the outcomes of a large variety of social and technological innovations, by providing an early assessment of the likelihood that interventions will achieve the anticipated impact. In addition, MAFEIP also helps to identify what drives interventions' effectiveness or efficiency in order to guide further design, development or evaluation. MAFEIP therefore represents a clear support to the decision-making process for different kind of projects. The tool rests on the principles of Markov's model, which is an analytical decision-making model developed for health economics (Bai, Wu, & Chen, 2015; Giuliani, Galelli, & Soncini-Sessa, 2014; Lewis, 2013; Siebert et al., 2012; Sonnenberg & Beck, 1993). Its main objective is to provide support in the decision-making process, including an ex ante analysis before a concrete intervention is implemented. The Markov's model is able to tackle uncertainty on the real effects and costs, and its flexibility allows for the analysis of a large and heterogenous range of interventions. The model uses the best evidence available from multiple sources, such as administration records, official data bases, ad-hoc information collected for projects' evaluation or results from evaluations in similar interventions.

The framework and the tool were initially developed to provide a common model and a shared language in response to the EIP on AHA members' specific monitoring needs. Today the tool has achieved a high level of maturity and has gone through a collaborative improvement and refinement process which makes it usable and flexible to adapt to different kinds of users. Besides EIP on AHA, MAFEIP is also being used on the H2020 and IMI projects such as Gravitate-Health, DigitalHealthEurope or Gatekeeper only to name a few.

MAFEIP could represent a very valid cross domain tool for the assessment phase for achieved results of Pilots in the different domains of OPEN DEI project.

The success of project involving numerous Pilots is not measured only through the achievement of the initial objectives but above all in the realization of solutions that can represent lighthouses for other pilots, easily replicable in heterogeneous contexts and sufficiently innovative to meet current and future needs in the European area that invests more and more in research and development projects.

Completing a successful project implies that obtained results are shared, that the proposed solutions are disseminated in different communication channels and that the main aspects developed in each pilot are disseminated both in the industrial and academic world.

The best methodology to adopt in Dissemination and Exploitation of Pilots' results is to properly use websites and social media. Through images, videos and social communications it will be easier to spread Pilots examples.

Moreover, the creation of advertising material targeted for each Pilot could represent a good strategy to stretch achievements and successful stories.

5 FUTURE OUTLOOK AND CONCLUSIONS

As motivated at the beginning, this document describes methodologies used in different Large Scale Pilots Projects selected according to specific internal criteria (e.g. number of pilots and different application domains).. The main objective is to outline a methodological path to follow in design and implementation of innovative research solutions in cases where projects are characterized by many pilots located in different areas.

In these conditions, in fact, it is very easy to lose control of the progress of the pilots or not be able to correctly manage and coordinate all the information produced in the projects. This is why, right from the initial phases of such complex projects, it is necessary to identify the methodologies to be followed during each state of progress of the proposed pilots, to have a coordination direction between the different actions and to favour the exchange of data and obtained results.

The most important aspect of this type of projects is that they must represent a beacon(lighthouse) for other similar projects and for future projects that will be funded under European programs. The pilots must have the characteristics of feasibility and replicability and must also involve all the players in the ecosystem that exists around them.

In this document, projects representing real success stories have been analyzed, distilling from them methodologies that can be easily replicated and also adopted in other projects both in progress and still in the initial phase.

Among the most successful methodologies there is certainly the use of Trial Handbooks. The classification in Trials, which can be based on the type of Pilots as in Boost4.0 or on the temporal trend of the project as in DataBio, allows to accurately identify the partners involved in each step and the responsibilities of each, favouring the constant monitoring of progress.

Fundamental, in these types of projects, is the documentation that must be produced and constantly updated during progress of each pilot and on how the results of the entire project affect each use case. For this reason, it is important to define the KPIs that can represent an important tool for each partner and will be the measure of the conformity between the obtained final results and those set at the beginning of the project.

The deployment and validation phases, in projects with many pilots and many partners, are delicate and complex since it is necessary that the hardware components are installed and tracked and that the software modules are interoperable and interconnected with the physical systems. Furthermore, it is essential to have a clear and exhaustive picture of the pilots at the beginning of the project and of what they will become at the end in order to have some parameters of comparison.

The documentation also in this phase is essential both to monitor each pilot and to provide directives on the actions to be followed and therefore, even in these cases the Trial-based methodology proves to be suitable and effective as it highlights both the timing and the responsibilities for each pilot. .

The work under Task 3.2 will continue until the OPEN DEI project conclusion.

In the coming months, analysis will be extended to cover additional financed projects included OPEN DEI Ecosystem projects whose pilots are in a state of progress that can be included. The methodologies and tools used will be evaluated and analytics will be developed that will allow to determine which solutions were most adopted in the different OPEN DEI domains.

The analytics can then be used as part of the activities of Task 3.3. At the end of the task, this document will represent guidelines for LSPs projects to allow coordinators and consortia to better manage the different project phases for all pilots.

Furthermore, in the coming months, the points of contact with T3.1 will also be identified in order to integrate the information collected regarding the methodologies and tools in the project Pilot Dashboard.